ClimateSmart Cities Assessment Framework 2.0
Cities Readiness Report

2021

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Climate Centre for Cities

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

Smart City
MISSION TRANSFORM-NATION

ClimateSmart Cities Assessment Framework 2.0
Cities Readiness Report
June 2021

Developed by:
Ministry of Housing and Urban Affairs
In association with the Climate Centre for Cities, National Institute of Urban Affairs

Authors:
Dr. Umamaheshwaran Rajasekar, Ms. Vaishnavi Shankar, Ms. Raina Singh,
Ms. Ahona Datta Gupta, Ms. Ankita Mandal, Ms. Manjaree Dutta, Mr. Punit Gandhi,
Ms. Mohini Bhaisare, Mr. Empati Uday Kumar, Ms. Shravani T, Ms. Pallavi Thool,
Mr. Anshul Abbasi, Ms. Amanjot Kaur and Mr. Akshay Atreja

Contributors:
Mr. Vibhor Sood, Ms. Prerna Mehta, Ms. Prarthana Borah,
Mr. Kanagaraj Ganesan and Mr. Manzoor Khan

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Designed by:
Mr. Deep Pahwa, Mr. Devender Singh Rawat and Mr. Bhavnesh Bhanot

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Executive Summary

A third of India's population is currently living in cities and contribute to 63% of the national GDP. Based on the current trend it is projected that in the next 10 years (by 2030) India's urban population will increase by 590 million and its GDP contribution will increase to 75%. Indian cities are key economic engines but face complex infrastructure challenges and environmental degradation due to rapid urbanization and climate change risks. Therefore, it is imperative that cities undertake sustained actions to prepare for and develop their ability to thrive in the changing environment.

With an intent to institutionalise the climate actions in India, Ministry of Housing and Urban Affairs (MoHUA) in partnership with the National Institute of Urban Affairs (NIUA) established the Climate Centre for Cities (C-Cube) in June 2020. Understanding the need for sustainable urban planning and climate informed development actions across Indian cities, the ClimateSmart Cities Assessment Framework (CSCAF) was developed and rolled out by the MoHUA. This is a first-of-its-kind self-assessment framework on climate relevant parameters with an intent to provide a roadmap for Indian cities towards mainstreaming climate actions within current and future policies, programs and projects.

A total of 126 cities including 100 Smart Cities, capital cities and other cities undertook the assessment in 2020. With a vision to be more aspirational and progressive the current CSCAF framework captures the climate performance of cities including the national and international initiatives including but not limited to National Mission on Sustainable Habitat, Nationally Determined Contributions, Sustainable Development Goals and Sendai Framework for Disaster Management.

The CSCAF 2.0 has been assessed across 28 indicators under five themes (i) Urban Planning, Green Cover and Biodiversity (ii) Energy and Green Buildings; (iii) Mobility and Air Quality; (vi) Water Management and (v) Waste Management. The indicators formulated are progressive and aspirational in nature. Each indicator not only assess but also provides guidance to cities to progress. CSCAF 2.0 aims to be Specific, Measurable, Actionable, Relevant and Time-bound. The framework has been designed to capture the contribution of cities to the national and international initiatives like National Mission on Sustainable Habitat, Intended Nationally Determined Contributions and Sustainable Development Goals.

Several initiatives have been taken by C-Cube to enhance the framework and the process of engagement with 126 cities. Various consultation meetings were conducted with MoHUA, Executive Committee and Thematic-sub group members, and Municipal Commissioners/ CEOs to simplify the ease of reporting of the assessment. To avoid duplication of data collation, the indicators of Waste Management were aligned with Swachh Survekshan 2020. Standardized templates were given to cities with description of various data points for easy understanding and faster data collection from line departments. All the data points were collected via a simplified portal with improved dashboards and guidance. Considering the ongoing pandemic, strategic handholding support and capacity building was provided to the city nodal officers. More than 1,000 city representatives were trained through 56 virtual city training workshops and theme specific mentoring sessions. These were conducted by thematic experts supported by members of C-Cube's core team. In addition, 8 webinars and 13 podcasts on climate sensitive urban development were conducted for knowledge sharing. Extensive communication and support were maintained with all 126 cities through one-to-one handholding sessions in preferred language. On-ground support to 121 cities was provided with the support of national and international partners.
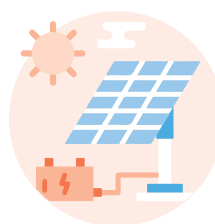
CSCAF 2.0 Performance Overview of 126 cities

65 Cities are meeting the prescribed URDPFI norm of **more than 12% green cover** within their municipal boundaries

10 Cities have **more than 15%** of their electricity needs generated **through renewable energy**

21 Cities have **attained MoHUA's SLB** for the availability of public transport

44 Cities have **initiated** flood/water stagnation **risk assessment**

40 Cities have **instituted mechanisms** for **processing 100% of collected wet waste**

87 Cities have some form of **air quality monitoring** stations in their cities

41 Cities conduct regular (annual) **energy audits** of their water supply system

This report is a detailed compilation of the CSCAF 2.0 assessment outcome across the five themes. Based on the overall and thematic scores, the 126 cities are given the progressive titles of – *Five Stars*, *Four Stars*, *Three Stars*, *Two Stars* and *One Star*. The assessment presents a transition of Indian cities towards reduction of GHG emissions with 10 cities fulfilling more than 15% of their energy needs through renewable sources and 88 cities converting all their streetlights to energy-efficient or renewable energy operated. 21 cities have attained MoHUA's SLB for availability of public transport and 14 cities having more than 35% of their road network with Non-Motorized Transport (NMT) infrastructure.

Besides reducing the energy consumption through fossil fuels, Indian cities have also initiated adaptation measures through blue green planning and city level action plans. 65 cities are currently meeting the green cover requirements of more than 12% as prescribed by URDPFI Guidelines (2014). 38 cities have formulated strategies or allocated budget for conservation and rejuvenation for water bodies and open spaces.

Further, cities are realising the importance to plan ahead for tackling extreme weather events. 35 cities have initiated the development of city disaster management plans and 30 cities have initiated vulnerability assessments and GHG inventories to inform their climate action plans. The increased efforts towards improving air quality monitoring are showing positive results with 87 cities having some form of air quality monitoring stations in their cities.

The C-Cube intends to build on the assessment outcomes to drive climate actions in cities. One of the pathways for mainstreaming is to build capacity of city officials through targeted training workshops, master classes, e-learning modules, podcasts and webinars. These engagements not only provide technical and strategic support to cities, but also provides a platform for peer-to-peer learning.

C-Cube is also dedicated towards promoting data driven and evidence-based approach for policy planning and resilience building. In line with this, the Climate Data Observatory and the Innovation Facilitation Centre envisaged at C-Cube will act as a common platform for cities, solution providers, institutions, and various other organizations as a data repository and a platform to collaborate on climate initiatives. Moving forward, the C-Cube will help bring convergence at national, state and city policies for building urban climate actions in association with all our partners.

CSCAF 2.0 Performance Overview of 126 cities

35 Cities have **initiated** preparation of **city disaster management plans**

101 Cities have **green buildings and are actively promoting the same**
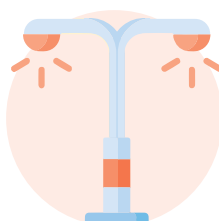
19 Cities have achieved **National Air Quality Standards** with two or more pollutants

67 cities have initiated water resource assessment

45 Cities are **scientifically managing landfill sites,** meeting CPEEHO, Solid Waste Management Rules, 2016

35 Cities have developed **Clean Air Action Plans**

88 Cities have converted all **streetlights to energy-efficient** or renewable energy operated

> *"*
>
> *Humanity is battling a global pandemic right now. And, this event is a timely reminder that the grave threat of Climate Change has not disappeared. For humanity to combat Climate Change, concrete action is needed. We need such action at a high speed, on a large scale, and with a global scope.*
>
> *"*

Shri. Narendra Modi
Hon'ble Prime Minister of India
April 2021, The Leaders' Summit on Climate

> "
>
> *Building climate resilience is a continuous process and not a one-time activity. With that objective, we implemented the second phase of the ClimateSmart Cities Assessment Framework assessment. I am hopeful that this exercise will provide an overarching roadmap for cities to move towards achievement of Sustainable Development Goals and Government of India's Nationally Determined Contributions (NDCs).*
>
> "

Shri Hardeep Singh Puri
Hon'ble Minister of State (Independent Charge)
Ministry of Housing & Urban Affairs

"

The COVID19 experience has shown us that effective leadership, empowered local governments and a participatory multi-stakeholder approach can play a key role in managing crises and strengthening the resilience of our communities. The ClimateSmart Cities Assessment Framework will pave the way for unlocking this potential and strengthening India's climate response that is driven and led by cities. I credit the efforts made by the Smart Cities Mission and the Climate Centre for Cities (C-Cube). NIUA and members of the ClimateSmart Cities Alliance for successfully completing the assessment in 2020. With collective effort we will be able to build climate actions in Indian cities.

"

Shri Durga Shanker Mishra
Secretary
Ministry of Housing & Urban Affairs

Abbreviations

AIR	-	Air Information and Response (Ahmedabad)
AMRUT	-	Atal Mission for Rejuvenation and Urban Transformation
AMRUT	-	Atal Mission for Rejuvenation and Urban Transformation
AQI	-	Air Quality Index
BEE	-	Bureau of Energy Efficiency
BMC	-	Biodiversity Management Committee
BPCL	-	Bharat Petroleum Corporation Limited
BRT	-	Bus Rapid Transit
C&D	-	Construction and Demolition
CAAP	-	Clean Air Action Plan
CAP India	-	Clean Air Project in India
CBD	-	Convention on Biological Diversity
CDMP	-	City Disaster Management Plan
CDWM	-	Construction and Demolition Waste Management
CNG	-	Compressed natural gas
CO_2	-	Carbon dioxide
CPCB	-	Central Pollution Control Board
CPHEEO	-	Central Public Health and Environmental Engineering Organization
CSCAF	-	ClimateSmart Cities Assessment Framework
CSR	-	Corporate Social Responsibility
CWC	-	Central Water Commission
DBOFT	-	Design Build Operate Finance and Transfer
DCR	-	Development Control & Regulation
DISCOMs	-	Distribution Companies
DMA	-	District Metered Areas
DMP	-	Disaster Management Plan
DPR	-	Detailed Project Report
DRR	-	Disaster Risk Reduction
DTE	-	Down to Earth
ECBC	-	Energy Conservation of Building Codes
EDGE	-	Excellence in Design for Greater Efficiencies
EESL	-	Energy Efficiency Services Limited
ENS	-	Eco-Niwas Samhita
EOC	-	Emergency Operation Centre/Cell
EWS	-	Early Warning System
FAME	-	Faster Adoption and Manufacturing of Electric/Hybrid vehicles
FAR	-	Floor Area Ratio
GDCR	-	The General Development Control Regulations
GEM	-	Green and Eco-friendly Movement
GHGs	-	Green House Gases
GIS	-	Geographic Information System
GoI	-	Government of India
GPC	-	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GRIHA	-	Green Rating for Integrated Habitat Assessment
HPCL	-	Hindustan Petroleum Corporation Limited
HRVA	-	Hazard, Risk and Vulnerability Analysis
ICCC	-	Integrated Command and Control Centre
IGBC	-	Indian Green Building Council
IL&FS	-	Infrastructure Leasing and Financial Services Limited (IL&FS) Environment
IMD	-	Indian Meteorological Department
IOCL	-	Indian Oil Corporation Limited
IUCN	-	International Union for Conservation of Nature
IWRM	-	Integrated Water Resource Management
Kw	-	Kilo Watt
KwH	-	Kilo Watt Hour
LBSAP	-	Local Biodiversity Strategies and Action Plans
LEED	-	Leadership in Energy & Environmental Design
LPG	-	Liquefied Petroleum Gas
MLD	-	Million Liters per Day
MMSCMD	-	Million Metric Standard Cubic Meter Per Day
MoEFCC	-	Ministry of Environment, Forest and Climate Change
MoHUA	-	Ministry of Housing and Urban Affairs
MRF	-	Material Recovery Facility
MRTS	-	Mass Rapid Transit System
MRV	-	Measurement, Reporting and Verification
MSW	-	Municipal Solid Waste
MSWM	-	Municipal Solid Waste Management

MT	-	Million Tonnes
MuDSM	-	Municipal Demand Side Management
NAAQS	-	National Ambient Air Quality Standards
NAPCC	-	National Action Plan for Climate Change
NBC	-	National Building Code
NCAP	-	National Clean Air Programme
NDMA	-	National Disaster Management Authority
NGT	-	National Green Tribunal
NLCP	-	National Lake Conservation Plan
NMSH	-	National Mission for Sustainable Habitat
NMT	-	Non-Motorised Transport
NOx	-	Nitrogen oxides
NRW	-	Non-Revenue Water
NUTP	-	National Urban Transport Policy
O&M	-	Operation & Maintenance
OEM	-	Original Equipment Manufacturer
PIB	-	Press Information Bureau
PM 10	-	Particulate Matter 10
PM 2.5	-	Particulate Matter 2.5
PPP	-	Public Private Partnership
PTU	-	Public Transport Unit
PWD	-	Public Works Department
RDF	-	Refused Derived Fuel
RO	-	Reverse Osmosis
RWA	-	Residential Welfare Association

SBA	-	Swachh Bharat Abhiyan
SBM	-	Swachh Bharat Mission
SCADA	-	Supervisory control and data acquisition
SCM	-	Smart Cities Mission
SDG	-	Sustainable Development Goal
SEDA	-	State Energy Development Agencies
SLNP	-	Street Lighting National Program
SOP	-	Standard Operating Procedure
SOx	-	Sulphur oxides
SPCB	-	State Pollution Control Board
SPV	-	Special Purpose Vehicle
SRF	-	Solid Recovered Fuel
SS	-	Swachh Survekshan
T&D	-	Transmission and Distribution
TCPO	-	Town and Country Planning Organisation
TPD	-	Tonnes Per Day
UHI	-	Urban Heat Island
UJALA	-	Unnat Jyoti by Affordable LEDs for All
ULB	-	Urban Local Body
ULs	-	Urban Local Bodies
URDPFI	-	Urban and Regional Development Plans Formulation and Implementation
URMP	-	Urban River Management Plan
USD	-	United States Dollar
WRM	-	Water Resource Management

Guide to read the document

Chapter Outline

The report has eight chapters which are categorised into three broad areas as mentioned below.

Chapter 1 - 2	Context, Methodology and Approach
Chapter 3 - 7	Climate Smart Cities Assessment Framework 2.0 Results
Chapter 8	Recommendations and Way Forward

Colour Indication of Thematic Areas

The report presents the results across five thematic areas (the colour codes are given below). Each thematic area comprises of multiple indicators that are used to arrive at the results. Read the indicators as per the colour codes of their parent thematic area.

Urban Planning, Green Cover & Biodiversity	The thematic area focuses on safeguarding biodiversity, conserving water bodies and open areas, increasing green cover, building disaster resilience and adopting climate action planning.
Energy & Green Buildings	The thematic area focuses on transitioning to clean energy and bringing efficiency in energy consumption besides promoting green buildings in cities.
Mobility & Air Quality	The thematic area focuses on transitioning to low carbon mobility besides ensuring adequate availability of non-motorized transport infrastructure and public transport. In addition, focus on clean air through monitoring, planning and implementation of measures are considered.
Water Management	The thematic area focuses on efficient water management to address current and future water demand besides bringing energy efficiency into water and waste water systems. In addition, focus on minimizing flood and water stagnation risks are also considered.
Waste Management	The thematic area focuses on waste minimization, recycling of dry and wet waste, management of construction and demolition waste and scientific remediation of landfills.

Colour Indication of Cities' Performance Levels

The cities' performance is presented as 3 sub-sections, - 1) Overall performance, 2) Thematic performance and 3) Indicator wise performance. Read the performance levels as per the colour codes given below.

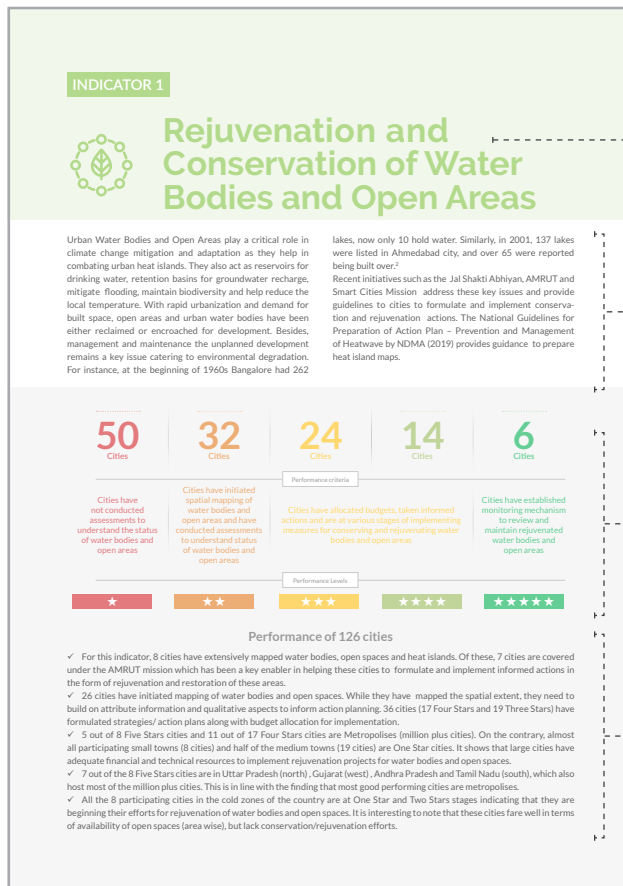|	
★★★★★	Five Stars - Cities that have showcased implementation of climate actions and are monitoring impacts.
★★★★	Four Stars - Cities that have initiated implementation of climate measures or have allocated budgets.
★★★	Three Stars - Cities that have initiated climate action planning or have established institutional mechanisms to enable planning.
★★	Two Stars - Cities that have initiated data collection to conduct assessments or have established committees to guide the development of climate strategies.
★	One Star - Cities that are in the early stages and are yet to conduct studies to inform the adoption of climate actions.

Layout for Indicator-wise Performance
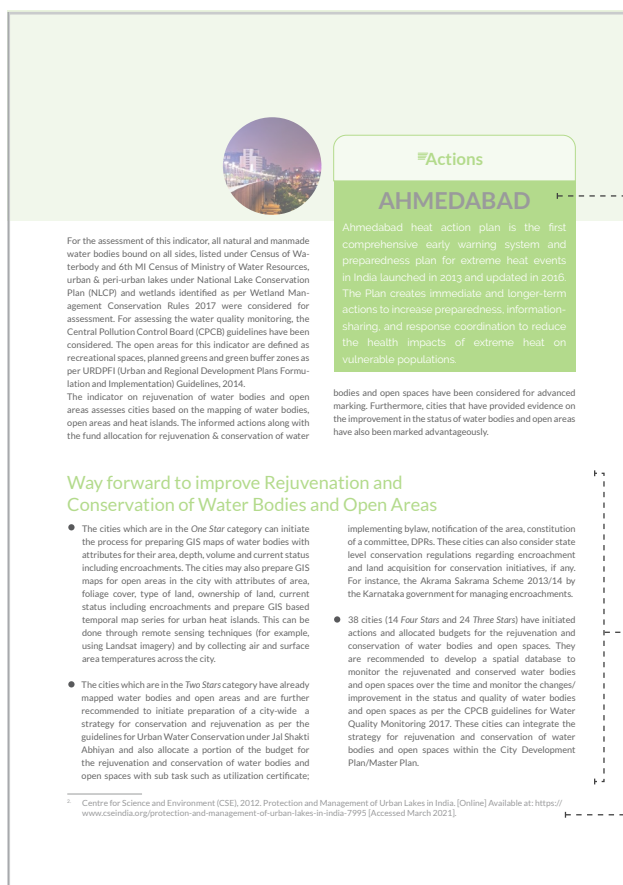
Description

INDICATOR 1

Rejuvenation and Conservation of Water Bodies and Open Areas

Urban Water Bodies and Open Areas play a critical role in climate change mitigation and adaptation as they help in combating urban heat islands. They also act as reservoirs for drinking water, retention basins for groundwater recharge, mitigate flooding, maintain biodiversity and help reduce the local temperature. With rapid urbanization and demand for built space, open areas and urban water bodies have been either reclaimed or encroached for development. Besides, management and maintenance the unplanned development remains a key issue catering to environmental degradation. For instance, at the beginning of 1960s Bangalore had 262

lakes, now only 10 hold water. Similarly, in 2001, 137 lakes were listed in Ahmedabad city, and over 65 were reported being built over.[2]

Recent initiatives such as the Jal Shakti Abhiyan, AMRUT and Smart Cities Mission address these key issues and provide guidelines to cities to formulate and implement conservation and rejuvenation actions. The National Guidelines for Preparation of Action Plan – Prevention and Management of Heatwave by NDMA (2019) provides guidance to prepare heat island maps.

50 Cities	32 Cities	24 Cities	14 Cities	6 Cities
Cities have not conducted assessments to understand the status of water bodies and open areas	Cities have initiated spatial mapping of water bodies and open areas and have conducted assessments to understand status of water bodies and open areas	Cities have allocated budgets, taken informed actions and are at various stages of implementing measures for conserving and rejuvenating water bodies and open areas		Cities have established monitoring mechanism to review and maintain rejuvenated water bodies and open areas

Performance criteria

Performance Levels

★ ★★ ★★★ ★★★★ ★★★★★

Performance of 126 cities

✓ For this indicator, 8 cities have extensively mapped water bodies, open spaces and heat islands. Of these, 7 cities are covered under the AMRUT mission which has been a key enabler in helping these cities to formulate and implement informed actions in the form of rejuvenation and restoration of these areas.

✓ 26 cities have initiated mapping of water bodies and open spaces. While they have mapped the spatial extent, they need to build on attribute information and qualitative aspects to inform action planning. 36 cities (17 Four Stars and 19 Three Stars) have formulated strategies/ action plans along with budget allocation for implementation.

✓ 5 out of 8 Five Stars cities and 11 out of 17 Four Stars cities are Metropolises (million plus cities). On the contrary, almost all participating small towns (8 cities) and half of the medium towns (19 cities) are One Star cities. It shows that large cities have adequate financial and technical resources to implement rejuvenation projects for water bodies and open spaces.

✓ 7 out of the 8 Five Stars cities are in Uttar Pradesh (north) , Gujarat (west) , Andhra Pradesh and Tamil Nadu (south), which also host most of the million plus cities. This is in line with the finding that most good performing cities are metropolises.

✓ All the 8 participating cities in the cold zones of the country are at One Star and Two Stars stages indicating that they are beginning their efforts for rejuvenation of water bodies and open spaces. It is interesting to note that these cities fare well in terms of availability of open spaces (area wise), but lack conservation/rejuvenation efforts.

For the assessment of this indicator, all natural and manmade water bodies bound on all sides, listed under Census of Waterbody and 6th MI Census of Ministry of Water Resources, urban & peri-urban lakes under National Lake Conservation Plan (NLCP) and wetlands identified as per Wetland Management Conservation Rules 2017 were considered for assessment. For assessing the water quality monitoring, the Central Pollution Control Board (CPCB) guidelines have been considered. The open areas for this indicator are defined as recreational spaces, planned greens and green buffer zones as per URDPFI (Urban and Regional Development Plans Formulation and Implementation) Guidelines, 2014.

The indicator on rejuvenation of water bodies and open areas assesses cities based on the mapping of water bodies, open areas and heat islands. The informed actions along with the fund allocation for rejuvenation & conservation of water

Actions

AHMEDABAD

Ahmedabad heat action plan is the first comprehensive early warning system and preparedness plan for extreme heat events in India launched in 2013 and updated in 2016. The Plan creates immediate and longer-term actions to increase preparedness, information-sharing, and response coordination to reduce the health impacts of extreme heat on vulnerable populations

bodies and open spaces have been considered for advanced marking. Furthermore, cities that have provided evidence on the improvement in the status of water bodies and open areas have also been marked advantageously.

Way forward to improve Rejuvenation and Conservation of Water Bodies and Open Areas

● The cities which are in the *One Star* category can initiate the process for preparing GIS maps of water bodies with attributes for their area, depth, volume and current status including encroachments. The cities may also prepare GIS maps for open areas in the city with attributes of area, foliage cover, type of land, ownership of land, current status including encroachments and prepare GIS based temporal map series for urban heat islands. This can be done through remote sensing techniques (for example, using Landsat imagery) and by collecting air and surface area temperatures across the city.

● The cities which are in the *Two Stars* category have already mapped water bodies and open areas and are further recommended to initiate preparation of a city-wide a strategy for conservation and rejuvenation as per the guidelines for Urban Water Conservation under Jal Shakti Abhiyan and also allocate a portion of the budget for the rejuvenation and conservation of water bodies and open spaces with sub task such as utilization certificate;

implementing bylaw, notification of the area, constitution of a committee, DPRs. These cities can also consider state level conservation regulations regarding encroachment and land acquisition for conservation initiatives, if any. For instance, the Akrama Sakrama Scheme 2013/14 by the Karnataka government for managing encroachments.

● 38 cities (14 *Four Stars* and 24 *Three Stars*) have initiated actions and allocated budgets for the rejuvenation and conservation of water bodies and open spaces. They are recommended to develop a spatial database to monitor the rejuvenated and conserved water bodies and open spaces over the time and monitor the changes/ improvement in the status and quality of water bodies and open spaces as per the CPCB guidelines for Water Quality Monitoring 2017. These cities can integrate the strategy for rejuvenation and conservation of water bodies and open spaces within the City Development Plan/Master Plan.

¹ Centre for Science and Environment (CSE), 2012. Protection and Management of Urban Lakes in India. [Online] Available at: https://www.cseindia.org/protection-and-management-of-urban-lakes-in-india-7995 [Accessed March 2021].

Description callouts:

1. *Title of the indicator*
2. *Indicator description*
3. *Performance of cities*
4. *Key highlights*
5. *Click to read more on the actions undertaken by the city*
6. *Way forward to progress in this indicator*
7. *References*

Contents

1

Introduction

Introduction

ndia has been one of the fastest growing economies in the world as per the World Economic Outlook in 2020[1] and 2021[2]. Much of this growth has been driven by cities and towns. In 2011, India's urban centres constituted approximately 31% of the total population, contributing to 63% of the national GDP[3], and are projected to accommodate close to 40%[4] of the total population, contributing to 75%[5] of the national GDP very soon. An analysis of urban GDP growth to 2035 found 17 out of 20 the fastest-growing cities in the world would be in India.[6] As cities continue to fuel India's economic growth and remain centres for development, they also face challenges with respect to physical infrastructure, institutions, health and environmental degradation. Studies indicate that poor planning and urban management are expected to cost Indian cities somewhere between $2.6 and $13 billion annually.[7]

With a vision to provide a better quality of life for citizens through sustainable and inclusive development, and cater to the $5 trillion economy by 2025, the Ministry launched 6 key urban missions[8], including the Smart Cities Mission, in 2014. Through these missions, during 2014-2019, Government of India has allocated more than $30 billion[9] towards integrated and comprehensive development of cities and implementing several initiatives for promotion of sustainable transport, reduce air pollution, generation of renewable energy, scientific waste management, smart water and wastewater management. In addition, the recently launched Jal Jeevan Mission (urban) and the National Urban Digital Mission focus on universal coverage of water supply, sewage management and digital infrastructure for improved urban governance.

However, these investments and development goals would be severely affected unless cities address the impacts of climate variability and environmental changes manifesting in the increasing instances of extreme events such as floods, heat waves and droughts, cyclones and storm surges, among others. The recently released Global Climate Risk Index 2021 ranks India as the 7th most affected country from climate related extreme weather events (storms, floods, heatwaves etc.) based on the recorded data for loss and damage during 2000-2019 in terms of fatalities per 100,000 inhabitants and losses per unit GDP in percentage.[10] As hubs of population, infrastructure and economic activities, cities have been most impacted by extreme events which are expected to increase in frequency and intensity with the changing climate.

1.   International Monetary Fund (IMF), 2020. World economic outlook. [Online]
     Available at: https://www.imf.org/en/Publications/WEO/Issues/2020/09/30/world-economic-outlook-october-2020 [Accessed March 2021].
2.   International Monetary Fund (IMF), 2021. World economic outlook update. [Online]
     Available at: https://www.imf.org/en/Publications/WEO/Issues/2021/01/26/2021-world-economic-outlook-update [Accessed March 2021].
3.   Ministry of Housing and Urban Affairs, Govt of India, 2015. Smart Cities: Mission Statement and Guidelines. [Online] Available at: https://smartcities.gov.in/themes/habikon/files/SmartCityGuidelines.pdf [Accessed March 2021].
4.   Department of Economic and Social Affairs, United Nations, 2018. World Urbanization Prospects 2018. [Online] Available at: https://population.un.org/wup/Country-Profiles/ [Accessed March 2021].
5.   Ministry of Housing and Urban Affairs, Govt of India, 2015. Smart Cities: Mission Statement and Guidelines. [Online] Available at: https://smartcities.gov.in/themes/habikon/files/SmartCityGuidelines.pdf [Accessed March 2021].
6.   Oxford Econonics, 2018. Global Cities: The Future of the World's Leading Urban Economies to 2035
7.   Mani, M. et al., 2018. South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards, Washington D.C.: World Bank Group.
8.   Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Pradhan Mantri Awas Yojana (PMAY-U), Swachh Bharat Mission (SBM-U), National Heritage City Development and Augmentation Yojana (HRIDAY), National Urban Livelihood Mission (NULM)
9.   Ministry of Housing and Urban Affairs, Govt of India, 2019. Transforming Urban Landscape 2014-19. [Online]
     Available at: http://mohua.gov.in/upload/5c7faf00eac57UT%20Book1.pdf [Accessed March 2021].
10. Eckstein, D., Kunzel, V. & Schafer, L., 2021. Global Climate Risk Index 2021, s.l.: Germanwatch e.V.

Shri Kunal Kumar
Joint Secretary & Mission
Director (SCM)
Ministry of Housing &
Urban Affairs

"

The Smart Cities Mission of Government of India focuses on sustainable, people-centric and climate resilient approach to urban development driven by innovation, digital governance and partnerships. The ClimateSmart Cities Assessment Framework is an initiative launched to support cities in assessing their development from a climate lens and further inform data driven decision making while designing their future plans and programs. The framework was developed after an extensive review of existing frameworks and assessment approaches adopted across the world followed by series of consultations with national and international organizations and experts. This report is an outcome of a gigantic cross-sectoral and multi-stakeholder effort to understand where we stand and how we can proceed towards building better climate action in cities.

"

Overview of Urban India

$2.94 Trillion
World's 5th largest economy
(nominal GDP) (IMF, 2019)

3rd Rank
World Ranking in start-up ecosystem
(Economic Survey, 2018-19)

135 Crore in 2019
World's 2nd largest population
(IMF, 2019)

81%
Workers in informal economy
(ILO, 2018)

27,668
Number of registered start-ups
(StartupIndia website, 2020)

56.6 Crores
Internet users in India
(2018)

4400+
CITIES AND TOWNS
(Census 2011)

53
CITIES WITH MILLION+ POPULATION
(Census 2011)

60 Crore
people will be living in India's cities by 2031 (The Global Commission on the Economy and Climate, 2014)

Dr. Antje C. Berger
Councillor, Climate & Environment,
Embassy of the Federal Republic
of Germany in India

"

Germany applauds India for its leadership in making cities more climate-friendly and more resilient and the current pandemic has shown us how important that is. We are committed to continue supporting India's Urban Missions and its efforts to find green and sustainable solutions for rapidly growing Indian cities for the benefit of the people, nature and climate.

"

Initiating and sustaining cohesive climate action in urban India requires intensive capacity building of cities, robust research, innovation and knowledge sharing to leverage the available skills and resources towards meeting these goals.

Results from this assessment will help not only mainstream climate actions at local level but also create action plans and capacities to address climate challenges and strive towards low carbon cities. NIUA established the Climate Centre for Cities (C-Cube) with support from MoHUA in 2020. As cities starts striving towards climate actions, we will establish and foster partnerships with cities to develop tools, templates, trainings, technologies to build local capacities to address challenges on a sustainable basis in the Indian context.

Shri Hitesh Vaidya
Director
National Institute of Urban Affairs

The frequency and severity of disasters have increased considerably in the country. In 2019, we experienced the highest rainfall since 1994 and the severe heatwave that swept the country put 10 Indian cities among the world's hottest places[11]. Between June and October 2020, the eastern coast of India experienced severe impacts from cyclone Amphan and extreme rainfall, and at least 10 million-plus cities were severely impacted[12]. Further, 43 smart cities in India are facing poor air quality that poses serious health concerns. Additionally, the CoVID-19 pandemic has severely impacted cities and highlighted the need for strengthening local capacities to address climate, environmental and public health risks.

Cities are also critical from a climate mitigation point-of-view as 70-80% of greenhouse gas emissions globally come from cities. As of 2017, India is the 3rd largest emitter of GHG emissions in the world.[13] While our per capita emissions are much lower - less than half - as compared to the global average, it is estimated that climate change will have an impact on Indian economy if emissions continue at their current rates[14]. India's Nationally Determined Contributions (NDCs), formulated in response to the Paris Climate Agreement, identify cities as one of the key sub-national actors and include commitments towards increasing energy efficiency of the buildings sector, developing climate resilient cities, emission reduction from the waste sector and developing sustainable transportation systems. The latest report from the Coalition for Urban Transitions (2021) projects substantial emission reduction potential in India's cities. It estimates that a set of proven low-carbon measures could reduce urban emissions from buildings, transport, waste and materials for infrastructure by 89% in 2050, saving 1,784 Mt CO2e relative to a baseline scenario[15]. To that end, number of cities including Pune, Chennai, Indore, Surat, Coimbatore, Kochi, Gorakhpur, Bhubaneshwar, Guwahati and Shimla have been formulating and implementing urban climate actions[16]. However, there is a need to scale up and create a road map for cities to achieve various national and international targets and commitments while planning and implementing their local development agenda and urban infrastructure investments (ibid).

To build climate actions in cities, the Climate Centre for Cities (C-Cube) was established by Ministry of Housing and Urban Affairs (MoHUA), Government of India within the National Institute of Urban Affairs (NIUA). C-Cube is intended to support capacity building and knowledge retention for mainstreaming climate change action across urban India. C-Cube's work focuses on six key verticals – P4 Support; Research and knowledge Management; Technology, Data Solutions and Innovation; Capacity Building; Advocacy and Communication; and Partnerships.

Since its inception, the Centre has also set up the ClimateSmart Cities Alliance, which is a multi-stakeholder group of institutions and partners to support mainstreaming of climate actions across Indian cities. As of January, 2021, the Alliance has 50+ partner organizations including international agencies and networks, donors, (I)NGOs, private sector organizations, rating agencies, incubators, data and technology firms.

11. Bhattacharya, B., 2020. Is extreme heat making India unlivable?. Livemint, 26 Sep [Online] Available at: https://www.livemint.com/mint-lounge/features/is-extreme-heat-making-india-unlivable-11601034638011.html [Accessed March 2021].
12. Thakkar, H., 2020. Where's the roadmap to prevent the next Hyderabad-like flood?, Citizen Matters. 28 Oct [Online] Available at: https://citizenmatters.in/preventing-urban-floods-the-real-problem-and-solution-22015 [Accessed March 2021].
13. Sethi, M., 2015. Decoding Urban India's Carbon Footprint: Spatial Numerical Mapping of Thermal Energy Emissions. JSTOR, 10 May, 108(No. 9), pp. 1616-1623.
14. Ricke, K., Drouet, L., Caldeira, K. & Tavoni, M., 2018. Country-level social cost of carbon. Nature Climate Change, Volume 8, p. 895–900
15. Coalition of Urban Transitions, 2021. Siezing the Urban Opportunity. [Online] Available at: https://urbantransitions.global/wp-content/uploads/2021/03/Seizing_the_Urban_Opportunity_WEB-1.pdf [Accessed March 2021].
16. NIUA and TERI, 2020. Mainstreaming Urban Resilience: Lessons from Indian cities. Policy Brief, New Delhi
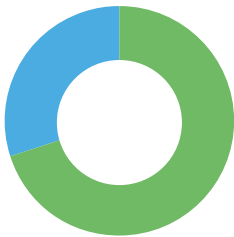
Overview of Climate Impact on India

7th most affected country on Global Climate Risk Index (in 2019)
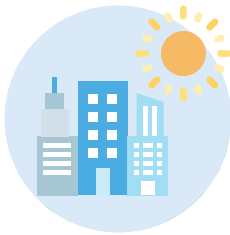
2.8% of the GDP could be the Climate Change cost for India as per The World Bank (2018)
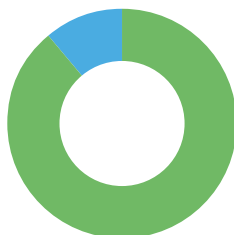
70% GHG emissions from cities

21 major cities in India including Delhi, Bengaluru, Chennai, and Hyderabad heading towards zero groundwater levels, affecting access for 100 million people (2020)

18 Smart Cities and 124 AMRUT Cities prone to high risk of flooding

89% emission reduction potential through low-carbon measures in Indian cities by 2050

Credits:

VIP model road, Surat:
Redevelopment of around 5Km road length into a user friendly model road that enhances pedestrian access and safety besides merging the blue and green infrastructure

Smart Cities Mission, MoHUA

2

ClimateSmart Cities Assessment Framework 2.0

ClimateSmart Cities Assessment Framework 2.0

ndia's GHG emissions have doubled between 1990 and 2015 and is expected to continue the trend.[1] CO_2 emissions from the energy sector is the largest driver of the overall GHG emissions and the country is one of the top energy consumers in the world (ibid). With the projected urbanization and GDP growth, the energy demand will increase significantly and with it the GHG emissions as well. The majority of emissions from Indian cities comes from industries followed by the energy consumed by the built environment (28% of all emissions) and the transportation sector (24% of all emissions).[2]

While cities play a key role in contributing toward climate change, cities are also adversely impacted by the changing climate. According to the IPCC 1.5°C Special Report, India is projected to experience more cyclones with high intensity storms, and has higher risk due to extreme rainfall and annually occurring heat waves. Cities, in addition to addressing the urbanization challenges are increasingly tackling extreme events like flooding, heat waves and cyclones. According to the National Disaster Management Authority (NDMA), 77 cities in the coastal regions of the country including some of the largest and most dense urban agglomerations are prone to frequent cyclones. The frequency of urban floods have also increased drastically in the last decade and the 2020 devastating flood in Hyderabad resulted in a loss of Rs.567 crores to the Greater Hyderabad Municipal Corporation(GHMC).[3]

Understanding the losses and damages from disasters, identifying the vulnerability hotspots, safeguarding urban assets, developing city level action plans to not only build disaster resilience but also adapt to the changing climate is becoming a key concern for Indian cities. While the national government has initiated 8 missions under the National Climate Action Plan for Climate Change (NAPCC) and indicated NDCs at the Paris Climate Agreement to mitigate emissions, cities can play a crucial role in greatly reducing GHG emissions by addressing energy consumption in the building and transportation sector in particular.

The Union Budget 2020-21 emphasized investments to infrastructure by allocating US$ 24.27 billion in the transport sector. Further, India plans to invest 1.4 trillion US$ on infrastructure between 2019-23.[4] With a massive push to develop cities and drive the economy, it is crucial to safeguard the investments from climate disasters and build forward looking cities. There is a need for cities to develop a clear roadmap for embedding climate change mitigation and adaptation strategies within their urban planning and development, including investments. To enable cities in taking this informed decision making a holistic assessment and benchmarking of urban development from climate lens is essential. To bridge this gap, the Ministry of Housing and Urban Affairs developed the ClimateSmart Cities Assessment Framework, the first-of-its-kind assessment on climate relevant parameters. The framework builds on the National Mission on Sustainable Habitat and is intended to be used as a tool for cities to inform investments, showcase evidence of their climate actions and monitor the impact.

The Climate Centre for Cities, with the support of MoHUA has conducted CSCAF 2.0 and is expected to conduct regular monitoring of the performance of Indian cities with respect to their climate action. In order to institutionalize the process the following structure has been established:

- **MoHUA** is the apex funding agency supporting through its Smart Cities Mission.
- **C-Cube, NIUA** being the project implementation unit has established the secretariat for ClimateSmart Cities Alliance and continues to conduct various training to build the capacity of cities for taking up climate actions.
- Chaired by JS and Mission Director (Smart Cities), an 18-member **Executive Committee** and **5 Thematic Sub-committees** have been formed. The Executive Committee provides technical guidance and validation, and the Thematic Sub-committees provides technical inputs to development and review of indicators. Member details are available in Annexure 1.
- The **ClimateSmart Cities Alliance** member organizations associated with C-Cube to provide on-ground support to cities in the implementation of CSCAF 2.0.

1. Climate Transparency, 2018. Brown to Green: The G20 transition to a low carbon economy. India Country facts. Available at: https://www.teriin.org/sites/default/files/2018-11/BROWN%20TO%20GREEN_2018.PDF [Accessed 26 April 2021]
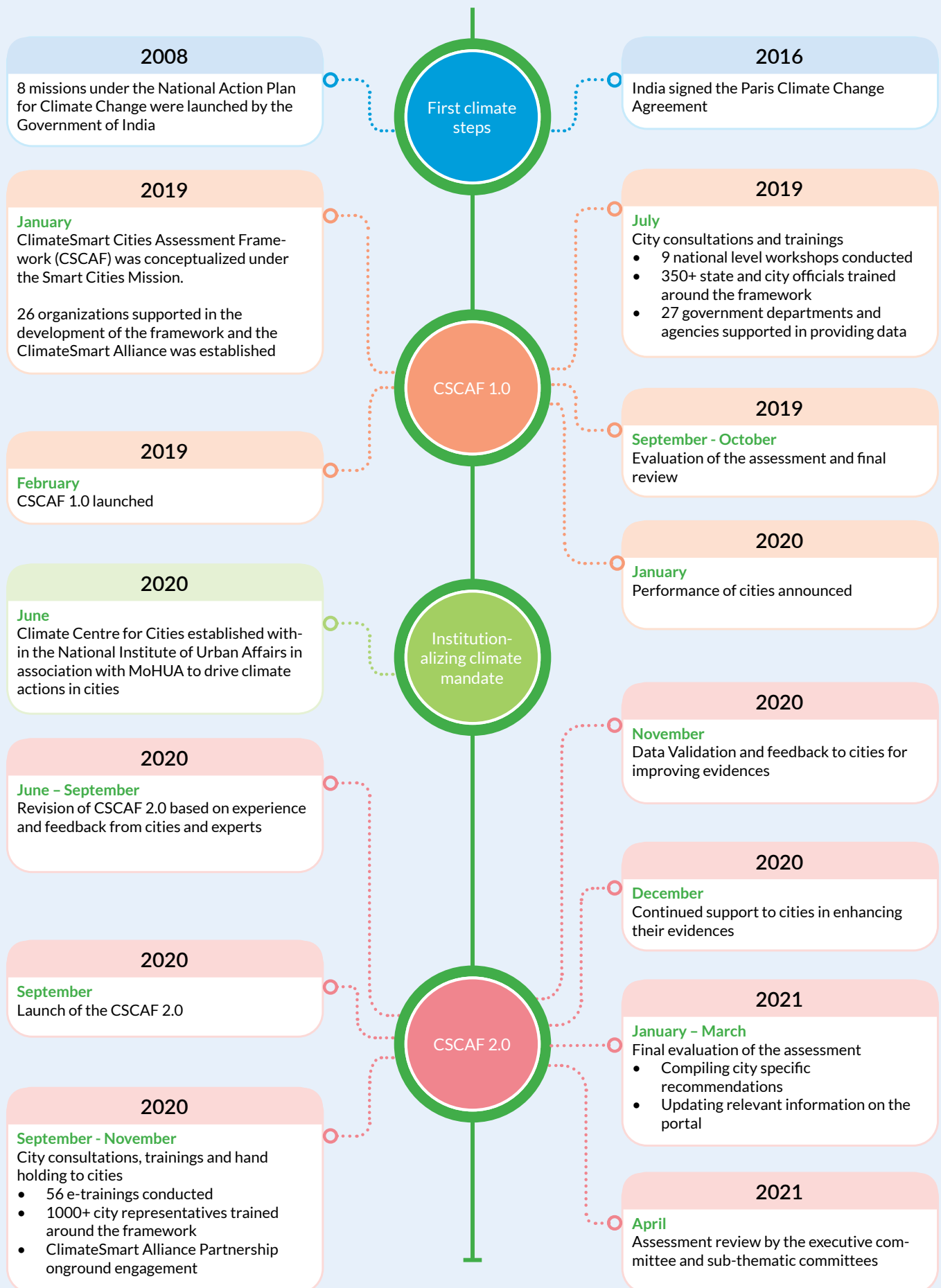2. Sridhar, K. 2010. Carbon Emissions, Climate Change, and Impacts in India's Cities. India Infrastructure Report 2010. Available at: https://irade.org/Program%20Details%20&%20reading%20Materials/Reading%20Materials/Impact%20on%20Indian%20Cities.pdf [Accessed 26 April 2021]
3. Ishaqui, S. 2020. Telangana tells Centre: State suffered nearly 9K crore loss due to floods. Deccan Chronicle [Online] Available at: https://www.deccanchronicle.com/nation/in-other-news/231020/telangana-state-informs-centre-on-flood-damage.html [Accessed 26 April 2021]
4. IBEF, 2021. Infrastructure Sector in India. [Online] Available at: https://www.ibef.org/industry/infrastructure-sector-india.aspx [Accessed 26 April 2021]

CSCAF 2.0 Journey

A first-of-its-kind city assessment on climate relevant parameters

First climate steps

2008
8 missions under the National Action Plan for Climate Change were launched by the Government of India

2016
India signed the Paris Climate Change Agreement

CSCAF 1.0

2019
January
ClimateSmart Cities Assessment Framework (CSCAF) was conceptualized under the Smart Cities Mission.

26 organizations supported in the development of the framework and the ClimateSmart Alliance was established

2019
July
City consultations and trainings
- 9 national level workshops conducted
- 350+ state and city officials trained around the framework
- 27 government departments and agencies supported in providing data

2019
February
CSCAF 1.0 launched

2019
September - October
Evaluation of the assessment and final review

2020
January
Performance of cities announced

Institutionalizing climate mandate

2020
June
Climate Centre for Cities established within the National Institute of Urban Affairs in association with MoHUA to drive climate actions in cities

CSCAF 2.0

2020
June – September
Revision of CSCAF 2.0 based on experience and feedback from cities and experts

2020
November
Data Validation and feedback to cities for improving evidences

2020
September
Launch of the CSCAF 2.0

2020
December
Continued support to cities in enhancing their evidences

2021
January – March
Final evaluation of the assessment
- Compiling city specific recommendations
- Updating relevant information on the portal

2020
September - November
City consultations, trainings and hand holding to cities
- 56 e-trainings conducted
- 1000+ city representatives trained around the framework
- ClimateSmart Alliance Partnership onground engagement

2021
April
Assessment review by the executive committee and sub-thematic committees

Improvements in the framework

The CSCAF 2.0 framework has been improved to capture the contribution of cities to the national and international initiatives like INDCs and SDGs respectively. This was done by capturing comprehensive feedback from 16 cities on the evidences and assessment methodology. In addition, deep-dive consultations with the thematic sub-committee and executive committee members were conducted. The improvements made in the framework with respect to indicators, scoring, evidence, support, engagement, coordination and the IT infrastructure are highlighted in this section.

Improved indicators

To avoid duplication and replication of data collation by cities for various MoHUA frameworks, indicators under the theme of waste management were aligned to Swach Survekshan. The data for these waste management indicators were sourced directly from the mission to avoid dual reporting.

Few indicators under the thematic area of **mobility, urban planning, green cover and biodiversity** were merged to enable ease of reporting. As a result, the total number of indicators were reduced from 30 to 28 within this assessment.

Standardized data templates were developed to ease the process of data collection from internal and external agencies. The design of the template helped in standardizing the data collected from line departments and other government agencies.

Spatial mapping support cities with better visualization and analysis is likely to improve decision making. Therefore, in addition to mandatory evidence, cities were encouraged to provide **maps as an additional evidence document.**

The definition and description of indicators and data points relevant to climate actions were simplified within this assessment to **support ease of understanding**.

Shri Lal Chhandama
Director - SC I
Ministry of Housing and Urban Affairs

> "
> Rapid pace of urbanisation made cities more vulnerable to the adverse impact of climate change with little time to act. Smart Cities Mission has launched the 'ClimateSmart Cities Assessment Framework' to sensitize cities to swiftly take up climate-oriented actions. This framework paves the way for increasing climate resilience and development of sustainable urban centres
> "

Better Coordination

C-Cube's core team **coordinated and managed** the assessment.

6 thematic experts **provided technical support to the cities** on a need to basis.

The team was supported by executive committee and sub-thematic committee members **in reviewing and improving the framework**

The ClimateSmart Alliance was established one month from the launch of the CSCAF to **support on ground coordination and climate action**

During the assessment, more than 50 ClimateSmart Alliance institutional members comprising both national and international organizations working in the area of climate change **extended on ground staff support to 121 cities.**

Comprehensive **data for green building performance indicators** were collated for all participating cities with support from Indian Green Building Council (IGBC), Green Business Certification Inc. (GBCI) and Green Rating for Integrated Habitat Assessment (GRIHA).

Dr. Umamaheshwaran Rajasekar
Chair Urban Resilience – Global
Resilience Cities Network
National Institute of Urban Affairs

" This report is a culmination of contribution and support C-Cube received from Climate Alliance Partners spanning a multitude of developmental organizations and practitioners from cities, states, national and international institutions. This report outlines the key findings from the 2020 assessment and provides future directions including opportunity for increased collaboration and need for collective climate actions across Indian cities. "

Increased Engagement

Online orientation sessions were conducted for city nodal officers and the supporting partner coordinators during the first two weeks of the assessment. The focus of these orientation and training sessions were to introduce the city nodal officers the framework, its indicators, our assessment methodology and the evidence required.

Daily mentoring sessions were conducted with the cities for the duration of the assessment period. During these sessions the nodal officers and other city officials got an opportunity to personally interact with the thematic experts. These sessions further helped nodal officers in not only understanding the requirements but also seek suggestions on data source and its access. A total of **56 such sessions were conducted** during the assessment period and over 1,000 city officials participated in these sessions.

Enhanced Digital Interactions

A help-desk to expedite the process of addressing queries from the cities was established. The **desk addressed over 800 queries and responded to over 2,200 calls** from city officials.

Support was provided in 8 different regional languages to city officials from varied geographies.

An online portal was developed in coordination with the National Informatics Centre (NIC). Carefully designed **dashboards with enhanced user interface** combined with real time updates were some of the added features.

Training videos on using the online portal were developed to further help the city officials.

Discussion on CSCAF 2.0
implementation in Pune

by Pune Smart City Development Corporation Limited
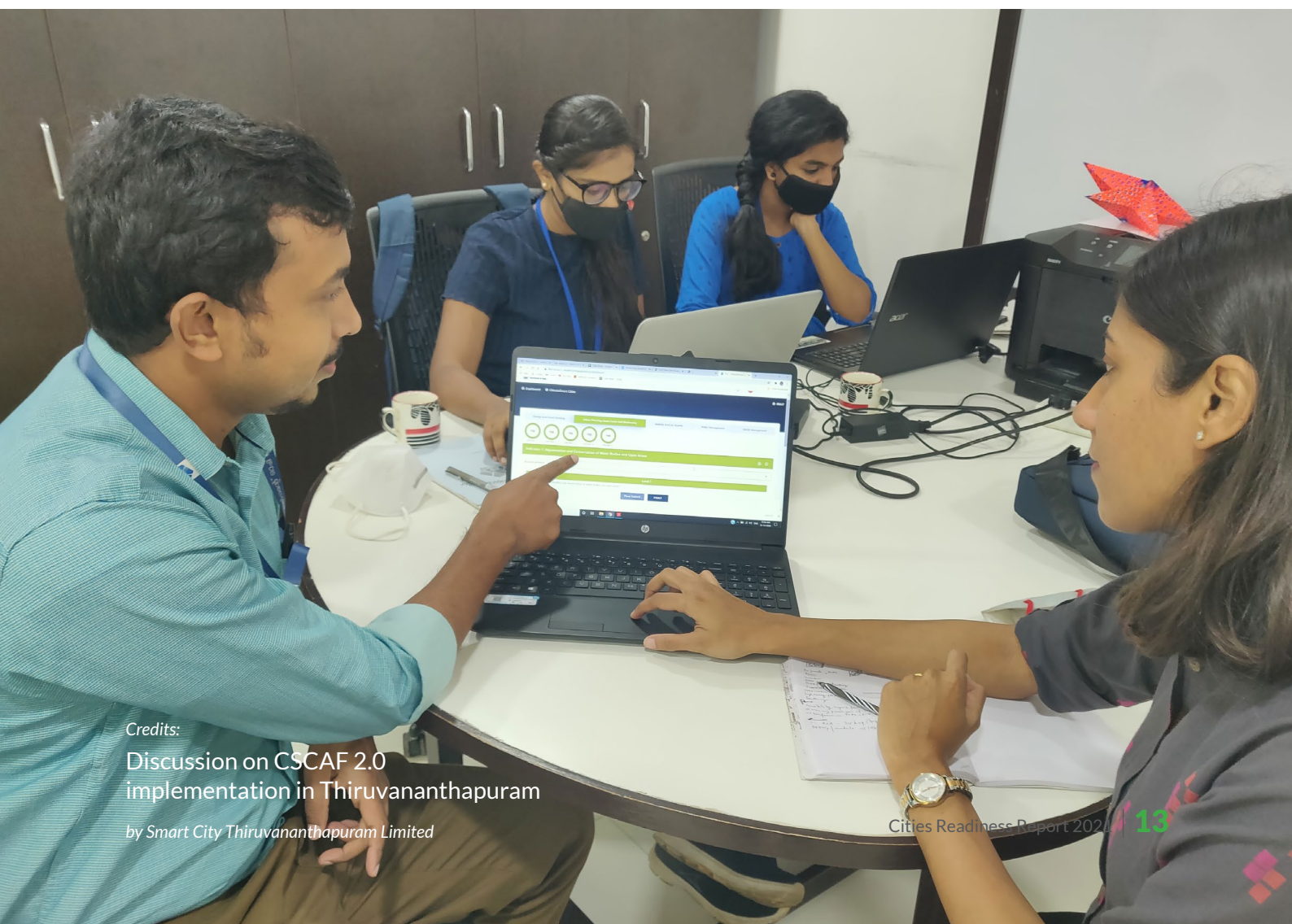
Discussion on CSCAF 2.0
implementation in Thiruvananthapuram

by Smart City Thiruvananthapuram Limited

Introduction to the Themes

The CSCAF 2.0 has five themes that captures both mitigation and adaptation aspects of various sectors in a city. The themes have varying weightages in the assessment based on their contribution to GHG emissions. The five themes of CSCAF are:

ClimateSmart Cities Assessment Framework 2.0

MOBILITY & AIR QUALITY 20%
- Clean Technologies Shared Vehicles
- Availability of Public Transport
- Percentage of coverage of Non-Motorized Transport network (pedestrian and bicycle) in the city
- Level of Air Pollution
- Clean Air Action Plan (Planning and Implementation)

WASTE MANAGEMENT 15%
- Landfill / dumpsite Scientific Remediation
- Scientific Landfill availability & operations
- Extent of Wet Waste Processed
- Construction & Demolition (C&D) waste management
- Extent of dry waste recovered & recycled
- Waste minimization initiatives undertaken by the City

WATER MANAGEMENT 15%
- Energy-efficient wastewater management system
- Energy-efficient water supply system
- Flood/ water stagnation risk management
- Wastewater Recycle and Reuse
- Extent of Non-Revenue Water
- Water Resources Management

URBAN PLANNING, GREEN COVER & BIODIVERSITY 25%
- Rejuvenation & Conservation of Water Bodies & Open Areas
- Proportion of Green Cover
- Urban Biodiversity
- Disaster Resilience
- City Climate Action Plan

ENERGY & GREEN BUILDINGS 25%
- Total electricity consumption in the city
- Total electrical energy in the city derived from renewable sources
- Fossil fuel consumption in the city
- Energy efficient street lighting in the city
- Promotion of green buildings
- Green building adoption

Urban Planning, Green Cover and Biodiversity

Water bodies and green spaces not only provide a better living environment but also help people to adapt to the adverse impacts of extreme climate events. Green areas also aid in carbon sequestration and minimising the impacts of air pollution. In this thematic area cities were assessed based on the measures taken to rejuvenate water bodies and open spaces, increase their green cover and conserve biodiversity. In addition, strategies, plans and actions adopted to build disaster resilience and climate actions were also considered.

Energy and Green Buildings

Growing urban population contributes to an increase in energy consumption. Currently, much of the energy consumed is derived from burning fossil fuels thereby contributing to GHG emissions. This theme therefore focused on assessing cities on their measures taken to reduce energy consumption, increase energy use efficiency and transition to clean energy (renewables). Further, the promotion and adoption of green buildings were also emphasised to address the built environment as they are prime contributors to GHG emissions.

Mobility and Air Quality

Vehicles plying within cities usually contribute to a significant portion of GHG emissions also result in deteriorating air quality. This thematic area assessed cities on the availability of public transportation, non-motorised transport infrastructure along with initiatives undertaken for transitioning to low carbon mobility. While these measures support in mitigating future GHG emissions, cities also need to address the challenges of air pollution. On these lines, cities were assessed based on measures taken to monitor air pollution and develop clean air city action plans.

Water Management

Achieving water security will be the key to growth and sustainable development of all Indian cities. Climate variability and change is expected to impact water resources especially its availability, accessibility and quality. To ensure sustainable development, this thematic area focused on water resource management considering the current supply and future demand. Other indicators in this thematic area include reduction of non-revenue water, recycling and reusing of waste water, energy efficiency in water supply and waste water management, flood and water stagnation risk management.

Waste Management

Urbanisation has resulted in tremendous increase in waste generation. Solid waste directly contributes to GHG emissions, treating waste / storm water / sewage consumes energy and indirectly contributes to GHG emissions. Further, the increased construction activity in cities results in waste that can also lead to air pollution. A detailed assessment of urban waste management is already being carried out within Swachh Survekshan (SS). Therefore the data provided by cities for the SS 2019 was used for assessing the performance of cities across selected indicators aligning to waste minimization, recycling of dry and wet waste, management of construction and demolition waste and scientific remediation of landfills.

Overview of cities' performance

To illustrate cities' performance in addressing climate change 5 performance levels were used. The levels capture the progressive nature of cities and provide directions that are needed to build climate actions.

- **One Star -** Cities that are in the early stages of development. These cities are yet to consider climate change or are in the process of conceptualizing climate actions.
- **Two Stars -** Cities that have initiated data analysis, established committees and are in the process of hiring technical agencies to initiate climate planning.
- **Three Stars -** Cities that have institutional mechanisms in place, this includes but not limited to functioning committees. These are also cities which have developed action plans or in the process of doing so.
- **Four Stars -** Cities that have allocated budgets and have initiated the implementation of identified projects
- **Five Stars -** Cities that have showcased successful implementation of climate actions and were able to showcase the impacts/ benefits of such actions.

Marks wre allocated to cities based on the evidences provided for the indicated measures across each of the indicators. The technical document can be referred to for more details on the scoring methodology.[5]

In order to better understand the performance of the cities, key insights based on city tiers, geographical regions and climatic zones are presented for each of the indicators. 4 tier classifications i.e. small towns (< 50,000 population), medium cities (50,000 - 5 lakhs population), large cities (5 - 10 lakhs population) and metropolitan cities (>10 lakhs population) based on the URDPFI population classification as per Census 2011 has been followed. Geographical regions such as Central, Northern, Eastern, North-Eastern, Southern and Western regions are considered for classification of cities. Further, the climatic zones of cities based on cold, composite, hot-dry, temperate and warm-humid zones are also considered for analysis. More details are available in Annexure 2.

Performance of participating cities in CSCAF

The CSCAF 2.0 assessment indicates that cities have been able to showcase considerable progress since the first assessment conducted in 2019. Significant progress has been reported specifically in the themes of urban planning, green cover and biodiversity; energy and green buildings; and waste management.

This year, considerable number of cities have progressed to the performance level of *Two Stars* by documenting data and initiating assessment studies that can inform

developing action plans. Cities progressing to the performance level of *Three Stars* have been able to establish institutional mechanisms for taking up relevant climate actions and have progressed to initiate the preparation of action plans. 9 cities have made good progress by implementing some of the identified climate initiatives and have moved to the performance level of *Four Stars.*

Note: The number of cities participating in CSCAF 2.0 has increased by 30 cities

[5]The technical document for CSCAF 2.0 can be accessed here - https://www.niua.org/csc/assets/pdf/CSCAF_2_Booklet.pdf

URBAN PLANNING, GREEN COVER & BIODIVERSITY

	★	★★	★★★	★★★★	★★★★★
CSCAF 2.0	55	40	22	6	3
CSCAF 1.0	62	27	7	0	0

ENERGY & GREEN BUILDINGS

	★	★★	★★★	★★★★	★★★★★
CSCAF 2.0	9	57	52	7	1
CSCAF 1.0	67	15	13	1	0

MOBILITY & AIR QUALITY

	★	★★	★★★	★★★★	★★★★★
CSCAF 2.0	64	38	19	5	0
CSCAF 1.0	60	34	2	0	0

WATER MANAGEMENT

	★	★★	★★★	★★★★	★★★★★
CSCAF 2.0	77	37	9	3	0
CSCAF 1.0	81	15	0	0	0

WASTE MANAGEMENT

	★	★★	★★★	★★★★	★★★★★
CSCAF 2.0	53	5	15	22	31
CSCAF 1.0	64	32	0	0	0
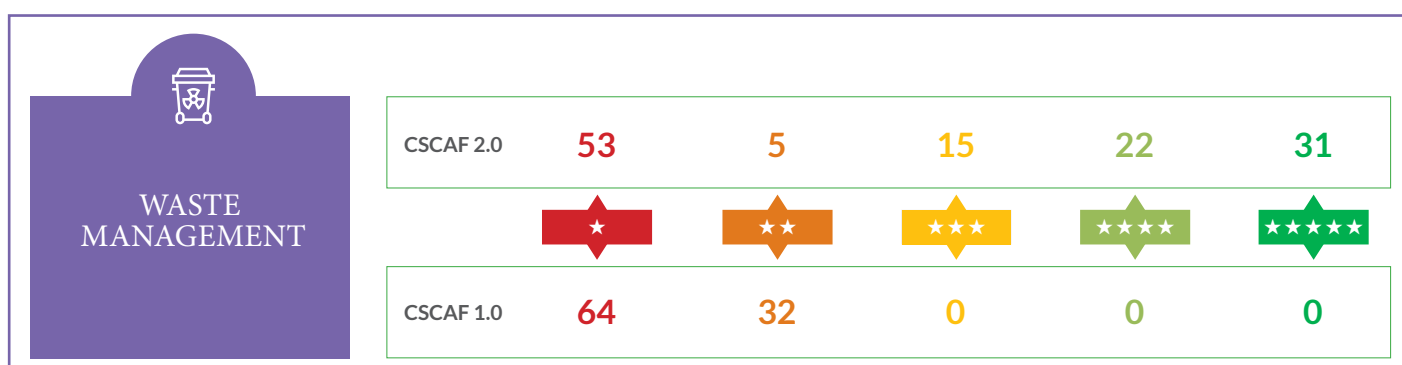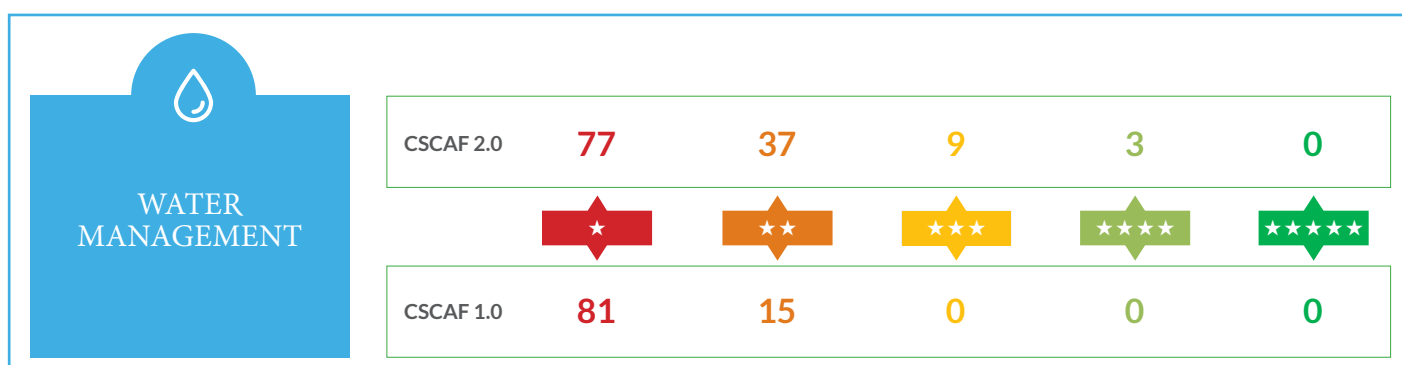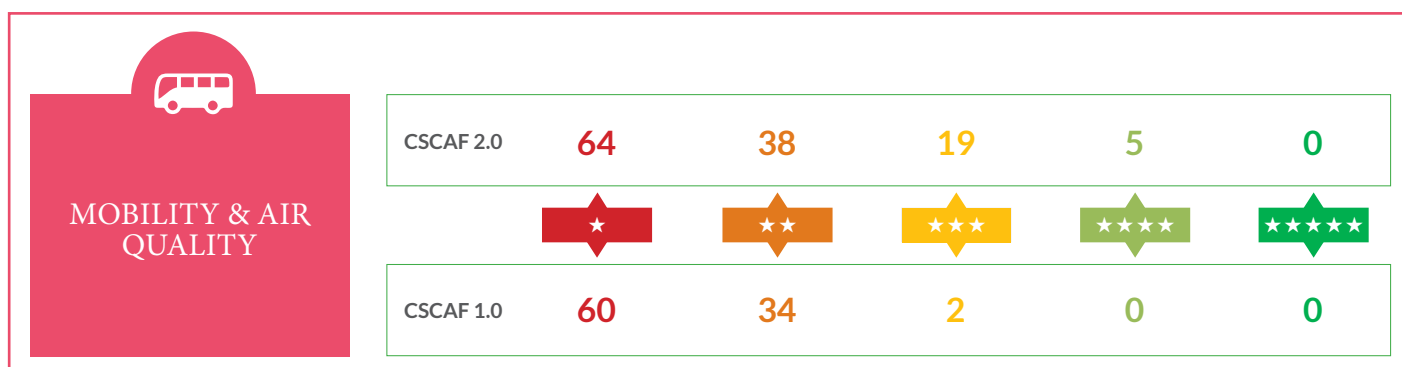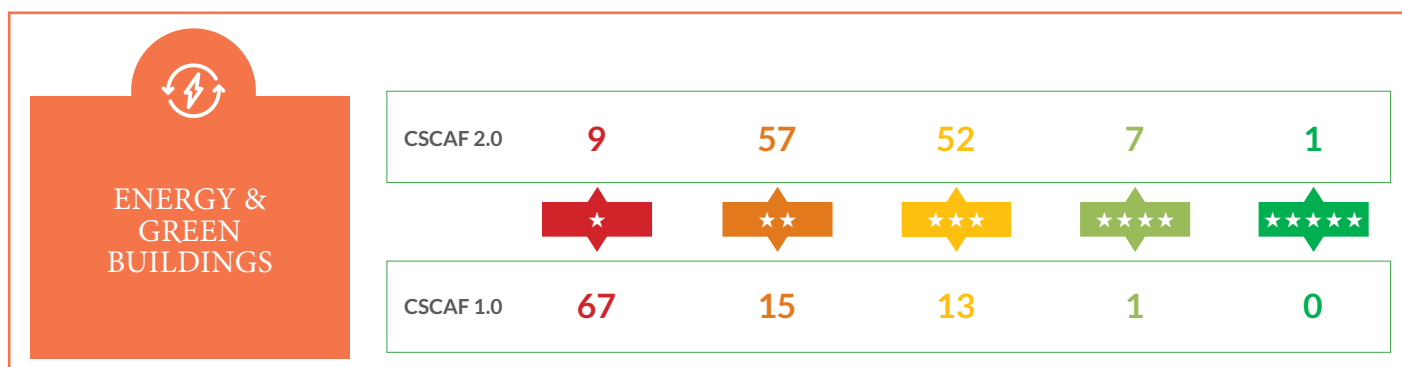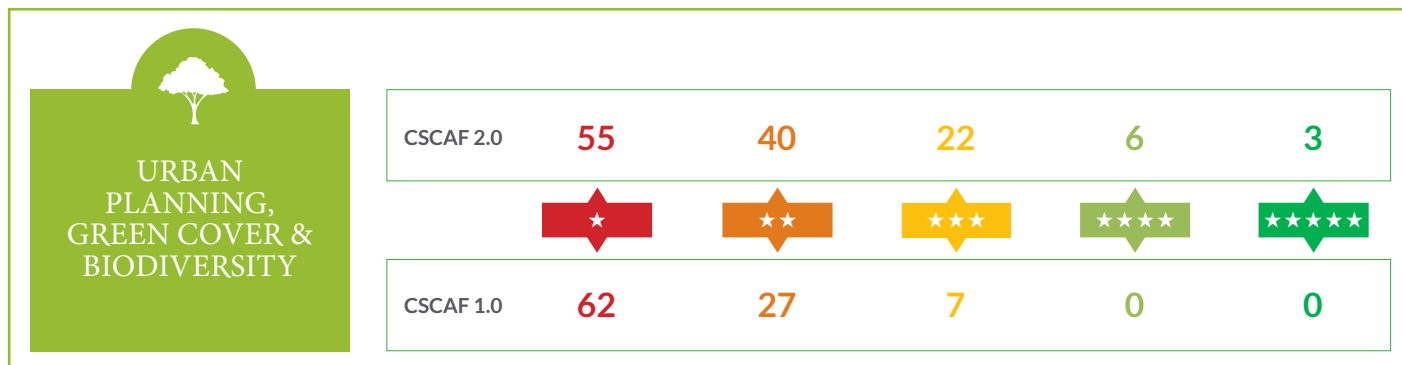
Note: The number of cities participating in CSCAF 2.0 has increased by 30 cities

Performance Levels

🟩 Four Stars
🟨 Three Stars
🟧 Two Stars
🟥 One Star

City Population

○ <0.5 million
○ 0.5-1 million
◯ >1 million
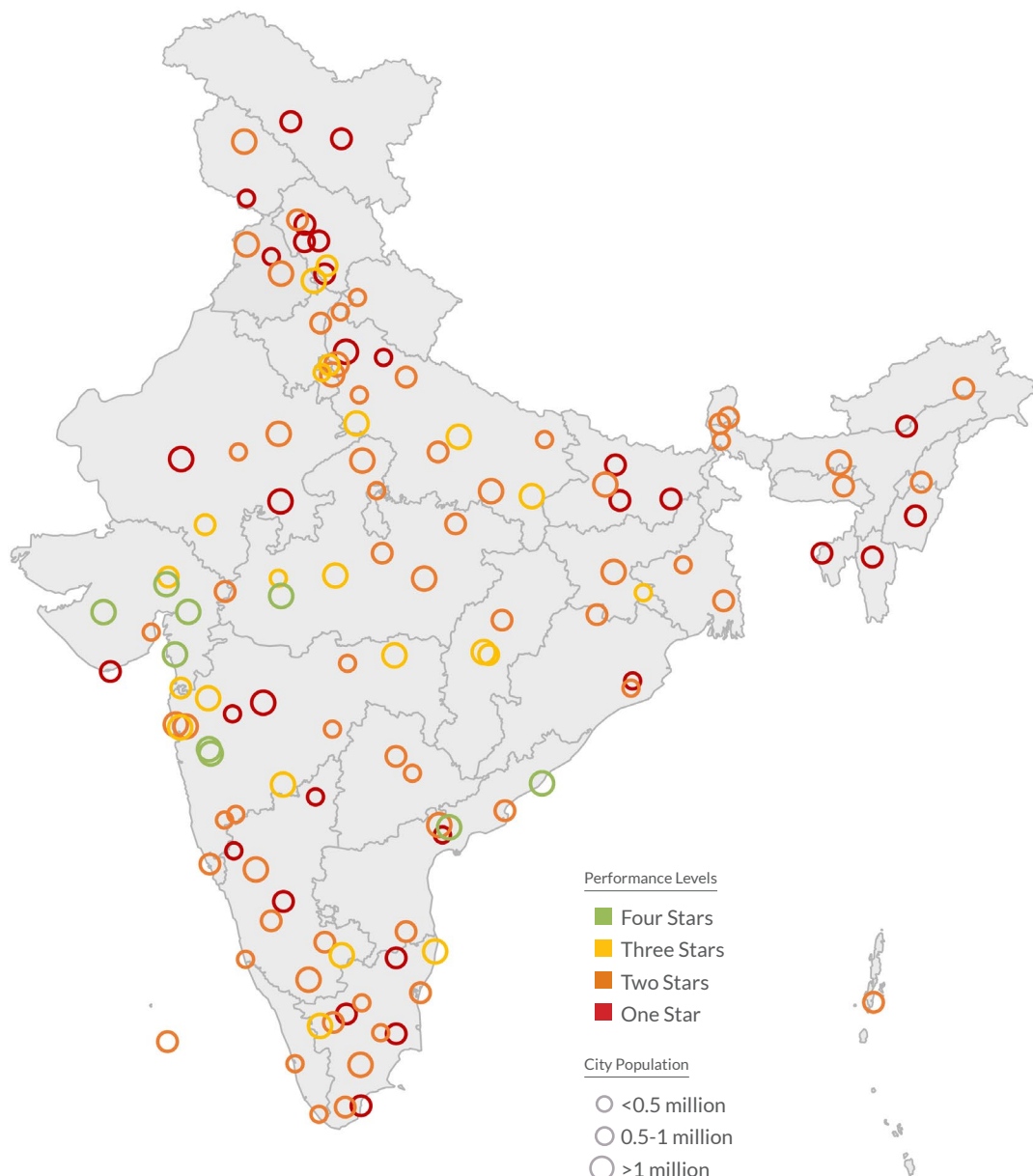
Performance of 126 cities in CSCAF 2.0

In CSCAF 2.0, conducted between September to December 2020, 126 cities have reported on 96 data points across 28 indicators under five themes. The participating cities included all 100 Smart Cites and 26 cities with population over that include state capitals and other interested cities.

0
5 Stars

9
4 Stars

22
3 Stars

64
2 Stars

31
1 Star

★ ★ ★ ★

- Ahmedabad
- Indore
- Pimpri Chinchwad
- Pune
- Rajkot
- Surat
- Vadodara
- Vijayawada
- Visakhapatnam

★ ★ ★

- **Agra**
- **Bengaluru**
- **Bhopal**
- Chandigarh
- **Chennai**
- **Coimbatore**
- Delhi
- Gandhinagar
- Gurugram
- Jamshedpur
- **Lucknow**
- **Nagpur**
- **Nashik**
- Naya Raipur
- **Raipur**
- Shimla
- Silvassa
- Solapur
- **Thane**
- Udaipur
- **Ujjain**
- **Varanasi**

★ ★

- Ajmer
- Aligarh
- Amravathi
- Amravati
- **Amritsar**
- Barielly
- Bhavnagar
- Bhubaneshwar
- Bilaspur
- Dahod
- Dehradun
- Dharamshala
- Durgapur
- **Faridabad**
- Gangtok
- Ghaziabad
- Gorakhpur
- Guwahati
- **Gwalior**
- Hubli Dharwad
- **Jabalpur**
- **Jaipur**
- Jhansi
- Kakinada
- **Kalyan Dombivali**
- **Kanpur**
- Karimnagar
- Karnal
- Kavaratti
- Kochi
- Kohima
- Kolhapur
- **Ludhiana**
- **Madurai**
- Mangalore
- Mira Bhayandar
- Mysore
- Namchi
- Nanded
- New Town Kolkata
- Panaji
- Pasighat
- **Patna**
- Port Blair
- **Prayagraj**
- Puducherry
- **Ranchi**
- Rourkela
- **Sagar**
- Saharanpur
- Salem
- Sangli Miraj &Kupwad
- **Satna**
- Shillong
- Shivamogga
- Siliguri
- **Srinagar**
- Tiruchirapalli
- Tirunelveli
- Tirupati
- Tiruppur
- Tiruvanantapuram
- Tumakuru
- Warangal

★

- Agartala
- Aizawl
- **Aurangabad**
- Belagavi
- Bhagalpur
- Bihar Sharif
- Cuttack
- Davangere
- Diu
- Erode
- Gulbarga
- Guntur
- Hamirpur
- Imphal
- Itanagar
- Jalandhar
- Jammu
- **Jodhpur**
- Kargil
- **Kota**
- Leh
- Loni
- Mandi
- **Meerut**
- Moradabad
- Muzaffarpur
- Palampur
- Solan
- Thanjavur
- Toothukudi
- Vellore

● Smart and AMRUT cities   ◇ Smart cities   ◆ AMRUT cities   ○ Other cities   ***Million + population cities**

3

Urban Planning, Green Cover and Biodiversity

Urban Planning, Green Cover and Biodiversity

Cities are a complex system of natural and built environments. With 4000+ urban centres and some of the fastest growing cities, Indian cities are facing immense urban planning challenges. Climate change impacts and the increasing number of extreme weather events pose additional risk to critical infrastructure and aggravate the vulnerability of residents. It is, therefore, important for our cities to adopt a climate sensitive approach to urban planning. This theme aims to assess the preparedness of cities for addressing and mitigating climate change impacts and disaster risks. It also focuses on nature-based solutions and conservation of natural systems like the water bodies, green cover, open spaces and biodiversity in the city for climate mitigation and adaptation. To that end, cities have been assessed based on formulation of strategies and action plans, integrating and mainstreaming climate actions in the masterplans, infrastructure DPRs and city budgets, implementation of projects, and functioning institutional, monitoring and review mechanisms.

Conserving, rejuvenating and increasing blue and green cover in a city can play a critical role in terms of climate mitigation and adaptation aspects by decreasing local temperature, carbon sequestration, protection in case of floods and helping recharge groundwater. For instance, urban forests can help mitigate some of the impacts of climate change by reducing Urban Heat Islands (UHIs) and heat stress, reducing storm water runoff, improving air quality, and improving health and wellbeing. In the US, urban forests reduce building energy use by 7.2%, equating to an emissions reduction of 43.8 million tonnes of CO_2 annually[1]. For rejuvenation and conservation of water bodies and open spaces, cities may refer the various schemes and policy guidelines to promote urban forestry as identified under India's National Redd+ Strategy 2018, the National Clean Air Action Plan 2019, Jal Shakti Abhiyan, Jal Jeevan Mission, and the URDPFI guidelines.

Loss of biodiversity can result in several direct and indirect impacts including reduced resilience to disasters (for instance, mangroves provide natural protection against cyclones and storm surges), reduced air/water/soil quality, changes in pest and disease patterns, changes in hydrological systems etc. The Biological Diversity Act, 2002 mandates constituting city level Biological Management Committees (BMCs), preparing inventories for local biodiversity, formulation of Local Biodiversity Strategies and Action Plans (LBSAPs). The City Biodiversity Index or Singapore Index helps cities to evaluate and monitor the progress of their biodiversity conservation efforts against their own individual baselines.

Another critical step for cities towards resilience building is developing city-level strategies, institutional and governance mechanisms for disaster risk reduction. While it is understood that the existing framework in India provides for formulation of a disaster management plan and committee at the district level, recent experience has shown that urban centres are at the frontline of managing and facing the brunt of disasters. This calls for focused local action to mitigate the impacts of extreme events on communities and infrastructures. National Disaster Management Authority (NDMA) guidelines of 2010, 2014, 2019 and the Ministry's SOP on urban flooding, 2017 provide guidance to cities on the subject.

The last indicator under this theme focuses on a comprehensive City Climate Action Plan addressing mitigation as well as adaptation aspects for cohesive local action. National and international guidelines recommend coordinated multi-stakeholder action; applying a climate lens to urban development plans, infrastructure investments & projects; and mainstreaming climate resilience in development codes, regulations & bylaws as key steps in the process. Cities may refer to the National Mission on Sustainable Habitat that provides the overarching framework and guidance to cities to undertake these actions.

> ❝
> CSCAF 2.0 has presented a number of proofs-of-concept on city-level initiatives towards climate-smart urban planning, rejuvenation and conservation of water bodies, green cover and biodiversity. As cities increasingly face compounded risks emerging from urbanisation stresses, climate change and the pandemic, it is encouraging to note that they are acknowledging their key role and building coordinated efforts to address the same. ❞

Ms. Raina Singh
Lead, Policy & Partnerships
Climate Centre for Cities, NIUA

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1. Nowak, D. J., Appleton, N., Ellis, A. & Greenfield, E., 2017. Residential building energy conservation and avoided power plant emissions by urban and community trees in the United States. Urban Forestry & Urban Greening, pp. 158-165.

INDICATOR **1**

Rejuvenation and Conservation of Water Bodies and Open Areas

6

14

24

32

50

INDICATOR **2**

Proportion of Green Cover

26

54

19

12

15

INDICATOR **3**

Urban Biodiversity

3

14

16

34

59

INDICATOR **4**

Disaster Resilience

10

11

27

28

50

INDICATOR **5**

City Climate Action Plan

9

7

9

5

96

- ● 5 Stars
- ● 4 Stars
- ● 3 Stars
- ● 2 Stars
- ● 1 Star

Performance Levels

■ Five Stars
■ Four Stars
■ Three Stars
■ Two Stars
■ One Star

City Population

○ <0.5 million
○ 0.5-1 million
○ >1 million
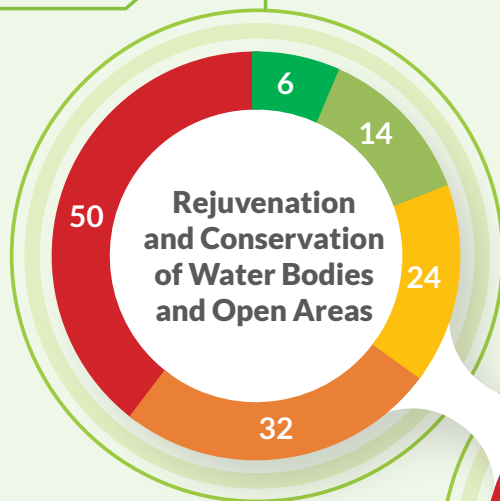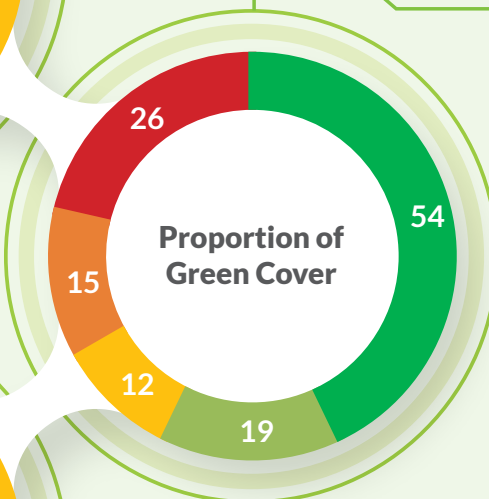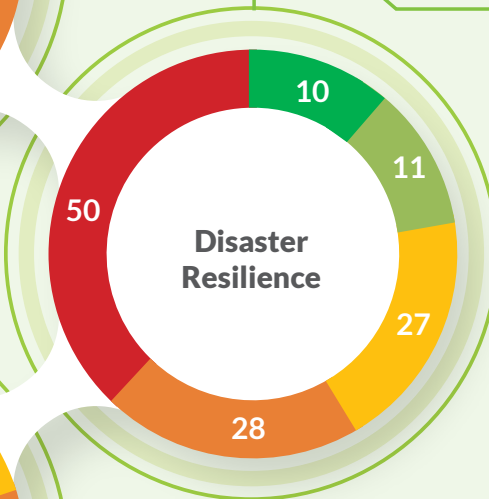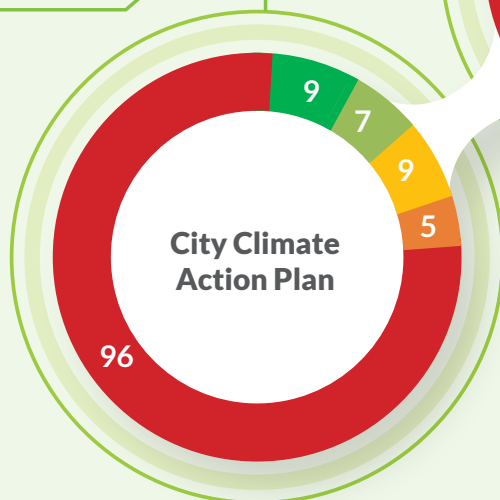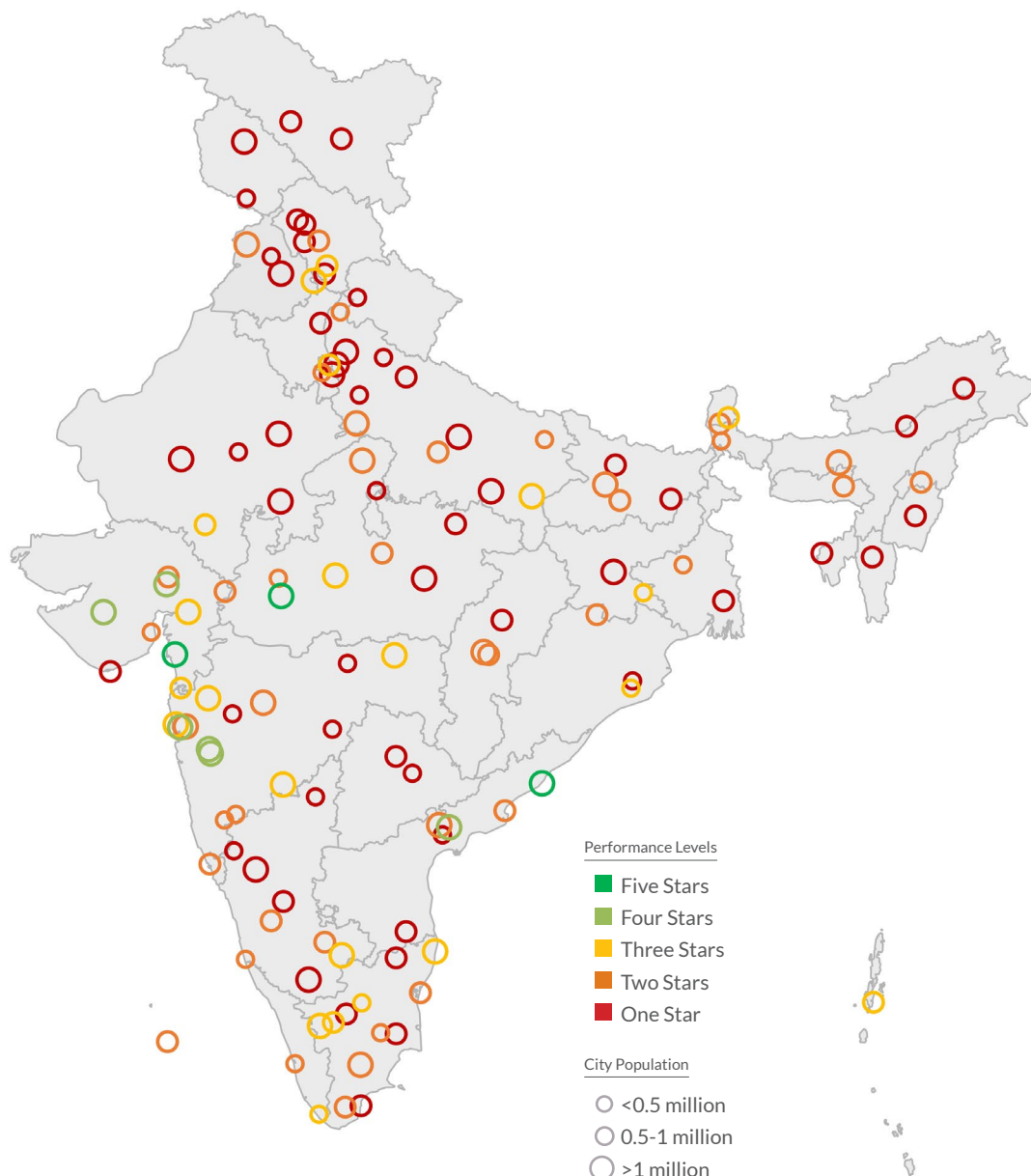
Performance of 126 Cities

3 cities (Visakhapatnam, Surat and Indore) are in the *Five Stars* category under the theme of Urban Planning, Green Cover and Biodiversity. The 3 cities have a population of more than a million and are covered under the Smart Cities Mission as well as AMRUT. 8 out of the 9 well performing cities (*Four Stars* and *Five Stars*) are from western and southern regions of the country. Overall, cities from the states of Gujarat and Maharashtra are relatively performing better.

Nearly all the cities are performing well in terms of the extent of green cover and water bodies present in the city. However, the evaluation indicates a gap in implementation of conservation actions and maintenance of these areas. Cities need to strengthen efforts through regular mapping, monitoring and targeted budget allocation to address these gaps. On the other hand, most cities - both under the Smart Cities and AMRUT Missions - are presently exploring the areas of urban biodiversity, disaster resilience and climate action planning at the local level. While recent guidelines from the Government of India, State Governments and the NGT have been instrumental in raising awareness and initiating the discourse on these aspects, cities are at a nascent stage of setting up institutional structures, planning and implementing measures. The evaluation reflects the key role of non-state actors in driving this process at city level.

3 5 Stars
6 4 Stars
22 3 Stars
40 2 Stars
55 1 Star

★ ★ ★ ★ ★

- Indore
- Surat
- Visakhapatnam

★ ★ ★ ★

- Ahmedabad
- Pimpri Chinchwad
- Pune
- Rajkot
- Thane
- Vijayawada

★ ★ ★

- Bengaluru
- Bhopal
- Bhubaneshwar
- Chandigarh
- Chennai
- Coimbatore
- Delhi
- Gangtok
- Jamshedpur
- Mira Bhayandar
- Nagpur
- Nashik
- Port Blair
- Salem
- Shimla
- Silvassa
- Solapur
- Tiruppur
- Tiruvanantapuram
- Udaipur
- Vadodara
- Varanasi

★ ★

- Agra
- Amravathi
- Amritsar
- Aurangabad
- Bhavnagar
- Bihar Sharif
- Dahod
- Durgapur
- Gandhinagar
- Gorakhpur
- Gurugram
- Guwahati
- Gwalior
- Kakinada
- Kalyan Dombivali
- Kanpur
- Kavaratti
- Kochi
- Kohima
- Kolhapur
- Madurai
- Mandi
- Mangalore
- Namchi
- Naya Raipur
- Panaji
- Patna
- Puducherry
- Raipur
- Rourkela
- Sagar
- Saharanpur
- Sangli Miraj & Kupwad
- Shillong
- Shivamogga
- Siliguri
- Tiruchirapalli
- Tirunelveli
- Tumakuru
- Ujjain

★

- Agartala
- Aizawl
- Ajmer
- Aligarh
- Amravati
- Barielly
- Belagavi
- Bhagalpur
- Bilaspur
- Cuttack
- Davangere
- Dehradun
- Dharamshala
- Diu
- Erode
- Faridabad
- Ghaziabad
- Gulbarga
- Guntur
- Hamirpur
- Hubli Dharwad
- Imphal
- Itanagar
- Jabalpur
- Jaipur
- Jalandhar
- Jammu
- Jhansi
- Jodhpur
- Kargil
- Karimnagar
- Karnal
- Kota
- Leh
- Loni
- Lucknow
- Ludhiana
- Meerut
- Moradabad
- Muzaffarpur
- Mysore
- Nanded
- New Town Kolkata
- Palampur
- Pasighat
- Prayagraj
- Ranchi
- Satna
- Solan
- Srinagar
- Thanjavur
- Tirupati
- Toothukudi
- Vellore
- Warangal

● Smart and AMRUT cities   ◈ Smart cities   ◆ AMRUT cities   ○ Other cities   *Million + population cities

INDICATOR 1

Rejuvenation and Conservation of Water Bodies and Open Areas

Urban Water Bodies and Open Areas play a critical role in climate change mitigation and adaptation as they help in combating urban heat islands. They also act as reservoirs for drinking water, retention basins for groundwater recharge, mitigate flooding, maintain biodiversity and help reduce the local temperature. With rapid urbanization and demand for built space, open areas and urban water bodies have been either reclaimed or encroached for development. Besides, management and maintenance the unplanned development remains a key issue catering to environmental degradation. For instance, at the beginning

of 1960s Bangalore had 262 lakes, now only 10 hold water. Similarly, in 2001, 137 lakes were listed in Ahmedabad city, and over 65 were reported being built over.[2]

Recent initiatives such as the Jal Shakti Abhiyan, AMRUT and Smart Cities Mission address these key issues and provide guidelines to cities to formulate and implement conservation and rejuvenation actions. The National Guidelines for Preparation of Action Plan – Prevention and Management of Heatwave by NDMA (2019) provides guidance to prepare heat island maps.

50 Cities

32 Cities

24 Cities

14 Cities

6 Cities

Cities have not conducted assessments to understand the status of water bodies and open areas

Cities have initiated spatial mapping of water bodies and open areas and have conducted assessments to understand status of water bodies and open areas

Performance criteria

Cities have allocated budgets, taken informed actions and are at various stages of implementing measures for conserving and rejuvenating water bodies and open areas

Cities have established monitoring mechanism to review and maintain rejuvenated water bodies and open areas

Performance Levels

★   ★★   ★★★   ★★★★   ★★★★★

Performance of 126 cities

✓ For this indicator, 6 cities have extensively mapped water bodies, open spaces and heat islands. All the 6 cities are covered under the AMRUT mission which has been a key enabler in helping these cities to formulate and implement informed actions in the form of rejuvenation and restoration of these areas. Two cities each from the states of Uttar Pradesh (Varanasi and Gorakhpur) , Gujarat (Ahmedabad and Surat) and Andhra Pradesh (Visakhapatnam and Vijayawada) constitute the cities in the *Five Stars* category.

✓ 32 cities have initiated mapping of water bodies and open spaces. While they have mapped the spatial extent, they need to build on attribute information and qualitative aspects to inform action planning. 38 cities (14 *Four Stars* and 24 *Three Stars*) have formulated strategies/ action plans along with budget allocation for implementation.

✓ 5 out of 6 *Five Stars* cities and 7 out of the 14 *Four Stars* cities are metropolitan cities. On the contrary, almost all participating small and medium towns are *One Star* cities. This reflects increased awareness and availability of resources - both technical & financial - to implement rejuvenation and conservation actions in metropolitan and large cities.

✓ All the 8 participating cities in the cold zones of the country are either in the *One Star* or *Two Stars* category indicating that they are beginning their efforts for rejuvenation of water bodies and open spaces. It is interesting to note that these cities fare well in terms of availability of open spaces (area wise), but lack conservation/rejuvenation efforts.

For the assessment of this indicator, all natural and manmade water bodies bound on all sides, listed under Census of Waterbody and 6th MI Census of Ministry of Water Resources, urban & peri-urban lakes under National Lake Conservation Plan (NLCP) and wetlands identified as per Wetland Management Conservation Rules 2017 were considered for assessment. For assessing the water quality monitoring, the Central Pollution Control Board (CPCB) guidelines have been considered. The open areas for this indicator are defined as recreational spaces, planned greens and green buffer zones as per URDPFI (Urban and Regional Development Plans Formulation and Implementation) Guidelines, 2014.

The indicator on rejuvenation of water bodies and open areas assesses cities based on the mapping of water bodies, open areas and heat islands. The informed actions along

Actions

AHMEDABAD

Ahmedabad heat action plan is the first comprehensive early warning system and preparedness plan for extreme heat events in India launched in 2013 and updated in 2016. The Plan creates immediate and longer-term actions to increase preparedness, information-sharing, and response coordination to reduce the health impacts of extreme heat on vulnerable populations.

with the fund allocation for rejuvenation & conservation of water bodies and open spaces have been considered for advanced marking. Furthermore, cities that have provided evidence on the improvement in the status of water bodies and open areas have also been marked advantageously.

Way forward to improve Rejuvenation and Conservation of Water Bodies and Open Areas

- The cities which are in the *One Star* category can initiate the process for preparing GIS maps of water bodies with attributes for their area, depth, volume and current status including encroachments. The cities may also prepare GIS maps for open areas in the city with attributes of area, foliage cover, type of land, ownership of land, current status including encroachments and prepare GIS based temporal map series for urban heat islands. This can be done through remote sensing techniques (for example, using Landsat imagery) and by collecting air and surface area temperatures across the city.
- The cities which are in the *Two Stars* category have already mapped water bodies and open areas and are further recommended to initiate preparation of a city-wide a strategy for conservation and rejuvenation as per the guidelines for Urban Water Conservation under Jal Shakti Abhiyan and also allocate a portion of the budget for the rejuvenation and conservation of water bodies and open spaces with sub task such as utilization

certificate; implementing bylaw, notification of the area, constitution of a committee, DPRs. These cities can also consider state level conservation regulations regarding encroachment and land acquisition for conservation initiatives, if any. For instance, the Akrama Sakrama Scheme 2013/14 by the Karnataka government for managing encroachments.
- 38 cities (14 *Four Stars* and 24 *Three Stars*) have initiated actions and allocated budgets for the rejuvenation and conservation of water bodies and open spaces. They are recommended to develop a spatial database to monitor the rejuvenated and conserved water bodies and open spaces over the time and monitor the changes/improvement in the status and quality of water bodies and open spaces as per the CPCB guidelines for Water Quality Monitoring 2017. These cities can integrate the strategy for rejuvenation and conservation of water bodies and open spaces within the City Development Plan/Master Plan.

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2.   Centre for Science and Environment (CSE), 2012. Protection and Management of Urban Lakes in India. [Online] Available at: https://www.cseindia.org/protection-and-management-of-urban-lakes-in-india-7995 [Accessed March 2021].

Proportion of Green Cover

Protected greenspaces reduce the impact of human activities on climate as they help in carbon sequestration, and maintaining urban microclimate, improving air and water quality, buffering noise pollution and conserving biodiversity. The World Health Organisation (WHO) prescribes 9 sqm of green space per capita in urban areas. In India, this figure varies from city to city with cities like Chennai and Pune having only 0.81 sqm per capita and 1.4 sqm per capita of green cover[3], respectively. At the national level, URDPFI (Urban and Regional Development Plans Formulation and Implementation) Guidelines, 2014, recommends at least 12%-18% green cover. Other policies and guidelines including MoHUA's Urban Greening

Guidelines, 2014, the National Mission for Green India (GIM) under National Action Plan for Climate Change (NAPCC), and the National Clean Air Programme (NCAP) also provide spatial standards for city level green cover and identify key stakeholders for implementing greening initiatives like eco-restoration in urban and peri urban areas and plantation schemes for pollution hotspots. In addition, the state horticulture policies and city master plans provide context specific policies and regulations based on the city's growth pattern.

As per the CSCAF assessment of 126 cities, it is observed that cities have green cover ranging from less than 1% to

26 Cities	15 Cities	12 Cities	19 Cities	54 Cities
		Performance criteria		
Cities have < 5% green cover	Cities have 5% to < 9% green cover	Cities have 9% to < 12% green cover	Cities have 12% to < 18% green cover meeting the prescribed norm by URDPFI	Cities have ≥ 18% green cover exceeding the prescribed norm by URDPFI
		Performance Levels		
★	★★	★★★	★★★★	★★★★★
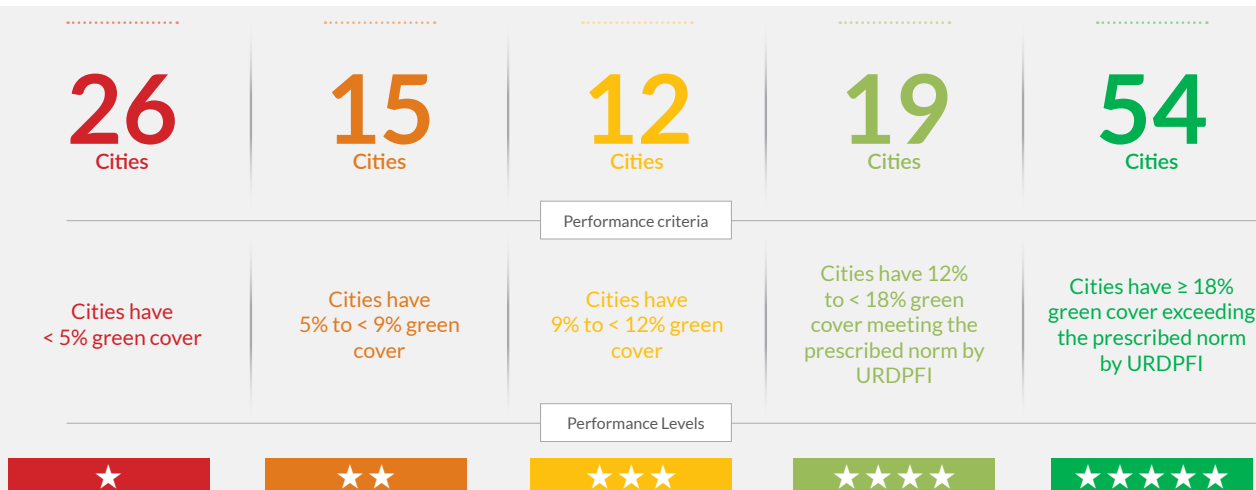
Performance of 126 cities

✓ Cities have performed well in this indicator with 65 cities meeting the prescribed URDPFI norm of 12% - >18% green cover within their municipal boundaries.

✓ The distribution of well performing cities (*Five Stars* and *Four Stars*) is almost equal across all types of towns- metropolitan cities, large cities, medium towns and small towns. Moreover, most of the participating small towns have performed well, with 7 out of the 9 participating small towns featuring among the *Four Stars* and *Five Stars* category with 12% - >18% or more green cover.

✓ The participating cities from Gujarat and Maharashtra have performed well with proactive local governments ensuring timely preparation and implementation of city planning and greening measures.

✓ Cities in the north-eastern region have also shown advanced actions with 8 out of 10 participating cities from the region in the *Four Stars* and *Five Stars* category. The hilly terrain along with conserved forest areas have contributed to this performance.

✓ 27 cities have taken qualitative initiatives for maintaining native tree species and density and taking measures to conserve and rejuvenate green cover under NACP and other applicable schemes.

✓ Of the top performing cities, 10 cities are of special mention as they have exhibited qualitative actions in addition to championing prescribed spatial standards for green cover, namely, Indore, Rajkot, Thane, Pune, Jamshedpur, Coimbatore, Salem, Varanasi, Sangli Miraj and Agra. All these cities are part of Smart City Mission and/or AMRUT except for Jamshedpur.

almost 90%. However, the equitable distribution and quality of the urban green cover remains a key issue, with most cities not monitoring or taking cohesive actions to improve the same. The Forest Survey of India and respective state forest departments have outlined measures like conducting Tree Census, but there remains a gap in its implementation at city level (by ULBs) and documentation of the qualitative aspects like tree density, canopy cover, native flora, etc. This may be attributed to limited mandate/guidelines for monitoring and reporting qualitative aspects of green cover management specific to urban areas. This indicator attempts to bridge this gap by assessing both quantitative and qualitative aspects.

The indicator on green cover assesses cities based on the proportion of existing green cover[4] within the city boundaries based on the standards set by URDPFI

Actions

THANE

The Green Thane initiative, implemented between 2015-18, focused on a plantation drive and regeneration of degraded forest cover within the city limits. The co-benefits included recharge of ground water table to deal with water scarcity.

Guidelines, 2014. To encourage conservation of native vegetation and promote green cover action planning, bonus marks were given to cities that provided additional evidence on list of native tree species, tree density and tree canopy density, and strategy for increasing green cover in the city in line with the National Clean Air Plan (NCAP) with action initiated for the same. Cities were encouraged to provide a spatial mapping of the green cover within the municipal boundary that can help in monitoring changes over the years.

Way forward to increase urban green cover

- 26 *One Star* cities are encouraged to leverage on the existing schemes like Smart City Mission and AMRUT to increase and maintain green cover.
- Cities with existing environmental cells/committees, horticulture or parks & garden or forest department within the ULB may engage with various stakeholders and include representatives from town planning dept, development authority, PWD, horticulture dept., civil society and community group representatives wherever possible. Further attention can be drawn to document the establishment of the committee along with its activities such as DPR preparations, budget allocations and record of maintaining green spaces that can support in making informed decisions.
- In order to prioritize native tree species, cities are recommended to initiate a tree census in collaboration with local stakeholders like the CSOs, nature clubs, schools/colleges. At the same time, People's Biodiversity Register (PBR) can also be initiated.
- Cities can adopt various measures like:

  » Align with state or national greening guidelines (National Greening Guidelines, MoHUA, 2014 and National Clean Air Action Plan, MoEFCC, 2019) to develop action plans.
  » Convergence with other national/ state policies for promoting city and community level greening initiatives. For example, cities can leverage various policies and schemes to promote urban forestry as identified under India's National Redd+ Strategy, 2018. Similarly, the National Mission for Sustaining the Himalayan Ecosystem, 2010 , can be referred by cities in this region.
  » Encourage the private sector to increase the green cover as part of Corporate Social Responsibility (CSR).
  » Engage various stakeholders to foster community level activities such as plantations, developing community gardens, training sessions for household level gardening/ terrace gardening/vertical garden- ing wherever possible.

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3. Imam, A. U. K. & Banerjee, U. K., 2016. [Online] Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4824703/ [Accessed March 2021].
4. For the purpose of this indicator, Green cover is defined as man-made city level and zonal/ district level greens; and reserved/ protected areas as per MoHUA's Urban Green Guidelines, 2014 and protected areas under Wildlife Protection Act 1972

INDICATOR 3

Urban Biodiversity

The SDG 11 (Sustainable Cities and Communities) and SDG 15 (Life on Land) outline the need to halt biodiversity loss. Urban biodiversity provides significant ecosystem services and any imbalance poses major challenges to sustainable development and affects the lives and livelihoods of residents. Extreme weather events due to climate change have grave impacts on urban biodiversity causing loss of habitats. The Rio Earth Summit 1992 was the first significant step towards formulating a policy/mandate for conserving biodiversity. In response to the Convention on Biological Diversity (CBD) signed at the Summit, the

Biological Diversity Act, 2002, came into effect in India. The Act mandated formation of National Biodiversity Board in Chennai, State Biodiversity Boards and city level Biological Management Committees (BMCs) to strategize for local biodiversity conservation.

The Act also mandated comprehensive recording and reporting of local flora and fauna through preparation of People's Biodiversity Register (PBR). The role of local community and nature enthusiasts is key to preparation of this register. The PBR Guidelines, 2013, provide step-

59 Cities	**34** Cities	**16** Cities	**14** Cities	**3** Cities
		Performance criteria		
Cities have not established Biodiversity Management Committee to guide conservation of urban biodiversity	Cities have set-up city level Biodiversity Management Committee as per the Biological Diversity Act, 2002 mandate	Cities have an inventory of urban ecosystems and species, and developed a People's Biodiversity Register	Cities have identified measures within master plan and other greening/ rejuvenation plans to safeguard/ increase biodiversity besides allocating funds to implement some measures	Cities have implemented measures and demonstrated improvements in urban biodiversity in addition to calculating the city biodiversity index
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 3 cities of Maharashtra - Thane, Pimpri Chinchwad and Pune have performed well in urban biodiversity management.

✓ While more than 50% of the participating cities have instituted a BMC and have started exploring biodiversity conservation measures, most of them are yet to initiate substantial actions on this indicator. In this regard, nearly all participating cities of Maharashtra have established BMCs and are at various stages of progress in their actions.

✓ 17 progressive cities (3 *Five Stars* and 14 *Four Stars*) have collaborated actively with scientific and technical experts/ organisations as well as the local community. Involvement of non-state actors is seen to be advantageous for strengthening technical support which is reflected in actions taken by Kochi, Gangtok, Coimbatore and most of the cities of Maharashtra.

✓ More than 90% of the participating cities of Northern India (27 *One Star* and 8 *Two Stars*) require to step up their efforts significantly. Considering northern India has a climate ranging from hot-dry to cold, it is important to leverage local biodiversity knowledge to understand the species type and richness.

✓ Along with these, 13 cities in biodiversity rich States/UTs of Himachal Pradesh, Lakshadweep, Andaman and Nicobar Islands, Imphal, Mizoram, and Meghalaya given their geography and rich biodiversity need to strengthen their actions to preserve and manage their pristine ecosystems in a sustainable manner.

✓ It was also evident from the assessment that none of the participating cities have allocated separate resources for bio-diversity management within their municipal budgets as of yet..

KOCHI

Kochi has developed Local Biodiversity Strategy and Action Plan (LBSAP) which allows the municipal corporation and other departments along with the local community to work together and deliver continued action for biodiversity stewardship. It includes the city profile, institutional and legal framework, actions and strategies, and its linkage with national and state objectives for biodiversity conservation.

by-step guidance to local departments/BMCs involved in preparation of PBR. The CBD Conference of Parties 2009 and 2019 introduced two other tools for self-assessment and plan making regarding urban biodiversity- the City Biodiversity Index or Singapore Index and Local Biodiversity Strategies and Action Plans (LBSAPs). The Singapore Index is a self-assessment tool for cities to evaluate and monitor the progress of their biodiversity conservation efforts against their own individual baselines. LBSAPs are integrated planning tools to manage internal and external biodiversity, and build a healthy and sustainable future for city dwellers. Therefore, the Convention of Biological Diversity (CBD) initiatives along with the Biological Diversity Act, 2002, provide the fundamental framework for urban biodiversity management in India.

The indicator on urban biodiversity assesses cities based on their compliance with the above legislation and policies in terms of institutional setup, inventory creation, action planning, review and monitoring at local level. This includes

formation of Biodiversity Management Committees (BMC) and preparation of People's Biodiversity Register (PBR). The cities are ranked highly based on other advanced actions taken viz. calculation of city biodiversity index, incorporation of biodiversity conservation measures in master plans and other thematic plans, and allocation of financial resources for relevant biodiversity measures.

Way forward to enhance urban biodiversity

- 59 *One Star* cities are recommended to prioritize urban biodiversity in their planning and development by establishing a city-level biodiversity management committee as per the Biological Diversity Act, 2002. The committee shall include representatives from the state horticulture department, state forest department, TCPO, ULB, development authority, civil society and community representatives among others.
- 34 cities which already have BMCs instituted within their respective ULBs can initiate preparation of a People's Biodiversity Register (PBR) with active involvement of the local community. The revised guidelines for PBR by the National Biodiversity Authority (2013) can be referred for the same. Cities can also refer to the IUCN guidelines to prepare an inventory (all forms of technical reports/studies) of urban ecosystems and species (including International Union for Conservation of Nature, IUCN-listed ones).
- 16 cities that have complied with the institutional setup and baseline assessment requirements as per

the legislation can initiate or update the calculation of the City Biodiversity Index (also called Singapore Index) to assess and monitor the city biodiversity status using the user's manual . Further, cities can initiate spatial mapping of biodiversity hotspots for better understanding and taking informed decisions regarding conserving biodiversity.
- Based on their baseline assessment (inventory/ PBR), 14 *Four Stars* cities are recommended to plan and implement appropriate measures for biodiversity conservation and management. This would include identifying measures to increase biodiversity within the master plan, greening plans and rejuvenation plans such as development and maintenance of a buffer zone between built and large natural areas to preserve biodiversity or also developing biodiversity parks.
- All 126 cities are recommended to prioritize allocation of funds within the municipal budget for various initiatives related to promotion of biodiversity in and around the municipal boundaries.

Disaster Resilience

As hubs of population and economic activity, urban areas face the brunt of disasters, affecting development gains and quality of life, infrastructure investments and environment. In the last two decades, urban India has experienced unprecedented and erratic rainfall, flash floods of high intensity, super cyclonic storms and heat and cold waves in many cities across the country including Visakhapatnam, Surat, Chennai, Kochi, Srinagar, Delhi and Bangalore among others. Floods and tropical cyclones contribute almost 75% to the total mortalities per year due to extreme weather events[5]. In 2014, Visakhapatnam was ravaged by cyclone Hudhud with 40 persons losing their lives and infrastructure damages of over Rs. 21,000 crore. Thousands of trees were uprooted causing habitat loss and damage to its only biodiversity park at that time. Chennai has faced recurring urban flooding, the worst being the 2015 floods which led to loss of lives of more than 250 people with more than 1.3 lakh people rescued.[6] It is evident that cities are the frontline bearing the immediate shocks of the disaster along with responding and managing the disaster. These events coupled with the ongoing pandemic has added to the complexity of the challenges

50 Cities	**28** Cities	**27** Cities	**11** Cities	**10** Cities
		Performance criteria		
Cities have not established a Disaster Management Cell/ Emergency Operation Centre within their ULB	Cities have established a Disaster Management Cell/ Emergency Operation Centre within their ULB and conduct regular mock drills for disaster response	Cities have conducted detailed hazard, risk, vulnerability assessment and developed a City Level Disaster Management Plan (CDMP) as per the NDMA guidelines	Cities have established early warning systems for priority risks linked weather forecasting system to their ICCC to better monitor and manage emergency situations	Cities have conducted regular monitoring to update their CDMP, mainstream disaster risk reduction measures in city departmental plans, building bylaws, development codes to mitigate risks
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 10 cities in the *Five Stars* category have adequate preparedness, response and recovery systems in place for tackling disasters. It is observed that a thrust from non-state actors has helped better performing cities like Shimla, Visakhapatnam, Surat, Vijayawada, among others. They have benefited via technical support in preparing Hazard, Risk & Vulnerability Assessment (HRVA) and mapping vulnerable areas, which is a precursor to preparing city disaster management plans.

✓ It is also noted that cities who have faced extreme weather events or natural disasters in the recent past have actively initiated adoption of city level guidelines for disaster management. For instance, 4 out of the 7 participating cities of Gujarat have shown increased adoption of the DM Act and NDMA guidelines at city level. With a history of plague epidemic and frequent urban flooding in Surat and Vadodara and the devastating Bhuj earthquake in 2001, city administrations have shown considerable preparedness for disaster management.

✓ A total of 35 cities have initiated preparation of city disaster management plans.

✓ 30 cities in states of Bihar, Himachal Pradesh (except Shimla), Uttarakhand, Arunachal Pradesh, Jammu and Kashmir, Ladakh, Kerala, Karnataka and West Bengal that are prone to cyclones, urban flooding and landslides, and 23 cities in Uttar Pradesh, Punjab and Rajasthan that are prone to heat and cold waves need to be proactive in gearing up their city level resilience structures considering the increased frequency of extreme weather events.

VISAKHAPATNAM

Visakhapatnam has prepared a comprehensive City Disaster Management Plan comprising of risk assessment of disasters and vulnerabilities and capabilities. The plan details out preparedness, response and action plan with focus on coastal mitigation measures.

faced by cities. Therefore, there is an urgent need for cities to not only be able to provide prompt disaster response but also be prepared better through identification of their potential hazards, vulnerabilities, risk and capacity. It is important for cities to have robust plans in place to mitigate potential disaster risks and "build back better" including recovery, reconstruction and rehabilitation.

The SDG 11 recognises the importance of disaster risk reduction (DRR) practices for disaster management. The existing international frameworks for disaster management- the Sendai Framework for DRR and the 2030 Agenda for Sustainable Development-provide the foundational guiding principles. The Disaster Management Act, 2005, is the key legislation for disaster management in India. It mandates the setup of National Disaster Management Authority (NDMA), State Disaster Management Authorities (SDMAs) and District Disaster Management Authorities (DDMAs), and provides disaster specific guidelines/SOPs. Any transformative action based on the national and sub-national decisions needs to be implemented on-ground through local government or ULBs. The National Disaster Management Authority (NDMA) guidelines prescribe constitution of disaster management committee/cell and Emergency Operation Centre (EOC) at ULBs and preparation of City Disaster Management Plans (CDMPs).It is to be accompanied with a vulnerability and risk assessment for various hazards (HRVA) and detailed mapping of the same. In spite of the robust policy framework, disaster management initiatives are largely

limited till district level with limited ULB level action. It is largely due to the fact that the city level institutional setup and planning is not a statutory requirement as per the Act, but only a prescribed guideline. This indicator seeks to address this challenge and encourage cities for prompt adoption of NDMA guidelines.

The indicator on disaster resilience assesses the readiness of cities/ULBs to tackle natural and manmade disaster events, and mitigate the loss and damages from the same by taking actions prescribed in the NDMA guidelines. This includes identifying vulnerable hotspots, developing HRV assessments, developing city disaster management plans aligning to district disaster management plans, establishing end-to-end early warning system and adopting relevant actions to reduce vulnerability to identified disasters. Cities are scored based on the progressive steps taken towards building disaster resilience such as institutionalizing a dedicated disaster management cell that can initiate basic disaster response actions, conducting assessments to understand their vulnerability and action taken towards building resilience, besides establishing communication networks in case of emergency.

Dr. Divya Sharma
India Executive Director
Climate Group

"

Congratulations! CSCAF is a significant milestone for Indian cities to move towards a climate resilient future and adopt sustainable pathways. The framework captures contextual nuances, complexities of scale and diversity, and the socio-cultural, economic and political underpinning under which Indian cities operate. It can be a remarkable tool to help cities tackle climate-related vulnerabilities while building long-term resilience.

"

5. Ray, K. et al., 2021. An assessment of long-term changes in mortalities due to extreme weather events in India: A study of 50 years' data, 1970–2019. Weather and Climate Extremes, Volume 32.
   Available at:https://www.sciencedirect.com/science/article/pii/S221209472100013X
6. National Institute of Urban Affairs. (2016). India- Urban Climate Change Fact Sheets: Urban Flooding. (NIUA, Ed.) Retrieved October 22, 2020 from Smartnet.niua.org: https://smartnet.niua.org/sites/default/files/resources/FS%203_Urban%20Flooding.pdf

Way forward to build disaster resilience

- 50 cities which are at the early stage of development *(One Star)* are yet to streamline city level disaster management actions. These cities are suggested to institutionalize dedicated City Disaster Management Cell/Emergency Operation Centre (EOC) within ULB as per the NDMA Guidelines. This would involve setting up a committee /communication channel between the city, district, state disaster management cells/authority, district magistrate, revenue departments and technical experts.

- All cities, through the district disaster management authority/revenue department and disaster management cell at ULB, can start to document the annual loss and damage incurred due to disasters. This would include capturing the hazard/event, date, number of injured persons, deaths and infrastructure damage (INR), natural resource loss. Such a record of disaster events will help in understanding the trends, vulnerable hotspots/ communities/ assets, and take informed decisions in mitigating future disaster risks and stock-taking of resources.

- All cities are recommended to conduct and document regular annual mock drills as capacity building exercises to develop a trained task force and identify volunteers for disaster response.

- 28 *Two Stars* cities that have established city level EOC can prioritise spatial mapping and plan making. The cities are recommended to conduct ward level Hazard Risk, Vulnerability and Capacity Assessment (HRVA) based on the last five years of disaster profiling and socio economic profile plus community participation as per NDMA Guidelines (2010, 2014 and 2019) covering risk assessment (disaster type, frequency, impact), vulnerability profiling (social, environmental, financial,physical), and also capacity/asset mapping (for quick response).The above step paves way for a comprehensive city level disaster management plan to be prepared as per NDMA Guidelines (2010, 2014 and 2019) and the Ministry's standard operational procedure (SOP) on urban flooding (2017). Cities are suggested to prioritize spatial documentation as part of the plan by creating relevant GIS maps. The Hazard, Risk and Vulnerability Assessment can be documented spatially (as GIS files) at the ward level for better monitoring, analysis, and quick response in the emergency situation.

- 27 *Three Stars* cities that have a city level EOC and a city level disaster management plan are recommended to establish early warning systems (EWS) for disaster response which include setting up forecasting mechanisms with IMD, developing communication with facilities like SMSs, helplines, and regional coordination

- These cities can link the early warning system and weather forecasting system to the Integrated Command and Control Centre (ICCC) maintained by the Smart City SPV and/or ULB. Through this, the city can start targeting vulnerable people and locations by providing alerts using GIS.

- 11 cities with established EOCs and EWS are recommended to regularly monitor, update and maintain the city disaster management plan, the early warning system and an inventory of activities of the department wise special task force and their training modules.

- Key departments of the ULB in the 11 *Four Stars* and 10 *Five Stars* cities can have initiatives to reduce disaster risk and/or emergency management action plans of their own. This could include capacity building of the technical as well as response staff for the emergencies, precautionary measures required by the departments, equipment inventory, response team shift plans, and also separate funds for the execution. For example, drainage department should have clearance of storm water drainages prior to monsoon, should check upon equipment (JCB, waste collection trucks, etc) for the emergency situation. The city should also ensure that the states/city-level building bylaws/development controls/codes are addressing the hazards and vulnerabilities identified for the city. The Compendium of Laws on Disaster Management by NDMA (2015) can be referred.

"

Every investment in climate readiness is an opportunity to enhance equity, to build more inclusive communities and protect people in an uncertain world. This Framework will help cities to seize this opportunity and to build and urban future that is more equitable and more resilient.

"

Ms. Lauren Sorkin
Executive Director
Resilient Cities Network

Credits:

ICCCC, Kochi:
The Integrated Command Control and Communication Centre (ICCCC) at Kochi aims to assist with disaster management operations besides supporting with governance and improved service delivery.

Smart Cities Mission, MoHUA

City Climate Action Plan

As of 2017, India's per capita emissions are much lower - less than half - as compared to the global average. However, more than 70% of our emissions are coming from urban areas[7]. As part of the Paris Agreement on climate change (2015), wherein nations committed to take immediate action to keep the global temperature rise below 2°C of pre-industrial levels, urban areas have been identified as one of four critical global systems that can accelerate and upscale climate action. In 2016, India ratified the Paris Agreement and committed under its 'nationally determined contributions' (NDCs) among others to reduce the emission intensity of its GDP by 33-35% from 2005 level by 2030. It is estimated that by 2050, under the carbon-intensive scenario India will experience a decline of about 2%-6% in its GDP, predicted to reduce incomes by 9.8%[8].

On one side, cities are key contributors to emissions, on the other, they also experience severe impact of climate change with various degrees of risk to basic services, infrastructure, housing, livelihoods, health posing a serious threat to economic growth.

The indicator on the City Climate Action Plan assesses the cities on the basis of initiatives undertaken for mainstreaming and addressing climate change - mitigation and adaptation - in the urban planning and development process. For instance, in master plans, infrastructure development plans and allocation of municipal budgets.

96 Cities	5 Cities	9 Cities	7 Cities	9 Cities
		Performance criteria		Cities have prepared and implemented Monitoring, Reporting and Verification (MRV) systems in addition to mainstreaming CCAP measures in city master plan/development plan
Cities have not established a climate coordination cell within their ULB	Cities have established a dedicated climate coordination cell within their ULB, conducted GHG inventories and HRV assessments, and developed a City Climate Action Plan (CCAP)		Cities have allocated budgets and initiated implementation of some of the measures identified in the CCAP	
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 9 cities have prepared and implemented city-level climate action plans, and are regularly monitoring and streamlining their climate actions. Support of non-state actors has been observed to be a key factor in this process, for e.g. Surat city has prepared a Sustainable Energy and Climate Action Plan with the support of IUC (International Urban Cooperation). Similarly, Udaipur and Rajkot have also prepared a city climate action plan with external support .

✓ 96 *One Star* cities are at the early stages of developing climate action planning. These cities need to initiate vulnerability assessment and GHG inventory preparation. Comprehensive training modules and climate assessment tool being developed by MoHUA will enable cities to prioritise and undertake contextualised climate actions. Cities are encouraged to initiate implementation of recommended measures in an integrated and participatory manner to build climate actions to advance in their performance.

Cities have been scored for setting up dedicated climate change cells, nodal officers & agencies within the ULB to coordinate actions with various departments & stakeholders, prepared climate action plans including mitigation and adaptation aspects based on ward level assessment and city GHG inventory.

≡Actions

UDAIPUR

Udaipur city has prepared the Climate Resilient City Action Plan that includes the preparation of the GHG emissions inventory for the city along with the vulnerability assessment and identification & prioritization of resilience interventions.

Way forward to prepare City Climate Action Plan

- 96 *One Star* cities are recommended to establish a city level stakeholder committee with key members from different agencies including, but not limited to, Municipal Corporation, Smart City SPV, Chamber of Commerce, Local University / Educational Institution, NGO/ INGOs, Regional or State Level Government Agencies such as State Disaster Management and civil society representatives.

- These cities may document the institutionalization of committee and climate coordination cell, and their activities (work plan timeline, initiatives/project reports, stakeholder engagement annual calendar). Climate coordination cell can develop and implement a work plan and annual reporting mechanism for activity tracking and performance evaluation in form of meeting time sheets, project reports, and annual reports. Regular monitoring/auditing of Climate Cell can be done by Climate Experts (State/Central agency) for each year. The City Municipal Commissioner/Officer may be responsible for the performance of Climate Cell of respective cities.

- Further, these cities can prepare a GHG emissions inventory for all sectors on the basis of established methodologies by IPCC, the Global Protocol for Community Scale GHG Emissions (GPC) and MoEFCC guidelines. City is also suggested to conduct a Climate Change Vulnerability assessment along with a GIS -based map of vulnerable areas/eco-sensitive zones. Cities can seek support from the Forest Department, National/State Remote Sensing Agencies, academia/ research institutions and/or civil society for this

mapping exercise.

- Cities are recommended to develop a climate action plan, in a participatory manner and in accordance with national guidelines such as Guiding Principles for City Climate Action Planning from UN-HABITAT and the National Mission on Sustainable Habitat, to reduce GHG emissions and reduce the negative impacts of climate change. This would also include a financial plan and allocation of dedicated funds within municipal budget for implementation of the climate action plan.

- 9 *Three Stars* cities with climate action plans may coordinate with respective state line departments and development agencies for implementation of the same. Cities can choose to identify relevant/ responsible departments and seek their support for the same or can implement the climate action plans through public private partnerships (PPP) models.

- 7 *Four Stars* cities that have initiated implementation of climate action plans are recommended to periodically monitor the same through monitoring and review framework or third party assessments.

- City climate cells can ensure that climate action plans are reviewed and updated at least every 5 years (preferably annually) in a participatory manner through the city level stakeholder committee. Cities are also suggested to document this process.

- All cities are recommended to initiate mainstreaming climate action plans within the master plans and infrastructure development DPRs to ensure sustainability.

7. Sethi, M. (2015, May 10). Decoding Urban India's Carbon Footprint: Spatial Numerical Mapping of Thermal Energy Emissions. JSTOR, 108(No. 9), 1616-1623.
8. Mani, M., Bandyopadhyay, S., Chonabayashi, S., Markandya, A., & Mosier, T. (2018). South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards. South Asia Development Matters. Washington, DC, United States of America: The World Bank Group.

Aerial view of Mumbai city before cyclone Nisarga, 2020

Actions in the cities

Vijayawada

Greenery Development on Vijayawada Hills
Vijayawada has prepared a strategy for converting a dumpsite into Model Park at Ajith Singh Nagar and allocated Rs.2.37 crores for the same. The city has prepared a detailed project report for Greenery Development on Vijayawada Hills with the objective of conserving all open spaces and hillocks withing the city.

Agra

Action Plan to increase Green Cover
The city of Agra has prepared an action plan to increase green cover in the city by 15%. The action plan includes current status of green cover and assessment of the master plan of the city to devise long term strategies for increasing green cover.

Gangtok

Local Biodiversity Strategy and Action Plan (LBSAP)
The LBSAP of Gangtok sets out a framework and a plan of action for conservation and sustainable use of biological diversity and equitable sharing of benefits derived from this use. The city has defined its LBSAP vision as 'a prosperous Gangtok with focus on climate-smart development while ensuring the conservation of its cultural and ecological heritage'.

65 cities are meeting the prescribed URDPFI norm of more than 12% green cover within their municipal boundaries

38 cities have formulated strategies/action plans and have allocated a budget for rejuvenation & conservation of water bodies and open areas

35 cities have initiated preparation of city disaster management plans

Shimla

Multi-Hazard Risk and Vulnerability Assessment (HRVA)

Shimla has conducted a Hazard, Risk and Vulnerability Analysis (HRVA) and developed a city level Risk Atlas to help stakeholders make risk-based choices to address vulnerabilities, mitigate hazards and prepare for response to and recovery from hazard events.

Chennai

City Disaster Management Plan

The Greater Chennai Corporation had prepared the first city disaster management plan as prescribed in the NDMA guidelines. The CDMP has taken into account the vulnerabilities present in the city based on its geography, demography, history and social and environmental aspects..

Surat

Sustainable Energy and Climate Action Plan

Surat has prepared the Sustainable Energy and Climate Action Plan that proposes actions for both climate change mitigation and adaptation based on a GHG emissions inventory and a climate change vulnerability assessment respectively.

62 cities

have instituted a Biodiversity Management Committee (BMC)

30 cities

have initiated/ completed vulnerability assessments and GHG inventory

4

Energy and Green Buildings

Energy and Green Buildings

India is leading the race to meet its climate change mitigation commitments[1]. The energy sector is expected to contribute to 73% of India's GHG emissions[2]. To achieve the climate goals, Indian cities, will have to focus on sustainable and resilient actions. With the urban population projected to increase from 30% to 60% by 2050[3] it is likely that India's residential electricity will triple[4]. Urban India is expected to build 700 million to 900 million square meters of residential and commercial spaces, 350-400 kilometres of metros and subways, and 19,000 to 25,000 kilometres of road lanes every year[5]. This provides a unique prospect for cities to combine the climate goals and develop in a sustainable and resilient approach.

The National Action Plan on Climate Change (NAPCC) initiated by the central government in 2008 draws attention to enhancing energy efficiency, heightening the penetration of renewable energy and driving the construction of sustainable habitats. Additionally, guidance on reducing the energy intensity for municipal services as well as for the construction sector is provided by the Bureau of Energy Efficiency (BEE). The National Mission on Sustainable Habitat (NMSH) under NAPCC is steering energy efficiency in buildings that contribute to overall reduction in energy consumption by the built environment besides improving the quality of life. Further, the National Solar Mission (NSM) under NAPCC is targeted towards increasing the renewable energy penetration in the grid infrastructure, leading to lower carbon emissions besides increasing the energy usage of urban centres. India is already working towards achieving 175 GW of renewable energy target by 2022, which includes 100 GW of solar (JNNSM) and 60 GW of wind. This will facilitate the reduction of per capita emissions as the rise in urban development will increase per capita energy consumption. The first four indicators in the thematic area of Energy and Green Buildings attempts to capture some of the key goals of the above mentioned missions. The indicator assesses the electricity consumption per capita in cities, the electricity derived from renewable energy sources, overall fossil fuel consumption and the coverage of energy efficient street lighting in the city.

Apart from the multiple missions, many standard frameworks and ratings such as Green Rating for Habitat Assessment (GRIHA), the global standard Leadership in Energy and Environmental Design or LEED (administered by GBCI India) and the Indian Green Building Council (IGBC) are available for cities to promote the construction of green buildings. The indicators on promotion of green buildings and adoption of green buildings tries to assess the cities based on the current and upcoming development.

Mr. Kanagaraj Ganesan
Director
Integrative Design
Solutions Pvt. Ltd. (IDSPL)

"
Roll-out of a comprehensive City Energy Action Plan considering energy access, energy efficiency and renewable energy integration will improve the quality of life of the citizens while reducing the climate impacts of city development and operations. The city administrators can also evaluate the implementation of innovative low carbon strategies like district energy or cooling systems, cool roofs and building energy codes.
"

1. Mirror Now Digital, Times Now News :2020. India only country among G20 national to meet climate change mitigation Commitments. [Online] Available at: https://www.timesnownews.com/india/article/india-only-country-among-g20-nations-to-meet-climate-change-mitigation-commitments/683884 [Accessed 20 March 2021].
2. PIB, 2018. Cabinet approves submission of India's Second Biennial Update Report (BUR) to United Nations Framework Convention on Climate Change (UNFCCC). [Online] Available at: https://pib.gov.in/Pressreleaseshare.aspx?PRID=1557609 [Accessesd 20 March 2021]
3. PTI, 2016. 60% of India's population to live in cities by 2050: Government. [Online] Available at: https://www.livemint.com/Politics/Cy-aMfUgL7r9dEAPKIRYMkI/60-of-Indias-population-to-live-in-cities-by-2050-governm.html
4. IEA, 2021. India Energy Outlook. [Online] Available at: https://www.iea.org/reports/india-energy-outlook-2021 [Accessed 25 February 2021]
5. McKinsey and Company, 2010. India's Urban Awakening: Building inclusive cities, sustaining economic growth. [Online] Available at: https://www.mckinsey.com/featured-insights/urbanization/urban-awakening-in-india [Accessed 25 February 2021]

Thematic indicators and assessment outcome

INDICATOR 1

Electricity Consumption of the City

- 5
- 31
- 46
- 44

INDICATOR 2

Total Electrical Energy in the City Derived from Renewable Sources

- 10
- 2
- 80
- 34

INDICATOR 3

Fossil Fuel Consumption in the City

- 14
- 9
- 26
- 29
- 48

INDICATOR 4

Energy Efficient Street Lighting in the City

- 10
- 9
- 10
- 9
- 88

INDICATOR 5

Promotion of Green Buildings

- 23
- 5
- 7
- 6
- 85

INDICATOR 6

Green Building Adoption

- 7
- 4
- 12
- 78
- 25

Legend:
- 5 Stars
- 4 Stars
- 3 Stars
- 2 Stars
- 1 Star

Performance Levels

- 🟩 Five Stars
- 🟩 Four Stars
- 🟨 Three Stars
- 🟧 Two Stars
- 🟥 One Star

City Population

- ◯ <0.5 million
- ◯ 0.5-1 million
- ◯ >1 million
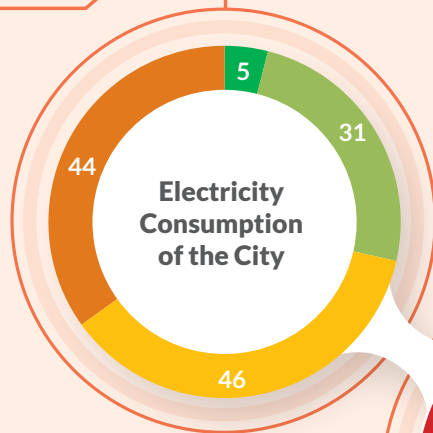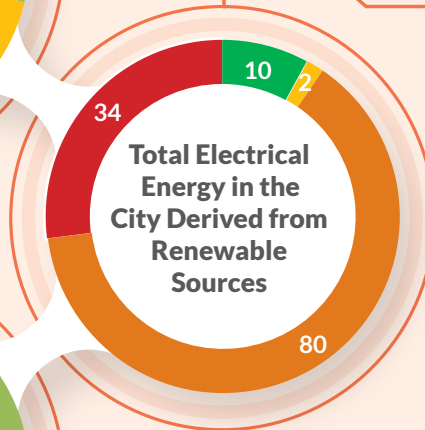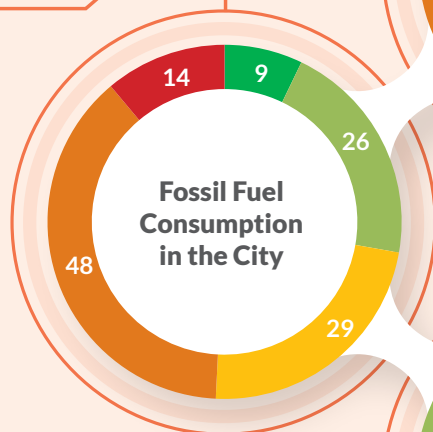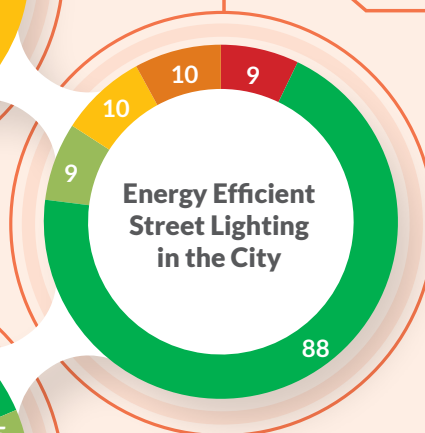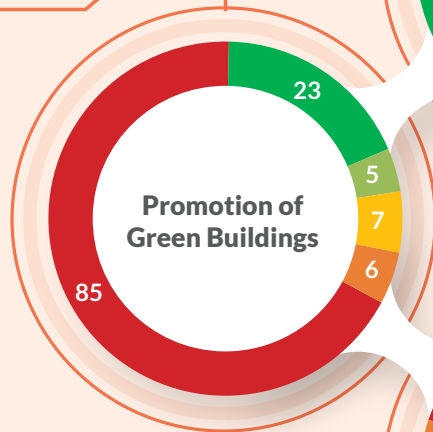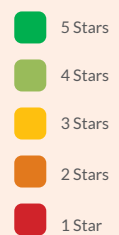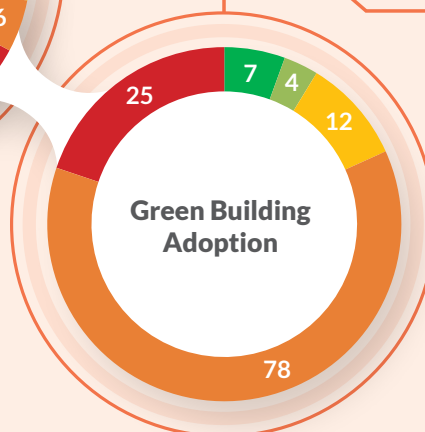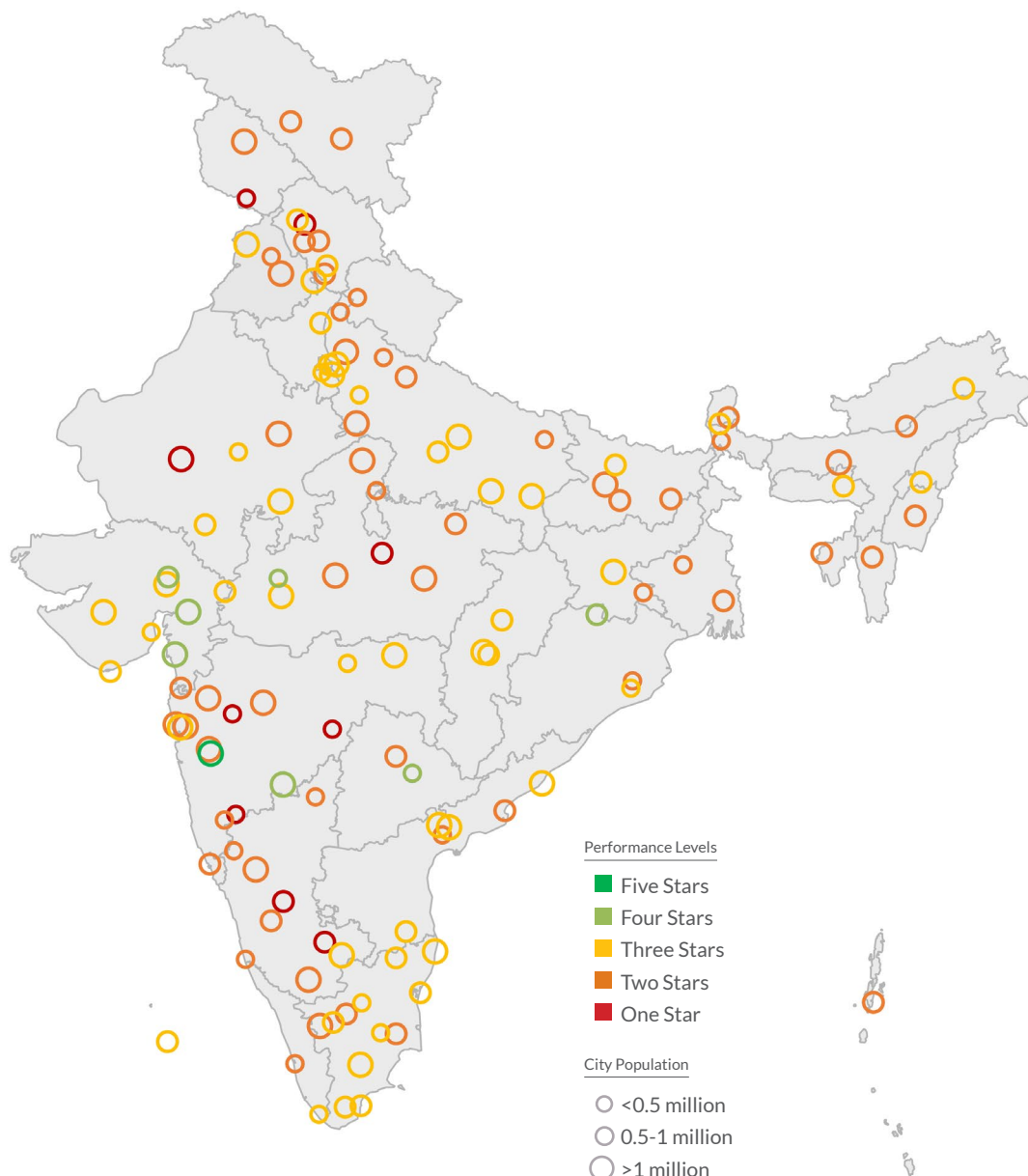
Performance of 126 Cities

Within this thematic area, cities have performed well with respect to green buildings and are in the process of adopting initiatives on energy efficiency and transitioning to clean energy. All states and Union Territories have established green building cells. Promotion and adoption of green buildings in cities are evident from this assessment.

Among the 8 well performing cities (*Five Stars* and *Four Stars*), 4 cities are metropolitan and 4 are large cities. Also, 4 of these 8 cities are also from the Western region showcasing their energy policy initiatives.

All the cities in Warm-Humid climatic zones are either in the *Three Stars* or *Two Stars* categories (except for Pune). These cities need to focus on energy efficiency and adoption of green buildings to address the cooling requirements of the built environment especially in light of extreme heat and GHG emissions.

Majority of the cities have adopted energy efficient street lighting solutions. Majority of cities have initiated installation of renewable energy systems in their cities.

1	5 Stars
7	4 Stars
52	3 Stars
57	2 Stars
9	1 Star

★ ★ ★ ★ ★

- Pune

★ ★ ★ ★

- Gandhinagar
- Rourkela
- Solapur
- **Surat**
- **Ujjain**
- **Vadodara**
- Warangal

★ ★ ★

- **Ahmedabad**
- Ajmer
- Aligarh
- Amravathi
- Amravati
- **Amritsar**
- **Bengaluru**
- Bhavnagar
- Bhubaneshwar
- Bilaspur
- Chandigarh
- **Chennai**
- Dahod
- Delhi
- Dharamshala
- Diu
- **Faridabad**
- **Ghaziabad**
- Gurugram
- **Indore**
- **Kanpur**
- Karnal
- Kavaratti
- Kohima
- **Kota**
- **Lucknow**
- **Madurai**
- Muzaffarpur
- **Nagpur**
- Namchi
- Naya Raipur
- Pasighat
- **Prayagraj**
- Puducherry
- **Raipur**
- **Rajkot**
- **Ranchi**
- Salem
- Shillong
- Shimla
- **Thane**
- Tiruchirapalli
- Tirunelveli
- Tirupati
- Tiruppur
- Tiruvananthapuram
- Toothukudi
- Udaipur
- **Varanasi**
- Vellore
- **Vijayawada**
- **Visakhapatnam**

★ ★

- Agartala
- **Agra**
- Aizawl
- **Aurangabad**
- Barielly
- Belagavi
- Bhagalpur
- **Bhopal**
- Bihar Sharif
- **Coimbatore**
- Cuttack
- Dehradun
- Durgapur
- Erode
- Gangtok
- Gorakhpur
- Gulbarga
- Guntur
- Guwahati
- **Gwalior**
- Hamirpur
- Hubli Dharwad
- Imphal
- Itanagar
- **Jabalpur**
- **Jaipur**
- Jalandhar
- Jamshedpur
- Jhansi
- Kakinada
- **Kalyan Dombivali**
- Kargil
- Karimnagar
- Kochi
- Kolhapur
- Leh
- **Ludhiana**
- Mandi
- Mangalore
- **Meerut**
- Mira Bhayandar
- Moradabad
- Mysore
- **Nashik**
- New Town Kolkata
- Panaji
- **Patna**
- **Pimpri Chinchwad**
- Port Blair
- Saharanpur
- **Satna**
- Shivamogga
- Siliguri
- Silvassa
- Solan
- **Srinagar**
- Thanjavur

★

- Davangere
- Jammu
- **Jodhpur**
- Loni
- Nanded
- Palampur
- **Sagar**
- Sangli Miraj & Kupwad
- Tumakuru

● Smart and AMRUT cities ◈ Smart cities ◆ AMRUT cities ○ Other cities ***Million + population cities**

Electricity Consumption of the City

Growing urban areas and urban population increase electricity consumption of cities around the world. Electricity generation is primarily dependent on fossil fuels, leading to higher GHG emissions. The global average for electricity consumption was 3,000kWh per capita per annum in 2017[6]. Controlling the per capita consumption of electricity will lead to lower GHG emissions.

India's average in the year 2018-20 was 1,181kWh per capita per annum[7]. The target for electricity consumption by 2040 is 3,000kWh per capita per annum where 60% demand is met from non-fossil fuel based sources[8]. While the per capita consumption in India is comparatively lower, it is important to ensure electricity access to all and improve efficiency for controlling per capita consumption. To enable

0 Cities	44 Cities	46 Cities	31 Cities	5 Cities
		Performance criteria		
The per capita electricity consumption in cities is >10 times compared to the city with lowest per capita electricity consumption	The per capita electricity consumption in cities is > 4 and < 10 times compared to the city with lowest per capita electricity consumption	The per capita electricity consumption in cities is > 2 and < 4 times compared to the city with lowest per capita electricity consumption	The per capita electricity consumption in cities is > 1.1 and < 2 times compared to the city with lowest per capita electricity consumption	The per capita electricity consumption in cities upto 1.1 times compared to the city with lowest per capita electricity consumption
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ The 5 *Five Stars* cities - Belagavi, Hubli Dharwad, Mysore, Bilaspur and Namchi, are growing cities. To sustain their performance, the cities will have to adopt new and energy efficient technologies as they expand. The average consumption across these cities is 394kWh per capita per annum.

✓ 31 *Four Stars* cities are taking advanced actions in this sector. The average consumption across these cities is 656kWh per capita per annum.

✓ 46 *Three Stars* cities have initiated some actions. The average consumption across these cities is 1,118kWh per capita per annum.

✓ 44 *Two Stars* cities have started mapping the ecosystem to enable climate actions. Average consumption across these cities is 1710kWh per capita per annum.

✓ None of the cities are in the *One Star* category, showcasing that all the cities have started mapping their consumption and initiated actions for the same.

✓ Based on the data collection, average consumption of all 126 cities is 1182kWh per capita per annum of which, more than 50% of large cities, and more than 60% of medium, small & metropolis cities are using less energy per capita than average of 126 cities.

SURAT

Surat Municipal Corporation has an energy efficiency cell which conducts energy audits, promotes energy conservation and renewable energy projects, and monitors usage of electricity of entire corporation. The Solar City Masterplan along with initiatives under Smart City Mission has ensured that the municipal corporation fulfils 34% of it's energy needs through renewable sources (as of 2019).

this, cities need to understand the energy consumption pattern and adopt relevant energy efficient measures to lower per capita electricity consumption.

An early adoption of energy efficient technologies will help in reducing per capita consumption in the long run. With this intent, the indicator on electricity consumption assessed cities based on per capita consumption and were scored relative to cities with similar population. Refer Annexure 2 for population data.

Way forward to regulate electricity consumption

- Cities may consider deploying Energy Monitoring Information System (EMIS) to segregate and record major electrical loads for municipal services, commercial, industrial, and residential electricity consumption separately. This will help cities to monitor and document sector wise use of EMIS can be embedded within the existing Integrated Command and Control Centre (ICCC) platform wherever possible to help monitor and document sector wise use of electricity consumption which can support strategic planning for improving efficiency.
- Establishing a monitoring and evaluation cell that can work along the Energy Service Company (ESCO) will enable cities to develop energy efficient projects and investment grade audits as part of BEE's municipal DSM program. This cell can also facilitate energy efficiency in the existing projects. Cities can refer more about Development of

Municipal Energy Efficiency Projects and Energy Audits to be energy efficient.
- Cities have various opportunities to develop and implement energy efficient projects:
  - » Cities can to utilize central schemes such as BEE facilitated energy audits and situational surveys to identify suitable projects to save electrical energy under Municipal Demand Side Management (MuDSM).
  - » Cities can to explore financing support through BEE's Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE). With the use of viable technology to monitor savings, cities can achieve demonstrable energy savings and mitigation in GHG emissions. Financial support through SIDBI's Partial Risk Sharing Facility (PRSF) can also be availed.

"

Historic as well as real-time data can be transformative for climate action and has become a key instrument into building resilient cities. While most data are aggregated at the national level, a lot of decision making happens at the local level. Cities need to be empowered with granular and real-time community embedded data to provide inclusive decision-making and ensure resilient communities for future crises.

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Dr. Debjani Ghosh
Associate Professor
National Institute of Urban Affairs

6. Kahan, A., 2020. Global electricity consumption continues to rise faster than population. [Online]
    Available at: https://www.eia.gov/todayinenergy/detail.php?id=44095 [Accessed 25 February 2021]
7. Kahan, A., 2020. Global electricity consumption continues to rise faster than population. [Online] Available at: https://www.eia.gov/todayinenergy/detail.php?id=44095 [Accessed 25 February 2021]
8. Niti Aayog, 2017. Draft National Energy Policy. [Online]
    Available at: http://niti.gov.in/writereaddata/files/new_initiatives/NEP-ID_27.06.2017.pdf [Accessed 25 February 2021]

Total Electrical Energy in the City Derived from Renewable Sources

India has witnessed the fastest rate of growth in renewable energy (RE) capacity addition among all large economies, with renewable energy capacity growing by 2.5 times and solar energy expanding by over 13 times from 2015[9]. Production of energy from cleaner renewable energy sources (solar PV, solar thermal, wind energy, hybrid-hydel power, small hydro, geo-thermal energy, tidal energy, biogas, waste to energy) will be the key for India to achieve its sustainable development goals. Renewable energy now constitutes over 36% of the country's installed power capacity and around 26% of the electrical energy generation[10]. To foster this, the Ministry of New and Renewable Energy (MNRE) has launched a number of initiatives including National Solar Mission and Green Energy Corridor (Wind & Solar PV) to increase the share of clean technologies in the electricity sector in order to mitigate the negative environmental effects of coal-based electricity generation. These national level initiatives envisages to achieve 175 GW of installed

34 Cities	**80** Cities	**2** Cities	**0** Cities	**10** Cities
		Performance criteria		
Cities have not demonstrated consumption of electricity generated from renewable energy sources	Cities' electricity consumption derived from renewable energy sources is less than 5%	Cities' electricity consumption derived from renewable energy sources is less between 5 - 10%	Cities' electricity consumption derived from renewable energy sources is less between 10 - 15%	Cities' electricity consumption derived from renewable energy sources is more than 15%
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 10 Cities have performed well in this indicator with more than 15% of its total energy needs generated through renewable sources. These cities have championed by increasing their renewable energy capacity by promoting and developing Solar Parks and Ultra Mega Solar and Hydro Power Projects.
  » States like Maharashtra (2 cities) and Himachal Pradesh (2 cities) have set up the renewable energy policies in place for the cities to improve generation through renewable sources.
  » Cities from Union Territories like Kargil, Diu, and Kavaratti have been progressive by using a higher share of solar & hydro powered energy systems.
  » Cities like Surat, Pune, Jabalpur, Amravati and Coimbatore are the examples where the RE generation has been given priority.
  » Hilly cities like Shimla, Shillong, Kargil and Dharamshala have the geographical advantage of using higher hydro electric energy and also with lower energy intensity per capita have championed the indicator.
✓ Around 80 cities in *Two Stars* category generate less than or equal to 5% of their total energy needs through renewable sources. Also, 53 of these cities which are a part of the Smart Cities Mission have less than 2% of generation through renewable energy. Although systems and processes to implement renewable energy projects are in place, cities from the states of Kerala, Odisha, Assam, Madhya Pradesh, Tamil Nadu and Maharashtra have further scope for improvement.
✓ 29 (out of which 21 are smart cities) of 34 cities which are in *One Star* category that participated in the assessment have not been able to provide the required information. Efforts to acquire relevant information should be a priority for these cities.

capacity of renewable energy in the power sector by 2022. In addition, the Government of India has proposed a target of 450 GW of renewable energy generation capacity by 2030[9].

This particular indicator encourages the replacement of existing electricity generation from fossil fuels with cleaner renewable energy sources. Total renewable energy contribution in the city was calculated based on the ratio of total electrical energy consumption derived from both on-grid and off-grid renewable energy sources to total connected electrical load in the city.

Way forward for cities to increase Electrical Energy derived from Renewable Sources

- 34 *One Star* Cities can initiate a dialogue with local power distribution companies (DISCOMs) and the state energy distribution agency (SEDA), State Electricity Regulatory Commission (SERC) to improve coordination and data sharing to make informed decisions for implementing recommended actions.
- There is huge potential for 80 *Two Stars* cities to increase their share of renewable energy. These cities can leverage government schemes and initiatives like the Rooftop Solar programme, Solar Net Metering and Grid Connected Wind-Solar Hybrid Power Projects, availing existing concessions in transmission and enhancing

their distribution tariffs through wheeling /banking arrangements to implement business models such as RESCO, EPC etc.
- The 10 *Five Stars* cities are recommended to develop proposals to actively take part in various Government of India schemes such as the "Solar Cities" program of MNRE. This includes steps such as preparing an energy baseline for the city, demand-based forecasts/ projections for the city's energy needs and then creating a sector-wise strategy for increasing the share of renewable energy.

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9.   PIB, 2018. Press Information Bureau. [Online] Available at: https://pib.gov.in/Pressreleaseshare.aspx?PRID=1685046 [Accessed 25 February 2021]
10. MNRE Report: YEAR END REVIEW-2020

Fossil Fuel Consumption in the City

Global energy consumption in 2018 increased at nearly twice the average rate of growth since 2010, driven by a robust global economy and higher heating and cooling needs in some parts of the world. Demand for fossil fuels increased by nearly 70% of the growth, led by natural gas. As a result of higher energy consumption, CO_2 emissions rose 1.7% last year and hit a new record[10]. The world is moving away from overwhelming dependence on fossil fuel, and within the fossil fuels, away from coal and oil in favour of gas. Against an 88% total share of fossil fuels globally in the primary energy mix in the year 2005, the same fell to 86% in the year 2015[11].

India's dependence on imported fossil fuels rose significantly, despite the country having substantial domestic fossil fuel resources. India ranked as the fourth-largest energy consumer in the world in 2011, following China, the United States, and Russia. In 2015, India

14 Cities	**48** Cities	**29** Cities	**26** Cities	**9** Cities
The per capita per annum CO_2 emissions from fossil fuel consumption in cities is >10 times as compared to the city with lowest per capita per annum CO_2 emissions	The per capita per annum CO_2 emissions from fossil fuel consumption in cities is > 4 and < 10 times as compared to the city with lowest per capita per annum CO_2 emissions	The per capita per annum CO_2 emissions from fossil fuel consumption in cities is > 2 and < 4 times as compared to the city with lowest per capita per annum CO_2 emissions	The per capita per annum CO_2 emissions from fossil fuel consumption in cities is > 1.1 and < 2 times as compared to the city with lowest per capita per annum CO_2 emissions	The per capita per annum CO_2 emissions from fossil fuel consumption in cities is up to 1.1 times as compared to the city with lowest per capita per annum CO_2 emissions
★	★★	★★★	★★★★	★★★★★

Performance criteria

Performance Levels

Performance of 126 cities

✓ The results from this assessment indicate two cities in *Five Stars* category, namely Thane and Varanasi fair relatively better in this indicator. This may be due to the availability and accessibility of public transportation and pedestrian friendly infrastructure leading to less fossil fuel consumption. Across the remaining 7 cities in the *Five Stars* category, given their relatively smaller size, it is quite likely that citizens largely prefer to use two wheelers or use non-motorised transport, leading to relatively low consumption of fossil fuels.

✓ All cities in *Four Stars* category have relatively small size of population except 5 cities which have a population of 1.5 lakhs or above. The per capital consumption of fossil fuels in these cities are less due to the likelihood of citizens' preference to use two wheelers and paratransit for commute. Also, given their small city size and issues related to parking within the core areas prevent people from using four wheelers.

✓ In Indian cities, petrol is generally used for transportation and diesel for both transportation and electricity backup (private use of generators). Average per capita petrol and diesel consumption across participating cities are as follows:

» *Five Stars* - In this category, cities consume on an average 23 and 22 litres per capita per annum of petrol and diesel respectively.

» *Four Stars* - In this category, cities consume on an average of 61 and 67 litres per capita per annum of petrol and diesel respectively.

» *Three Stars* - In this category, cities consume on an average of 100 and 148 litres per capita per annum of petrol and diesel respectively.

✓ Only 37 cities managed to submit data related to CNG and PNG consumption respectively. This indicates that the majority of the cities either do not have sufficient infrastructure or were unable to collect data from the concerned authorities during the assessment period.

consumed 121 million tonnes of petroleum products, of which high speed diesel accounted for 40.42%, petrol accounted for 11.83% and LPG accounted for 10.63% [12]. Diesel, petrol, CNG, and LPG are the major sources of energy for municipal services in India, leading to increasing GHG emissions. Vehicular emissions account for a major chunk of the emissions in India owing to the fuels used to run them. The share of transport-based emissions contributes in a large measure to the release of GHGs. Fossil fuel consumption in the transport sector contributed to 17.8% or 245 million tonnes of CO_2 emissions in India in 2015[13]. Hence this sector has been identified as an area which needs immediate intervention to see desirable results. The Target 2030 envisions that natural gas will cater to 20% of the primary energy mix compared to 11% in 2010[14]. As the country's energy demand continues to climb due to its dynamic economic growth and modernization, therefore there is a need to switch to a safe, smart and sustainable energy consumption as key means of limiting greenhouse gas emissions in India.

This indicator aims to incentivize cities to lower their CO_2 emissions per capita per area by encouraging them to switch to alternative cleaner fuel sources and to lower the per capita emissions from the consumption of fossil fuels by shifting to lower emitting fossil fuels and non-fossil fuel based sources. Availability of data through a single point source has led to challenges in reporting. Approximately 90 cities did not submit data for PNG and CNG. Therefore, the assessment across the 126 cities were done based on data provided for petrol, diesel and LPG. Cities were scored in relative to cities with similar population. Refer Annexure 2 for population data. Additional points were given to the cities which managed to submit PNG and CNG data.

Way forward to reduce per capita fossil fuel emissions

- Cities are suggested to initiate a dialogue with petroleum products distribution companies (eg. BPCL, IOCL, HPCL, Shell etc.) to facilitate data collection which will enable them with the implementation of recommended actions.
- From our analysis it is evident that cities with improved public transportation have managed to bring down their per capita fuel consumption. Therefore, augmentation of public transport, particularly based on clean energy like CNG, electric etc, is recommended.
- Cities should promote the use of cleaner fuels for vehicular fuel consumption (Example: Biofuels, CNG,

LPG, Renewable energy). An action plan can be developed with the Regional Transport Department, for the transition of vehicles (used by Municipality and Citizens) towards low carbon and renewable energy options.
- Cities can improve renewable energy generation, adopt electric/clean fuel vehicles and haul the EV charging infrastructure by participating in the FAME-II program initiated by the Ministry of Heavy Industries and Public Enterprises.

10. Global Energy & CO_2 Status Report, 2019. [Online]
    Available at: https://www.iea.org/reports/global-energy-co2-status-report-2019 [Accessed 6 April 2021]
11. Draft National Energy Policy NITI Aayog, Government of India, 2017. [Online]
    Available at: https://niti.gov.in/writereaddata/files/new_initiatives/NEP-ID_27.06.2017.pdf [Accessed 6 April 2021]
12. Central Statistics Office, 2017. Energy Statistics 2017, New Delhi: Ministry of Statistics and Programme Implementation.
13. Shakti Foundation, 2017. Vehicles and Fuels. [Online]
    Available at: https://shaktifoundation.in/work/transport/fuel-efficiency-norms-in-india/ [Accessed 25 February 2021]
14. PNGRB, 2013. Vision 2030 Natural Gas Infrastructure in India. [Online]
    Available at: https://www.pngrb.gov.in/Hindi-Website/pdf/vision-NGPV-2030-06092013.pdf [Accessed 25 February 2021]

Energy Efficient Street Lighting in the City

Street lighting is a major contributor to the city's electricity consumption. Energy efficient and renewable energy operated street lighting systems will reduce the dependence on electricity from fossil fuels thus indirectly reduce GHG emissions in the city. As a city grows, the energy needs increases proportionately. Since street lighting is one of key mandates of ULBs and municipal corporations it is also one of the major contributors to the ULB's total electricity consumption. Further, replacing the conventional streetlights with LEDs in countries across globe, could result in a potential annual savings of 4,300 million KWh, which is about 50% of total energy consumed[15].

Energy efficient street lighting in India has seen a slew of transformations with advent of the government's initiatives like Unnat Jyoti by Affordable LEDs for All (UJALA), the Smart Cities Mission and Street Lighting National Program (SLNP), under which the Energy Efficiency Services Limited (EESL) has set the ambitious target for replacement of traditional streetlights. Street Lighting National Program (SLNP) aims to replace 1.34 crore conventional streetlights in India with smart LEDs. This ambitious goal will make a tremendous difference, enabling peak demand reduction of about 1500 MW, annual energy savings of 9 billion kWh, and reduction in 6.2 Million tons of CO_2 per year[16].

9 Cities	10 Cities	10 Cities	9 Cities	88 Cities
		Performance criteria		
Cities have not demonstrated the use of energy efficient or renewable energy operated street lighting	Up to 25% streets lights in the city are energy efficient or renewable energy operated	Up to 50% streets lights in the city are energy efficient or renewable energy operated	Up to 75% streets lights in the city are energy efficient or renewable energy operated	All streets lights in the city are energy efficient or renewable energy operated
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ The performance for cities across this indicator is very progressive with 97 cities in *Five Stars* and *Four Stars* categories moving towards 100% conversion of energy efficient street lights.
  » Bangalore, Chennai, Jaipur, Pune and Lucknow are top 5 cities in *Five Stars* category with highest numbers of total energy efficient street lights accounting for more than 1.5 lakh installations per city.
  » Uttar Pradesh (11), Tamil Nadu (9), Gujarat (5), Bihar (4) and Andhra Pradesh (6) are the states which have managed to achieve almost 100% conversion rate to energy efficient street lights.
✓ 10 cities in *Three Stars* category are from the states of Maharashtra, Madhya Pradesh, Haryana, Sikkim and Mizoram.
✓ 10 cities in *Two Stars* category are from Karnataka (6), Madhya Pradesh (1), Punjab (1), Kerala (1 city) and Jammu & Kashmir (1). Given their progressive reforms, these states have tremendous potential for supporting the transition of their cities from existing street light fixture to energy efficient street lights.
✓ 9 cities in *One Star* category currently have limited energy efficient street light installations. Except for two small towns, the rest are large and metropolitan cities which can scope existing government schemes and PPP arrangements for conversion of their existing street light fixtures.

The indicator on energy efficient street lighting, projects the extent to which cities have shifted to use of energy efficient street lights and smart street-lighting automation systems for better monitoring, operation and control of street lights. Energy efficient streetlights should have lamps with luminous efficacy of more than 85 lumens per watt. LED and renewable energy operated street lights, have been successful in improving energy efficiency of municipal services in cities across India.

Way forward for increasing Energy Efficient Street Lighting in the City

- 10 *Two Stars* cities are recommended to improve upon the existing design and implementation of smart street lighting automation for remote operation, monitoring and control of streetlights. This involves site selection (road type/width, electrical infrastructure, location etc), an investment grade audit and baseline assessment of the proposed sites.
- 10 *Three Stars* cities are suggested to expand the number of energy efficient and renewable energy operated streetlights in the city and implement smart street-lighting automation projects. This includes expanding the stakeholders network and designing PPP models/ ESCO models for financing.
- All Municipal corporations can create a GIS based map of all streetlights in the city with attributes for type of lighting (energy efficient and renewable energy operated) which can further be monitored through the Integrated command and control centres (ICCCs) established under the smart cities mission.
- 97 *Five Stars* and *Four Stars* cities are recommended to focus on innovative solutions including but not limited to EV charging units, smart poles with wireless communication systems in tandem with renewable-energy based street lighting systems.
- The non-performing cities can also avail benefits from Street Lighting National Program (SLNP) and Atal Jyoti Yojana (AJAY) scheme for installation of solar street lights.

"

Rapid pace of urbanisation has made cities vulnerable to impacts of climate change. MoHUA's initiative "ClimateSmart Cities Assessment Framework" helps sensitize cities and empowers them to take informed climate-oriented actions. GIZ through the Indo German 'Climate Smart Cities' Project is supporting MoHUA and C-Cube to achieve the vision for sustainable urban centres. As a member of the ClimateSmart Cities Alliance, GIZ is mainstreaming local climate actions across 17 Smart Cities

"

Mrs. Vaishali Nandan
Project Head, Climate Smart Cities
GIZ

15. World Bank, 2015. India: Energy Efficient Street-Lighting--Implementation and Financing Solutions. [Online]
Available at: https://openknowledge.worldbank.org/handle/10986/22275 [Accessed 25 February 2021]
16. PIB, 2020. Press Information Bureau: Government of India's UJALA & Street Lighting National Programme Complete Five Successful years of Illuminating India. [Online]
Available at: https://pib.gov.in/newsite/PrintRelease.aspx?relid=197275 [Accessed 25 February 2021]

Promotion of Green Buildings

Buildings and the construction industry together account for 36% of global energy use and 39% of energy-related CO_2 emissions annually[17]. Green buildings provide some of the most effective means of achieving a range of global goals, such as addressing climate change, economic growth and social aspects.

In India, the building stock accounts for more than 40% of the country's total energy consumption[18], energy rise from buildings is increasing at 8% annually[19]. According to the International Finance Corporation (IFC), 70 percent of the buildings required by 2030 are yet to be constructed in India. In a business as usual scenario, buildings would account for over 70% of the emissions by 2050[20], thus posing a major threat to India's green ambitions. With this in consideration, Government of India (GoI) notified the

85 Cities	6 Cities	7 Cities	5 Cities	23 Cities
		Performance criteria		
Cities have not initiated any of the four measures indicated to promote green buildings	Cities have implemented 1 measure among including green building codes, enforcing code compliance, establishing green building cell and high level green building committee to promote green buildings	Cities have implemeted 2 measures among including green building codes, enforcing code compliance, establishing green building cell and high level green building committee to promote green buildings	Cities have implemented 3 measures among including green building codes, enforcing code compliance, establishing green building cell and high level green building committee to promote green buildings	Cities have implemented all 4 measures of including green building codes, enforcing code compliance, establishing green building cell and high level green building committee to promote green buildings
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 23 cities in *Five Stars* category have implemented all four key measures both at city and state level with majority of the cities to be metropolitan cities.

✓ 18 cities in *Four, Three and Two Stars* categories belong to large and metropolitan city with majority of them to be smart and AMRUT cities.

✓ 85 cities in *One Star* category majorly belong to large towns (26), medium (24) and metropolitan cities (26) with northern region, southern region and western region.

✓ 41 cities have implemented all the measures at the state level. These cities have integrated the green buildings norms and guidelines in their bye laws and Development Control Regulations (DCRs). Within these, 32 cities have also implemented the promotional and penalty schemes.

✓ While all the participating cities have a Green Building cell at the state level, 28 out of 126 cities have dedicated cells within their ULBs to strengthen the implementation of green building measures. Nevertheless, 40 medium cities belonging to Madhya Pradesh, Tamil Nadu, Bihar, Chhattisgarh, North-Eastern states and Union Territories are yet to establish a city level unit for implementation and monitoring of green building measures.

WARANGAL

Warangal has included Energy Conservation Building Codes (ECBC) in its building bye laws and also established green building cells/committees at local level. The Telangana Energy Conservation Building Code Guidelines (TSECBC) has prescribed compliance guidelines for adoption of ECBC in building codes and building permission systems at ULB level.

National Building Code (NBC), 2016, Energy Conservation of Building Codes (ECBC), 2007 and Eco-Niwas Samhita (ENS) 2018 in order to encourage the construction and use of green and energy efficient buildings. Besides, various green building rating systems monitoring and measuring the adoption and promotion include Bureau of Energy Efficiency (BEE), Leadership in Energy & Environmental Design (LEED), Excellence in Design for Greater Efficiencies (EDGE), Green Rating for Integrated Habitat Assessment (GRIHA), Indian Green Building Council (IGBC), Green and Eco-friendly Movement (GEM).

The indicator on promotion of green buildings addresses four key measures on green buildings that indicates the readiness of the city regarding its compliance procedures, penalty/ reward schemes, stakeholder co-operation for promotion of new and existing green and construction of energy efficient buildings. The other measures include institutionalizing a green building cell at the ULB level for knowledge dissemination, and a functioning high-level green building committee acting as strategic advisory and promotional/ penalty schemes available for code compliance, pre- certification, certification of green buildings. Since cities were facing trouble in collating the NBC, ECBC and ENS approval information, all data for this indicator was secured directly from green building approval agencies within the country. This also ensured the validity of the information analysed and reduced the additional burden on the cities for reporting on this indicator.

Way forward for the Promotion of Green Buildings

- 40 Cities are recommended to adopt Part 11 (approach to sustainability) in NBC 2016 or ECBC 2017 or Eco-Niwas Samhita 2018 in their building rules/bye-laws/development control regulations.
- 45 cities that have not started the practice of promotional/ penalty schemes for the code compliance, pre-certification and certification of green buildings can initiate this measure.
- 49 cities that have not utilized the green building incentives available at the state level can start promotional awareness raising campaigns for community, government buildings/institutions, other public institutions (school, colleges, hospitals), and private sector.
- 100 cities that have green building cells or green building committee at the state level but not at city level can aim to establish green building committees at the city level to promote implementation of measures including strategic and technical guidance. The committee may include representatives from PWD, relevant government department representatives, city planners, building architects, construction developers, material suppliers, third party certification agencies, consultants and other relevant green building stakeholders.

17. UN Environment and International Energy Agency, 2017. Towards a zero emissions, efficient and resilient buildings and construction sector. [Online]
Available at: https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf [Accessed 25 February 2021]
18. Soi, U. & Ahuja, M., 2020. The case for green buildings in India. [Online]
Available at: https://www.orfonline.org/expert-speak/case-green-buildings-india/ [Accessed 25 February 2021]
19. Khosla, R. & Janda, K. B., 2018. India's building stock: towards energy and climate change solutions. [Online]
Available at: https://www.tandfonline.com/doi/full/10.1080/09613218.2019.1522482 [Accessed 25 February 2021]
20. McKinsey & Company, 2010. India's Urban Awakening: Building inclusive cities, sustaining economic growth. [Online]
Available at: https://www.mckinsey.com/featured-insights/urbanization/urban-awakening-in-india [Accessed 25 February 2021]
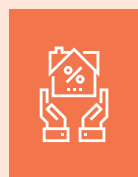
Green Building Adoption

Buildings account for more than 40% of India's total energy consumption, 20% of the raw material use, 20% of water use, and 20% of land use in cities[21]. They are also responsible for 40% of total carbon emissions, 30% of solid waste generation, and 20% of water effluents (ibid). Studies indicate that the energy use from buildings is increasing at 8% annually and, in a business-as-usual scenario buildings would account for over 70% of emissions by 2050[22]. The growth of buildings sector and its contribution to climate change plays a critical role in India's actions towards addressing climate risks and achieving sustainable development goals.

Currently, India's 'Green Buildings', constitute for only 5% of the building market[23]. However, current evidence shows promising potential in reduction of energy consumption and emissions through appropriate policies and implementation procedures in place. A study indicates that the national

25 Cities	**78** Cities	**12** Cities	**4** Cities	**7** Cities

Performance criteria

No indication of green buildings in the city	The occupant load in green buildings is 1-200 persons for every 10,000 population	The occupant load in green buildings is 201-400 persons for every 10,000 population	The occupant load in green buildings is 401-600 persons for every 10,000 population	The occupant load in green buildings is >600 persons for every 10,000 population

Performance Levels

★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 7 cities in *Five Stars* category are performing well with relatively high green building adoption factor. Out of these, 4 are metropolitan cities and 3 are large cities.

✓ 4 cities in *Four Stars* category are mostly metropolitan (1), medium sized cities (2) and small towns(1). The average green building adoption factor per 10,000 population in this category is 468.

✓ 12 cities in *Three Stars* category are mostly metropolitan cities (5) with majority being Smart and AMRUT cities that are likely to have initiated the adoption of green buildings under these missions. However, they will need dedicated efforts to take progress in improving their green building adoption

✓ With 78 cities in *Two Stars* category, it is evident that majority of the participating cities are progressing towards improved green building adoption.
  » This includes 50% of the participating metropolitan and large cities that are mostly from the northern, western and southern regions of the country.
  » Over 75% of the cities in this category are from the composite or warm-humid climatic zone and can greatly contribute towards GHG reduction by addressing the heating and cooling requirements of their buildings.

✓ 50% of the cities in *One Star* category are medium sized cities. 22 out of 25 cities in *One Star* category are from composite and warm humid climatic zone and focus on green buildings can help reduce cooling requirements in the buildings.

The image at the top left shows a building (Chandigarh architecture).

Actions

CHANDIGARH

Chandigarh master plan has encouraged adoption of the green building rating system and design concepts in line with the Energy Conservation Building Code (ECBC), 2007. The administration has also adopted the CPWD guidelines for placing a minimum three-star GRIHA rating in all public buildings in the future.

power demand can be reduced by as much as 25 per cent in 2030 by improving energy efficiency of buildings and operations[24].

This indicator focuses on the adoption of green building wherein cities are assessed based on the ratio of green buildings to the total number of buildings approved for construction and occupancy in the city for the assessment year. Data for this indicator was centrally collected from the central green building councils/rating agencies - BEE, IGBC, GRIHA and GBCI.

Way forward for Green Buildings Adoption

- Cities are recommended to create a green building cell or committee consisting of stakeholders like ULB green building cell, PWD, city planners, architects, developers, material suppliers, and other relevant stakeholders to promote green building development through knowledge dissemination and construction of demonstration projects. The tasks can include awareness programs to the stakeholders, advertisement to the public, constructing/retrofitting buildings for ECBC/ENS Compliance or Green building certification.
- Cities can start capitalizing on the technical assistance available at the state level from ECBC Cells and other government schemes like PMAY(U) and AMRUT.
- Cities are suggested to initiate the ECBC/ ENS Compliance and/or green building certification for the government buildings, institutional buildings such as schools, colleges and hospitals and residential buildings constructed or promoted by ULBs such as Low Income

Group (LIG) and Medium Income Group (MIG) housings to increase the green building penetration and also to aid awareness amongst citizens to rent/purchase energy efficient or green buildings.
- Cities can consider implementing incentive programs like fast-track approval, extra FAR, property tax rebate, EIA approvals, and other benefits (Towards building developers and end users) for the development of energy efficient buildings.
- Cities may regulate the building approval process with the rules and regulations for compliance with ECBC and ENS. It is also suggested to put in place an effective enforcement system into the online building approval system.
- Cities may initiate discussions with third party building certification agencies, planners, architects, engineers, developers and vendor OEMs who support the construction of green buildings in the city.

21. The Economic Times, 2012. Nearly 70% of building stock that will be there in 2030 is yet to be built in India.[Online]
Available at: https://economictimes.indiatimes.com/realty-trends/nearly-70-of-building-stock-that-will-be-there-in-2030-is-yet-to-be-built-in-india/articleshow/14732400.cms [Accessed 8 April 2021]
22. U.S. Energy Information Administration, 2010. Buildings energy consumption in India is expected to increase faster than in other regions. [Online]
Available at: https://www.eia.gov/todayinenergy/detail.php?id=33252 [Accessed 8 April 2021]
23. (IFC) International Finance Corporation - World Bank Group, GREEN BUILDINGS MARKET INTELLIGENCE. [Online]
Available at: https://edgebuildings.com/wp-content/uploads/2018/05/India-Green-Building-Market-Intelligence.pdf [Accessed 9 April 2021]
24. 7 Down To Earth, 2012. Construction boom will make cities unliveable. [Online]
Available at: https://www.downtoearth.org.in/news/construction-boom-will-make-cities-unliveable-centre-for-science-and-environment-3854 [Accessed 9 April 2021]

पिंपरी चिंचवड नवनगर विकास प्राधिकरण

Credits:

Pimpri Chinchwad:
This is the Pimpri Chinchwad New Town Development Authority building with 5 star certification under the GRIHA green building rating system. The design concentrates on natural ventilation, bringing higher efficiency of electro mechanical system installed and utilization of renewable energy system in the building.

by TERI and GRIHA

Actions in the cities

Tirupati

Solar Energy Generation through efficient usage of land, water and rooftop surface
To contribute towards national goals of GHG reduction, Tirupati has undertaken a giant leap towards renewable source of energy through "11 MW Solar Power projects". The projects include rooftop solar installations and land based solar park along with an innovating floating solar park at at Kailashgiri Reservoir.

Pimpri Chinchwad

GRIHA rated development authority building
The Pimpri Chinchwad municipal corporation has adopted GRIHA, the national rating system for green buildings in India, with the objective of promoting sustainable development and wise use of natural resources. Incentives like discounted premium for developers and reduced property tax for home owners have been implemented to promote adoption of green buildings. The Pimpri Chinchwad Navnagar Development Authority building designed in 2008 is also a certified green building which is naturally ventilated and runs on solar energy.

Nagpur

Project green light
Nagpur has initiated retrofitting the existing conventional street lighting system with LED lights that has resulted in energy savings of more than 40% of electricity annually and has led to reduction in carbon footprints. It is one of the largest environmental friendly LED (Light Emitting Diode) lights project ever undertaken by a city with an aim to replace 1,36,000 streetlights.

Average electricity consumption per capita per annum
Five Stars cities –
394 kWh
Two Stars cities –
1710 kWh

All States and UTs
have established green building cells

88 cities
have converted all streetlights to energy-efficient or renewable energy operated

Ms. Shruti Narayan
Regional Director
South and West Asia
C40 Cities

"Climate action has to become the measure of the health of an economy and its resilience. Cities need to lead the way in structuring this as an integrated effort part of their budgets ensuring inclusive stakeholder consultation and leading to job creation and quality of life."

"CSCAF being a first-of-its-kind city assessment framework on climate relevant parameters for Indian cities, has addressed unique challenges and brought out the environmental responsiveness in participating cities. Going forward it shall provide directions to enhance energy and water efficiency, waste management and improve urban mobility and air quality in Indian Cities. GBCI is very honored to have been a part of this key initiative."

Ms. Mili Majumdar
Managing Director
GBCI, India and Senior
VP,USGBC,USA

Mr. Ernst Doering
Cluster Coordinator,
Sustainable Urban & Industrial
Development Cluster, GIZ

"GIZ is committed to support India in the areas of Climate Change and Sustainable Urban Development. In close cooperation with the Ministry, States and Cities, GIZ jointly-develops customised solutions to meet local needs and achieve sustainable, climate relevant and inclusive development."

101cities
have green buildings and are actively promoting the same

Average fuel consumption (MS & HSD) per capita per annum
Five Stars cities –
22 litres
Three Stars cities –
124 litres
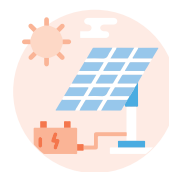
10cities
have more than 15% of their electricity needs generated through renewable energy

Credits:

Chennai:
A pedestrian plaza with the aim of utilizing the additional road space to incorporate all essential pedestrian amenities besides creating a traffic-free social space has been developed at Sir Thyagaraya Nagar

by Chennai Smart City Corporation

5

Mobility and Air Quality

Mobility and Air Quality

The mobility requirements are bound to increase with the projected urbanization trend in cities and this entails increased CO_2 emissions, a key contributor to climate change. The SDG 11 acknowledges the role of sustainable urban transport in achieving targets of Paris Agreement. In India, 13% of CO_2 emissions is attributed to the transport sector and this is three times the emissions since 1990[1].Increasing CO_2 deteriorates the air quality and cities are beginning to experience its adverse impact, especially on human health. Cities and the urban residents are, thus, both contributors and victims of poor air quality. Focus on urban mobility can help address not only transport related challenges but also mitigate climate change and improve air quality paving the way for sustainable and resilient cities.

Cities are on the course of mobility transformation and central government policies and schemes such as the National Urban Transport Policy (NUTP) 2014, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Automotive Mission Plan 2026 and Faster Adoption and Manufacturing of Electric/Hybrid (FAME) India are supporting and guiding cities in the process. Under AMRUT, cities are improving non-motorized transport infrastructure like footpaths and walkways and developing infrastructure for Multimodal Integrated Transit (MRT) and Bus Rapid Transit System (BRTS). State departments are identifying gaps in infrastructure to approve funds for city-level schemes. While cities recognize the significance and need for efficient and sustainable transport systems, transitioning into low carbon mobility requires holistic planning and dedicated implementation.

Besides reducing CO_2 emissions from the transport sector, cities need to focus on improving their air quality. In order to understand this concern, cities need to monitor air quality regularly besides identifying the sources of pollution. With this information, cities can develop clean air action plans and further adopt sector specific actions to control air pollution. Improvements in air quality would have the dual benefits for cities to achieve sustainable development goals in mitigating climate change and improving the quality of lives.

Under this theme, cities are assessed on measures taken to transition towards low carbon mobility along with improving the coverage of public transport and infrastructure for non-motorized transport. Cities are also assessed based on the steps taken to monitor air quality and measures initiated towards developing clean air action plans and implementing some of the actions.

> **"** As the world grapples with climate change, India's growing cities will not only become significant contributors of GHG emissions but will also be adversely impacted by extreme weather events. India's efforts at building future cities will, therefore, need to be climate conscious, inclusive and resilient. **"**

Dr. O.P. Agarwal
CEO
WRI India

> **"** CSCAF is an innovative program that integrates air quality within a climate framework, thus highlighting the co-benefit approach. It mainstreams addressing air pollution in the city development process, to drive data generation, communication, and mitigation activities for clean air. It sets an example of including air quality within a structured multi-year program that can track air quality management progress and highlight solutions. **"**

Ms. Prarthana Borah
India Director
Clean Air Asia

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[1]. S, Ralph et. al, 2014. Transport. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.Available at: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter8.pdf[Accessed 31 March 2021]

INDICATOR 1

Clean Technologies Shared Vehicles

- 16
- 2
- 3
- 14
- 91

INDICATOR 2

Availability of Public Transport

- 21
- 9
- 16
- 30
- 50

INDICATOR 3

Percentage of coverage of Non-Motorized Transport network (pedestrian and bicycle) in the city

- 6
- 8
- 8
- 10
- 94

INDICATOR 4

Level of Air Pollution (Monitoring)

- 13
- 14
- 30
- 25
- 44

INDICATOR 5

Clean Air Action Plan (Planning and Implementation)

- 1
- 23
- 15
- 48
- 39

Legend:
- 5 Stars
- 4 Stars
- 3 Stars
- 2 Stars
- 1 Star

Performance Levels

🟩 Four Stars
🟨 Three Stars
🟧 Two Stars
🟥 One Star

City Population

○ <0.5 million
○ 0.5-1 million
◯ >1 million
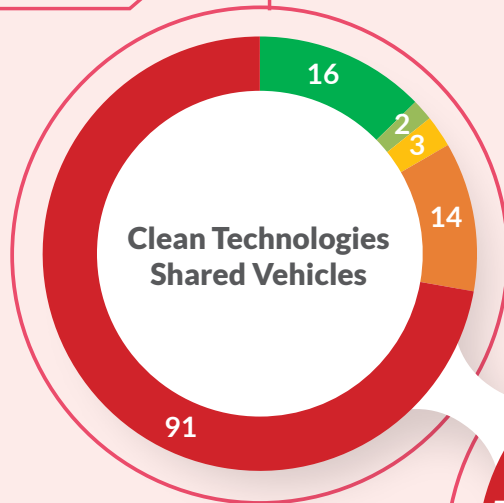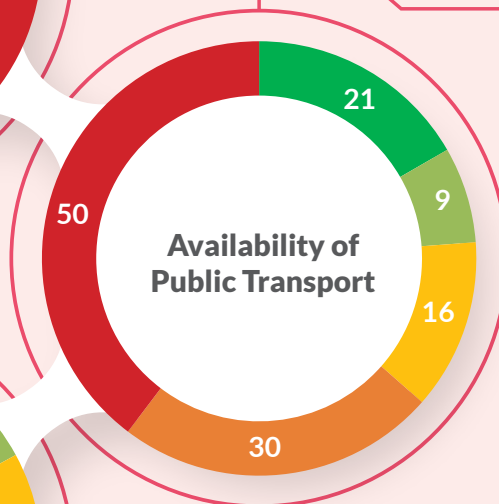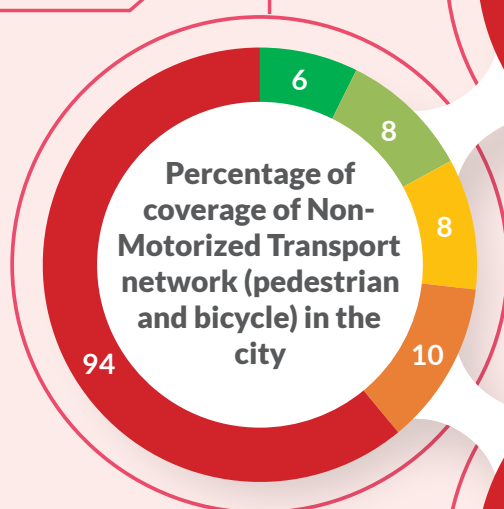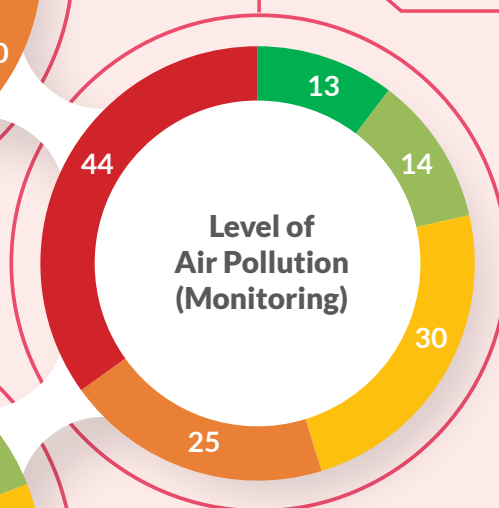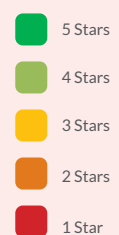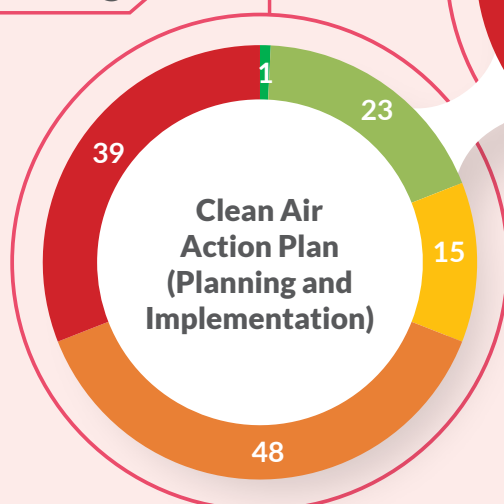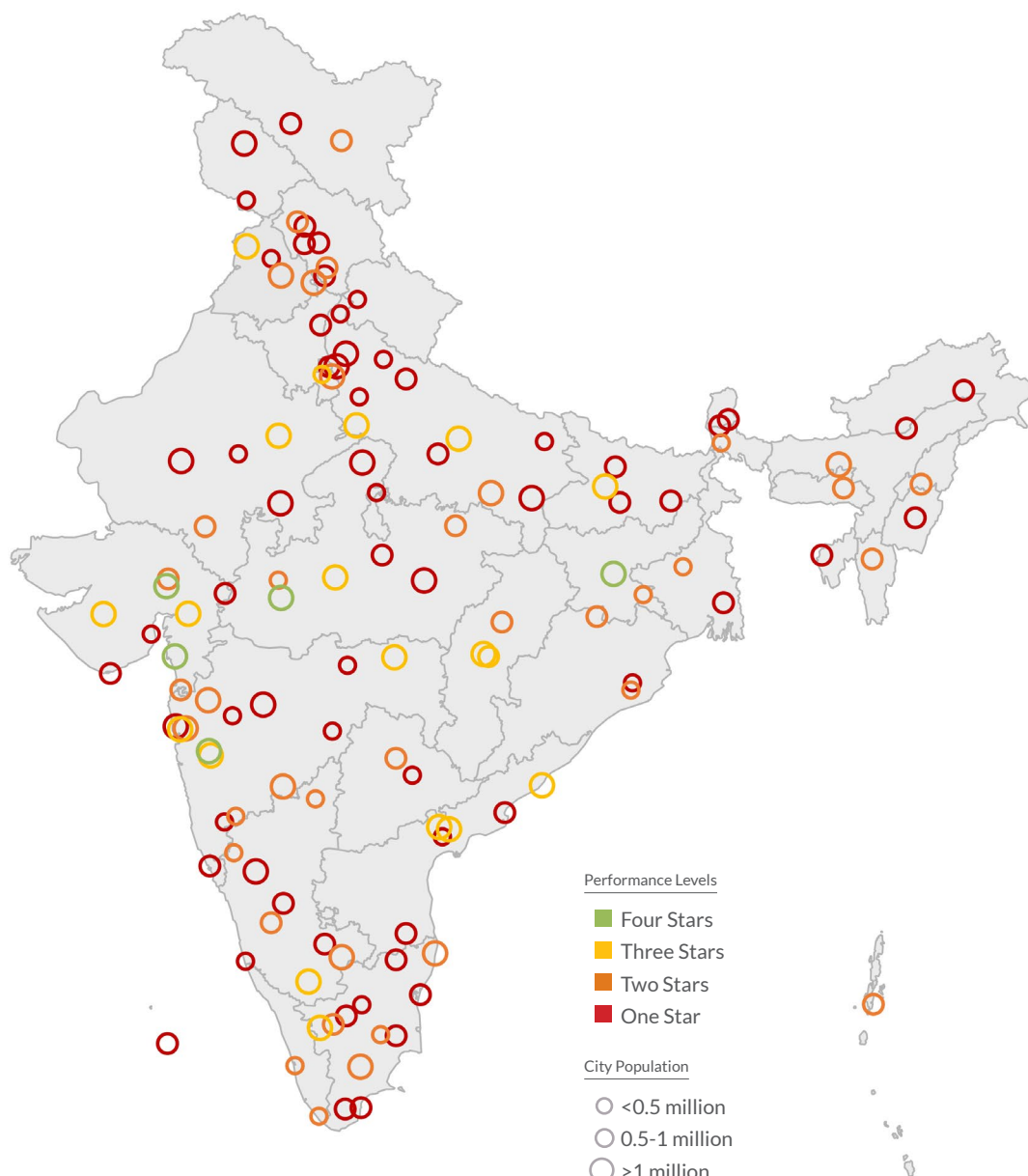
Performance of 126 Cities

5 cities have shown progress and are at *Four Stars* category. These are metropolitan cities which are actively leveraging Smart City Mission for their mobility needs.

Almost 50% of the participating cities (57 cities) are in *Two Stars* and *Three Stars* category. Among 64 *One Star* cities 25 cities are from the northern region of India.

Considering that the northern states have been facing severe air pollution for the past few years, it is crucial for cities from the states of UP, Rajasthan, Punjab and Delhi to take up more measures in this thematic area.

All the participating cities from hilly and cold climatic zones are either in *One Star* or *Two Stars* categories. Hilly terrain can be challenging in developing transport infrastructure. Further due to their terrain, these cities also lack adequate air quality monitoring sensors.

All participating small-towns in the assessment are in *One Star* and *Two Stars* categories. Lack of infrastructure and resources in these cities pose challenges in planning and implementing new technologies for improving transportation and monitoring air quality.

0	5 Stars
5	4 Stars
19	3 Stars
38	2 Stars
64	1 Star

★ ★ ★ ★

- Ahmedabad
- Indore
- Pimpri Chinchwad
- Surat
- Ranchi

★ ★ ★

- **Agra**
- Amravathi
- **Amritsar**
- **Bhopal**
- **Coimbatore**

- Gurugram
- **Jaipur**
- **Lucknow**
- Mysore
- **Nagpur**

- Naya Raipur
- **Patna**
- **Pune**
- **Raipur**
- **Rajkot**

- **Thane**
- **Vadodara**
- **Vijayawada**
- **Visakhapatnam**

★ ★

- Aizawl
- Belagavi
- **Bengaluru**
- Bhubaneshwar
- Bilaspur
- Chandigarh
- **Chennai**
- Dharamshala
- Durgapur
- **Faridabad**

- Gandhinagar
- Gulbarga
- Guwahati
- Jamshedpur
- **Kalyan Dombivali**
- Karimnagar
- Kochi
- Kohima
- Leh
- **Ludhiana**

- **Madurai**
- **Nashik**
- Port Blair
- **Prayagraj**
- Rourkela
- Sangli Miraj & Kupwad
- **Satna**
- Shillong
- Shimla
- Shivamogga

- Siliguri
- Silvassa
- Solapur
- Tiruchirapalli
- Tiruppur
- Tiruvanantapuram
- Udaipur
- **Ujjain**

★

- Agartala
- Ajmer
- Aligarh
- Amravati
- **Aurangabad**
- Barielly
- Bhagalpur
- Bhavnagar
- Bihar Sharif
- Cuttack
- Dahod
- Davangere
- Dehradun
- Delhi
- Diu
- Erode

- Gangtok
- **Ghaziabad**
- Gorakhpur
- Guntur
- **Gwalior**
- Hamirpur
- Hubli Dharwad
- Imphal
- Itanagar
- **Jabalpur**
- Jalandhar
- Jammu
- Jhansi
- **Jodhpur**
- Kakinada
- **Kanpur**

- Kargil
- Karnal
- Kavaratti
- Kolhapur
- **Kota**
- Loni
- Mandi
- Mangalore
- **Meerut**
- Mira Bhayandar
- Moradabad
- Muzaffarpur
- Namchi
- Nanded
- New Town Kolkata
- Palampur

- Panaji
- Pasighat
- Puducherry
- **Sagar**
- Saharanpur
- Salem
- Solan
- **Srinagar**
- Thanjavur
- Tirunelveli
- Tirupati
- Toothukudi
- Tumakuru
- **Varanasi**
- Vellore
- Warangal

● Smart and AMRUT cities   ◈ Smart cities   ◆ AMRUT cities   ○ Other cities   *****Million + population cities**
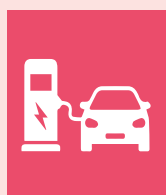
Clean Technologies Shared Vehicles

Transportation accounts for a significant proportion of energy-related CO_2 emissions globally. In Asian countries, a three-to-five-fold increase of transport related CO_2 is expected by 2030 compared to emissions in 2000[2]. Increasing urbanization coupled with inadequate public transport and increased affordability and aspiration of citizens has led to a tremendous increase in number of motor vehicles plying on Indian roads where the growth in ownership per 1,000 population has increased from 53 in 2001 to 167 in 2015[3]. This is not only contributing to global warming but also deteriorating air quality in cities. Hence, there is a need to reduce dependence on private vehicles. With many cities still working on providing public transport options like buses and metros, shared vehicles like app-

based taxis and autos have emerged as an alternative mode. The ease and comfort of availing these services is contributing to a modal shift especially among private car owners. If this is done in coherence with switching to low carbon fuels like electricity and CNG, it will be significantly successful in reducing GHG emission of transport sector.

The central government is taking various initiatives to switch to cleaner fuels and to reduce emissions, namely, the implementation of Bharat Stage-VI norms from April 2020, promotion of electric/hybrid vehicles through National Electric Mobility Mission Plan 2020 and Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME), and introduction of cleaner / alternate fuels such as LPG,

91 Cities	14 Cities	3 Cities	2 Cities	16 Cities
		Performance criteria		
Cities have not indicated the use of shared vehicles plying on clean fuels like CNG, LPG, biofuels or are hybrid/ electric	Cities have <5% of their shared vehicles using clean fuels like CNG, LPG, biofuels or are hybrid/ electric	Cities have 5% to <15% of their shared vehicles using clean fuels like CNG, LPG, biofuels or are hybrid/ electric	Cities have 15% to 25% of their shared vehicles using clean fuels like CNG, LPG, biofuels or are hybrid/ electric	Cities have >25% of their shared vehicles using clean fuels like CNG, LPG, biofuels or are hybrid/ electric
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ Only 35 of the 126 participating cities have reported all the requisite details for this indicator. Among them, 32 cities have provided partial data on the use of clean technology buses, taxis and/or e-rickshaws. The evidences for this indicator had to be collected from external authorities including Roads and Transport Authority (RTA) and licensing agencies. Coordination between departments and agencies outside the purview of Municipal Corporations and ULBs during the pandemic situation was cited as one of the key challenge by the cities.

✓ Among the 35 cities that have reported on this indicator, 22 are metropolitan, 7 are large cities and 6 are medium sized cities. Based on the results of the evaluation, 15 metropolitan, 1 large city and 2 medium sized cities have performed well and are in the *Five Stars* and *Four Stars* category. None of the participating small towns have reported on this indicator.

✓ Among all categories of shared vehicles, 59 cities have been able to report on the availability of low carbon autos and e-rickshaws indicating high penetration of such transport options.

CNG, Bio-Diesel Blends, Battery Operated, Hydrogen and Solar Operated vehicles. These measures, in addition to availability of renewable energy, skilled manpower and technology, infrastructure transition and culture to accept the sharing of assets have created an opportunity in India for accelerated adoption of cleaner technologies over convention fuel vehicles enabling a conducive environment for sustainable mobility paradigm[4]. To successfully attain this transition, it will also be important to strengthen the fragmented institutional framework as well as increase cleaner fuel infrastructure like EV charging stations, CNG/ Biofuel stations etc. along with increasing availability of vehicles running on cleaner fuels/technologies.

The indicator on Clean Technologies Shared Vehicles assesses the cities based on the percentage of clean technology shared vehicles adoption. The clean

≣Actions

KOCHI

Under the Integrated Sustainable Urban Transport Systems for Smart Cities (SMART-SUT) project, Kochi has prepared for pilot of 100 e-autos with lithium-ion batteries including options for a viable business model, demand analysis, technology selection, cost estimates and supporting infrastructure. Pilot areas are Fort Kochi, Kadavanthara and Elamkulam and is intended to lead to upscaling to other parts of the city.

technologies shared vehicles included in this assessment are buses, taxies, app- based cabs, app based two wheelers, autos, e-rickshaws, private buses and ferries consuming fuel types like - CNG/ LPG/ Hybrid/ Biofuels/ Electric.

Way forward to transition towards low carbon shared mobility

- Cities are suggested to initiate a step-by-step process for procuring low carbon vehicles, installing required infrastructure and developing plans for a phased mobility transition. Cities which are part of the Faster Adoption and Manufacturing of Electric Vehicles in India (FAME) phase-II scheme can procure electric buses. The NITI Ayog guidelines on shared mobility may be referred for enhanced actions.

- Cities can promote CNG paratransit (especially autorickshaws) and buses and incentivize the use of low carbon vehicles. To build infrastructure for clean technology vehicles, cities can refer to the guidelines

developed by the Ministry of Petroleum and Natural Gas or setting up CNG stations.

- Cities are recommended to strategize the deployment of shared vehicles including buses, metros, trains, and leverage shared vehicles such as Ola, Uber, Shuttl, Bykerr and other ride sharing services. They can sensitize citizens to adopt ride splitting such as carpooling, car and bike sharing, and use of micro transit when possible. Such efforts can lead to the dual benefit of reduced emissions and fuel consumption in addition to creating employment opportunities.

Ms. Prerna Mehta
Associate Director
WRI India

" Sectoral contributions are critical for advancing climate change discourse in cities. Addressing the mobility sector is particularly crucial as it is one of the highest contributors of GHG emissions in India. Measuring climate conscious actions of this sector, through CSCAF, will boost climate action and enable cities to meet their targets. "

2. Asian Development Bank, 2010. Reducing Carbon Emissions from Transport Projects. Evaluation study. Available at: https://www.oecd.org/derec/adb/47170274.pdf[Accessed 31 March 2021]
3. Shakti Sustainable Energy Foundation , n.d. Fuel Efficiency Norms in India. [Online] Available at: https://shaktifoundation.in/work/transport/fuel-efficiency-norms-in-india/[Accessed March 2021].
4. NITI Aayog & World Energy Council, 2018. ZERO EMISSION VEHICLES (ZEVs) : TOWARDS A POLICY FRAMEWORK, NITI Aayog.

Availability of Public Transport

European and North American cities have witnessed a reduction trend of car share over the years. Whereas, rapid urbanization in Asia has pushed its car share to 40% of global usage, which 1.5 times the 2015 level[5]. The annual growth rate of motor vehicle numbers in India has been about 10% during the last decade. It is important to note that 32% of these vehicles are plying in metropolitan cities alone, which constitute about only 11% of the total population[6]. This is resulting in increased GHG emissions, traffic congestion, increased travel times and poor air quality in the cities. A switch to efficient, affordable and convenient public transport is the need of the hour.

In India, only 17 cities have operational city bus services, 12 cities have rail transit option and 18 cities have operational metro systems with 1,016 km of Metro and Regional Rapid Transit System lines under construction in 27 cities[7]. Seeing the need, the government is actively promoting and investing in the public transport sector with Rs.18,000 crores allocated in the 2021-22 budget for public bus service augmentation. In addition, 'MetroLite' and 'MetroNeo' will be deployed to provide metro rail systems at much lesser cost with the same experience, convenience and safety in Tier-2 cities and peripheral areas of Tier-1 cities.[8] Over the last two decades, the national, state and

50 Cities	30 Cities	16 Cities	9 Cities	21 Cities
Cities have not indicated the availability of public transport	The availability of public transport unit per 1000 population is <0.2	The availability of public transport unit per 1000 population is between 0.2 and 0.4	The availability of public transport unit per 1000 population is between 0.4 and 0.6	The availability of public transport unit per 1000 population is ≥ 0.6

Performance criteria

Performance Levels

| ★ | ★★ | ★★★ | ★★★★ | ★★★★★ |

Performance of 126 cities

✓ 21 cities from the states of Bihar, Chhattisgarh, Himachal Pradesh, Karnataka, Maharashtra and Tamil Nadu managed to provide adequate public transportation data and have advanced to the level of *Five Stars* in this indicator.

✓ 110 of the 126 participating cities have indicated the availability of public transport. However, only 76 cities have managed to provide all requisite data.

✓ 37 of 50 metropolises, 12 of 34 large cities, 24 of 33 medium sized cities, 3 of 9 participating small towns were able to report on this indicator. A major gap is evident among the large and medium cities where over 60 percent of the participating cities have not been able to report on the availability of public transport.

✓ 76 cities have reported on availability of bus service, 5 cities have indicated the availability of metros, 4 cities on the availability of suburban rail and 2 cities have reported on the availability of ferries. Although metro services are available in many cities and ferries are available in many coastal and river dependent cities, coordination between multiple transport departments was cited as the key reason for cities not securing the required evidences. With respect to data on use of ferries, lack or absence of documentation owing to informal services is a challenge.

✓ As per MoHUA, the ideal service level benchmark (SLB) for the availability of public transport per 1,000 persons is >=0.6. From this analysis, it was evident that only 10 of 50 metropolitan cities, 1 of 34 large city, 8 of 33 medium cities and 2 of 9 small towns satisfy the SLB criteria. It was also evident that more percentage of medium sized cities have adequate fleet size of buses compared to large or metropolitan cities.

city governments have been driving the provision of bus and rail-based mass transit systems through organized and well-planned models. The Jawaharlal Nehru Urban Renewal Mission (JNNURM), launched in 2005, made provisions for buses and has sanctioned over 23 lakh buses across 141 cities. The National Urban Transport Policy, revised in 2014, have indicated the benefit of metro rail system for cities with over 20 lakh population. The recently launched Green Urban Mobility Scheme envisages 1,300 km of BRT in 28 cities supporting better management of bus transport.

While a range of policies and projects are being implemented, it will also be crucial to address the institutional and operational challenges of public transport expansion. Various agencies involved in the urban transport sector needs to be brought under a single ambit for increased efficiency and accountability. Besides this, dynamic data collection through urban analytics and transport modelling, improving public transport infrastructure and last mile connectivity will be required.

≡Actions

AMRITSAR

Amritsar has a 31 km BRTS corridor which has improved commuter conditions to a large extent. To further improve public transportation modal share and improve last mile connectivity, the city is implementing a range of sustainable mobility measures under the CITIIS (City Investments to Innovate, Integrate and Sustain) program. It includes provision of e-mobility options and feeder network to the BRTS corridor, enhancing EV charging infrastructure and provision of common smart card.

The indicator on Public Transport assesses cities based on availability of public transport per 1000 population. The availability is measured as fleet size of buses, metro coaches, suburban rail coaches and ferries which is converted to a comparable standard unit called Public Transport Unit (PTU). Refer Annexure 2 for details on population.

Way forward for expanding public transport

- Based on the demand as per transportation assessments and comprehensive traffic and transportation studies, cities can invest in increasing the fleet size of public transportation. Cities can explore PPP models for increasing the fleet size of buses and MoHUA's guidelines on city bus operations can be referred for the same.
- In case of lack of demand, cities can improve efficiency, route rationalization, schedules and last mile connectivity to attract people to shift to public

transport. Campaigns for sensitizing people to use public transport can also be conducted.
- In order to understand the usage of public transport, cities can develop a digital transportation database for documenting data regarding ridership, modal share, networks and fleet size of different modes of public transportation on a monthly basis. With this information cities can understand the supply and demand and take appropriate actions. Cities can develop or revise their comprehensive mobility plan to address the need.

5. International Transport Forum, 2017. Chapter 5, Mobility in cities, ITF Transport Outlook 2017. OECD. [Online] Available at: https://www.oecd-ilibrary.org/sites/9789282108000-8-en/index.html?itemId=/content/component/9789282108000-8-en[Accessed 31 March 2021]
6. Singh, S, 2005. Review of Urban Transportation in India. Journal of Public Transportation, 8(1), 79-97. DOI:http://doi.org/10.5038/2375-0901.8.1.5
7. The Hindu, 2 February 2021. Public Bus Scheme, Expansion of Metros. Union Budget 2021.New Delhi. [Online] Available at: https://www.thehindu.com/business/budget/union-budget-2021-public-bus-scheme-expansion-of-metros/article33722572.ece [Accessed 31 March 2021]
8. The Hindu, 2 Februrary 2021. Union Budget 2021 | Public bus scheme, expansion of Metros. [Online] Available at: https://www.thehindu.com/business/budget/union-budget-2021-public-bus-scheme-expansion-of-metros/article33722572.ece [Accessed March 2021].

Percentage of coverage of Non-Motorized Transport (NMT) network (pedestrian and bicycle) in the city

Non-motorised Transportation (NMT) includes walking and bicycling, and variants such as small-wheeled transport (cycle rickshaws, skates, skateboards, push scooters and hand carts) and wheelchair travel[9]. NMT does not emit GHG, nor local air pollutants. Every increase in NMT therefore leads to a direct decrease in GHG emissions and also contributes to SDGs 11 sustainable cities and communities especially for promotion of inclusive public transport. A recent study conducted by the World Health Organization on global road safety concluded that only 68 countries (out of 195 countries) in the world have national or local level policies that promote walking and cycling[10]. Traditionally, Asian cities have been characterized by short distance non-motorized transport trips. But this scenario is rapidly changing as cities in Asia are getting increasingly motorized with limited attention to NMT facilities, extreme heat and cold conditions and poor road safetyleading to a decrease in the overall NMT trip mode share.

In India, around 50% of the population commute by foot or by cycle/cycle rickshaw. A 2008 study of 30 Indian cities found that in cities with more than 8 million population: 22% walked all the way, 8% used cycles and 44% used public transport. This adds up to 74% of people who rely on non-motorized transport for at least part of the commute.[11] During the pandemic, India witnessed bicycle sales multiply, with nearly five million cycles sold between May and September 2020[12].Despite having a high share, most Indian roads are unsafe for walking and cycling. Although only 25% of trips are made using private vehicles there is 75% dedicated road space The Central Government has been actively addressing this concern through various policies and schemes. The National Urban Transport Policy (NUTP) of 2006, envisions a new planning paradigm which recognizes that, "people occupy center-stage in cities and all plans should be for their common benefit and well-being". The Code of Practice for Urban Roads developed by MoHUA through updating on the IRC (Indian Roads

94 Cities	10 Cities	8 Cities	8 Cities	6 Cities
		Performance criteria		
Cities that have <15% of road network with NMT infrastructure as per MoHUA's street design guidelines	Cities that have 15% to <25% of road network with NMT infrastructure as per MoHUA's street design guidelines	Cities that have 25% to <35% of road network with NMT infrastructure as per MoHUA's street design guidelines	Cities that have 35% to <50% of road network with NMT infrastructure as per MoHUA's street design guidelines	Cities that have ≥ 50% of road network with NMT infrastructure as per MoHUA's street design guidelines
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 86 of 126 participating cities have provided all requisite data for this indicator.

✓ Among the reporting cities, only 6 cities (5 metropolitan and 1 medium sized city) have more than 50% NMT network.

✓ 38 of 126 participating cities have reported on the provision of cycle track as per MoHUA's street design guidelines respectively. These include 22 metropolitan cities, 7 large sized cities, 8 medium city and 1 small towns. None of the small towns managed to showcase evidence on availability of cycle track/lane.

✓ 88 of 126 participating cities have reported on provision of footpath as per MoHUA's street design guidelines respectively. These include 40 metropolitan cities, 24 large sized cities, 20 medium sized cities and 4 small towns.

Actions

RANCHI

Ranchi initiated an almost overnight transformation of one ot's busiest streets, MG Road, through a quick tactical urbanism intervention. Using simple temporary measures like paint and traffic barricades, the street space was redesigned to create colourful, dedicated walking paths for pedestrians. This simple first step has created a cascade of promising changes – a first in the state of Jharkhand.

Congress) codes helps cities in developing NMT street design elements. Cities are leveraging funding from the Smart Cities Mission to introduce projects like Public Bicycle Sharing and Smart Roads paving a way for citizens to explore alternative and inclusive ways of transportation. Recent initiatives of Cycles for Change and Streets for People challenge has brought a healthy competitive spirit and inspired cities to initiate pedestrian and cycling-friendly through a participatory approach.

NMT is a highly cost-effective transportation strategy and brings about large health, economic and social co-benefits. The unique nature of Indian sidewalks having a mix of hawkers, property shop spillovers, advertisements and presence of public utilities (toilets, waste collection/ segregation points etc.) create a conflict in usage and poses complex challenges for street redesigning. In addition, difficulty in land acquisition for NMT development in prime locations of the city delays the process in some cases. Keeping in mind these complexities, a more people centric

and innovative approach is needed for NMT development and promotion. The indicator on NMT coverage assesses cities on the efforts made to increase NMT infrastructure based on the increase in efficient walking and cycling tracks/lanes. The percentage of total NMT (walking and cycling lanes) length with respect to the total road length of the city is evaluated for this purpose along with evaluating if the city has a dedicated NMT plan.

Way forward to improve NMT infrastructure

- Cities can promote NMT modes by developing a safe environment for cycle lanes and footpaths. Better regulation for signages and safe crossroad islands can be incorporated. Most importantly, improving NMT connectivity to motorized-share mobility hubs will attract more users to use NMT.
- Cities can create awareness on road safety and promote cycle sharing schemes in strategic locations.
- Preparing a baseline for NMT infrastructure, identifying

actors and stakeholders who benefit from NMT and evaluating the readiness of the city will help cities to prepare actions and implement to increase the NMT network. Cities can follow the Guidance document developed by MoHUA to develop NMT infrastructure .
- Allocating dedicated funds in the municipal budget for improving NMT and creating new cycle lanes and foot paths can also be considered.

9,10. Climate Technology Centre and Network, Promotion of non-motorised transport. [Online] Available at: https://www.ctc-n.org/technol-ogies/promotion-non-motorised-transport[Accessed March 2021].

11. Singh. K, 2018. Mobility and NMT in Sustainable Urban Development –Role of City Developers. Intergovernmental eleventh regional environmentally sustainable transport (est) forum in Asia. United Nations Centre for Regional Development. Ulaanbaatar, Mongolia. [Online] Available at: https://www.uncrd.or.jp/content/documents/6988Background%20Paper%20for%20EST%20Plenary%20Ses-sion%205-11th%20Regiona%20EST%20Forum.pdf[Accessed 31 March 2021]

12. Desai. D, 2020. Non-motorised transport should top the global urban agenda in 2021.Urban futures. Observer Research Foundation. [Online] Available at: https://www.orfonline.org/expert-speak/non-motorised-transport-should-top-global-urban-agenda-2021/[Ac-cessed 31 March 2021]

13. ITDP India, 2019. Cars take a back seat, People of Chennai coming through.[Online] Available at: https://www.itdp.in/tag/nmt/[Ac-cessed 31 March 2021]
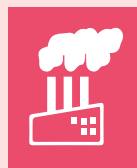
Level of Air Pollution (Monitoring)

Air pollution is one of the world's largest health and environmental problems, attributed to 5 million deaths each year, with 9% being globally.[15] The current energy model is fuelling climate change and deprivation of air quality. Asian cities, particularly Indian cities are facing severe consequences wherein the particulate matte are reaching as high as five times above the safety limits creating a major health concern[16]. Globally, the SGDs 3, 11 and 12 provides a framework to reduce mortality due to air quality, reduce urban GHG emissions and regulate safe handling of chemical/hazardous waste to avoid release in air.

In India, the National Air Quality Monitoring Program states that nearly half of the cities monitored have reached critical levels of particulate matter[16]. The National Clean Air Programme (NCAP) initiated in 2019 sets a target of 20 to

44 Cities	25 Cities	30 Cities	14 Cities	13 Cities
		Performance criteria		
Cities have not initiated regular monitoring of their air quality	Cities have installed sensors to monitor air quality. PM2.5, NOx and SOx are being captured as per CPCB guidelines	Cities have made air quality data available in the public domain through display boards/ SAFAR/ Sameer app/ any other apps	Cities have demonstrated reduction in air pollution level in compliance to NCAP with base year being 2017	Cities have achieved ambient air quality standard for PM10, PM2.5, NOx and SOx as per National Air Quality Standards
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ Improvement in the air quality has become most significant in recent years with ramping up of pollution monitoring and implementation of mandates/guidelines pertaining to pollution mitigation. Among the 13 *Five Stars* and 14 *Four Stars* cities,
  » 7 cities have achieved the National Air Quality standard in all the 4 main pollutants (PM10, PM2.5, NOx, Sox as per CPCB).
  » 12 cities have achieved the National Air Quality Standard in either 2 or 3 of the total main pollutants. The pollutants which were mostly missing were NOx and SOx; as the capturing of PM10 and PM2.5 was highly prominent in cities.
  » 13 cities have successfully achieved the reduction trend in air pollution as per NCAP target (base year 2017).
✓ 97 out of 126 cities were not able to achieve the reduction trend, as the measures of air pollution reduction is an emerging concept for the Indian cities and have come into implementation in recent years. Hence, in the current stage, the capturing of air pollutants has been observed as prominent, and not the reduction trend.
✓ Only 16 out of 126 cities are in early stage of basic monitoring as these cities generally having annual/monthly AQI data. However, 4 cities - Jamshedpur, Rourkela, Ujjain and Visakhapatnam are performing regular (minimum 104 readings in a year) basic monitoring of PM10, PM2.5, NOx, Sox as per CPCB guidelines and CO, NH3, Pb, O3 as per NAAQS.
✓ 20 of the 126 cities are conducting basic monitoring of both main and additional pollutants at regular intervals. However, monitoring of PM2.5, Pb, O3 is missing.
✓ All 9 participating small towns and 6 of 8 hilly cities are in the category of *One Star* and *Two Stars*, indicating that the promotion of air pollution in not active. While air quality may not necessarily be of priority concern in some of these cities, absence of mandatory mandates to align with national level programmes also does not encourage cities to initiate monitoring.

PUNE

The action plan for emission control details out the activities undertaken for ambient air quality monitoring and the identified sources of pollution in Pune city. It takes stock of the actions taken and a proposed road-map for improved monitoring and reduced pollution.

30% reduction of air pollution levels with 2017 as the base year and has mapped out priority strategies for multi-level actions in cities to work towards targeting it.[17] India has approximately 800 total monitoring stations, 200 of which are continuous real time monitoring stations (CAAQMS)[18]. Only five percent of cities and towns (339 out of 6,166) are monitored, and less than one percent (only 60 out of 6,166) of cities have CAAQMS.[19] NCAP aims to increase the monitoring stations across the country along with promoting and researching cost effective technology for source and ambient air quality monitoring. Monitoring data on air quality and making it available to the public will help in framing policies and also allow citizens to make informed decisions that can improve the quality of their lives.

In order to understand the status of cities and foster key actions in monitoring air quality, this indicator on level of air pollution assesses cities based on PM10 PM2.5, NOx, SOx pollutants monitoring, measures taken to comply with the National Air Quality Standards and the extent of air quality data made available to the public.

Way forward to improve air quality monitoring

- 44 cities which are in the category of *One Star* are recommended to initiate coordinating with their State Pollution Control Board (SPCB) to install continuous air quality monitoring equipment's in public places to capture PM10, PM2.5, NOx and Sox. Using annual arithmetic means of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals needs to be followed to capture appropriate data .
- 25 *Two Stars* cities are recommended to calculate the AQI and make it available to the public via display

- boards, local apps developed, or data made available as per the SAFAR/SAMEER apps of GoI.
- 30 *Three Stars* cities can compile data from monitoring stations taking 2017 as the base year to document progress and aim to achieve the national level target of 20%–30% reduction of PM2.5 and PM10 concentration by 2024.
- 14 *Four Stars* cities are recommended to initiate implementation of priority actions identified in their Clean Air Action Plan to reduce air pollution and achieve the national standard.

15. Ritchie, H. & Roser, M., 2019. Air Pollution. [Online]
Available at: https://ourworldindata.org/air-pollution#air-pollution-is-one-of-the-world-s-leading-risk-factors-for-death
[Accessed 19 March 2021].
16. McHardy, J. S., Aneja, K., Cinà, M. M. & Cinà, M. M., 2020. Delhi In A Chokehold: Air Pollution As A Public Health Emergency. [Online]
Available at: https://www.healthaffairs.org/do/10.1377/hblog20200130.710866/full/
[Accessed 19 March 2021].
17. Ministry of Housing & Urban Affairs, 2020. Long-Term, Time-Bound, National Level Strategy to Tackle Air Pollution-National Clean Air Programme (NCAP). [Online]
Available at: https://pib.gov.in/PressReleasePage.aspx?PRID=1655203#:~:text=The%20Central%20Government%20launched%20National,2017%20as%20the%20base%20year[Accessed 19 March 2021].
18. Central Control Room for Air Quality Management - All India, Jan 2020
Available at: https://app.cpcbccr.com/ccr/#/caaqm-dashboard-all/caaqmlanding[Accessed March 2021].
19. Natural Resources Defense Council (NRDC), Jan 2020, Clearing The Air: A Review Of 10 City Plans To Fight Air Pollution In India
Available at: https://www.nrdc.org/sites/default/files/10-city-plans-fight-air-pollution-india-202001.pdf [Accessed April 2021].
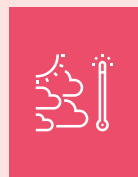
Clean Air Action Plan (Planning and Implementation)

Air quality, weather and climate, and human health are closely linked. According to the Health Organisation (WHO), seven million people die prematurely from health risks every year owing to air pollution. The First WHO Global Conference on Air Pollution and Health that took place in 2018 passed a resolution that recognized the health impacts of air pollution urging member countries to implement interventions to improve indoor and outdoor air quality. This action symbolized a radical shift in the narrative around air quality management wherein clean air is viewed necessary for poverty reduction and economic growth.

In India, air pollution is the 5th biggest cause of death. There is six times increase in the deaths from air pollution from 2000 to 2010 where high blood pressure that is one of the top five leading causes of death in India has 6% direct linkage with air pollution[21] With the Air (Prevention and

39 Cities	**48** Cities	**15** Cities	**23** Cities	**1** City
		Performance criteria		
Cities have not indicated regular monitoring of their air quality or have developed city clean air action plan	Cities have established monitoring stations to measure ambient air quality and have linked this mechanism with ICCC	Cities have conducted pollutant source apportionment studies and emission inventories in addition to developing a clean air action plan as per CPCB guidelines	Cities have implemented at least 2 measures identified in the clean air action plan under the scope of ULB	Cities have conducted impact assessments for implementing the clean air action plan and have demonstrated improvements in their air quality
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ CAAP is a recent mandate for cities in India and the NCAP has identified 122 non-attainment cities based air quality data between 2014-18. Out of 122 cities which are required to submit an action plan to reduce their respective air pollution levels in 2024 by at least 20-30%., only 57 are part of this assessment. 35 out of these 57 non-attainment participating cities have successfully prepared CAAP.

✓ Only Pune has managed to progress beyond implementing the identified actions under CAAP and have documented the impact.

✓ Among the 38 *Three Stars* and *Four Stars* cities, 24 cities have developed CAAP, action plans or other government related studies and have implemented one to two initiatives towards combating air pollution.

✓ 48 *Two Stars* Cities have monitoring stations active at city level with varying types of Manual Stations, Continuous Ambient Air Quality Monitoring Stations (CAAQMS), and Continuous Emission Monitoring System (CEMS). These cities are mostly from the states of Andhra Pradesh, Bihar, Gujarat, Karnataka and Tamil Nadu.

✓ Among the 126 participating cities, based on the evidences submitted-
  » 62 cities have CAAQMS which is highly suggested to get the accurate and regular readings of air pollutants;
  » 18 cities have manual stations operating in their respective areas;
  » 6 cities have sensor based monitoring stations.
  » 1 city has CEMS.

Control of Pollution) Act, 1981, India had taken the first step 40 years ago. Since then, various measures have been undertaken by the central government such as upgradation of National Ambient Air Quality Standards (NAAQS), launch of National Air Quality Index in 2015, and launch of the National Clean Air Programme (NCAP) in 2019- with special focus on comprehensive air quality management in urban area. Following the NCAP, the Central Pollution Control Board (CPCB) identified 122 non-attainment cities for achieving the target of 20 to 30 percent reduction by 2024 with respect to 2017 levels[22].

The indicator of Clean Air Action Plan assesses cities based on their efforts to develop Clean Air Action Plan (CAAP) and air quality management strategy in a comprehensive manner addressing all sectors like transport, industry, energy etc. Identifying the basic level of pollutant sources along with regular monitoring and the preparation, assessment and implementation of CAAP are considered for assessing cities. [23] For a city to become climate smart it should be able to address the issues of reducing air pollution wherein the multiple benefits of good public health and economic growth can also be achieved.

Way forward to implement Clean Air Action Plan in cities

- 39 *One Star* cities can install air pollutant monitoring stations based on the Central Pollution Control Board (CPCB) guidelines for the Measurement of Ambient Air Pollutants. It is important to calibrate the installed sensors in consultation with the CPCB/SPCB. These cities can also map the locations of air pollution stations and air pollution sensors in the city using a GIS database, by synchronizing Air Quality Monitoring mechanisms with the Integrated Command and Control Centre of the Smart City (ICCC). Cities can refer to the Ministry of Housing and Urban Affairs guidelines to unlock the potential of ICCC.

- Based on the MoEFCC's National Clean Air Program (NCAP), 48 *Two Stars* cities along with the State Pollution Control Board (SPCB) can initiate the development of a Clean Air Action Plan.
- 15 *Three Stars* cities are recommended to strengthen institutional capacity to implement actions as per the Clean Air Action Plan (CAAP). This includes public awareness campaigns and promoting air quality within development projects at the planning and design stages.
- 23 *Four Stars* cities can conduct an impact assessment study to understand air quality improvements upon implementing projects under the Smart City Mission aligned with a clean air action plan.

21. Centre for Science and Environment, 2020. Air pollution is now the fifth largest killer in India, says newly released findings of Global Burden of Disease report. [Online]
Available at: https://www.cseindia.org/air-pollution-is-now-the-fifth-largest-killer-in-india-says-newly-released-findings-of-global-burden-of-disease-report--4831#:~:text=Shocking%20increase%20in%20Indian%20death,%E2%80%93%20a%20six%2Dfold%20increase.
[Accessed 19 March 2021].

22. Press Information Bureau, 2019. Various Initiatives undertaken by Government for mitigation of Air Pollution. [Online]
Available at: https://pib.gov.in/newsite/PrintRelease.aspx?relid=194865
[Accessed 19 March 2021].

23. Ganguly, T., Selvaraj, K. & Guttikunda, S., 2020. National Clean Air Programme (NCAP) for Indian cities: Review and outlook of clean air action plans. [Online]
Available at: https://www.sciencedirect.com/science/article/pii/S2590162120300368
[Accessed 19 March 2021].

Credits:

Nariman Point in Mumbai,

by Satyajeet Mazumdar, 2019

Actions in the cities

Delhi

Electric Vehicle Policy

Delhi Electric Vehicle Policy launched in 2020 has a vision to make Delhi the EV Capital of India. The Policy aims to achieve the overarching objective to improve Delhi's air quality and create an entire supply-chain ecosystem for this new segment of vehicles. In order to significantly benefit Delhi's air quality, the policy intends to deploy 25% of all new vehicles to be battery-operated vehicles by 2024.

Naya Raipur

BRTS public transport

Naya Raipur has initiated a Bus Rapid Transit service for a seamless connectivity with Raipur and within the city of Atal Nagar. "Intelligent Tracking System" are being used for managing the bus system.

Chennai

Streets for People

Chennai is one of the first cities in India to adopt a NMT Policy in 2014. Since then it has implemented a host of initiatives prioritising pedestrians, cyclists and public transport users. The 'Streets for People' initiative has been instrumental in transforming more than 100 km the city's streets through adoption of complete street guidelines, segregation of vehicular and pedestrian traffic, creation of pedestrian plazas, introduction of public bike sharing services and better management of on-street parking.

59 cities
have reported the use of low carbon shared vehicles like buses, e-rickshaws, cabs etc.

87 cities
have some form of air quality monitoring stations in their cities

Coimbatore

City wide Cycling and Pedestrian Network Plan

Coimbatore has recently prepared a city wide cycling and pedestrian network plan which was approved in January 2020. The plan sets out a comprehensive approach for building a network of cycling and pedestrian routes in the city and sets forth a comprehensive set of measures which would put city on a path of achieving sustainable transport goals. The plan has an implementation period of 15 years.

Agra

Air Quality Monitoring enhanced through ICCC

Agra city has deployed 39 Polludrone sensors across the city to monitor ambient air quality It assesses all the critical pollutants present in the air - PM2.5, PM10, CO_2, CO, SO_2, NO, NO_2, and O3, along with the weather parameters - noise, light, UV radiation, temperature, humidity, and rainfall. The dashboard of the system has been integrated with the city's Command and Control Centre. Real-time pollution data can be observed here, which can assist in mitigating the root cause and create awareness among local people and tourists about the current environmental health.

Dehradun

Clean Air Action Plan

Dehradun has prepared the Clean Air Action Plan (2018-22) with the aim to meet the prescribed annual average ambient air quality standards. The Plan includes a city specific need assessment, a detailed GHG inventory and a proposed action plan.

14cities

have more than 35% of their road network with Non-Motorized Transport (NMT) infrastructure

21cities

have attained MoHUA's SLB for the availability of public transport
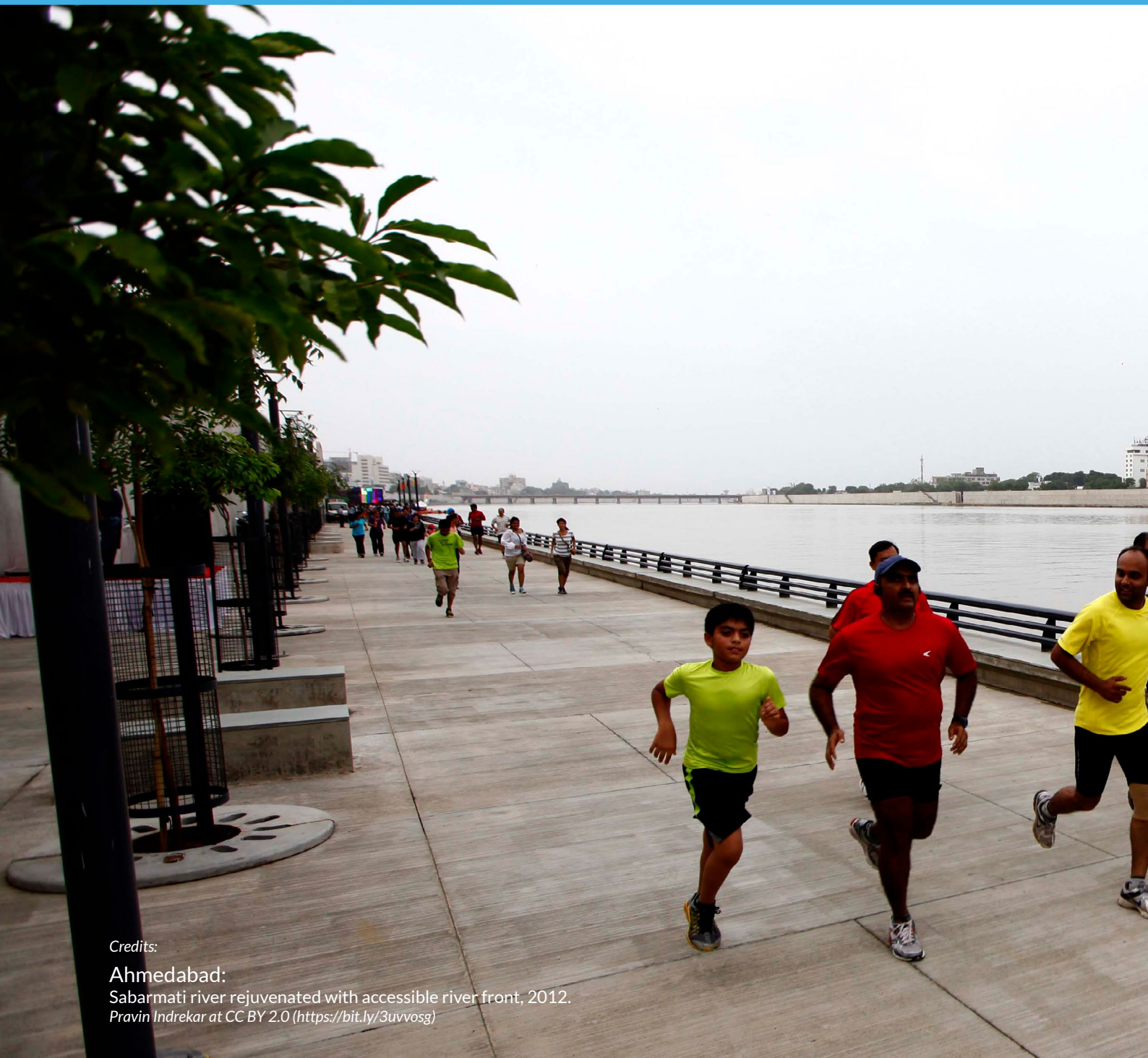
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Water Management

Water Management

The stresses on natural resources and access to basic services like water is intensifying with the growing urban population. Unplanned urbanization leads to encroachments and disposal of untreated sewage and industrial waste into water bodies leading to pollution of urban water resources. Further, cities are adversely impacted by extreme events like heat waves, increased precipitation and flash floods triggered by extreme weather. Most cities are unable to tackle the twofold challenges of increasing demand for potable water during sumer time and management of excess water during extreme precipitation events mainly due to ageing infrastructure, inadequate monitoring, improper management and lack of holistic planning.

Achieving the SDG Goal 6 will require adopting various measures such as recycle, reuse of water and reducing loss in transmission. An effective water and waste water management plan can reduce the stress on existing water resources. Guidelines and initiatives undertaken by the Ministry of Water Resources includes Repair, Renovation & Restoration (RRR), river basin management, ground water irrigation etc. can help cities ensure the conservation of existing water resources and help meet future demand. Cities can also follow the guidelines provided in the Urban River Management Plan (URMP) framework for enhancing river management and conserving the quality of water. Conversely, embedding energy efficiency in pumping and treatment plants can help cities contribute towards mitigating GHG emissions.

This particular theme supports cities to better understand their water challenges, and infrastructure and management gaps. The indicators allow cities to revisit their water resource management plans, consider conserving and reviving water resources to cater future demand, address loss of water, increase recycle and promote efficient reuse of recycled water.

Dr. Panagiotis Karamanos
Urban Development Expert
International Urban & Regional
Cooperation India

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The CSCAF is a thoroughly conceived, all-inclusive and truly valuable initiative for Indian cities. We appreciated the cooperation and motivation of Mayors and cities during the fact finding process and believe that Indian cities will play a key role addressing the climate change challenge. The CSCAF is an essential step forward towards more sustainable, healthy and livable cities

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Water resources must be managed with respect and highest degree of responsibility both individually and collectively. Climate change is a factor which is impacting it in and around us. Hence more engineered and scientific ways of managing our resources are the need of the day. CSCAF is a one step forward.

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Mr. Manzoor Khan
Consultant- Urban Specialist
World Bank Group

Dr. Victor Shinde
Sector Coordinator for Water
and Environment
National Institute of Urban Affairs

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Water is the primary medium through which the effects of climate change are manifested. Invariably these effects are more pronounced in cities. A sound and holistic water management strategy is, therefore, at the heart of any robust climate change adaptation mechanism that a city develops. The CSCAF can serve as a very useful tool in informing the design of such strategies.

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Thematic indicators and assessment outcome

INDICATOR 1
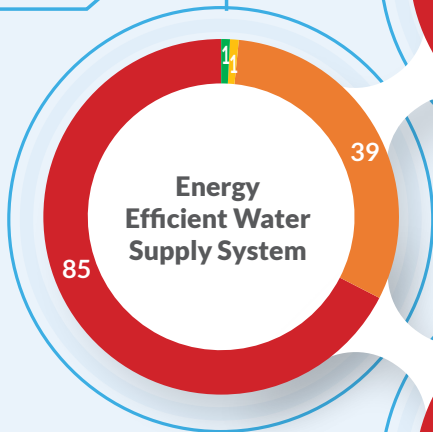### Water Resources Management
- 3
- 18
- 16
- 30
- 59

INDICATOR 2
Extent of Non Revenue Water
- 1
- 23
- 27
- 30
- 45

INDICATOR 3
Waste Water Recycle and Reuse
- 9
- 24
- 7
- 22
- 64

INDICATOR 4
Flood/Water Stagnation Risk Management
- 6
- 7
- 10
- 21
- 82

INDICATOR 5
Energy Efficient Water Supply System
- 1
- 1
- 39
- 85

INDICATOR 6
Energy Efficient Wastewater Management System
- 2
- 14
- 110

Legend:
- 5 Stars
- 4 Stars
- 3 Stars
- 2 Stars
- 1 Star

Performance Levels

🟩 Four Stars
🟨 Three Stars
🟧 Two Stars
🟥 One Star

City Population

◯ <0.5 million
◯ 0.5-1 million
◯ >1 million
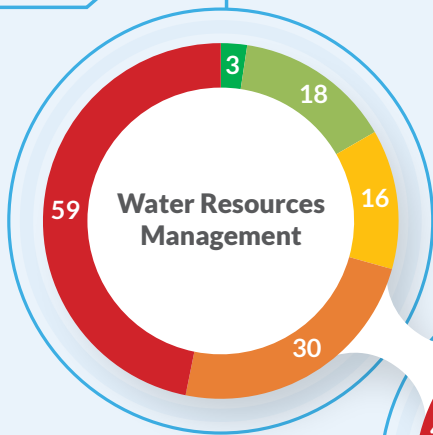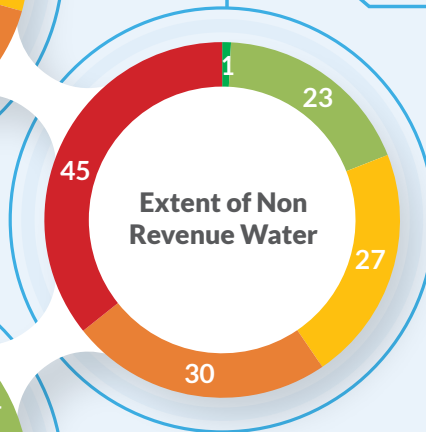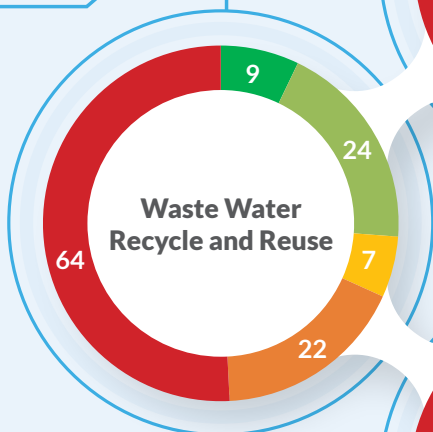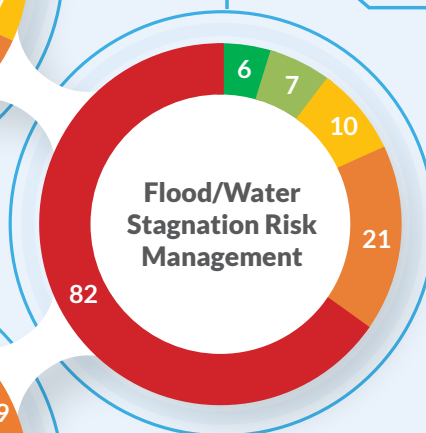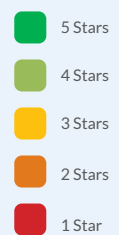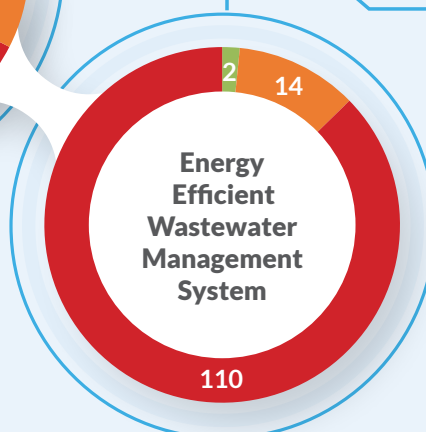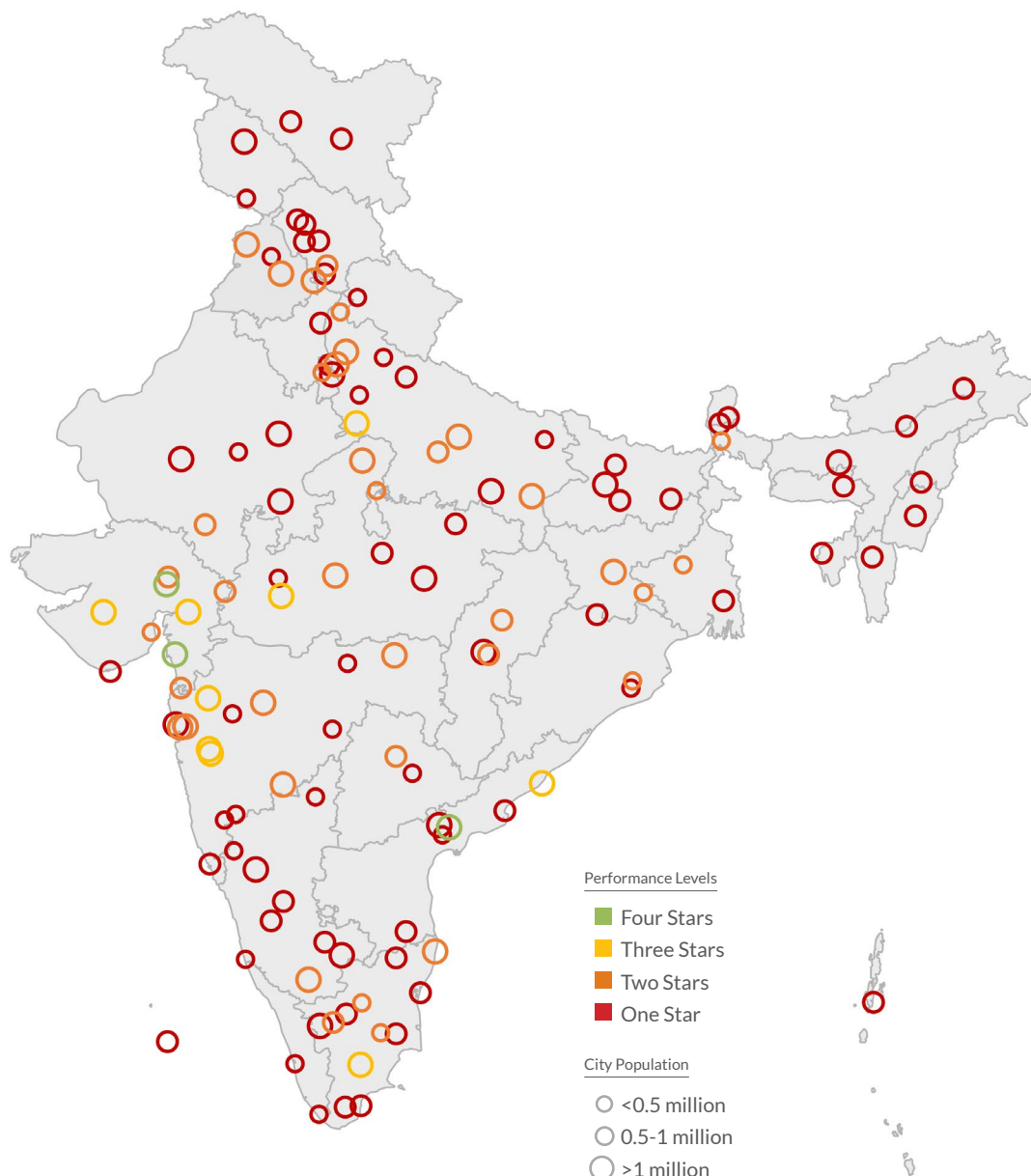
Performance of 126 Cities

Overall, 3 metropolitan cities from Gujarat (2) and Andhra Pradesh (1) have emerged as *Four Stars*. These cities have considered the climate change aspect in water management and are in the process of implementing it. 46 cities that are *Two Stars* and *Three Stars* are at various stages of water management plan preparation and have potential for addressing the climate change challenges within the plans.

25 out of 126 participating cities are at high water risk as per the WWF Water Risk Filter. Out of these, only 2 cities, namely, Ahmedabad and Surat are performing well. The rest of the 23 cities in high risk states of Maharashtra, Gujarat, Tamil Nadu, Uttar Pradesh, Rajasthan, Madhya Pradesh, Punjab and Jammu & Kashmir need to take initiatives to enhance water security in their respective cities.

77 *One Star* cities are mostly from the cold or hot-dry climatic regions. 21 out of 77 *One Star* cities from mostly small and medium sized cities belonging to the Northern and North-Eastern regions are most vulnerable to the climate change impact with respect to water management.

| 0 |
| 5 Stars |

| 3 |
| 4 Stars |

| 9 |
| 3 Stars |

| 37 |
| 2 Stars |

| 77 |
| 1 Star |

★ ★ ★ ★

- Ahmedabad
- Surat
- Vijayawada

★ ★ ★

- Agra
- Indore
- Madurai
- Nashik
- Pimpri Chinchwad
- Pune
- Rajkot
- Vadodara
- Visakhapatnam

★ ★

- **Amritsar**
- **Aurangabad**
- Bhavnagar
- **Bhopal**
- Bilaspur
- Chandigarh
- **Chennai**
- Cuttack
- Dahod
- Durgapur
- Gandhinagar
- **Ghaziabad**
- Gurugram
- **Gwalior**
- Jamshedpur
- Jhansi
- **Kalyan Dombivali**
- **Kanpur**
- Karimnagar
- **Lucknow**
- **Ludhiana**
- **Meerut**
- Mysore
- **Nagpur**
- Naya Raipur
- **Ranchi**
- Saharanpur
- Salem
- Shimla
- Siliguri
- Silvassa
- Solapur
- **Thane**
- Tiruchirapalli
- Tiruppur
- Udaipur
- **Varanasi**

★

- Agartala
- Aizawl
- Ajmer
- Aligarh
- Amravathi
- Amravati
- Barielly
- Belagavi
- **Bengaluru**
- Bhagalpur
- Bhubaneshwar
- Bihar Sharif
- **Coimbatore**
- Davangere
- Dehradun
- Delhi
- Dharamshala
- Diu
- Erode
- **Faridabad**
- Gangtok
- Gorakhpur
- Gulbarga
- Guntur
- Guwahati
- Hamirpur
- Hubli Dharwad
- Imphal
- Itanagar
- **Jabalpur**
- **Jaipur**
- Jalandhar
- Jammu
- **Jodhpur**
- Kakinada
- Kargil
- Karnal
- Kavaratti
- Kochi
- Kohima
- Kolhapur
- **Kota**
- Leh
- Loni
- Mandi
- Mangalore
- Mira Bhayandar
- Moradabad
- Muzaffarpur
- Namchi
- Nanded
- New Town Kolkata
- Palampur
- Panaji
- Pasighat
- **Patna**
- Port Blair
- **Prayagraj**
- Puducherry
- **Raipur**
- Rourkela
- **Sagar**
- Sangli Miraj & Kupwad
- **Satna**
- Shillong
- Shivamogga
- Solan
- **Srinagar**
- Thanjavur
- Tirunelveli
- Tirupati
- Tiruvanantapuram
- Toothukudi
- Tumakuru
- **Ujjain**
- Vellore
- Warangal

● Smart and AMRUT cities   ◈ Smart cities   ◆ AMRUT cities   ○ Other cities   *Million + population cities

Water Resources Management

More than 40% of the world's population is estimated to live in water stressed river basins, and by 2025, about 1.8 billion people will be living in regions or countries with absolute water scarcity.[1] By 2030, a gap of 40% in global water demand and availability is expected. In India, more than 40% of the annually available surface water is being consumed and the growing demand from urbanization and the industrial water needs are further leading to the exploitation of ground water resources.[2]

India is at higher risk of water challenges as per WWF Water Risk Filter about 30 Indian cities, mostly metropolitan cities have been identified as cities that will face increasing water risks in the next few decades.[2] States like Andhra Pradesh, Chhattisgarh and Tamil Nadu are already experiencing water shortages due to changing rainfall patterns.[3] India holds only 4% of global freshwater and the projected climate trends impact water availability along with the growing demand.[2]

59 Cities	**30** Cities	**16** Cities	**18** Cities	**3** Cities
		Performance criteria		
Cities have not initiated action towards water resources assessment	Cities have conducted assessment of current water resources along with future demand and water availability for at least five years	Cities have developed Water Resource Management (WRM) Plan with short, medium and long term actions	Cities have implemented measures specified in the WRM Plan and have revised their current plan to incorporate climate change factors	
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ The participating cities from Gujarat, Madhya Pradesh and Jharkhand have performed well by ensuring timely preparation and implementation of actions to augment existing water resources through recharge, rejuvenation and storage including rain-water harvesting, developing demand management plan and reviewing existing WRM plan to include climate considerations.

✓ 27 cities have WRM plans. Of these, 3 cities have emerged as *Five Stars* (Surat, Ranchi and Indore) and have considered the climate change factor in the existing WRM Plans and are in the process of implementing climate sensitive actions with notable impacts.

✓ 30 *Two Stars* and 16 *Three Stars* cities have provided partial data for three sub-indicators namely existing water resources, demand management and information on augmentation of the existing water resources.

✓ 59 *One Star* cities do not have or are not able to provide the WRM plan for their cities

✓ Among the cities in hilly areas, only Namchi and Shimla are able to perform relatively better in this indicator. All the participating small towns (except Namchi) have not performed well in this indicator. The North Eastern cities (except for Namchi which is *Four Stars*) are yet to initiate substantial measures.

✓ Cities with 10 million+ population especially from the states of Bihar, Rajasthan, Madhya Pradesh and Uttar Pradesh need to conserve their surface & ground water resources, alongside assessing the availability of existing water resources to meet the current and future water demand.

Recognizing this significance, the National Water Mission is working towards conserving water, minimizing wastage and ensuring more equitable distribution is achieved both across and within states. The Jal Shakti Abhiyan by the Ministry of Jal Shakti is campaigning for water conservation and water security and promoting interventions like rainwater harvesting, renovation of traditional and other water bodies/tanks, reuse, bore well recharge structures, watershed development and intensive afforestation. With a focus on river management, Namami Gange has developed river centric planning framework and urban river restoration mechanisms that is currently benefitting cities along the Ganges. While setting a path towards improved water resources management, cities face various challenges in planning and implementation due to institutional overlaps and lack of man power in managing water bodies and area around it. Further, gaps in local capacity is a challenge in formulating strategies and implementing the same.

In this indicator, the cities are assessed based on progress made on aspects, ground water management to mitigate water stress, development of a water resources management with short, medium and long term actions, and revision of the same aligning to projected climate trends to address future water demand. The latter also contributes to SDG 6 where cities can contribute towards implementing Integrated Water Resource Management (IWRM).

Way forward to improve water resource management

- 59 *One Star* cities need to establish a water resource management committee to guide them in the process of development of city/ catchment wide water management plans. This committee can include representatives from the water utility department/ water board, ULB, ground water department, SPVs, and technical experts like engineers and infrastructure experts.
- Cities can refer to the guidelines for Integrated Water Resources Development and Management for detailing out the functions of the team. Cities can initiate a study along with mapping of ground and surface water to assess the status of existing water resources. Further, assessing the availability of water considering the future demand can be conducted.
- 30 *Two Stars* cities can initiate the development of demand management plan to support improved utilization of water resources and adopt measures to rejuvenate water resources and replenish groundwater. This particular initiative also aligns with an indicator in the theme of urban planning, green cover and biodiversity. Cities can focus on preparing the water resource management plan wherein short, medium and long-term actions can be identified. Cities can follow the 2014 guidelines for improving water use efficiency in irrigation, domestic and industrial sectors to develop the plan.
- 16 *Three Stars* cities that have already developed water management plans can start allocating budget for implementing some of the actions identified and institutionalize monitor review verification for the activities performed. These cities can also think about dovetailing some of their planned initiatives through the central government and state government funded schemes.
- 18 *Four Stars* cities can review and update their WRM plan as per the climate trends for a return period of 10-30 years. They can conduct studies on assessing future water availability in various climate change scenarios and drawing out plans to safeguard the availability of water.

1. Guppy, L., Anderson, K., 2017. Global Water Crisis: The facts. United Nations University Institute for Water, Environment and Health. Available at: https://inweh.unu.edu/wp-content/uploads/2017/11/Global-Water-Crisis-The-Facts.pdf [Accessed 23 March 2021]
2. WWF India, 2020. [Online] Available at: https://www.wwfindia.org/news_facts/pres/?19602/Cities-across-the-globe-face-an-alarming-rise-in-water-risks#:~:text=About%2030%20Indian%20cities%20including,Dr. [Accessed March 2021].
3. NITI Aayog, 2019. Composite Water Management Index. Ministry of Jal Shakti and Ministry of Rural Development. Available at: http://social.niti.gov.in/uploads/sample/water_index_report2.pdf [Accessed 23 March 2021]
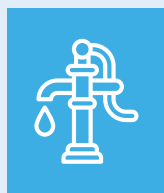
Extent of Non-Revenue Water

Non-Revenue Water (NRW) is a broader estimate of water loss, which includes loss of revenue not only from physical leakages of treated water but also from metering inaccuracies, unbilled consumption, and unauthorized connections. The estimated NRW in developed countries like the United States and the United Kingdom varies between 15-16% whereas in Asia, there is a broad variation between 4-65%.[4] In addition, it is estimated that 30% of global water abstraction is lost due to leakages[5] whereas in developing countries, one-third to a half of the pumped water is lost due to leakages.[5] Considering the amount of water loss, addressing NRW can be one of the key aspects for securing water availability.

Water loss is one of the key challenges faced by cities in India. The NRW loss varies from 40-50% and 50-60% in large metropolitan and smaller cities respectively.[5] Water loss in cities happen mainly due to old pipes used for

45 Cities	30 Cities	27 Cities	23 Cities	1 City
Cities have not initiated any actions to conduct study on Non-Revenue Water (NRW)	Cities have conducted NRW study and have demonstrated >40% NRW during 2016-20	Cities have conducted NRW study and have demonstrated >30% to 40% NRW during 2016-20	Cities have conducted NRW study and have demonstrated ≥20% to 30% NRW during 2016-20	Cities have conducted NRW study and have demonstrated <20% NRW during 2016-20
★	★★	★★★	★★★★	★★★★★

Performance criteria

Performance Levels

Performance of 126 cities

✓ 24 (23 *Four Stars* and 1 *Five Stars*) cities have performed relatively well in this indicator. These cities have conducted NRW study including strategies to reduce and achieve a minimal NRW percentage.

✓ Participating cities from Gujarat, Jharkhand, West Bengal and Andhra Pradesh have performed relatively well. Some of the measures undertaken by the cities include replacement of the existing assets, GIS mapping, metered connections, establishment of District Metered Areas (DMA) and Supervisory Control And Data Acquisition (SCADA).

✓ As per WWF Water Risk Filter, 25 out of 30 high risk cities have undertaken this assessment. 8 cities out of 25 have performed well in this indicator.

✓ The results from the assessment indicate that 45 *One Star* cities and 30 *Two Stars* cities with more than 40% NRW are still at an early stage of targeting their NRW reduction. 45 *One Star* cities have not submitted NRW study reports or have not secured the data. Cities that do not have metered water connections may pose a challenge in assessing NRW.

✓ All small cities (except Mandi) and cities in hilly and coastal regions (except Shimla and Surat) are yet to initiate measures to reduce their NRW considerably.

✓ The *One Star* million+ cities from Bihar, Haryana, Jammu & Kashmir, Rajasthan and Madhya Pradesh with an increasing population, expanding service areas can focus on reducing water loss for efficient water utilization and limiting revenue expenses.

SURAT

Surat has established a NRW cell to take up dedicated actions. A comprehensive NRW study along with leakage mapping has been conducted. A scheme of 24 x 7 water supply with 100% metering has been in operation since 2015. This scheme has helped to monitor NRW by assessing the quantity of water treated versus the quantity of water supplied. Through metering and levy of water charges, the city has not only been able to monitor NRW but also improved revenue income.

transmission and distribution due to broken or corroded pipes. These conditions are also not favourable to maintain the quality of ground water as there are chances for the sewage seeping into the ground water. In order to guide states and cities in addressing NRW reduction and efficient management, a toolkit was developed under JnNURM. The toolkit also provides guiding principle for auditing water supply and calculating losses at various stages that cities can follow. Various measures for leak detection to minimize leakages and reducing other unaccounted water losses are also captured in the draft general guidelines for Water Audit and Water Conservation released in 2017 that can inform enhanced management. However, lack of technical manpower and funds to conduct NRW study and inefficient coordination and management across various departments involved at the city and state levels pose challenges in identifying priority areas of water loss and adopting relevant measures.

As recognized in SDG 6, NRW is a powerful demand management instrument to reduce stress on existing water resources and aligning to the same this indicator assessed cities based on the extent of water loss due to NRW. This comprises consumption which is authorized but not billed, such as public stand posts; apparent losses such as illegal water connections, water theft and metering inaccuracies; real losses which are leakages in the transmission and distribution networks. Cities provided data on the amount of water put into the distribution system after treatment and the amount of water sold (billed) to the consumers for calculating water loss due to NRW in this indicator.

Way forward to improve monitoring of Non-Revenue Water

- Majority of the cities can start understanding the gaps by identifying problem areas, leakage points and reduction of illegal connections.
- Cities can prepare Non-Revenue water study or conduct a water audit in order to understand the real losses, apparent losses and unbilled authorized consumption.
- 45 *One Star* cities can conduct NRW study through specialized and experienced agencies/experts. This will enable cities to understand the gaps and plan for its reduction. Initiatives such as water supply audit and assessment, locating problem areas, implementing supply monitoring system through supervisory control

and data acquisition (SCADA) , etc., can be explored.
- Cities which have conducted the NRW assessment may continue to monitor the leakages and loss of water in the existing water supply system and focus on reducing the percentage of loss. This can include preparation of GIS database of water resource infrastructure and preparation of strategy and action plan for NRW reduction. Measures such as Tariff revision and organizing public awareness programs can lead to larger participation of stakeholders in water resource management.

4. Kumar, P., Matto, M. & Sharda , C., 2017. Policy Paper on Mainstreaming Energy Efficiency in Urban Water and Wastewater Management in the Wake of Climate Change, Centre for Science and Environment, Ministry of Urban Development. https://tinyurl.com/to995kgp [Accessed 23 March 2021]
5. Guppy, L., Anderson, K., 2017. Global Water Crisis: The facts, United Nations University Institute for Water, Environment and Health. https://inweh.unu.edu/wp-content/uploads/2017/11/Global-Water-Crisis-The-Facts.pdf [Accessed 23 March 2021]
6. Never, B., 2016. Wastewater systems and energy saving in urban India. https://www.researchgate.net/publication/305308932_Wastewater_systems_and_energy_saving_in_urban_India [Accessed 23 March 2021]
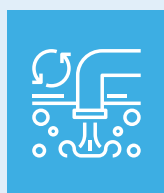
Wastewater Recycle and Reuse

Globally, only 20% of the total wastewater generated is treated[8]. Two-third of the sewage from urban areas globally is let into water bodies untreated[9]. In the case of India, 32% of urban households have piped sewer systems and only 10% of the overall sewage generated is treated[10]. Around 62% of total urban sewage generated in India is directly discharged into nearby water bodies[11]. This is a key reason for water pollution that is impacting the water quality and the overall water ecosystem.

SDG 6 goal for sustainable management of water and sanitation identifies the need for strengthening city wastewater management and increasing the reuse of recycled waste water. Recycle and reuse of wastewater are an important part of the sanitation cycle and critical for water conservation, especially in conditions with decreasing freshwater availability and increasing costs for delivering safe water, often from far distance. Moreover, adopting recycle and reuse of water for non-potable domestic use, horticulture, agricultural, power plants and industrial use can reduce water pollution and the stress on water availability which is expected to be adversely impacted by climate change.

At the national level, the National Water Policy, 2012 encourages cities to increase the recycling and reuse of wastewater after treatment and has set preferential tariffs to incentivize the reuse of treated wastewater.

64 Cities	22 Cities	7 Cities	24 Cities	9 Cities
		Performance criteria		
Cities have not initiated actions to recycle and reuse treated wastewater in the last twelve months	Cities have recycled and reused < 5% of treated wastewater as per last twelve months record	Cities have recycled and reused 5% to < 10% of treated wastewater as per last twelve months record	Cities have recycled and reused 10% to < 20% of treated wastewater as per last twelve months record	Cities have recycled and reused ≥20% of treated wastewater as per last twelve months record
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 40 cities are in the category of *Three Stars*, *Four Stars* or *Five Stars* category among which 9 cities are currently recycling and reusing more than 20% of their wastewater. 29 of the 40 cities are from western region, having either composite or hot-dry climatic or warm-humid zones and are benefitting from the reuse of recycled water.

✓ The relatively better performing cities are mostly metropolitan cities (except Gandhinagar and Udaipur)

✓ Majority of the coastal cities and all cities in the hilly areas are yet to establish wastewater treatment facilities and increase their capacity to cater to the current and future demand.

✓ 64 *One Star* and 22 *Two Stars* cities are in the early stages of development with less than 5% of their wastewater being recycled and reused.

✓ All the cities in the north-eastern region are in the *One Star* category.

The National Urban Sanitation Policy, 2008 has also set a minimum of 20% reuse of waste water for cities. Further, Smart Cities Mission, AMRUT mission and Namami Gange supports cities with financial and technical resources respectively for enhancing waste water treatment and management.

In this indicator, cities are assessed based on the extent of treated water being recycled wherein cities provided data on the quantum of wastewater recycled and reused for various purposes for the last 12 months.

≡ Actions

BENGALURU

Bengaluru has conducted studies on the wastewater treatment and reuse for establishing a Decentralized Wastewater Treatment and Reuse Unit (DWTRU) using small-scale on-site sewage treatment plants. They have also incorporated the concept of zero liquid discharge and urban wastewater recycling, an attractive solution for addressing the problems of water pollution and scarcity.

Way forward to increase Wastewater Recycle and Reuse

- Cities which are in the initial stage of assessment, with or without the wastewater management system can initiate assessment of existing wastewater scenarios of the city and strategize the immediate measure to be considered for managing the wastewater.
- All the cities, which are located along coastal regions and situated along river stretches; impacting the water bodies and water ecosystem most, need to strengthen their wastewater management system with the help of national programs as mentioned above.
- Cities can explore sustainable measures for recycling the wastewater, such as biogas, biofiltration, combined heat and power (CHP) technology, decentralised wastewater system, and many more.
- Cities can plan to re-evaluate the water demand

- sectors and explore the possible avenues for treated wastewater use within or nearby the city such as irrigation, horticulture, green belts within the transport network.
- Cities can formulate the plans for reuse of wastewater for the different purposes, such as selling it to industries, for landscaping at municipal roads, selling it to nearby housing societies for gardening etc. Accordingly, required infrastructure such as laying of pipes etc., can be budgeted in development projects.
- The efficiency and effectiveness of wastewater treatment plants can be enhanced as per CPHEEO guidelines and also monitor to increase the quantum of recycled/ reusable water.

7.   Guppy, L., Anderson, K., 2017. Global Water Crisis: The facts, s.l.: United Nations University Institute for Water, Environment and Health. https://inweh.unu.edu/wp-content/uploads/2017/11/Global-Water-Crisis-The-Facts.pdf [Accessed 23 March 2021]
8.   UNEP, UN-Habitat, 2005. Coastal Area Pollution, The roles of city.
9.   Never, B., 2016. Wastewater systems and energy saving in urban India. https://www.researchgate.net/publication/305308932_Wastewater_systems_and_energy_saving_in_urban_India [Accessed 23 March 2021]
10. Kumar, P., Matto, M. & Sharda , C., 2017. Policy Paper on Mainstreaming Energy Efficiency in Urban Water and Wastewater Management in the Wake of Climate Change, Centre for Science and Environment, Ministry of Urban Development. https://tinyurl.com/to995kgp
11. Shrivastava, M., Ghosh, A., Bhattacharyya, R. & Singh, S., 2018. Urban Pollution in India. In: Urban Pollution: Science and Management. Available at: https://www.researchgate.net/publication/328216636_Urban_Pollution_in_India

Flood / Water Stagnation Risk Management

Globally, urban flooding[13] events impacting large urban populations have increased in frequency and intensity. Rise in sea levels and changing rainfall patterns due to global warming is a key reason for this. In addition to flooding, many cities also experience water stagnation[14] due to various urban development patterns such as increasing impervious surfaces deterring ground water absorption, inefficient storm water network, growing development activities in flood plains and decreasing green cover that has the potential to slow down stagnation. Further, lack of adequate flood management makes cities vulnerable to floods.

India experienced the highest monsoon rainfall in 2019 when compared to previous 25 years.[15] Every year, around 75 lakhs hectares of land is impacted by floods resulting in loss of more than 1,600 lives and damages to houses and public utilities exceeding over Rs.1,800 crores.[16] Understanding the increased frequency in major floods due to climate variability, the National Disaster Management Authority (NDMA) along with MoHUA has developed Standard Operating Procedures (SOPs) for urban floods. Many states have also improved their State and District Disaster Management Authority (SDMA/DDMA) for taking up prevention, mitigation, preparedness and capacity building for addressing disasters. The Central Water Commission (CWC) along with the Ministry of Water Resources has implemented a flood forecast program to set up a network of forecasting stations covering all important flood prone river areas supporting with early warnings.

82 Cities	21 Cities	10 Cities	7 Cities	6 Cities
		Performance criteria		
Cities have not initiated flood/ water stagnation risk assessment	Cities have conducted a rapid flood/ water stagnation risk assessment identifying vulnerable hotspots	Cities have conducted a flood risk assessment for various return periods and developed flood management plan as per NDMA guidelines	Cities are at various stages of implementing recommendations from the flood management plan including flood management SOP as per MoHUA guidelines and establishing early warning systems and	
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ 6 *Five Stars* cities have implemented more than one key measures for flood management plan, SOPs and have established the urban flood alerts and early warning systems. The relatively better performance is evident in Metropolitan cities. 5 (Ahmedabad, Nagpur, Nashik, Pimpri Chinchwad and Pune) are from western and 1 (Vijayawada) is from the southern region.

✓ Of 6 *Five Stars* cities, 3 cities (Ahmedabad, Pune, Vijayawada) have implemented all 3 measures and 3 cities (Pimpri Chinchwad, Nagpur and Nashik) have implemented at least 2 measures.

✓ Only 10 *Three Stars* cities are able to provide information on detailed flood/water stagnation risk assessment and flood management plan.

✓ Out of 21 *Two Stars* cities, only 7 cities (Bhopal, Bilaspur, Delhi (NDMC), Ghaziabad, Ludhiana, Silvassa, Toothukudi) were able to provide data on flooding hotspots, reasons of floods, level of floods etc.

✓ 82 *One Star* cities are at very early stage and have not conducted flood/water stagnation risk assessment. These cities are currently referring to their District Management Plans and have not yet started preparing city level management plans.

Actions

CUTTACK

Cuttack, located at the confluence of Mahanadi and Kuakhau rivers is highly vulnerable to floods and water stagnation. The city has prepared an integrated city level disaster management plan which consists of vulnerability & exposure analysis at ward-level, resource inventory and capacity analysis, preparedness plan, response plan, reconstruction & rehabilitation measures and mitigation plan. The ULB has also setup a city control unit to monitor the water logging and blocking of drains. The existing drainage infrastructure has been improved by adopting structural measures such as building retaining walls, barrages and diversion channels etc.

However, with growing cities and increasing floods, the need for city level flood management plan in alignment to the district disaster management plan is becoming critical. Conducting assessments, identifying vulnerable hotspots, ensuring SOPs can be followed during a flood and establishing end-to-end Early Warning Systems (EWS) are important for the cities that experience flooding and water stagnation. Aligning to these pertinent measures, the indicator assessed cities based on the initiatives taken to mitigate flood and water stagnation for becoming flood resilient. In the merged levels of *Four Stars* and *Five Stars*, cities were marked based on initiatives implemented towards mitigating flood risk and establishing early warning systems.

Way forward for flood and water stagnation risk management

- 82 *One Star* cities do not have any plans and are likely to be affected in extreme weather events. As an initial step, these cities can initiate the process of interdepartmental consultation for collecting data on flood events and conduct Hazard Risk Vulnerability (HRV) assessments to understand reasons for flooding. WRM team can be mobilized to create a departmental rapid risk assessment report and action plan. Spatial mapping of hotspots along with attributes such as frequency, impact level, and damage/loss, etc may be carried out.

- 21 cities are in the *Two Stars* category where there is evidence of increased awareness of the impacts due on recent extreme events. These cities may ensure that all departments have their departmental level flood management plans. As an initial step, drainage master plan or the storm-water management plan can be aligned with the flood management plan. The flood management plan of the city can include structural and non-structural strategies which may entail the designs

and implementation methodology in accordance with parallel development plans. Cities can refer to the district level disaster management plan and detail out city level actions in alignment with the existing district level disaster or flood management plans.

- Establishing an end-to-end EWS will help cities prepare better for the disaster. Cities can also enforce building bylaws and development codes to address building vulnerabilities to floods. This entails updating DCRs and bylaws regularly as per 2015 national level guidelines.

- The cities which have advanced to the level of *Four Stars* and *Five Stars* may continue to monitor the implementation of actions mentioned within the flood management plan. These cities may consult technical agencies to a strong GIS database for drainage and storm water networks overlaid with historical and projected flood data. They can also coordinate with the local training institutions and community based organizations to establish a volunteer network and trained task force for disaster response.

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13. Urban flood is the submergence of usually dry area by a large amount of water that comes from sudden excessive rainfall, an overflowing river or lake, melting snow or an exceptionally high tide.
14. Water accumulated for more than four hours with a depth of more than six inches.
15. Masih, N., 2019. The Washington Post. https://www.washingtonpost.com/world/2019/10/01/more-than-have-people-have-died-heavy-rains-india-heres-what-flooding-looks-like/ [Accessed 23 March 2021]
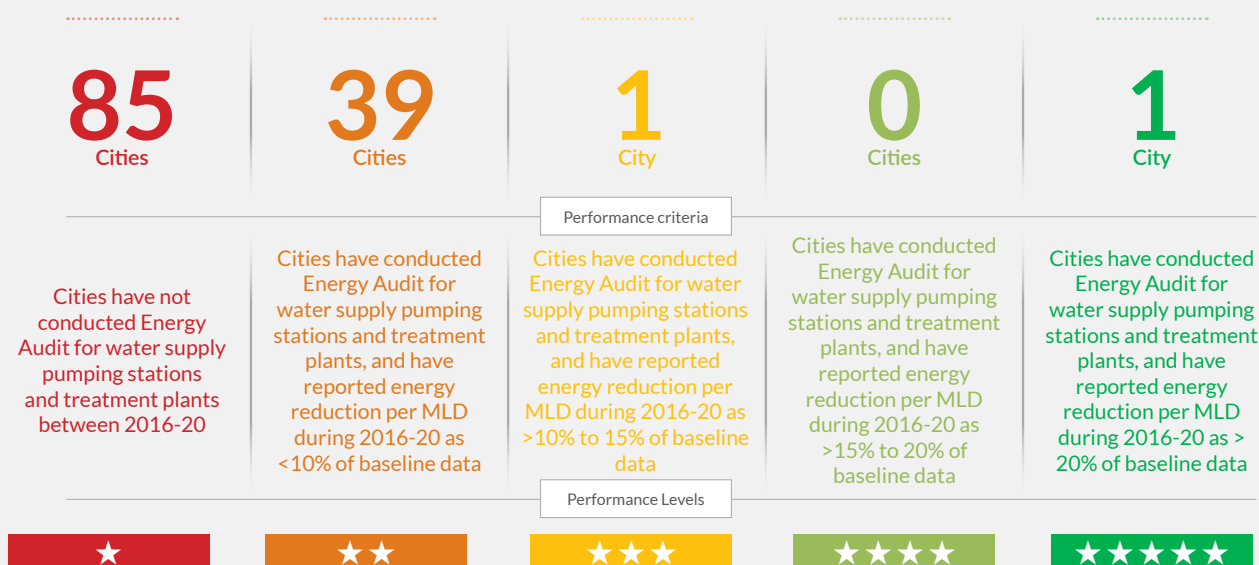16. National Disaster Management Authority, [Online]. Available at: https://ndma.gov.in/. [accessed on 23 March 2021]

Energy-Efficient Water Supply System

Water supply system includes the entire process of water extraction from source, treatment to meet standard quality, storage as required and supply to the end users. This system has a number of electro mechanical equipment that consumes energy, however, water pumps account for the maximum usage. The expanding urbanization increases the demand for electricity consumption that is required for the water supply system. With estimates for municipal water and wastewater utilities demand in developing countries increasing by 40% by 2030,[17] emphasizing the focus on energy efficient water supply system is of significance for reducing energy consumption and indirectly mitigating GHGs emissions.

Cities in India spend around 30-40% of their annual expenditure towards energy charges for pumping, storing, transporting and distributing water.[18] With almost 50% of municipal budget spending[20] and expanding urban areas that demand higher energy for water supply system, cities have the opportunity to cater the rising need in an energy efficient manner. Cities in hilly areas leveraging the slopes can benefit in conserving energy, however, cities that are pumping up water experience increased municipal expenditure and can focus on installing an energy efficient system. BEE has indicated the potential for energy saving across municipal services wherein energy efficient water supply can lead to substantial cost reduction and savings

85 Cities	**39** Cities	**1** City	**0** Cities	**1** City
		Performance criteria		
Cities have not conducted Energy Audit for water supply pumping stations and treatment plants between 2016-20	Cities have conducted Energy Audit for water supply pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as <10% of baseline data	Cities have conducted Energy Audit for water supply pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as >10% to 15% of baseline data	Cities have conducted Energy Audit for water supply pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as >15% to 20% of baseline data	Cities have conducted Energy Audit for water supply pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as > 20% of baseline data
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ Only 2 cities, Ahmedabad (*Five Stars*) and Indore (*Three Stars*) have managed to showcase regular audits being conducted and energy efficiency improvements achieved over the years. Both of these are metropolitan cities.

✓ 39 *Two Stars* cities have conducted an energy audit in the last 5 years but have not monitored the same regularly. Majority of the cities that managed to conduct these studies are from the states of Gujarat, Karnataka, Maharashtra, Tamil Nadu and Uttar Pradesh.

✓ 85 *One Star* cities have not provided evidences/ requisite supporting documents for this indicator. All the cities from north-eastern region, and majority of the participating small towns are in the *One Star* category. None of the coastal and hilly cities are performing well in this indicator.

for the ULBs. Further, the Investment Grade Energy Audit (IGEA) conducted around 2007 for municipal services in 134 cities estimated the potential to save 120 MW through energy efficiency projects.[19]

In India, the Section 18 of Energy Conservation (EC) Act requires all states to regulate energy consumption and drive energy efficiency for water and waste water management.[20] The AMRUT mission is also encouraging cities to conduct an energy audit that can support in identifying inefficient equipment such as pumps and replacing the same. This particular indicator in the assessment focuses on bringing energy efficiency in the water supply system with a two-fold benefit of reducing municipal expenditure and reducing

energy demand. Cities are assessed based on the energy audit conducted and extent of measures taken to reduce energy consumption.

Way forward to improve energy efficiency in water supply system

- The first step for the 85 cities which are in the *One Star* level is to conduct an energy audit. Central schemes such as BEE facilitated energy audits and situational surveys to identify suitable projects to save electrical energy under as per MuDSM guidelines can be leveraged.
- 39 Cities which are in *Two Stars* level can make plans for improving their efficiency by replacing their old pumps. These cities can also ensure that all new and upcoming water supply systems may adhere to energy efficiency systems and standards. Cities can also plan to install solar pumps and motors, BE rating pumps and motors, auto operation and control systems to reduce the energy consumption and O&M cost.

- Maintain the monthly energy consumption records of the water supply pumping stations, electro mechanical equipment such as pumps, motors, aerators and other equipment in the entire water supply system, and prepare plans for making them more energy efficient. These cities can also plan to introduce design innovation for the energy efficiency of water supply system such as network analysis, supply flow moderation and terrain 3D modelling to use the gravitational force can be explored.

17. Kumar, P., Matto, M. & Sharda , C., 2017. Policy Paper on Mainstreaming Energy Efficiency in Urban Water and Wastewater Management in the Wake of Climate Change, Centre for Science and Environment, Ministry of Urban Development. https://tinyurl.com/to995kgp

18. Kumar, P., 2013. Energy and Water Efficiency in Municipal Water Supply System. Guwahati: CSE India. http://cdn.cseindia.org/userfiles/pradeep_kumar_director.pdf

19. BEE India, n.d. Municipal Demand Side Management Programme. [Online] Available at: https://beeindia.gov.in/content/municipal-dsm. [Accessed 20 03 2021]

20. AEEE, 2019. State Energy Efficiency Index, Ministry of Power, GoI. https://beeindia.gov.in/sites/default/files/State-Efficiency-Index-2019.pdf [Accessed 23 March 2021]

Energy-Efficient Wastewater Management System

Cities in India spend 50% of their municipal budget for the energy charges of water supply and waste water management[21]. With increasing urbanization, the amount waste water is bound to increase and energy consumed to treat and manage the same will also increase. Further, around 10% of the waste water generated in India is estimated to be treated using old pumping and electro-mechanical equipment that consume high amounts of energy[22]. Focusing on energy efficiency waste water management is key for reducing energy demand and hence reduced municipal expenditure. Reduced energy demand also provides a co-benefit of mitigating GHGs emissions.

BEE has indicated the potential for energy saving across municipal services wherein energy efficient can lead to substantial cost reduction and savings for the ULBs. The Investment Grade Energy Audit (IGEA) conducted around 2007 for municipal services in 134 cities estimated the potential to save 120 MW through energy efficiency projects[23]. The Section 18 of Energy Conservation (EC) Act requires all states to regulate energy consumption and drive energy efficiency for water and waste water management[24]. The AMRUT mission is also encouraging cities to conduct an energy audit that can support in identifying inefficient equipment such as pumps and replacing the same. This

110 Cities	14 Cities	0 Cities	2 Cities	0 Cities
		Performance criteria		
Cities have not conducted Energy Audit for wastewater pumping stations and treatment plants between 2016-20	Cities have conducted Energy Audit for wastewater pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as <10% of baseline data	Cities have conducted Energy Audit for wastewater pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as >10% to 15% of baseline data	Cities have conducted Energy Audit for wastewater pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as >15% to 20% of baseline data	Cities have conducted Energy Audit for wastewater pumping stations and treatment plants, and have reported energy reduction per MLD during 2016-20 as > 20% of baseline data
		Performance Levels		
★	★★	★★★	★★★★	★★★★★

Performance of 126 cities

✓ Only 2 metropolitan cities namely Surat and Indore have performed well with respect to bringing energy efficiency in their waste water management. They are able to demonstrate lower energy consumption in the last year based on the audit conducted.

✓ In total, 16 cities (14 *Two Stars*, 2 *Four Stars*) are able to assess the energy efficiency of their existing electromechanical equipment used in wastewater management system and are gradually shifting towards energy efficient water supply system which will help to mitigate GHG emissions. Majority of these cities are from Gujarat, Karnataka, Punjab, and Uttar Pradesh.

✓ 110 *One Star* cities have not provided evidences/ requisite supporting documents for this indicator. All the cities from eastern and north-eastern regions, and majority of the participating small towns are in the *One Star* category. All coastal cities (except Surat) and hilly cities are also not performing well in this indicator.

INDORE

Indore has replaced the traditional electro-mechanical equipment of the existing wastewater management system with a solar energy system that has helped in 22% reduction in the energy consumption. The use of clean energy has resulted in the municipal expenditure savings on electricity bills.

particular indicator in the assessment focuses onbringing energy efficiency in the wastewater management system where cities are assessed based on the energy audit conducted and extent of measures taken to reduce energy consumption in wastewater management.

Way forward to improve energy efficiency in waste water management

- Cities can conduct energy audits annually to understand energy usage trend in the waste water management system wherein potential areas to reduce energy cost and consumption can be identified. 110 cities that are in the very early stages of bringing energy efficiency can follow MuDSM guidelines and leverage central schemes such as BEE facilitated energy audits and situational surveys to identify suitable projects to save electrical energy.

- 14 Cities which are in *Two Stars* level and have conducted energy audits can focus on bringing in efficiency based on the identified priorities in the audit. They can consider installing solar pumps and motors, BE rating pumps and motors, auto operation and control systems to reduce the energy consumption and O&M cost.

Mr. Sanjay Seth
Senior Director – Sustainable Habitat Programme
The Energy and Resources Institute (TERI)

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With increasing frequency of erratic and extreme weather events, it is necessary to improve urban resilience through use of innovative & data-driven solutions and systems that are dynamic & adaptive. The climate-sensitive approach of CSCAF provides cities with a roadmap to integrate such considerations and solutions in their resilience building processes across priority sectors.

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21. Kumar, P., 2013. Energy and Water Efficiency in Municipal Water Supply System. Guwahati: CSE India. http://cdn.cseindia.org/userfiles/pradeep_kumar_director.pdf
22. Kumar, P., Matto, M. & Sharda , C., 2017. Policy Paper on Mainstreaming Energy Efficiency in Urban Water and Wastewater Management in the Wake of Climate Change, s.l.: Centre for Science and Environment, Ministry of Urban Development., https://cdn.cseindia.org/attachments/0.73120800_1505297784_Policy-Paper-Mainstreaming-Energy-Efficiency-in-Urban-Water.pdf
23. BEE India, n.d. Municipal Demand Side Management Programme. [Online] Available at: https://beeindia.gov.in/content/municipal-dsm [Accessed 20 03 2021]
24. AEEE, 2019. State Energy Efficiency Index, Ministry of Power, GoI. https://beeindia.gov.in/sites/default/files/State-Efficiency-Index-2019.pdf [Accessed 23 March 2021]

Actions in the cities

Namchi

Integrated water supply management, augmentation of existing distribution network & strategy for water conservation & reuse

Namchi has implemented a strategy for water conservation & reuse using co-polymer based rain water harvesting technology. The city aids towards the greater objective of water management and conservation and to increase recharge of groundwater by capturing and storing rainwater. Rainwater harvesting from rooftop run-offs and natural waterbodies augment the community development.

Bhubaneshwar

Assessment and implementation for NRW reduction

The city has planned to expand the network to achieve universal coverage by providing every household with water supply service connection. One of the key municipal reforms under AMRUT programme, is to reduce NRW from current levels to 20% providing the following benefits: Ensuring equitable water supply and reduce demand/supply gap; Improvement in network efficiency by reducing water losses; Improvement in water supply coverage, reliability and quality of service; Improving cost recovery from water supply operations.

Surat

Reuse & Recycle of Treated Wastewater Action Plan 2019

The city of Surat has prepared an action plan which promotes the reuse of treated sewage for different purposes of gardening, industrial reuse, tanker filling, lake restoration, flushing and construction with a vision to maximize the collection & treatment of generated sewage and reuse of treated wastewater on a sustainable basis, thereby reducing dependency on freshwater resources. Also, the reuse of treated wastewater can become a source for revenue generation.

67 cities have initiated water resource assessment

44 cities have initiated flood/ water stagnation risk assessment

41 cities conduct regular (annual) energy audits of their water supply system

Pune
Standard Operation Procedure for Flood Control (SOP)
The city of Pune has prepared a SOP for taking timely action, systematic co-ordination among department and public, streamlining communication and decision making. The core objectives include identifying hazard potential on downstream of the dam, warning about probable floods in advance, taking preventive actions in advance, monitor flood situation, protection of human lives & infrastructure, restore damaged infrastructure due to floods.

Durgapur
Investment grade energy audit report
The city of has conducted an energy audit of the water supply system to carry out a performance evaluation of pump sets. Based on the energy audit, the pump and pump set efficiencies for all the pumping stations have been estimated. Along with estimation of efficiency of pump sets, performance indicators such as specific energy consumption were also evaluated for the city. The energy saving has been calculated on the basis of energy audit activity conducted, where the estimated energy saving has a potential of 32%.

Saharanpur
Investment grade energy audit
The city has conducted an energy audit of the waste water management system to carry out a performance evaluation of pump sets. Based on the the energy audit, the overall pump efficiencies for each running pumps of borewells, sewage treatment plant and sewage pumping station have been estimated. Along with estimation of efficiency of pump sets specific energy consumption was also evaluated for pump. The energy saving calculated on the basis of energy audit estimates an energy saving potential of 48%.

16cities
conduct regular (annual) energy audits of their wastewater supply system

62cities
have instituted mechanisms for promoting recycle and reuse of waste-water

7

Waste Management

Waste Management

Significant increase in Municipal Solid Waste (MSW) generation has been recorded world wide due to rapid population growth accompanied with industrialization, urbanization, and economic growth. Globally, the average waste generated per capita per day is around 0.74 kilogram but ranges widely, from 0.11 to 4.54 kgs per capita per day[1]. Global municipal solid waste is expected to grow to 3.40 billion tonnes by 2050 from the current 2.01 billion tonnes annually, with doubled population growth over the same period.[1] The statistical data of waste production around the world is concerning. Waste accumulation and improper disposal severely affects the environment causing air, water and soil pollution which affects public health and causes ecological damage.

In India, waste management is one of the major environmental concerns, especially in metropolitan cities due to high amount of waste generation in comparision to the capacity of landfill availability. According to the "Swachhata Sandesh Newsletter" by the MoHUA, as of January 2020, 147,613 metric tonnes (MT) of solid waste is being generated per day, from 84,475 urban wards. The amount of waste generation in these wards ranges from 32 MT to 22,080 MT per day. The smaller towns and cities face challenges in managing the waste effectively and are usually disposed in low-lying areas without taking necessary precautions or operational controls. Hence, adopting government policies at national, state, and local level is required especially in the context of rapid urbanization of peri-urban areas. That said, India has shown progressive waste management approaches in recent years with the introduction Swachh Bharat Mission (SBM) and Swachh Survekshan (SS) in 2014 and 2016 respectively.

The waste management theme of CSCAF 2.0 is aligned with the SS 2020 and the same has been referred for this assessment. The 6 indicators in this theme include waste minimization initiatives, extent of dry waste recovered, extend to wet waste processed, construction and demolition (C&D) waste management, scientific land availability and landfill/dumpsite scientific remediation. These 6 indicators are mapped with 11 relevant service level indicators of SS 2020. The total SS score of these 11 indicators across one quarter was 620 and the same has been normalized to 600 in CSCAF 2.0.

"

With launch of the ClimateSmart Cities Assessment Framework, an attempt is made to look into waste management practices in cities with a climate lens and adopt an outcome-oriented approach for implementation and monitoring.

"

Mr. Vibhor Sood
Technical Expert
Climate Smart Cities Project, GIZ and
SWM Expert PMU Member, CSCAF 2.0

Ms. Paramita Datta Dey
Team Lead (SCIAP)
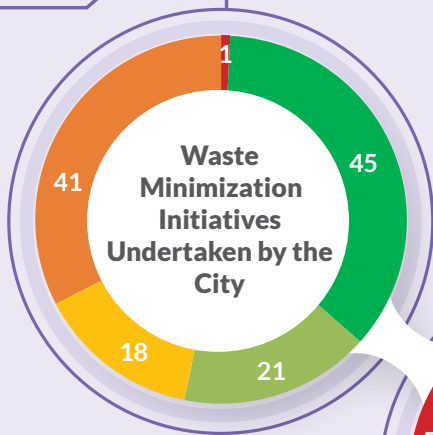National Institute of Urban Affairs

"

The scientific management of solid waste can substantially reduce the GHGs arising out of the waste sector. This will require more aggressive management of waste at source (source segregation) at the upstream, more recycling and reuse, at midstream and safer disposal, at the downstream. A great impetus to this has been the Swachh Bharat Mission and the competitive process of the Swachh Survekshan. The CSCAF framework will further strengthen and motivate more cities leapfrog to achieve its cleanliness targets, thereby making them more climate resilient.
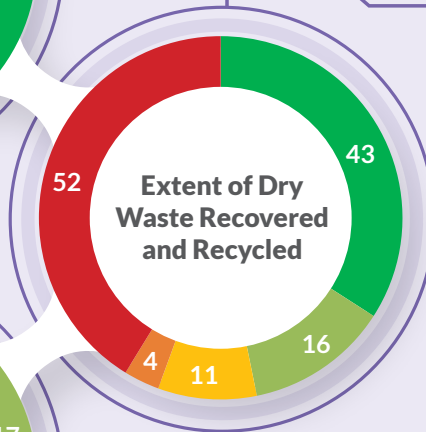
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1.   The World Bank. Trends in Solid Waste Management. [Online]Available at: https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html#:~:text=The%20world%20generates%202.01%20billion,from%200.11%20to%204.54%20kilograms. [Accessed April 2021]
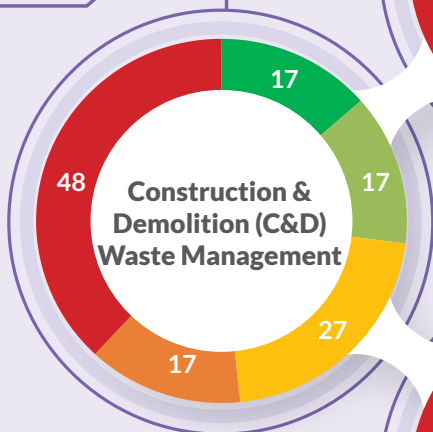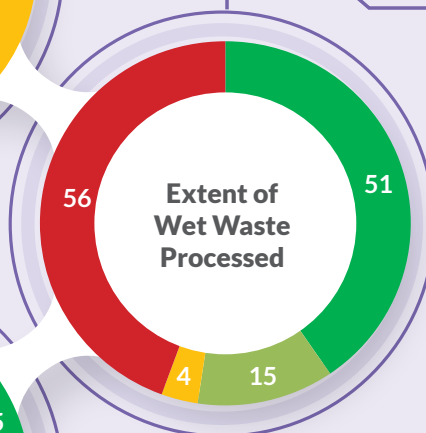
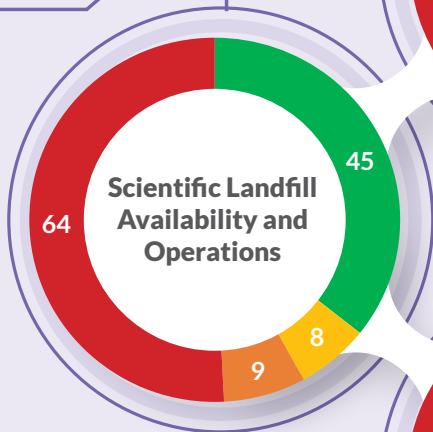# Thematic indicators and assessment outcome

INDICATOR 1

Waste Minimization Initiatives Undertaken by the City

- 45
- 21
- 18
- 41
- 1

INDICATOR 2

Extent of Dry Waste Recovered and Recycled

- 43
- 16
- 11
- 4
- 52

INDICATOR 3

Construction & Demolition (C&D) Waste Management

- 17
- 17
- 27
- 17
- 48

INDICATOR 4

Extent of Wet Waste Processed

- 51
- 15
- 4
- 56

INDICATOR 5

Scientific Landfill Availability and Operations

- 45
- 8
- 9
- 64

INDICATOR 6

Landfill/ Dumpsite Scientific Remediation

- 26
- 8
- 11
- 17
- 64

Legend:
- 5 Stars
- 4 Stars
- 3 Stars
- 2 Stars
- 1 Star

Performance Levels

- 🟩 Five Stars
- 🟩 Four Stars
- 🟨 Three Stars
- 🟧 Two Stars
- 🟥 One Star

City Population

- ◯ <0.5 million
- ◯ 0.5-1 million
- ◯ >1 million

Performance of 126 Cities

In this thematic area, 31 cities have progressed to the level of *Five Stars* cities. 21 out of the 31 *Five Stars* cities are metropolitan cities from Andhra Pradesh, Chattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, and Uttar Pradesh. These cities have managed to showcase evidences of practice and performance in the areas of plastic waste management, 3R principles, treatment of domestic hazardous waste, on-site processing of wet-waste by bulk waste generators, household/community level wet waste processing, landfill availability and scientific remediation.

Half of the 53 *One Star* cities are medium size cities from the eastern, north-eastern and southern region (except Jamshedpur). All hilly cities (with an exception of Shimla) are at early stages of improving their waste management. Waste management requires adequate road infrastructure and the terrain in hilly areas may posecomplex challenges in transportation and management of waste. Even the small-town cities lack most aspects of waste management. This can be due to lower generation of waste owing to relatively low population or lack of resources to contextualize solutions and implement them.

9 out of the 15 participating coastal cities are not performing well. These cities face a risk of improper waste dumping in the sea, estuaries and creeks leading to negative impacts on coastal ecology.

31 5 Stars

22 4 Stars

15 3 Stars

5 2 Stars

53 1 Star

★ ★ ★ ★ ★

● **Agra**	● **Gwalior**	◈ Naya Raipur	● Solapur
● **Ahmedabad**	● **Indore**	● **Pimpri Chinchwad**	● Tirupati
● Aligarh	● **Jabalpur**	● **Prayagraj**	● **Ujjain**
◆ Amravati	◆ Kolhapur	● **Pune**	● **Vadodara**
● **Bhopal**	● **Lucknow**	● **Raipur**	◆ **Vijayawada**
● Delhi	◆ Mysore	● **Rajkot**	● **Visakhapatnam**
● Gandhinagar	● **Nagpur**	● Saharanpur	
◆ Gorakhpur	● **Nashik**	● Shimla	

★ ★ ★ ★

● **Bengaluru**	● Jhansi	◆ Nanded	● Tiruchirapalli
◆ Bhavnagar	◆ **Jodhpur**	● **Sagar**	● Tumakuru
● Chandigarh	● Kakinada	● **Satna**	● Udaipur
◈ Dahod	● **Kalyan Dombivali**	● Silvassa	● **Varanasi**
◆ **Ghaziabad**	● **Kanpur**	● **Srinagar**	
○ Jamshedpur	● Karimnagar	● **Thane**	

★ ★ ★

● Ajmer	◆ Gurugram	◆ Loni	● Port Blair
● **Chennai**	● Hubli Dharwad	● **Ludhiana**	◆ Sangli Miraj & Kupwad
● **Coimbatore**	● **Jaipur**	● Mangalore	● Warangal
● Dehradun	● Karnal	◆ Mira Bhayandar	

★ ★

● Barielly	◆ Guntur	● **Ranchi**
● Bhubaneshwar	● Moradabad	

★

|			
● Agartala	● Erode	● **Kota**	● Salem
● Aizawl	● **Faridabad**	◆ Leh	● Shillong
● Amravathi	● Gangtok	● **Madurai**	● Shivamogga
● **Amritsar**	● Gulbarga	○ Mandi	◆ Siliguri
● **Aurangabad**	● Guwahati	◆ **Meerut**	○ Solan
● Belagavi	○ Hamirpur	● Muzaffarpur	● Thanjavur
● Bhagalpur	● Imphal	◈ Namchi	● Tirunelveli
● Bihar Sharif	● Itanagar	● New Town Kolkata	● Tiruppur
● Bilaspur	● Jalandhar	○ Palampur	● Tiruvanantapuram
◆ Cuttack	● Jammu	● Panaji	● Toothukudi
● Davangere	◆ Kargil	◈ Pasighat	● Vellore
◈ Dharamshala	● Kavaratti	● **Patna**	
◈ Diu	● Kochi	● Puducherry	
◆ Durgapur	● Kohima	● Rourkela	

● Smart and AMRUT cities   ◈ Smart cities   ◆ AMRUT cities   ○ Other cities   ***Million + population cities**

Waste Minimization Initiatives Undertaken by the City

This indicator is mapped with the marks of 5 service level indicators of Swachh Survekshan 2019. They are plastic waste management (1.8), 3R principles of dry and wet waste (1.9), domestic hazardous waste collected and processed (2.5), management of bulk waste generators (2.9) and wet waste processing at household or community level (2.11). The performance levels are categorized based on resulting CSCAF 2.0 score.

1 City	**41** Cities	**18** Cities	**21** Cities	**45** Cities

Performance Levels

★	★★	★★★	★★★★	★★★★★
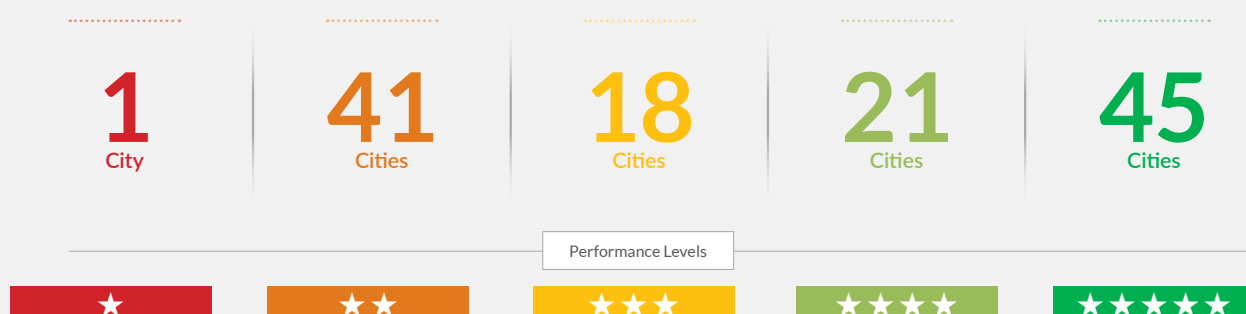
Performance of 126 cities

✓ Among the 126 cities, only Amravati (A.P) is in *One Star* category, since it is a new and developing city and is yet to inititate necessary steps for efficient waste management.

✓ Cities from the northern and western region are performing better than the cities from north-eastern and southern region. Half of the *Five Stars* cities are from the northern and western regions. Half of the cities in the *Two Stars* category are from the north-eastern and southern regions.

✓ 45 cities managed to showcase their efforts in minimizing waste generation through various methods. 29 out of these 45 cities are from the northern and western regions. Innovative ways for reduction of waste generation at a household/ community level, hazardous waste treatment and other technological interventions to strengthen existing waste management practices have been explored by these 29 cities. Among the 45 cities, 24 are metropolitan cities where infrastructure and technology available for waste management are good.

✓ 41 *Two Stars* cities have initiated comprehensive actions adopting waste reduction practices and are in process to develop further. Among the *Two Stars* cities, 21 are medium sized cities where their waste management practices and especially the 3R principles, plastic waste, and domestic hazardous waste management can be improved.

✓ 98 out of 126 cities have already banned single use plastic including plastic with <50 micron during all festivals/social gatherings/events.

✓ With respect to 3R Principles, measures are being taken by cities to reduce generation of Dry/Wet Waste. These include, 5 initiatives undertaken across 40 cities, 4 initiatives in 1 city, 3 initiatives across 19 cities, 2 initiatives across 11 cities, 1 initiative across 13 cities. Currently, no initiatives are being taken across 42 cities.

✓ 44 cities have more than 95% of their collected domestic hazardous waste are being treated either by decentralized or centralized processing techniques. Also, only 35% of participating cities are scientifically collecting and processing their hazardous waste.

✓ 25% of participating cities are successfully managing their waste at household level, thereby supporting the waste management ecosystem. In 31 cities, more than 5% of their households process wet waste at home or community level.

✓ All the participating cities (except Shimla) from hilly regions are under *Two Stars* category. Shimla has performed well and is among *Five Stars* category and can act as an exemplar for other hilly cities .

Actions

JABALPUR

The city was awarded the title of "Best Big City in Innovation and Best Practices" in the SwachhSurvekshan 2019. With 100% segregation at source, most of the city's waste is transported to waste to energy plant at Kathonda, where the Municipal Corporation and Essel Infra projects Ltd. has set up 600 TPD processing plant.

Around the world, with the growing population, waste generation is rising rapidly. With rapid population growth and urbanization, annual waste generation is expected to increase by 70% from 2016 levels to 3.40 billion tonnes in 2050.[3] India is among the highest generators of waste globally, as per The World Bank report. Delhi, Greater Mumbai and Chennai top the list of Indian cities with maximum waste generation. Goa and Delhi produce as much as 60 grams and 37 grams per capita per day respectively, whereas the national average as per SBM is 11 grams per capita per day[4]. The current practice of waste management in India involves collecting waste from sources through a collective community bin system followed by intermediate processing before transported to a landfill. The major challenges experienced by Indian cities include open dumping leading to various problems such as contamination[5], lack of scientific treatment, inadequate waste collection and increased generation of plastic waste.[6]

During the recent past, the management of solid waste has received considerable attention from the Central, State and local governments in India. Swachh Bharat Mission (SBM), an initiative by the Government of India, was launched in 2014 with the vision of enhancing sanitation and hygiene in cities. In 2016, the MoHUA has also introduced a new scheme known as Swachh Survekshan to assess the progress made. Important guidelines published by MOHUA through Central Public Health and Environmental Engineering Organisation (CPHEEO) in the year 2016 provide implementation guidelines for all the aspects of Municipal Solid Waste Management (MSWM) especially for segregation, collection, transportation, treatment and disposal.

Many cities are innovating around waste minimization initiatives through public-private, community-public and private-private partnerships. This indicator focuses on capturing the impacts of interventions made to manage waste generation. Aligning to the Swachh Survekshan, this indicator focuses on capturing the measures adopted by cities in implementing Plastic Waste Management Rules 2016 and initiatives undertaken to reduce dry/wet waste, treatment of domestic hazard waste, onsite waste processing by non-bulk waste generators, measures taken by bulk waste generators to treat dry and process wet wastes and processing of wet waste at household/community level.

3. TNN, 2020. In 30 years, India tipped to double the amount of waste it generates. [Online]
    Available at: https://timesofindia.indiatimes.com/india/in-30-years-india-tipped-to-double-the-amount-of-waste-it-generates/article-show/74454382.cms [Accessed March 2021].
4. Nair, S., 2020. Plastic waste is India's and the world's most formidable environmental challenge today, and the COVID-19 pandemic has made matters worse: CSE. [Online]
    Available at: https://www.cseindia.org/plastic-waste-is-india-s-and-the-world-s-most-formidable-environmental-challenge-10375#:~:-text=A%20Central%20Pollution%20Control%20Board%20%28CPCB%29%20report%20%282018-19%29,frightening%20as%20it%20is%2C%20might%20be%20an%20under
    [Accessed March 2021].
5. Reddy, K. V. R. & Ram, A. S., 2019. Waste Management Initiatives And Activities In India For Society's Welfare. International Journal of Scientific & Technology Research, DECEMBER, 8(12), pp. 2995-2998.
6. BBanerjee, A., 2019. India Is Generating Much More Plastic Waste Than It Reports. Here's Why. [Online]
    Available at: https://www.indiaspend.com/india-is-generating-much-more-plastic-waste-than-it-reports-heres-why/ [Accessed March 2021].

	Mapped Swachh Survekshan 2019 Service Level Indicators Swachh Survekshan	Swachh Survekshan Total marks of Mapped indicators	CSCAF 2.0 Score
5 Service Level Indicators			
1.8	Plastic Waste Management Rules: Whether the City has banned single use plastic including plastic with <50 micron during all festivals/social gatherings/events?	30	27.5
1.9	3R Principles: Whether measures taken to reduce generation of Dry/Wet Waste? If yes, share details	50	45
2.5	Percentage of total domestic hazardous waste collected is treated, either by decentralized or centralized processing	30	27.5
2.9	Percentage of Bulk Waste Generators (BWG), including those generating more than 100 Kgs (or less as notified by the State/city) of waste per day, practicing on site processing of their wet waste or outsourced to private agency -processing not outsourced to ULB. However, cities with <1 Lakh population can outsource to ULB on a commercial rate.	50	45
2.11	Percentage of households processing their wet waste at Home/ Community Level (Households under RWAs will qualify under the BWG definition)	50	45
	Total	210	190

Way forward to transition towards Waste Minimization Initiatives Undertaken by the City

- Cities can implement Plastic Waste Management Rules 2016 and enforce the Single Use Plastic Ban.
- Cities can encourage their citizens to reduce waste by practicing source segregation, recycling and reuse of dry waste at household level through citizen awareness programs and campaigns.
- Cities can promote segregation of Domestic Hazardous waste in accordance with Solid Waste Management Rules 2016. Recently, National Green Tribunal has also issued an order (order NGT OA 72/2020) regarding the same.
- Cities can monitor all the Bulk Waste Generators (BWGs) within their purview on a monthly basis and ensure the segregated wet waste including kitchen/garden waste are being processed onsite or collected and processed by private parties authorized by ULB.

Ms. Shabnam Siddiqui
Executive Director
United Nations Global
Compact Network India

"The private sector must be a primary catalyst in building a progressive business case for climate action, scaling-up private investment in climate-smart urban infrastructure and supporting innovative ecopreneurs in this decade of action. Collective action and ethical leadership will help strengthen mitigation and resilience strategies in the long run and provide a fillip to the commercial opportunities that sustainability presents."

WASTE TO ENERGY
BIOMETHANATION PLANT
ELECTRICITY GENERATION FROM ORGANIC W

Treatment capacity: 2 Tons Per Day

Commissioned

Supported By: Swiss Agency for Development and Cooperation (SDC)
In Partnership with
Udaipur Municipal Corporation
Under CapaCITIES Project

BIO - GA
HOLDE

Credits:

Udaipur:
Waste to energy biomethanation plant that is capable of scientifically
disposing 730 tonnes of wet waste annually

by Udaipur Municipal Corporation

Extent of Dry Waste Recovered & Recycled

In many developed and developing countries the collection, segregation and disposal of solid waste is a widespread problem.[7] Segregation, recycling and reusing of waste can be a viable and cost-effective solution to reduce waste. Recycling mostly involves recovering and reprocessing usable materials (predominantly dry waste) that generally might end up as waste such as plastic, paper, etc.[8] Presently, around 7 million tons of paper is being consumed in India for packaging, of which only 33% are being recycled.[9] Dry waste also contains several non-recyclable components, such as plastic bags, laminated metallized plastics or mylar, shredded paper and textiles. This makes dry waste

recovery and recycling challenging. Furthermore, many Indian cities practice open dumping at sites which were originally allocated for developing sanitary landfills, leading to no further segregation to recover the usable waste.[8] In the last two decades, there has been a sharp increase in the use of plastics by citizens leading to increased plastic waste generation.

Aligning to the Swachh Survekshan, section 2.3 and 2.4; the focus of this indicator is on assessing the capacity of dry waste processing facilities and the quantity of dry waste processed MRF, RDF or Waste to Energy plants.

This indicator is mapped with the marks of 2 service level indicators of Swachh Survekshan 2019. They are dry waste collected and processed (2.1) and treatment/ recycle/ reuse of plastic waste collected (2.2). The performance levels are categorized based on resulting CSCAF 2.0 score.

52 Cities	4 Cities	11 Cities	16 Cities	43 Cities

Performance Levels

★	★★	★★★	★★★★	★★★★★
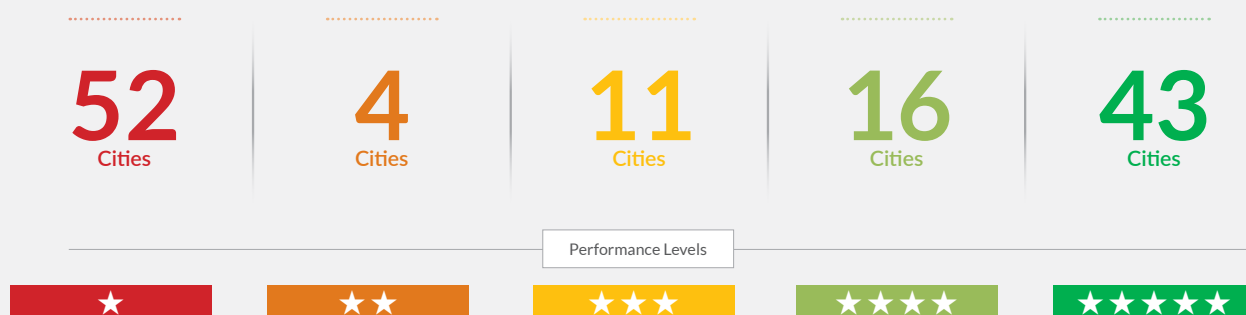
Performance of 126 cities

✓ 23 metropolitan cities, 10 large cities and 10 medium sized cities are performing well in this indicator. This includes measures such as secondary and tertiary sorting, and processing facilities in their cities.

✓ 24 out of 43 *Five Stars* cities are able to process 100% of their collected dry waste. Majority of these cities are from the western, central and northern regions.
   » Cities from Gujarat, Madhya Pradesh, Maharashtra, Chhattisgarh and Uttar Pradesh have performed relatively better.
   » Shimla is the only hill city that has considered implementing waste management practices for recycle and reuse of dry waste.
   » Among the coastal cities, Kakinada, Surat, and Visakhapatnam have been successful in managing their dry waste with initiatives like Refuse Derived Fuel (RDF) facility and decentralized dry-waste recycling centers.

✓ 16 cities in the *Four Stars* category are mostly metropolitan cities from the northern, southern and western regions. This includes 2 coastal cities, Chennai and Port Blair.

✓ 40 out of the 126 cities have more than 95% of their generated dry waste (excluding plastic and domestic hazardous waste) collected and processed (re-used or recycled), either by decentralized or centralized facilities. These cities are majorly from the states of Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra, and Uttar Pradesh.

✓ 32 out of the 52 cities in *One Star* category are mostly from the southern (16), northern (14), eastern and north-eastern regions (9). These cities are mostly small and medium towns indicating inadequate infrastructure and institutional resources at local level to take actions.

This indicator assesses the efficiency of city's waste management systems based on the extent of recyclables recovered from the city's total dry waste and further processed by the authorized recycling units.

▤Actions

VARANASI

Scrapshala, Ravindrapuri – is a unique initiative that works toward creating decorative products from waste materials and discarded items. Non-degradable, dry trash/scrap is used to customized products and is being encouraged by the city.

	Mapped Swachh Survekshan 2019 Service Level Indicators		Swachh Survek-shan Total marks of Mapped indicators	CSCAF 2.0 Score
2 Service Level Indicators	2.1	Percentage of generated dry waste (excluding plastic and domestic hazardous waste) collected that is actually processed/Re-used/recycled, either by decentralized or centralized facilities	60	60
	2.2	Percentage of total plastic waste collected is treated/Re-used/recycled, either by decentralized or centralized processing	40	40
		Total of Indicator 2	100	100

Way forward to transition towards reducing the extent of dry waste recovered and recycled

- Cities can focus on promoting source segregation of dry waste through various awareness programs and rigorous campaigning to achieve 100% recycling and reuse of waste.
- Cities should maintain proper baseline data for assessing the quantity of waste recycled per year.
- Cities can announce incentives to encourage reuse and recycling of waste.
- Cities should maintain the monthly record of the quantity of recyclables, SCF/RDF generated in the waste stream for estimating the capacity of the treatment facility (Material Recovery Facility or Refused Derived Fuel).
- Cities can refer to the following advisory and guideline pertaining to Plastic waste management,
  » Advisory on Material Recovery Facility
  » Guidelines on Usage of Refuse Derived Fuel in Various Industries

7. Bhatia, A., 2017. 5 Cool Waste Management Ideas From The World That India Can Adopt. [Online] Available at: https://swachhindia.ndtv.com/5-cool-waste-management-ideas-world-india-can-adopt-6190/ [Accessed March 2021].
8. Patel, U., 2018. Solid Waste Management in India An Assessment of Resource Recovery and Environmental Impact. [Online] Available at: https://icrier.org/pdf/Working_Paper_356.pdf [Accessed March 2021].
9. Singh, S., 2020. Solid Waste Management in Urban India: Imperatives for Improvement. [Online] Available at: https://www.orfonline.org/research/solid-waste-management-in-urban-india-imperatives-for-improvement-77129/ [Accessed March 2021].

Construction & Demolition (C&D) Waste Management

Construction waste at global level accounts to 2-3 billion tonnes per year of which 30-40% is concrete.[10] Construction and Demolition (C&D) waste management is highly important especially for the developing countries, where much of their infrastructure requirements are mostly under development or expected to be implemented in the next two to three decades.

Water bodies, green areas and public spaces in Indian cities are severely getting affected by unsafe disposal of concrete, bricks, and metal waste from construction.[11] Toxic dust particles from the debris further impact the air

quality, eventually increasing the pollutants level above the National Ambient Air Quality Standards (NAAQS). As India's construction sector is projected to grow at a rate of 7-8% over the next 10 years, it is likely to become the world's third largest country in the construction sector by mid next decade.[12]

According to the Building Material Promotion Council, India generates an estimated 150 million tonnes of C&D waste every year, although the official recycling capacity is a meagre 6,500 tonnes per day which accounts to a little over 1% of the total generation of C&D waste[11]. In the year

This indicator is mapped with the marks of 1 service level indicator of Swachh Survekshan 2019 - Mechanism in place for Construction and Demolition (C&D) waste as per C&D Waste Management Rule, 2016 (3.1). The performance levels are categorized based on resulting CSCAF 2.0 score.

48 Cities	17 Cities	27 Cities	17 Cities	17 Cities

Performance Levels

★	★★	★★★	★★★★	★★★★★
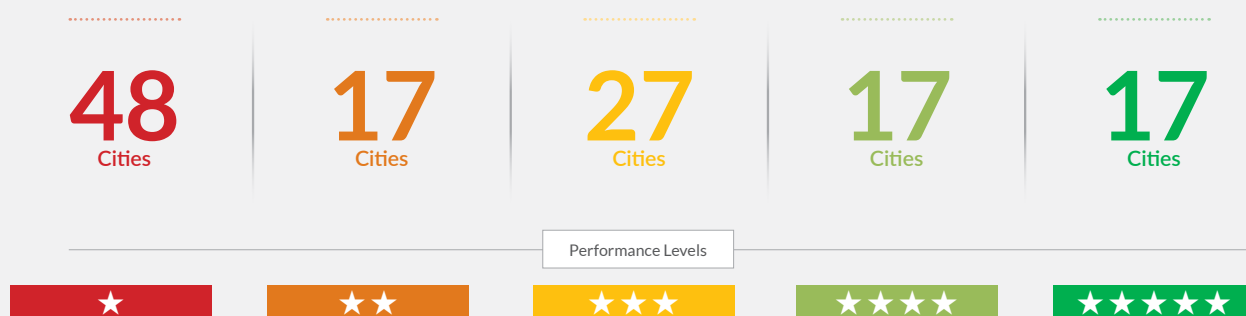
Performance of 126 cities

✓ 17 cities in the *Five Stars* category are from Gujarat (4), Maharashtra (4), Uttar Pradesh (4), Andhra Pradesh (3), Madhya Pradesh (1) and Tamil Nadu (1). These cities have succeeded in implementing C&D Waste rules. 11 out of these 17 cities are metropolitan cities.

✓ 20 out of the 27 cities in the *Three Stars* category are metropolitan and large cities. As per C&D Waste Management Rules 2016 it is mandated for large cities to set up recycling plants within 18 months. 10 of the 31 large cities participating in the assessment have managed to set up such recycling plants.

✓ 32 of the 48 cities in the *One Star* category are medium sized cities and small towns. These cities have highlighted that they do not have formal C&D waste collection system or related infrastructure for treatment and management.

✓ All 10 participating cities from the north-eastern region and 15 of the 33 participating cities from the southern region are in the *One Star* category.

✓ 8 of the 15 participating coastal cities are also in the *One Star* category wherein the sensitive water ecosystem and other aquatic life may get severely impacted if safe practices of C&D waste management are not adopted.

2017, 53 cities committed to set up the recycling facilities to recover material from C&D waste, although only 13 cities were able to achieve the same by 2020[11].

Under Swachh Bharat Mission (SBM) and aligning to the Swachh Survekshan 2020, section 2.6; the focus of this indicator is to document the mechanisms which are currently in place to collect, process and reuse C&D waste. Through this indicator we have managed to capture the extent of decentralized management of C&D waste generated and its utilization.

	Construction & Demolition (C&D) waste management		SwachhSurvekshan Total marks of Mapped indicators
1 **Service** **Level** **Indicator**	3.1	Any mechanism in place to manage Construction & Demolition (C&D) waste as per C&D Waste Management Rule, 2016? Whether plans in place to initiate processing of C&D Waste?	50
		Total of Indicator 3	50

Way forward to transition towards improving C&D waste management

- Cities may prioritize setting up C&D Waste management system and maintain the inventories of construction activities in the city. To begin with, cities can notify dumping points and storage facilities for C&D waste.
- Cities are encouraged to form a collection mechanism using a helpline system. Cities can enforce user charges, penalty for non-compliance while implementing a robust C&D waste management system.
- Cities can set up facilities for processing of C&D waste in collaboration with private entities. If it is not financially viable to set up such a processing facility due to limited C&D waste generation, then cities can explore options for setting up such a facility in partnership with neighbouring towns or cities. The following documents can be referred for additional information:
  - » A Ready Reckoner for utilization of recycled produce of C&D waste.
  - » Guidelines on Environmental Management of Construction & Demolition Waste, CPCB, 2017.
  - » Coarse and Fine Aggregate for Concrete – Specification- IS 383: 2016.

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10. Shrivastava, S. & Chini, A., 2016. Construction Materials and C&D Waste in India. [Online] Available at: https://www.irbnet.de/daten/iconda/CIB14286.pdf [Accessed March 2021].
11. DTE Staff, 2020. India recycles only 1% of its construction and demolition waste: CSE. [Online] Available at: https://www.downtoearth.org.in/news/waste/india-recycles-only-1-of-its-construction-and-demolition-waste-cse-73027#:~:text=India%20recycles%20just%20one%20per,25%2C%202020%2C%20has%20shown.&text=This%20demands%20a%20circular%20economy,C%26D%20waste%20into [Accessed March 2021].
12. Resource Efficiency & Circular Economy – Current Status and way forward, NITI Aayog: 2019, p16

Extent of Wet Waste Processed

Human wellbeing is affected by inadequate wet waste management as it is a major cause of environmental and water pollution. Besides, burning of wet waste contributes to the depletion of ozone layer which accelerates climate change. Globally, in comparison to the amount of waste produced there are insufficient treatment plants for wet waste processing. Therefore, the global wet waste management industry is expected to expand in the future.

By 2022, the global wet waste management market is expected to be worth more than USD 130 billion, providing an economic potential for improved waste management[13]. India generates 62 million tonnes of waste per year (mixed waste containing both recyclable and non-recyclable waste), with an annual growth rate of 4%. Organic waste (all types of biodegradable waste), dry waste (or recyclable waste) and biomedical waste (or sanitary and hazardous waste) are the three major categories of waste produced in our country[13]. Appropriate management of organic waste is therefore essential as 50% of the waste generated in India is organic waste[14]. This will further substantially reduce the volume of pollution induced by improper waste management.

In order to mitigate climate change and improve quality of lives, it is important for cities to manage wet waste by

This indicator is mapped with the marks of 1 service level indicator of Swachh Survekshan 2019 - Processing of wet waste generated (4.1). The performance levels are categorized based on resulting CSCAF 2.0 score.

56 Cities	0 Cities	04 Cities	15 Cities	51 Cities

Performance Levels

★	★★	★★★	★★★★	★★★★★
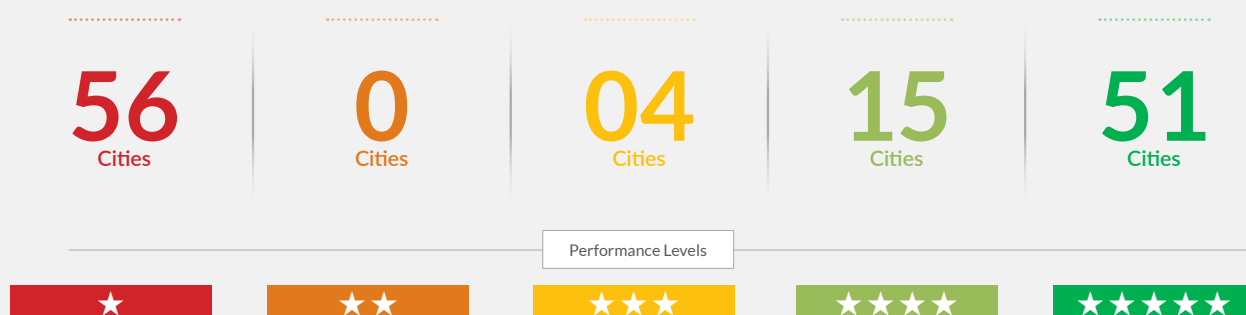
Performance of 126 cities

✓ The assessment of this indicator highlights that cities are either performing extremely well or poorly. Majority of cities (66) are in either *Five Stars* or *Four Stars* categories, or are in *One Star* category (56).

✓ Among the 51 *Five Stars* cities, 40 cities are able to process 100% of their collected wet waste.

✓ Metropolitan cities (26 cities) have performed well in this indicator, followed by large cities (14 cities) and 11 medium cities who have achieved wet waste handling, separation, storage and processing.

  » Shimla is the only hill city, and Surat and Visakhapatnam are the only two coastal cities that have been successful in undertaking wet waste management initiatives such as enforcement of onsite wet waste processing units (bio methanation and vermicomposting plants) at various locations (industrial, restaurants, commercial).

  » Port Blair and Kakinada are the only coastal cities in *Four Stars* category. These cities have managed to successfully implement decentralized compost yard plants and city-wide strict cleanliness initiatives, respectively. 11 of the 15 participating coastal cities are in the early stages of processing their wet waste.

✓ Majority of the participating medium sized cities (41) and all of the 10 participating small towns are in the *One Star* category. A large portion of waste in these cities are often dumped in open areas, water bodies and stormwater drains leading to water pollution and clogging of the drainage.

✓ 40 of the 56 *One Star* cities are part of both AMRUT and Smart Cities missions and can make use of the central government funding to prioritise and initiate measures for improving their wet waste management systems.

Actions

NAGPUR

Nagpur has a centralized vermi-composting plant at Bhandewadi operational since 2008. Large quantities of the city's waste from vegetable market, fruit market and hotels are processed in this plant.

setting up appropriate processing facilities and scientifically operated systems.The focus of this indicator is on capturing actions initiated by cities in wet waste processing as per the Swachh Bharat Mission (SBM) and aligning to the section 2.2 of Swachh Survekshan.

1 Service Level Indicators	Extent of Wet Waste Processed		SwachhSurvek-shan Total marks of Mapped indicators	CSCAF 2.0 Score
	4.1	Percentage of wet waste generated actually processed, either by decentralized or centralized facilities.	150	150
		Total of Indicator 4	150	150

Way forward to transition towards reducing the extent of wet waste processed

- Cities can treat their wet waste effectively by segregating and processing of the same through decentralised approaches such as composting and community level biomethanation plants.
- Cities can encourage citizens for home composting to reduce the overall generation of Municipal Solid Waste.

To promote such endeavours, cities should implement incentive schemes and increase awareness generation.
- Cities can establish regulatory mechanisms by mainstreaming advisory on on-site and decentralized composting of municipal organic waste.

"

CSCAF 2.0 has been a steep learning curve for Indore Smart City. It not only challenged us to deliver beyond the realm of a Smart City but also launched us into an arena of global best practices of building Climate resilient cities. Indore has aimed to think out of the box, while at the same time keep a local flavour to our solutions; and CSCAF2.0 has helped us do just that. It has enabled us to enhance our capabilities and skills sets internally, build bridges with the community in tackling the challenge of climate change, and at the same time devise ongoing cooperative mechanisms for inter-departmental coordination which is our greatest tool in designing a Climate Smart Framework for the city. CSCAF 2.0 has truly helped redefine and reinvigorate the role of a Smart City in the present context.

"

Ms. Aditi Garg, IAS
CEO of Indore Smart City (during the implementation of CSCAF 2.0)

13   Press Information Bureau, 2018. Press Release Details. New Delhi. [Online] Available at: https://pib.gov.in/PressReleseDetail.aspx-?PRID=1532692 [Accessed 20 June 2020].

14   Ayilara, M., 2020. Waste Management through Composting: Challenges and Potentials. [Online] Available at: https://www.mdpi.com/2071-1050/12/11/4456/htm [Accessed March 2021]. [Accessed March 2021].

# Scientific Landfill Availability & Operations

Since the last few decades, scientific landfill management has been implemented around the world to address site-specific issues and to enable the construction of bigger landfill sectors in the same region. Population expansion in urban areas over the years has resulted in landfills becoming dump yards, with little regard for their capacity or lifespan. Due to the difficulty in achieving economic viability of a sanitary landfill project, the application of landfill operations to other situations where the main motivation is the removal of a potential source of contamination or the recovery of resources has been limited to very few cases so far. Scalability of this operation can only be achieved by providing specific incentives or accessing public funding.

In India, landfills pose numerous threats due to their unscientific design and indiscriminate disposal of waste. One of the key threats is the emission of methane gas due to accumulation of waste, causing fires at landfills and hence resulting in garbage burning which causes severe air pollution. Landfills also pose tremendous health hazards as they are a storehouse of virus and bacteria, causing cardiovascular and lung diseases. Presently in India, only 5% of the total municipal waste collected, is processed. Untreated landfill sites account for approximately 20% of methane gas emissions in India[16]. With nearly 72% of India's garbage remaining untreated, scientific landfills are an option for urban India to ensure proper waste management[17].

This indicator assesses cities conformity to Solid Waste Management Rules, 2016 and guidance given in the Municipal Solid Waste Management (MSWM) Manual, 2016 (CPHEEO, 2016) along with any other updated criteria published by CPCB/ State PCB for Solid Waste Disposal Facilities.

This indicator is mapped with the marks of 1 service level indicator of Swachh Survekshan 2019 - Sanitary landfill or zero landfill city (5.1). The performance levels are categorized based on resulting CSCAF 2.0 score.

64 Cities	9 Cities	8 Cities	0 Cities	45 Cities

Performance Levels

★	★★	★★★	★★★★	★★★★★
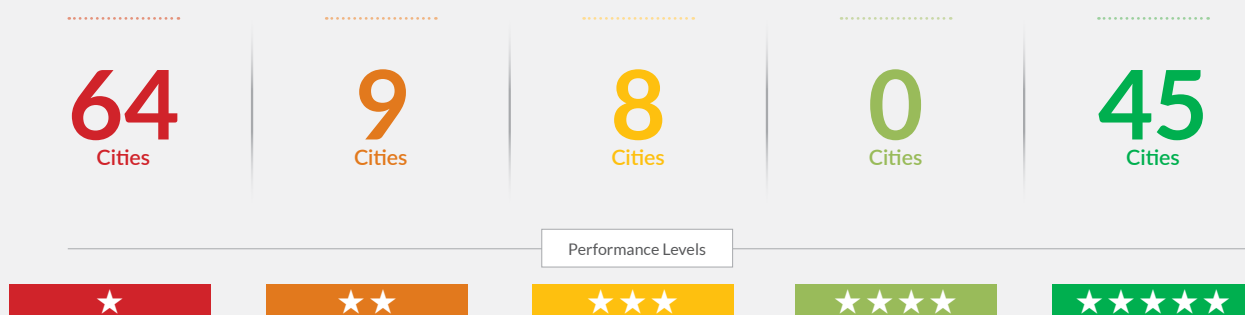
Performance of 126 cities

✓ The assessment indicates that majority of cities are either performing well and are in *Five Stars* category (45) or in *One Star* category (64) and are yet to adopt relevant measures.

✓ 27 out of the 45 cities in *Five Stars* category are metropolitan cities that have scientific landfills meeting the prescribed guidelines by the CPEEHO, Solid Waste Management Manual, 2016.

✓ A majority of the cities from north-eastern and eastern regions of the country are in the *One Star* category. 9 out of 10 small towns are also in the *One Star* category. The small towns generally produce relatively less waste, therefore, may have not prioritised construction and operation of their landfills in a scientific manner.

✓ 9 out of the 15 coastal cities are in the *One Star* category and this is concerning because lack of scientific landfill availability, besides polluting the groundwater, can severely impact the marine life.

The focus of this indicator is towards capturing the amount of collectable waste which is going to the landfill and whether the management and operations of landfills are according to the guidelines under the Swachh Bharat Mission (SBM) and aligning to the section 2.8 of Swachh Survekshan.

☰Actions

MYSURU

The Zero Waste Management Plant at Kumbarakoppal was started in 2005 and covers 5 wards of Mysuru Municipal Corporation. Wet and dry waste is segregated at two stages to ensure all parts are retrieved and sold or sent for composting. This ensures that zero waste is sent to landfill from these 5 wards.

1 Service Level Indicators	Scientific Landfill availability & operations		SwachhSurvekshan Total marks of Mapped indicators	CSCAF 2.0 Score
	5.1	Is the landfill in the city a sanitary landfill? Or landfill not required/ Zero landfill city	50	50
	Total of Indicator 5		50	50

Way forward to transition towards improving scientific landfill operations

- Non-performing cities should initiate the process of setting up sanitary landfill and monitor the same. The construction, operation and maintenance of these facilities may be in accordance with the guidelines provided within Manual on Municipal Solid Waste Management, 2016, CPHEEO (Chapter IV on Technical Aspects of Municipal Sanitary Landfill).

- Non-performing cities should initiate construction of sanitary landfill. Focus on adopting sanitary measures for disposal and recycle of municipal solid waste and promoting waste to energy can be considered. Examples for sample contracts for Design Build Operate of sanitary landfill can be referred.

Mr. Emani Kumar
Deputy Secretary General, ICLEI Global and Executive Director ICLEI South Asia

"
ICLEI South Asia witnessed the enthusiasm of fore-runner cities to showcase existing and ongoing climate actions, while responding to the CSCAF. The framework helped build capabilities of cities that are just embarking on their climate action journey by guiding them through a step-wise process of assessing the present status and laying out the next steps to deploy sustainable climate solutions.
"

16. Bhatia, A., 2017 . Waste Management: How India Is Drowning In Garbage. [Online] Available at: https://swachhindia.ndtv.com/waste-management-india-drowning-garbage-2147/ [Accessed March 2021].
17. Centre for Science and Environment, 2020. Clean It Right - Dumpsite Management in India. [Online] Available at: http___cdn.cseindia.org_attachments_0.75728500_1606740511_clean-it-right--dumpsite-management-in-india.pdf [Accessed March 2021].

Landfill/ Dumpsite Scientific Remediation

Dumpsite is defined as a dedicated land allocated for disposal of municipal solid waste. The deposited waste in these areas should be covered with soil in order to isolate it from the environment. Humans and animals are usually restricted from entering these areas. The waste deposited in these areas gradually decomposes through a combination of biological, chemical and physical processes. If not adequately managed, they are likely to cause concern with respect to two major emissions namely, leachate and landfill gas. These emissions can have severe impact on the environment during the decomposition process. According to the Waste Atlas report (2013), cases from 50 biggest dumpsites in the world revealed that together they affect the lives of almost 65 million people[18]. In 2015, the GWMO report estimated that at least 2 billion people do not have access to regular waste collection and they depend on unmanaged dumpsites[18].

In India, urban areas account for a third of India's population and generates 54.75 million tonnes of MSW annually[19]. The current estimate is that 22.5 million tonnes of waste dumped annually is unprocessed[20]. On the top of that, 77% of the waste generated in India is disposed of in open dumpsites as per The World Bank[18]. Unmanaged dumping of mixed municipal waste has created around 3,159 dumpsites across the country[20]. These dumpsites have led to environmental consequences, including contamination of the air, water (ground and surface), and soil.

This indicator is mapped with the marks of 1 service level indicator of Swachh Survekshan 2019 - Remediation of existing dumpsites (6.1). The performance levels are categorized based on resulting CSCAF 2.0 score.

64 Cities	17 Cities	11 Cities	8 Cities	26 Cities

Performance Levels

| ★ | ★★ | ★★★ | ★★★★ | ★★★★★ |
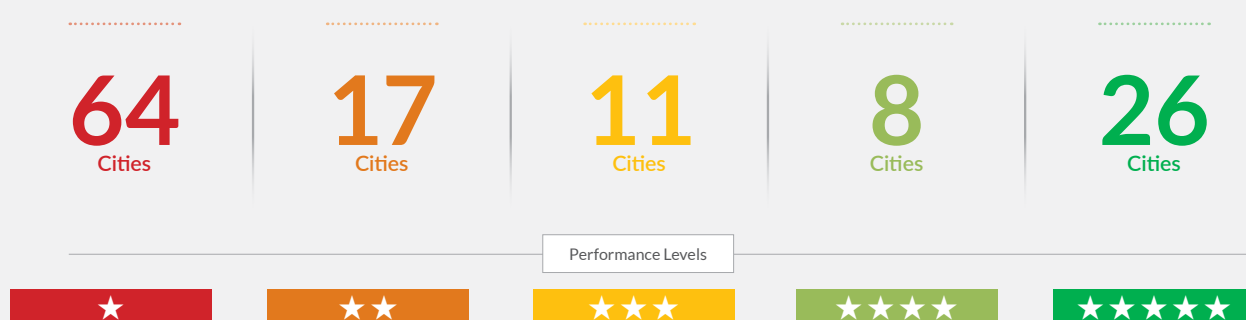
Performance of 126 cities

✓ Around two third of the participating cities do not have their landfills scientifically remediated.

✓ 26 cities in the *Five Stars* category meet the prescribed norms by CPEEHO for scientific landfill remediation. 16 of these are metropolitan cities from the states of Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Maharashtra, Gujarat, Himachal Pradesh, Tamil Nadu, Jammu & Kashmir, Karnataka and Jharkhand.

✓ 7 out of the 8 participating hilly cities and 9 out of the 15 coastal cities are in the *One Star* category. The probability of surface water and groundwater pollution due to improper remediation is highly likely in these cities.

✓ Most of the cities in the eastern-northern, north-eastern and southern regions are also in the *One Star* category.

✓ 27 out of the 41 medium sized cities and all the 10 small towns participating in the assessment are also under the *One Star* category. These cities generally produce relatively less waste and therefore are yet to prioritise landfill remediation processes.

≡Actions

TIRUPATI

Tirupati is in the process of remediating the Rampuram dump site through bio-mining process. It will help in reduction of soil, air and water pollution in the area along with restoring the local flora and fauna. It will also be beneficial for residents' health living in close proximity the site.

The Swachh Bharat Mission has been emphasising on reclamation of landfill sites with an aim to recover over an estimated 10,000 hectares of urban land that is locked in these dumpsites in India. Innovative and sustainable landfill remediation methods like bio-mining and bio-remediation are promoted over the traditional 'capping' which means covering the landfill with a layer of soil.

The focus of this indicator was on evaluating the city's readiness to scientifically manage or efforts made to remediate landfills and dump sites.

1 Service Level Indicators	Landfill/ dumpsite Scientific Remediation		SwachhSurvekshan Total marks of Mapped indicators	CSCAF 2.0 Score
	6.1	Remediation of existing dumpsites undertaken and the stage of the same or no legacy waste (dumpsite)	60	60
		Total of Indicator 6	60	60

Way forward to transition towards landfill/dumpsite scientific remediation

- As a first step, cities can assess the baseline condition of existing dump sites in terms of quantification of legacy waste, topographical survey, geotechnical investigation, other environmental parameters such as water, air and leachate quality and characteristics of legacy waste etc.
- Non-performing cities need to refer to the document Model RFP for Closure and Capping of Existing Dumpsite.

- Cities can prepare a DPR of scientific landfill/ dumpsite closure and initiate the work of remediation once agreement of remediation is completed.
- Cities can explore options for converting landfills into conceptual landscape areas.

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18. International Solid Waste Association, 2016. A Roadmap for closing Waste Dumpsites The World's most Polluted Places. [Online] Available at: https://www.iswa.org/fileadmin/galleries/About%20ISWA/ISWA_Roadmap_Report.pdf [Accessed 22 March 2021].
19. Advisory on Improving Municipal Solid Waste Management Services, 2013 (Ministry of Urban Development, CPHEEO). [Online] Available at: http://cpheeo.gov.in/upload/uploadfiles/files/Advisory%20on%20Improving%20Municipal%20Solid%20Waste%20Management%20Services.pdf [Accessed April 2021].
20. The Week, 2021. India's answer to the mounting landfill problem: Bio-mining and Bio-remediation [Online] Available at: https://www.theweek.in/news/biz-tech/2021/01/09/india_s_answer_to_the-mounting-landfill-problem--bio-mining-and-.html [Accessed April 2021]

Actions in the cities

Ujjain

Bio-methanation project
The city has adopted an integrated approach to strategically process and reduce the bio-degradable waste of the city to generate electricity by a bio-methanation plant. This plant is helping in the solid waste management of the city and is also a step towards reducing the burden on non-renewable resources by producing electricity used in the nearby street lights. The slurry generated from bio-methanation is utilized for landscaping, gardening and farming purposes. The project has reduced greenhouse emissions onto the environment by 12,176 Kg/month.

Ahmedabad

Material Recovery Facility
The Material Recovery Facility (MRF) at Ahmedabad runs on a public private partnership (PPP) model between Ahmedabad Municipal Corporation (AMC) and Nepra Resource Management Pvt. Ltd. The daily sorting capacity of dry waste of the MRF plant is around 100 MT. Dry Waste is collected with the help of waste pickers and through collection vehicles and brought to the material recovery facility (MRF) where it is manually segregated, checked and segregated waste is then sold to the authorized recyclers.

Delhi

Construction and Demolition Waste recycling facility at Burari
North Delhi Municipal Corporation has installed a recycling facility in Burari which is installed, operated and maintained on a Public Private Partnership (PPP) basis between the Corporation and Infrastructure Leasing and Financial Services Limited (IL&FS) Environment. There are 168 designated intermediate collection points across the city from which waste is transported to the processing facility.

98 cities
have banned single-use plastics including plastics <50 micron

40 cities
have instituted mechanisms for processing 100% of collected wet waste

40 cities
have more than 95% of generated dry waste (excluding plastic & domestic hazardous waste) collected that is actually processed/recycled/reused

Coimbatore

Biogas plant and Vermicomposting plant in Coimbatore - Processing and treating wet waste

The Coimbatore city municipal corporation has installed a biogas plant at Amma Unavagam premises at Chitra Nagar. Vegetable waste, cooked and uncooked food waste from the hotels and restaurants in and around the are used to generate biogas through anaerobic digestion. At the vermicomposting plant, segregated waste is processed and converted into compost at this site.

Jabalpur

Zero landfill & bin free city

The city has adopted a robust solid waste management solution which aims to integrate Waste-to-Energy plant with the centralized monitoring system with a better governance on collection of daily garbage, monitoring of garbage collection, transportation system by the command control center, while ensuring cost reduction and resource optimization.

Indore

Bioremediation/ Bio-mining of legacy waste

Indore had taken considerable steps to tackle waste management in new and innovative ways. One such example is Indore's Devguradiya dumpsite where the dumping yard is saddled by heaps of garbage for decades. The project aims to clear legacy waste dumps and reclaim 100 acre land of worth Rs. 300 Cr. Due to adoption of scientific bio-remediation process the area inside the processing and disposal site is transformed into beautiful green-belt uplifting the environment, eliminating dump fires, reducing emissions, soil pollution and ground water contamination.

17 cities have successfully implemented Construction & Demolition (C&D) Waste Rules

45 cities are scientifically managing landfill sites, meeting CPEEHO, Solid Waste Management Rules, 2016

45 cities Have implemented scientific remediation of their landfills

8

Way Forward to Build Climate Actions

Way Forward for Cities' Actions

ClimateSmart Cities Assessment Framework 2.0

MOBILITY & AIR QUALITY 20%
- Clean Technologies Shared Vehicles
- Availability of Public Transport
- Percentage of coverage of Non-Motorized Transport network (pedestrian and bicycle) in the city
- Level of Air Pollution
- Clean Air Action Plan (Planning and Impelmentation)

WASTE MANAGEMENT 15%
- Landfill / dumpsite Scientific Remediation
- Scientific Landfill availability & operations
- Extent of Wet Waste Processed
- Construction & Demolition (C&D) waste management
- Extent of dry waste recovered & recycled
- Waste minimization initiatives undertaken by the City

ENERGY & GREEN BUILDINGS 25%
- Total electricity consumption in the city
- Total electrical energy in the city derived from renewable sources
- Fossil fuel consumption in the city
- Energy efficient street lighting in the city
- Promotion of green buildings
- Green building adoption

WATER MANAGEMENT 15%
- Energy-efficient wastewater management system
- Energy-efficient water supply system
- Flood/ water stagnation risk management
- Wastewater Recycle and Reuse
- Extent of Non-Revenue Water
- Water Resources Management

URBAN PLANNING, GREEN COVER & BIODIVERSITY 25%
- Rejuvenation & Conservation of Water Bodies & Open Areas
- Proportion of Green Cover
- Urban Biodiversity
- Disaster Resilience
- City Climate Action Plan

Urban Planning, Green Cover and Biodiversity

1. **Establishing dedicated city level committees to strengthen coordination and management across various departments**

    Cities can strengthen their institutional coordination and management to ensure holistic planning, implementation and monitoring of climate actions. Specialized committees such as Biodiversity Management Committees, City Climate Cells and Environmental Committees, and City Disaster Management Cells can be established to focus on rejuvenating and safeguarding biodiversity and environment, and guide dedicated activities towards disaster management respectively.

2. **Alignment across various city, state and national plans to ensure coherence in planning and implementation**

    In order to adopt rejuvenation and conservation of water bodies and open spaces, enhance biodiversity and drive disaster resilience in cities, local level strategies can be aligned with national and state level plans like the National and State Action Plans for Climate Change (NAPCC and SAPCC), National Clean Air Plan (NCAP), National and State Biodiversity Guidelines (Biological Diversity Act, 2002) and the State/District Disaster Management Plans. Alignment across national and state level plans will bring coherence in the planning and can provide direction to channel required resources for implementation. Besides, streamlining these plans into departmental plans, city master plans and infrastructure DPRs may be ensured for holistic sustainable development in cities.

3. **Data informed decision making**

    Spatial mapping and analysis are crucial for assessing gaps and guiding policy making and planning for blue-green planning, biodiversity management and disaster resilience. Cities are recommended to prepare and update GIS maps for attributes like water bodies and open spaces coverage, encroachments, urban heat island, disaster specific risks and vulnerabilities, tree type and biodiversity, etc.

Energy and Green Buildings

1. Leverage government programmes and schemes to enhance energy efficiency in cities

Cities can leverage government schemes and initiatives like the Rooftop Solar programme, Solar Net Metering and Grid Connected Wind-Solar Hybrid Power Projects for adopting renewable energy at city level. Cities may coordinate with local power distribution companies (DISCOMs), state energy distribution agency (SEDA), and State Electricity Regulatory Commission (SERC) to adopt the schemes. A monitoring and evaluation cell can be established to work with the Energy Service Company (ESCO) for facilitating energy efficient projects and conducting audits as part of Bureau of Energy Efficiency's Municipal Demand Side Management Program.

2. Integrating systems with ICCCs to monitor energy efficiency

Cities that have ICCCs can integrate an Energy Monitoring Information System (EMIS) integrated with the ICCCs to monitor sector wise energy usage. Smart automation through GIS based monitoring integrated with the ICCCs can also bring in further efficiency in street light management. Suitable PPP/ESCO models of financing may be used for such implementation.

3. Driving green building adoption in cities

For promoting green building practices, cities are suggested to adopt the National Building Codes, 2016 or Energy Conservation Building Code, 2017 or Eco-Niwas Samhita, 2018 in their building rules/bye-laws/ development control regulations. City level green building cells may be established to ensure compliance with the regulations, initiate green building certifications for institutional and commercial buildings, and promote incentives like additional FARs and property tax rebates to enhance adoption of green buildings in the city.

Mobility and Air Quality

1. **Enhancing low carbon public transport for reducing GHG emissions and improving air quality**

   Cities can conduct public transport demand assessments and explore PPP models for increasing fleet size of buses. Cities can improve efficiency, route rationalization, schedules and last mile connectivity to attract people to shift to public transport. Leveraging FAME-II scheme and adopting Niti Ayog's guidelines on shared mobility for procuring low carbon vehicles (like E-rickshaws and E-Taxis) cities can procure low carbon vehicles and develop desired infrastructure to enable low carbon mobility transition.

2. **Increase NMT coverage**

   Many cities have initiated various projects on public bicycle sharing and awareness campaigns to improving NMT infrastructure. Moving forward, cities can aim to increase the NMT coverage for cycle lanes and footpaths to over 35%, especially in high traffic clusters and high-use networks through dedicated planning and budget allocation.

3. **Monitoring air quality sensors and adopting NCAP**

   Cities are recommended to install continuous air quality monitoring sensors and make the dynamic data available to public through display boards and public applications like SAFAR/SAMEER. It is important to calibrate the installed sensors in consultation with the Central and State Pollution Control Boards to ensure the quality of data captured. Further, cites can develop city clean air action plans aligning to the National Clean Air Plan (NCAP) and initiate some of the actions to improve air quality and achieve the national air quality standards.
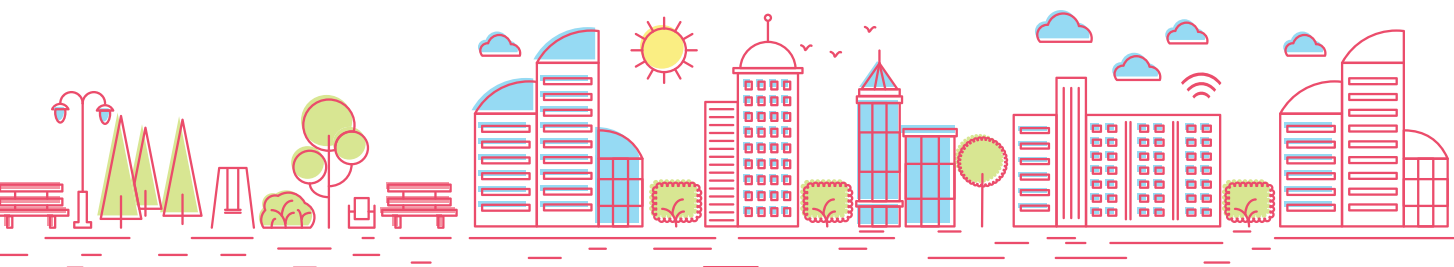
Water Management

1. Initiate water demand management plan

Cities are recommended to initiate a water demand management plan to inform utilization of water resources keeping in mind the current and projected demand. This can provide direction towards adopting measures for rejuvenating water resources and replenishing groundwater. As a first step, cities can establish a water resource management committee to guide the process of conducting city wide water management plan.

2. Measures to mitigate floods and water stagnation

Cities can conduct assessments to identify vulnerable hotspots and adopt relevant structural and non-structural strategies to reduce the impact of floods and water stagnation. This includes measures such as preparing a storm-water management plan in alignment with the flood management plan to channel flood water efficiently and establishing SOPs for flood management. Further, initiating the implementation of an end-to-end Early Warning Systems (EWS) can greatly support cities in better preparing for floods.

3. Studies to inform water and energy efficiency

Studies to assess non-revenue water and energy audits can provide valuable information on water losses and energy consumed in water supply system and waste water management systems respectively. These studies can support in identifying gaps and can guide measures to reduce water losses and enhance energy efficiency in water supply and waste water management.

Waste Management

1. Enhancing waste segregation

Cities can focus on promoting source segregation of dry and wet waste through various incentive based awareness programs and rigorous campaigning to achieve 100% recycling and reuse of waste. Citizens can be encouraged to adopt home or neighbourhood composting. Besides, following guidelines from the advisory on Material Recovery Facility (MRF) can help cities to strengthen their plastic waste management.

2. Strengthening Construction and Demolition (C&D) waste management

It is important for cities to build a robust C&D waste management system. This includes maintaining inventories of construction activities in the city, notifying dumping points, expanding storage facilities for C&D waste, establishing a collection mechanism, enforcing user charges & penalty for non-compliance etc. ULBs themselves or in association with the private sector can initiate some of these measures.

3. Scientific management of landfills

Cities are encouraged to make efforts to scientifically manage and close engineered landfills and dumpsites in order to avoid significant GHG emissions. Innovative and sustainable landfill remediation methods like biomining and bioremediation can be promoted over the traditional 'capping' which means covering the landfill with a layer of soil.
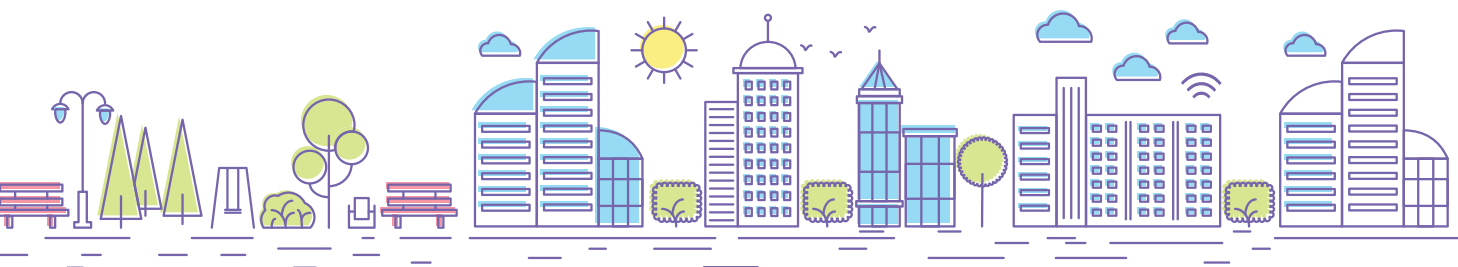
Climate Centre for Cities

Building Climate Actions in Indian Cities

01

P4 Support

Provide Policy, Planning, Program and Project development support to incorporate climate change considerations in land use planning, master planning, housing and urban development, in addition to implementing demonstrative local climate actions and supporting the national program related to climate change.

02

Research & Knowledge Management

Conduct research and develop knowledge products to inform relevant climate interventions in urban development.

03

Technology, Data Solutions & Innovations

Create opportunities for solution providers to innovate, create tools and methods, and to incorporate data analytics to support informed decision making in addressing climate challenges in cities.

04
Capacity Building

Develop capacity amongst urban practitioners and public officials to understand and apply a climate change perspective to projects and decisions aimed at reducing future risks and enhancing urban resilience.

05
Advocacy & Communications

Develop communication materials to inform and influence public and private sector decision-makers at the city, state and national levels.

06
Partnerships

Build national and global partnerships that can complement and support MoHUA and C-Cube in advocacy, knowledge management, capacity building, innovation, and financing to address the increasing climate risks in Indian cities.

ClimateSmart Cities Alliance

The ClimateSmart Cities Alliance is intended to bring together the diverse skills, strengths and resources available across various organizations working with Indian cities to complement and scale the efforts towards mobilising advocacy, knowledge sharing, capacity building, innovation, and resources to address climate risks.

Starting with 26 member organisations that contributed to development of the CSCAF 1.0, the Alliance continues to play a key role in driving the climate smart cities discourse, including implementation and review of the CSCAF. In June 2020, the Climate Centre for Cities (C-Cube) was given the mandate to manage the Alliance Secretariat and further strengthen the Alliance as a national level multi-stakeholder partnership to facilitate and build urban climate action in India. As of January, 2021, the Alliance has over 50 partner organizations including international agencies and networks, donors, (I)NGOs, private sector organizations, rating agencies, data and technology firms, incubators, etc. Of these, 25 partner organisations provided on-ground handholding and data collection support to cities in implementing the CSCAF 2.0. The general terms of reference for Alliance Members include, and are not limited to:

- Providing technical and financial support, sharing tools & toolkits, innovation, proofs-of-concept and good practices to facilitate implementation of pilots and projects in cities
- Support/ collaborate with C-Cube to bring in knowledge and resources for strengthening capacities of ULBs/ Smart City SPVs and scale up transformative actions

As Alliance Secretariat, C-Cube facilitates network engagement – Partner to Partner, Partner to City and City to City – to enable knowledge sharing, P4 (policy, planning, program and project) support, peer learning and engagement. As a way forward to CSCAF 2.0 evaluation, C-Cube will conduct a needs mapping for the 126 cities and provide them with network support for accessing technical, financial and project implementation assistance towards improving their performance. C-Cube will also continue to facilitate training and handholding support to cities on-ground for the subsequent phases of CSCAF evaluation.

How cities can benefit from the Alliance

- Seek strategic support for performance improvement on CSCAF indicators and meeting national and international targets on ease of living, climate action and sustainable development
- Access technical assistance for development of city level strategies, action plans, projects (DPRs) and procurement (ToRs, tenders, etc.) for climate-smart development
- Access cutting-edge research, technology, innovative solutions, proofs-of-concepts, use cases for implementation of pilots
- Access tools & toolkits, training, capacity building and handholding support for strengthening institutional capacities and business processes for climate-informed decision-making
- Peer-to-peer learning and engagement with cities in India and beyond
- Showcase pioneering initiatives and participate in national and international events, platforms, challenges, awards and project proposals

Building climate capacities in the cities

For mainstreaming climate actions, cities require a detailed understanding of their baseline GHG emissions, climate related risks emerging from hydro-meteorological hazards and vulnerabilities. While city administrations are actively focussing on development to cater to the growing urban population, they sometimes lack the capacity to undertake relevant climate measures. Being at the crossroads of urban transformation, cities have an unique opportunity to cater to sustainable and resilient development. With this intent, the Climate Centre for Cities is in the process of undertaking several initiatives to help build conceptual, technical, administrative and innovation capacities across key areas of ULBs.

Dedicated trainings aligning to CSCAF indicators
Technical know-how to progress across CSCAF

Dedicated technical training for all the CSCAF indicators are being developed in association with experts and climate alliance partners to enable cities progress across their indicators of choice over time. Training for flood management, water conservation, preserving open areas and biodiversity, increasing green cover, management of construction and demolition waste have already been provided till date. In addition to city representatives, trainings were also provided to trainers from regional training institutions through the National Urban Learning Platform (NULP) to enable ease of access and scaling up of such trainings beyond. Regular training to cities in partnership with regional institutions across all indicators are planned.

Master class
Fostering peer to peer learning

In addition to building technical capacities, understanding the processes involved in administrative decision-making taking into consideration the operational and financial feasibility are crucial. Master classes focus on bridging this gap by providing a platform for senior city administrative officials and decision makers to share their experience around mainstreaming city actions with officials from other cities. The first master class was conducted in February, 2021 by the CEO of Indore Smart City and provided details on the processes required for cities towards generating additional revenue from carbon credits. Moving forward, C-Cube plans to organize a master class every month to showcase the journey of decision makers and what it takes to foster climate actions in Indian cities.

E-learning series
For cities to improve climate actions

The e-learning series targeting city officials will focus on the governance and management processes required for addressing climate challenges. Aligning to the themes of CSCAF, the series will bring thematic experts and city officials to discuss the best practices in conserving biodiversity, rejuvenation of freshwater ecosystems, developing city climate action plans and implementing nature based solutions. The e-learning series is conceptualized in association with WRI India and intends to demonstrate the benefit of cross-sectoral and multi-institutional collaborations for implementing climate actions.

> **Ms. Vaishnavi. T. G. Shankar**
> Lead, Training and Capacity Building
> Climate Centre for Cities, NIUA

" Indian cities are beginning to understand the high cost of climate change and the need for climate mitigation and adaptation. Building capacities to plan and implement climate-smart measures is crucial for successfully addressing climate risks. The holistic approach of CSCAF inherently guides cities with the way forward and can help in identifying capacity gaps that need to be addressed for building effective climate actions. "

Understanding the Future
Podcast to advance innovative climate measures

Focussing on successful innovations at the intersection of sustainability, climate change and urban development, the podcast provides a platform for practitioners from both public and private sectors to provide their perspectives on the future of cities grounded on current innovation and their interventions at macro and micro scales. The podcast reveals the aspects of 'how to do it' with an intent to support urban professionals and urban managers in implementing such innovations in their cities. A total of 13 podcasts have been conducted in season one.

Chat for Change
Webinar series for conceptual orientation

The webinar series titled, 'chat for change' brings national and international climate experts who share experiences, insights and good practice examples with urban professionals, city officials and decision makers. The focus of this webinar series is targetted towards strengthening local capacities for reducing GHG emissions, improving air quality, bringing efficiency in water and waste management, and safeguarding green cover and biodiversity. So far, 8 webinars have been conducted.

ClimateSmart Cities - Self Assessment Tool
Tool to assess GHG emissions

The ClimateSmart Cities – Self Assessment Tool (CSC – SA Tool, developed by GIZ) is an excel-based emissions assessment tool that is aligned with the CSCAF. The tool follows the 'Global Protocol for Community-Scale Greenhouse Gas Emission Inventories' (GPC) to estimate indicator-wise GHG emissions. The intent is to highlight the mitigation potential that cities can prioritise for adopting interventions aligned to the CSCAF indicators. Based on the emission numbers, the tool provides recommendation to cities for focusing actions and prioritising relevant sectors and indicators. The tool is available at https://www.niua.org/csc/index.html

Supporting Data and Innovation

Climate data observatory
Enabling data informed decision making

Given the myriad challenges of rapid urbanization being experienced by Indian cities, it is necessary for cities to shift towards data-informed decision making. The significance of data collection, correlations and data visualization is key for promoting evidence-based approaches. With this intent, a common platform for cities, solution providers, institutions, and partners has been developed.

The observatory will help cities and solution providers to visualize and analyze the performance of cities and potential areas for action. It will act as a platform to host both spatial and non-spatial data for decision makers based on evidences from the cities.

With data insights giving a greater picture of resources, capabilities, and aspirations, cities will be able to position themselves effectively to strategize and augment their abilities to access the support provided by the state, national government and global organizations for mainstreaming climate actions.

Innovation Facilitation Centre
Fostering urban innovation

Innovations can greatly benefit cities in addressing urbanization and climate related challenges in an optimal manner using limited resources. The central government has actively encouraged start-ups to support urban innovation and some cities have also witnessed improved management of service delivery from the innovation developed by start-ups. To strengthen the urban innovation ecosystem to develop sustainable, resilient and inclusive cities, an Innovation Facilitation Centre (IFC) will be established within C-Cube.

The IFC will work in a systematic manner to map city challenges and provide training to innovators. IFC will leverage the outcomes of the CSCAF 2.0, Climate Data Observatory, National Urban Learning Platform and the Climate Alliance to connect innovators with the cities. Training for start-ups on urban climate challenges and city administrative processes will enable them in aligning their innovation to better meet the needs of city administration for upscaling.

In association with the Future Cities Catapult, 12 start-ups from India and the UK were provided strategic training on city engagement during 2020 and similar engagement with more start-ups from India are planned.

Grounding Climate Actions

One of the key objectives of the CSCAF is to enable cities to adopt a climate-sensitive approach to urban planning and development besides regularly monitoring their progress on the same. To that end, the following 4 cross-cutting areas of interventions will be undertaken:

Convergence with national and international programs and initiatives

Leveraging national and international programs and initiatives on urban climate action and sustainable development can go a long way in availing the required technical resources and gap funding. For instance, the National Mission on Sustainable Habitat provides the overall guidance framework to undertake actions on various thematic areas as identified under the CSCAF. At the same time, the Jal Jeevan Mission (U), Swachh Bharat Mission (U) and AMRUT provide technical as well as financial resources for implementation of initiatives on water management, sanitation, sewage and solid waste management. The recently released 15th Finance Commission Report provides an overall outlay of more than INR 1.21 lakh crores for cities to undertake actions on ambient air quality, water supply, sanitation and solid waste management. Convergence with these programs can help cities in implementing and building on proposed and current initiatives.

At the international level, inter-governmental programs such as the Global Environment Facility (GEF) and international network initiatives such as the Resilient Cities Network, Global Covenant of Mayors, International Urban and Regional Cooperation, and the Coalition for Disaster Resilient Infrastructure are also providing support for building climate and disaster resilience of Indian cities. Interested ULBs/ Smart City SPVs may seek support from C-Cube to align with the same.

Engagement with States

Engagement with the states is crucial to build climate actions in the cities, especially to enhance efficiency and coordination among various stakeholders, and to further streamline the process in other cities. In view of this, several states in India have established climate change cells to assist in the preparation of the State Action Plan on Climate Change (SAPCC) and to monitor its progress.

C-Cube aims to scale up this initiative to all the states and act as a facilitator to enhance state level collaboration for synergistic climate actions. The key focus of engagement with the states will be regarding data informed decision making and building capacities. In this context, identifying existing institutions, analysing their institutional capacity, expertise, financial & human resources are the next steps to assess the functions and scope of the state level institutions for ensuring climate actions.

In order for such institutions to be fully empowered to discharge their roles, they must be equipped with the essential legal sanction, well-defined mandate supported with a pool of expertise drawn from diverse backgrounds inter alia; state government officials, research institutions/think tanks, private sector, civil societies, etc. This will ensure that these centres have necessary institutional capacity and budgetary allocation for an efficient implementation of climate actions.

An area of engagement with the states is in the field of data sharing across different sectors and departments for developing effective climate actions in the cities. The CSCAF 2.0 provides valuable data on the status of cities, their contributions to overall GHG emissions from various sectors and highlights major gaps in climate actions besides underscoring the priority sectors which require urgent attention. There is potential to update the SAPCC to prepare more

comprehensive climate action plans by augmenting the various sectoral strategies pertaining to energy & green building promotion & adoption, mobility, air quality, water management, waste management, urban planning & green cover in the urban sector. Further, data relating to hazard vulnerability mapping of urban socio-economic systems from the CSCAF could assist in preparing robust State Disaster Management Plans (SDMPs).

The other area of engagement with the states is in the field of capacity building and resource mobilization for building climate actions. Various training provided to ULB officials as a part of the CSCAF enables them to participate and contribute to developing climate resilient actions for the urban sector. States could set up climate change cells and strengthen existing cells to build institutional capacity to address climate change with relevant and contextual solutions. Well informed state and city administrators would be sensitive to the need for mainstreaming climate change aspects in the city development plan and its effective implementation and monitoring.

Mainstreaming in city level initiatives, institutional and governance framework

Addressing climate risks in city development agenda, including master plans, local area plans, infrastructure development projects and municipal budgets is the first step towards enabling local action. Cities may refer to the recommendations enlisted in their respective City Diagnostic Reports for the same and seek required technical and financial support from the Ministry and the Climate Alliance through C-Cube.

Besides, establishing supporting institutional and governance structures it is equally important for ensuring implementation of the plans and projects. ULBs/ Smart City SPVs should constitute the city climate cells, advisory committees and other institutional structures as prescribed under various guidelines and regulations, and recommended by this report under various thematic chapters. These should include representation from governmental organizations; private sector; academia, and civil society organizations and local community. C-Cube has also established a network of 'Climate Practitioners' to provide on-ground support to ULBs/ Smart City SPVs. Cities are recommended to seek overall guidance, advisory/assistance and work in close collaboration with these expert/ advisory committees and practitioners. Appointing a nodal person within the climate cell is recommended to convene stakeholders and coordinate inter-departmental initiatives.

As cities are collecting large amount of data through various assessments viz. CSCAF, Ease of Living, Swachh Survekshan and the Integrated Command and Control Centres (ICCCs), it becomes crucial to manage this data and make it accessible to various development agencies to inform decision-making processes. To that end, C-Cube is developing use-cases to help cities in implementing digital solutions and urban observatories within the ICCCs for data-driven climate action planning. Cities are recommended to seek assistance from C-Cube on the same.

Scaling initiatives by Alliance members/ partners organisations

Many ClimateSmart Cities Alliance members and partner organisations are supporting city level risk assessments, capacity building programs, formulation and implementation of interventions and pilot projects across urban India. These initiatives are currently being implemented by partners with support from MoHUA and C-Cube, NIUA.

Learnings from such initiatives can help cities in informing their development projects. Furthermore, a closer collaboration with non-state actors at the local level will help in scaling these pilots for transformative action. Cities are encouraged to seek support from C-Cube to facilitate this process.

Annexure 1

Strategic Committee for CSCAF 2.0		
Mr Kunal Kumar, JS & MD (SSCM), MoHUA		
Mr Lal Chhandama, Director - SC I, MoHUA		
Mr O.P. Agarwal, WRI India		
Mr Hitesh Vaidya, Director, NIUA		
Ms Vaishali Nandan, GIZ India		
Dr Umamaheshawaran Rajasekar, NIUA		

Core team at NIUA for CSCAF 2.0		
Dr Umamaheshawaran Rajasekar	Mr Punit Gandhi	Ms Pallavi Thool
Ms Vaishnavi T G Shankar	Mr Empati Uday Kumar	Mr Anshul Abbasi
Ms Raina Singh	Ms Mohini Bhaisare	Ms Amanjot Kaur
Ms Ankita Mandal	Ms T. Shravani	Ms Manjaree Dutta

Contributors for Urban Planning, Green Cover and Biodiversity		
Ms Raina Singh, NIUA	Ms Monalisa Sen, ICLEI South Asia	Ms Pooja Shukla, GBCI India
Mr R. Srinivas, TCPO	Dr Divya Sharma, The Climate Group	Mr A. Nambi Appadurai, WRI India
Dr Erach Bharucha, BVIEER	Ms Vaishali Nandan, GIZ India	Dr Neeraj Khera, GIZ India
Dr T.S. Panwar, WWF India	Ms Parul Agarwala, UN Habitat India	Mr Kamlesh Yagnik, IUC India
Dr Kavas Kapadia, SPA Delhi	Mr Vijay Saini, ICLEI South Asia	

Contributors for Energy and Green Buildings		
Mr Kanagaraj Ganesan, Integrative Design Solutions Pvt. Ltd.		
Dr Shailesh Kr. Agrawal, BMTPC	Mr Apoorv Vij, GBCI India	Mr Indradip Mitra, GIZ India
Mr Sanjay Seth, TERI	Ms Ruchi Sneha, GBCI India	Mr Kanchan Kumar Agrawal, GIZ India
Mr Saurabh Diddi, BEE	Ms Mili Majumdar, GBCI India	Mr Keshav Kumar Jha, ICLEI South Asia
Mr C.K. Varma, CPWD	Ms Anna Agarwal, Centre for Policy Research	Ms Anukriti Pathak, Alliance for an Energy Efficient Economy
Mr Emani Kumar, ICLEI South Asia	Mr Tarun Garg, Alliance for an Energy Efficient Economy	Ms Shabnam Bassi, GRIHA

Contributors for Mobility and Air Quality		
Ms Prerna Vijaykumar Mehta, WRI India	Mr VK Shukla, CPCB	Dr Poornima Prabhakaran, Public Health Foundation of India
Ms Prarthana Borah, Clean Air Asia	Mr Rashid Hasan, SIAM	Mr Raghu Babu Nukala, GIZ India
Dr Sanjay Gupta, SPA Delhi	Mr Ashish Rao Ghorpade, ICLEI South Asia	Mr Daniel Robinson, ADB
Dr O.P. Agarwal, WRI India	Mr Bhaskar Padigala, ICLEI South Asia	Mr Laghu Parashar, GIZ India

Contributors for Water Management		
Mr Manzoor Khan, Consultant, The World Bank		
Dr A.K. Gosain, IIT Delhi	Ms Bedoshruti Sadhukhan, ICLEI South Asia	Mr Rahul Sharma, GIZ India
Mr Radhey Shyam Tyagi, Delhi Jal Board	Mr Victor Shinde, NIUA	Dr Nitin Bassi, Institute for Resource Analysis and Policy
Dr Bhakti Devi, Urban Water Doctor	Ms Monika Bahl, GIZ India	Dr Devesh Sharma, Central University of Rajasthan

Contributors for Waste Management		
Mr Vibhor Sood, GIZ India	Mr Nirod Baran Mazumdar, International Academy of Environmental Sanitation and Public Health	Ms Soumya Chaturvedula, ICLEI South Asia
Mr Pratap U Asnani, UMC Global	Ms Swati Singh Sambyal, UN Habitat India	Ms Vaishali Nandan, GIZ India
Dr Shyamala Mani, NIUA	Ms Sakshi Chadha Dasgupta, SDC	Dr Lakshmi Raghupathy, Independent Consultant and Visiting Faculty, TERI SAS

Annexure 2

List of 126 participating cities in CSCAF 2.0

S No.	City Name	State Name	Geographic Zone	Climate Zone	Tier of the city
1	Agartala	Tripura	North - Eastern Region	Warm - Humid Zone	Large city
2	Agra	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
3	Ahmedabad	Gujarat	Western Region	Hot - Dry Zone	Metropolitan city
4	Aizawl	Mizoram	North - Eastern Region	Warm - Humid Zone	Medium city
5	Ajmer	Rajasthan	Northern Region	Hot - Dry Zone	Large city
6	Aligarh	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
7	Amravathi	Andhra Pradesh	Southern Region	Warm - Humid Zone	Medium city
8	Amravati	Maharashtra	Western Region	Composite Zone	Large city
9	Amritsar	Punjab	Northern Region	Composite Zone	Metropolitan city
10	Aurangabad	Maharashtra	Western Region	Hot - Dry Zone	Metropolitan city
11	Barielly	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
12	Belagavi	Karnataka	Southern Region	Warm - Humid Zone	Large city
13	Bengaluru	Karnataka	Southern Region	Temperate Zone	Metropolitan city
14	Bhagalpur	Bihar	Eastern Region	Warm - Humid Zone	Medium city
15	Bhavnagar	Gujarat	Western Region	Hot - Dry Zone	Large city
16	Bhopal	Madhya Pradesh	Central Region	Composite Zone	Metropolitan city
17	Bhubaneshwar	Odisha	Eastern Region	Warm - Humid Zone	Metropolitan city
18	Bihar Sharif	Bihar	Eastern Region	Composite Zone	Medium city
19	Bilaspur	Chattisgarh	Central Region	Composite Zone	Medium city
20	Chandigarh	Punjab & Haryana	Northern Region	Composite Zone	Metropolitan city
21	Chennai	Tamil Nadu	Southern Region	Warm - Humid Zone	Metropolitan city
22	Coimbatore	Tamil Nadu	Southern Region	Warm - Humid Zone	Metropolitan city
23	Cuttack	Odisha	Eastern Region	Warm - Humid Zone	Large city
24	Dahod	Gujarat	Western Region	Hot - Dry Zone	Medium city
25	Davangere	Karnataka	Southern Region	Warm - Humid Zone	Medium city
26	Dehradun	Uttarakhand	Northern Region	Composite Zone	Large city
27	Delhi	Delhi	Northern Region	Composite Zone	Medium city
28	Dharamshala	Himachal Pradesh	Northern Region	Composite Zone	Medium city
29	Diu	Daman & Diu	Western Region	Warm - Humid Zone	Medium city
30	Durgapur	West Bengal	Eastern Region	Warm - Humid Zone	Large city
31	Erode	Tamil Nadu	Southern Region	Warm - Humid Zone	Large city
32	Faridabad	Haryana	Northern Region	Composite Zone	Metropolitan city
33	Gandhinagar	Gujarat	Western Region	Hot - Dry Zone	Medium city
34	Gangtok	Sikkim	North - Eastern Region	Cold Zone	Medium city
35	Ghaziabad	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
36	Gorakhpur	Uttar Pradesh	Northern Region	Composite Zone	Large city
37	Gulbarga	Karnataka	Southern Region	Warm - Humid Zone	Large city
38	Guntur	Andhra Pradesh	Southern Region	Warm - Humid Zone	Large city
39	Gurugram	Haryana	Northern Region	Composite Zone	Metropolitan city
40	Guwahati	Assam	North - Eastern Region	Cold Zone	Metropolitan city
41	Gwalior	Madhya Pradesh	Central Region	Composite Zone	Metropolitan city

Both Smart & AMRUT cities   AMRUT cities   Smart Cities   Other cities

S No.	City Name	State Name	Geographic Zone	Climate Zone	Tier of the city
42	Hamirpur	Himachal Pradesh	Northern Region	Composite Zone	Small Town
43	Hubli Dharwad	Karnataka	Southern Region	Warm - Humid Zone	Metropolitan city
44	Imphal	Manipur	North - Eastern Region	Warm - Humid Zone	Medium city
45	Indore	Madhya Pradesh	Central Region	Composite Zone	Metropolitan city
46	Itanagar	Arunachal Pradesh	North - Eastern Region	Warm - Humid Zone	Medium city
47	Jabalpur	Madhya Pradesh	Central Region	Composite Zone	Metropolitan city
48	Jaipur	Rajasthan	Northern Region	Hot - Dry Zone	Metropolitan city
49	Jalandhar	Punjab	Northern Region	Composite Zone	Large city
50	Jammu	Jammu and Kashmir	Northern Region	Cold Zone	Large city
51	Jamshedpur	Jharkhand	Eastern Region	Composite Zone	Large city
52	Jhansi	Uttar Pradesh	Northern Region	Composite Zone	Large city
53	Jodhpur	Rajasthan	Northern Region	Composite Zone	Metropolitan city
54	Kakinada	Andhra Pradesh	Southern Region	Warm - Humid Zone	Large city
55	Kalyan Dombivali	Maharashtra	Western Region	Warm - Humid Zone	Metropolitan city
56	Kanpur	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
57	Kargil	Ladakh	Northern Region	Cold Zone	Small Town
58	Karimnagar	Telangana	Southern Region	Composite Zone	Medium city
59	Karnal	Haryana	Northern Region	Composite Zone	Large city
60	Kavaratti	Lakshadweep	Southern Region	Warm - Humid Zone	Small Town
61	Kochi	Kerala	Southern Region	Warm - Humid Zone	Large city
62	Kohima	Nagaland	North - Eastern Region	Warm - Humid Zone	Medium city
63	Kolhapur	Maharashtra	Western Region	Warm - Humid Zone	Large city
64	Kota	Rajasthan	Northern Region	Hot - Dry Zone	Metropolitan city
65	Leh	Ladakh	Northern Region	Cold Zone	Small Town
66	Loni	Uttar Pradesh	Northern Region	Composite Zone	Large city
67	Lucknow	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
68	Ludhiana	Punjab	Northern Region	Composite Zone	Metropolitan city
69	Madurai	Tamil Nadu	Southern Region	Warm - Humid Zone	Metropolitan city
70	Mandi	Himachal Pradesh	Northern Region	Composite Zone	Small Town
71	Mangalore	Karnataka	Southern Region	Warm - Humid Zone	Large city
72	Meerut	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
73	Mira Bhayandar	Maharashtra	Western Region	Warm - Humid Zone	Metropolitan city
74	Moradabad	Uttar Pradesh	Northern Region	Composite Zone	Large city
75	Muzaffarpur	Bihar	Eastern Region	Warm - Humid Zone	Large city
76	Mysore	Karnataka	Southern Region	Warm - Humid Zone	Metropolitan city
77	Nagpur	Maharashtra	Western Region	Composite Zone	Metropolitan city
78	Namchi	Sikkim	North - Eastern Region	Warm - Humid Zone	Small Town
79	Nanded	Maharashtra	Western Region	Hot - Dry Zone	Large city
80	Nashik	Maharashtra	Western Region	Hot - Dry Zone	Metropolitan city
81	Naya Raipur	Chattisgarh	Central Region	Composite Zone	Medium city
82	New Town Kolkata	West Bengal	Eastern Region	Warm - Humid Zone	Medium city
83	Palampur	Himachal Pradesh	Northern Region	Composite Zone	Small Town
84	Panaji	Goa	Western Region	Warm - Humid Zone	Medium city
85	Pasighat	Arunachal Pradesh	North - Eastern Region	Warm - Humid Zone	Small Town
86	Patna	Bihar	Eastern Region	Composite Zone	Metropolitan city

Both Smart & AMRUT cities   AMRUT cities   Smart Cities   Other cities

S No.	City Name	State Name	Geographic Zone	Climate Zone	Tier of the city
87	Pimpri Chinchwad	Maharashtra	Western Region	Warm - Humid Zone	Metropolitan city
88	Port Blair	Andaman and Nicobar Islands	Southern Region	Warm - Humid Zone	Medium city
89	Prayagraj	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
90	Puducherry	Puducherry	Southern Region	Warm - Humid Zone	Medium city
91	Pune	Maharashtra	Western Region	Warm - Humid Zone	Metropolitan city
92	Raipur	Chattisgarh	Central Region	Composite Zone	Metropolitan city
93	Rajkot	Gujarat	Western Region	Composite Zone	Metropolitan city
94	Ranchi	Jharkhand	Eastern Region	Composite Zone	Metropolitan city
95	Rourkela	Odisha	Eastern Region	Warm - Humid Zone	Medium city
96	Sagar	Madhya Pradesh	Central Region	Composite Zone	Medium city
97	Saharanpur	Uttar Pradesh	Northern Region	Composite Zone	Large city
98	Salem	Tamil Nadu	Southern Region	Warm - Humid Zone	Large city
99	Sangli Miraj & Kupwad	Maharashtra	Western Region	Hot - Dry Zone	Large city
100	Satna	Madhya Pradesh	Central Region	Composite Zone	Medium city
101	Shillong	Meghalaya	North - Eastern Region	Cold Zone	Medium city
102	Shimla	Himachal Pradesh	Northern Region	Cold Zone	Medium city
103	Shivamogga	Karnataka	Southern Region	Warm - Humid Zone	Medium city
104	Siliguri	West Bengal	Eastern Region	Warm - Humid Zone	Large city
105	Silvassa	Dadra and Nagar Haveli	Western Region	Warm - Humid Zone	Medium city
106	Solan	Himachal Pradesh	Northern Region	Composite Zone	Small Town
107	Solapur	Maharashtra	Western Region	Hot - Dry Zone	Metropolitan city
108	Srinagar	Jammu and Kashmir	Northern Region	Cold Zone	Metropolitan city
109	Surat	Gujarat	Western Region	Hot - Dry Zone	Metropolitan city
110	Thane	Maharashtra	Western Region	Warm - Humid Zone	Metropolitan city
111	Thanjavur	Tamil Nadu	Southern Region	Warm - Humid Zone	Medium city
112	Tiruchirapalli	Tamil Nadu	Southern Region	Warm - Humid Zone	Metropolitan city
113	Tirunelveli	Tamil Nadu	Southern Region	Warm - Humid Zone	Medium city
114	Tirupati	Andhra Pradesh	Southern Region	Warm - Humid Zone	Medium city
115	Tiruppur	Tamil Nadu	Southern Region	Warm - Humid Zone	Metropolitan city
116	Tiruvanantapuram	Kerala	Southern Region	Warm - Humid Zone	Large city
117	Toothukudi	Tamil Nadu	Southern Region	Warm - Humid Zone	Medium city
118	Tumakuru	Karnataka	Southern Region	Warm - Humid Zone	Medium city
119	Udaipur	Rajasthan	Northern Region	Hot - Dry Zone	Large city
120	Ujjain	Madhya Pradesh	Central Region	Composite Zone	Large city
121	Vadodara	Gujarat	Western Region	Hot - Dry Zone	Metropolitan city
122	Varanasi	Uttar Pradesh	Northern Region	Composite Zone	Metropolitan city
123	Vellore	Tamil Nadu	Southern Region	Warm - Humid Zone	Large city
124	Vijayawada	Andhra Pradesh	Southern Region	Warm - Humid Zone	Metropolitan city
125	Visakhapatnam	Andhra Pradesh	Southern Region	Warm - Humid Zone	Metropolitan city
126	Warangal	Telangana	Southern Region	Composite Zone	Large city

Both Smart & AMRUT cities   AMRUT cities   Smart Cities   Other cities

Note:
The population provided by cities has been considered. In case of discrepancy, population data provided for Ease of Living has been considered. In case of data not available then the population data from Census 2011 has been projected considering 1.3% annual growth.