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Ministry of Housing and Urban Affairs
Government of India

150 YEARS OF CELEBRATING THE MAHATMA

स्वच्छ भारत एक कदम स्वच्छता की ओर

ClimateSMART CITIES

ASSESSMENT FRAMEWORK

- ENERGY & GREEN BUILDINGS
- URBAN PLANNING, GREEN COVER & BIODIVERSITY
- MOBILITY & AIR
- WATER RESOURCE MANAGEMENT
- WASTE MANAGEMENT

DAY-NULM Deendayal Antyodaya Yojana-National Urban Livelihoods Mission

HRIDAY

प्रधान मंत्री आवास योजना-शहरी Pradhan Mantri Awas Yojana-Urban
Rejuvenating the Soul of Urban India

अमृत Atal Mission for Rejuvenation and Urban Transformation

Urban Transport

ClimateSMART CITIES

ASSESSMENT FRAMEWORK

MINISTRY OF HOUSING
AND URBAN AFFAIRS
2019

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List of Abbreviations

AFLOU	Agriculture, Forestry and other Land-use
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AQI	Air Quality Index
AT&C	Aggregate Technical & Commercial losses
BEE	Bureau of Energy Efficiency
BEI	Baseline Emissions Inventory
BSI	British Standards Institution
BUA	Built-up Area
C&D Waste	Construction and Demolition Waste
CAAQMS	Continuous Ambient Air Quality Monitoring Stations
CAGR	Compound Annual Growth Rate
CDP	Comprehensive Development Plan
CEMS	Continuous Emission Monitoring System
CMP	Comprehensive Mobility Plan
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CPCB	Central Pollution Control Board
NAMP	National Air Quality Monitoring Programme
CPHEEO	Central Public Health and Environmental Engineering Organisation
CSCAF	Climate Smart Cities Assessment Framework
CTTS	Comprehensive Traffic & Transportation Plan
CWMI	Composite Water Management Index
DCR	Development Control Regulations
DM	Disaster Management
DPRs	Detailed Project Reports
EC	Environmental Clearance
ECBC	Energy Conservation Building Code
EC-CoM	European Commission Covenant of Mayors Initiative
EOC	Emergency Operation Centre
GBCI	Green Building Certification Inc.

GDCRs	General Development Control Regulations
GDP	Gross Domestic Product
GHG	Green House Gas
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GoI	Government of India
GPC	Global Protocol for Community
GPS	Global Positioning System
GRIHA	Green Rating for Integrated Habitat Assessment
GRIP	Greenhouse Gas Regional Inventory Protocol
HH	House Hold
ICCC	Integrated Command and Control Centres
IEA	International Energy Agency
IEAP	International Local Government GHG Emissions Analysis Protocol
IGBC	The Indian Green Building Council
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
IUCN	International Union for Conservation of Nature
KPI	Key Performance Indicators
KW	Kilowatt
KwH	kilowatt hour
LCMP	Low-Carbon Mobility Plan
LEED	Leadership in Energy and Environmental Design
LFG	Landfill Gas
LPG	Liquefied Petroleum Gas
LUCF	Land use change and forestry
MoHUA	Ministry of Housing and Urban Affairs
MRF	Materials Recovery Facility
MRV	Monitoring, Reporting and Verification
MSW	Municipal Solid Waste
MSWM	Municipal solid waste management
NATCOM	India's Initial National Communication

NBC	National Building Code
NCAP	National Clean Air Programme
NDCs	Nationally Determined Contributions'
NDMA	National Disaster Management Authority
NGOs	Non-Governmental Organization
NIUA	National Institute of Urban Affairs
NMT	Non-Motorised Transport
NOx	Nitrogen Oxide
NPDM	National Policy on Disaster Management
NRW	Non - Revenue Water
O_3	Ozone
PAS 2070	Specification for the assessment of greenhouse gas emissions of a city
PCB	Pollution Control Board
PM	Particulate Matter
PMC	Project Management Consultancy
PPP	Public Private Partnership
PT	Public Transportation
PV	Photovoltaics
PWD	Public Work Department
RA	Recycled Aggregates
RCA	Recycled Concrete Aggregates
RDF	Refuse-Derived Fuel
RFID	Radio-Frequency Identification
RPOs	Renewable Purchase Obligation
RTO	Regional Transport Office
SBM	Swachh Bharat Mission
SCF	Segregated combustible fractions
SCM	Smart Cities Mission
SCP	Specialist Transportation Planning
SEAC	State Expert Appraisal Committee
SEIAA	State Environment Impact Assessment Authority

SOx	Sulphur Oxides
SPCB	State Pollution Control Board
SPV	Special Purpose Vehicle
SqKm	Square Kilometre
SWDS	Solid Waste Disposal Site
SWM	Solid Waste Management
TCO_2e	Tons CO_2 Equivalent
TERI	The Energy and Resources Institute
TOD	Transit-oriented development
TPD	Tons Per Day
ULB	Urban Local Bodies
UMTA	Unified Metropolitan Transport Authority
UNEP	The United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	The United Nations Human Settlements Programme
URDPFI	Urban and Regional Development Plans Formulation and Implementation Guidelines
VOCs	Volatile Organic Compounds
WHO	The World Health Organization
WRI	World Resources Institute

MESSAGE

Ministry of Housing and Urban Affairs
Government of India

HARDEEP SINGH PURI

Honourable Minister
of State
(Independent Charge)

Ministry of Housing &
Urban Affairs

It is the Vision of our Hon'ble Prime Minister Shri Narendra Modi to foster economic growth and improve the standard of living of the people of the country, while ensuring sustainable and inclusive development. The development of the country is intricately linked with the development of its cities. Smart Cities Mission is a people-centric and transformational Mission of the Government of India aimed at delivering a high quality of life for citizens and a clean and sustainable environment.

Smart cities are working towards integrated and comprehensive development of cities and implementing several initiatives for promotion of sustainable transport, reduction in traffic congestion and air pollution, generation of renewable energy, scientific waste management, smart water and wastewater management, disaster management etc. Cities bear a huge responsibility for balancing the needs of the present with the requirements of the future generations, in order to maintain equilibrium and to diminish the adverse effects of growing urbanisation on environment.

I am happy to launch "ClimateSMART Cities Assessment Framework" which is a felt need for inculcating climate-sensitive development approach in cities, not only while implementing the urban infrastructure schemes but also to adapt and mitigate the ongoing challenges faced by cities. This assessment framework is based on the premise that effective and long-term solutions with respect to changing climate and extreme weather events are evolved in an empowered city governance approach which acknowledges the respective roles and contributions of a wide array of actors.

I am sure with this framework, cities will step towards Sustainability, thereby contributing to Sustainable Development Goals and Government of India's Nationally Determined Contributions (NDCs).

FOREWORD

Ministry of Housing and Urban Affairs
Government of India

DURGA SHANKER MISHRA

Secretary

Ministry of Housing &
Urban Affairs

Cities are engines of growth generating around 66% of the country's GDP, 90% of tax revenue and around 70% of job opportunities. India is experiencing an unprecedented rise in the urban population which is expected to reach around 600 million by year 2030

This rapid growth in urban population poses huge challenges for the environment and well-being of citizens. It is observed that nearly 44% of India's rapidly growing carbon emissions have urban origins, emanating from transport, industry, buildings and waste contributing towards climate change. This makes our cities vulnerable and imposes huge risks towards increased water stress, heat island effect, increased frequency and severity of extreme weather events such as urban floods/ droughts. Further, curbing air quality deterioration pose serious challenges for city administrators as 43 Smart Cities in India is already facing poor air quality.

The flagship Smart Cities Mission of the Government of India aims to the economic growth of cities and improve the quality of life of citizens by encouraging measures that enable sustainable and inclusive. Cities are responsible for the climate-sensitive development of their urban areas. By taking appropriate measures, cities can make a significant contribution to mitigating climate change and increase their resilience to climate-related shocks.

To order to incentivize a holistic, climate responsive development, Ministry of Housing and Urban Affairs has initiated "ClimateSmart Cities Assessment Framework" for the 100 smart cities. This is first of its kind Assessment Framework for Cities, aimed at creating a green mind-set in the cities while they plan and undertake various development projects. This framework includes various air and climate relevant parameters that shall guide the cities and help them to assess their own preparedness to tackle the menace of climate change and degrading air quality.

I wish to place my appreciation for this assessment framework and hope it will serve as a guidance framework for a sustainable and climate resilient development. I extend my best wishes to all cities which are taking part in this initiative.

PREFACE

Ministry of Housing and Urban Affairs
Government of India

KUNAL KUMAR

Joint Secretary & Mission Director (SCM)

Ministry of Housing & Urban Affairs

Cities today host a world of contradictions as they are at the same time hubs of economic opportunity and climate risk; highly populated and cultural centres; sources of carbon emissions and birthplaces of social and technological innovation. Rapid urbanisation has enormous environmental consequences, and this may also lead to impact on human well-being. Growing numbers of city residents put pressure on energy and water resources, depleting blue-green cover, waste management, sewer systems, and transport networks.

The Government of India's "Smart City Mission" handholds the cities to adopt an approach for a sustainable and climate friendly development wherein a citizen meets the needs of the present without compromising the needs of future generations.

India accounts for about 6.5% of the global GHG emission and thereby our cities can play a significant role for contributing toward Nationally Determined contributions. If we compare the GHG emissions to Economy and Urban Population in India; GHG emissions grow at nearly 3 times the rate of Urban Population. Transport, Buildings and Waste constitutes a significant share to the National GHG contributions.

To facilitate cities in understanding these challenges, Ministry has introduced "ClimateSMART Cities Assessment Framework". This assessment framework is developed after an extensive consultative process and reviewing already existing frameworks and other assessment approaches adopted throughout the world. The assessment framework has 30 diverse indicators across five categories namely; (i) Energy and Green Buildings, (ii) Urban Planning, Green Cover & Biodiversity, (iii) Mobility and Air Quality, (iv) Waste Management and (v) Water Resource Management.

The “ClimateSmart Cities Assessment Framework” will serve as a tool for cities to assess their present situation and will facilitate cities to adopt, implement and disseminating the best practices adopted by our cities and further to set standards in comparison to the international efforts towards the green, sustainable and urban resilient habitats.

I place on record my sincere thanks to the strategic team led by GIZ and NIUA for making this assessment framework possible in such short span of time. I also thank all stakeholders and partner organizations who have provided their valuable inputs during the consultation process.

I extend my wishes to all Cities for moving towards “Sustainability and Climate Resilience” and achieving the sustainable development goals in true spirit!

EXECUTIVE SUMMARY

Executive Summary

Cities which increasingly account for most of the global population, face aggravated Climate Change impacts due to their densities. Cities while being the engines of growth and centres for economic, social & cultural development are also the biggest consumers of energy, and at risk due to the density of human population and the impacts of Climate Change. India's economic growth story and urban population increase reflects the same story, but at an enhanced scale and faster pace. Hence, Urban India's approach towards growth will play a big role in the course of global climate response.

Climate action at the level of Sustainable Development Goals and Nationally Determined Contributions demand both mitigation and adaptation measures. Indian cities have to realize that their role as consumers and their vulnerabilities to Climate change is also offset by their consumption & waste footprint and degradation of the environment. Cities can make a significant contribution to mitigating climate change and increase their resilience to climate-related shocks, if they were aware of the relevant and correct measures that were advised based on an objective and yet contextual framework. Hence, the need for a framework that recognizes the pressures of urban management in India, is integrative of ongoing actions and development aims, and can set a path to Climate Action is most desired.

Ministry of Housing and Urban Affairs has hence initiated the "ClimateSMART Cities Assessment Framework" for the 100 smart cities.

This is a first-of-its-kind public assessment framework on climate relevant parameters, including those of the recently launched National Clean Air Programme. The objective is to provide a clear roadmap for the cities and in effect, urban India as a whole, towards combating Climate Change while planning their actions within the city including investments.

The Ministry has studied the various global Climate Assessment models and their applications in India in various cities under several bilateral programs. Also, there are several India-specific frameworks that are varied in their objectives, scope, definitions and methodology. Several of these organizations and City representatives were consulted while formulating the Indicators of this assessment framework. This is in addition to the Ministry's own Ease of Living Index and those of other Ministries related to Energy Efficiency, Bio-diversity, among others. Where possible, the framework uses data sets that are already being captured in other indices or missions, but by virtue of being brought together, get focussed on Climate Action.

The challenge has been to extract the best of each that are most relevant to combating Climate Change, to address both the functionality of indicators towards tangible & effective Climate Actions and the practicality of data collection, assessment and implementing capacities across a diversity of Indian cities. This, in addition to the usual challenges of being accurate, objective and yet sensitive to inequality, assigning weights, benchmarking (relative or absolute) and the task of aggregation and indexation.

Clearly, the most prominent sectors for urban Climate Action across any frameworks, are: Transportation; Infrastructure Management (incl. Water, Wastewater & Waste management); Energy & Green buildings; Ecology (incl. Water Bodies & Green Cover) and Urban Planning (incl. Disaster resilience). Sectors such as transportation, waste, energy consumption and green cover form the most important areas for mitigation, while for adaptation, sectors such as water, bio-diversity and land-use play an important role.

The ClimateSMART Cities Assessment Framework, has 30 indicators across 5 sectors, namely, (i) Energy and Green Buildings; (ii) Urban Planning, Biodiversity and Green Cover; (iii) Mobility and Air; (vi) Water Resource Management and (v) Waste Management. It hence attempts to address both the mitigation and adaptation sides and evolves the weight of the sectors across both the above in the Indian urban context. This also includes an understanding of the particular sectors that the city authorities can assess and control themselves.

The indicators are also progressive in nature so that cities can assess where they stand in their current state and can already know the actions that will enable better ranking in the future and consequent increase in climate resilience. The framework is presented in detail in the document including a short discussion of the methodological issues.

The ClimateSMART Cities Assessment framework is an honest and bold step to put together a methodology and develop an objective approach that is clearly aspirational in its objectives, and relies on both individual and collective effort, and consequent action.

The ClimateSMART Cities Assessment Framework

has 30 Indicators across 5 Sectors

- ENERGY AND GREEN BUILDINGS
- URBAN PLANNING, BIODIVERSITY AND GREEN COVER
- MOBILITY AND AIR
- WATER RESOURCE MANAGEMENT
- WASTE MANAGEMENT

As a collective exercise, it is presently being taken up in the Smart Cities Mission, simply to attempt it in the 100 Smart cities and take advantage of the reporting systems already in place, and then take it into a cycle for improvement and further adaptation. This assessment framework, therefore aims to be SMART – i.e. Specific, Measurable, Actionable, Relevant and Time-bound. But above all, it will rely on an honest and conscious self-assessment by the cities, which will then be validated by evidence, audit and expert assessment.

Key outcomes that can be expected to emerge from this exercise include

- Benchmarking
- Peer-learning
- Capacity building needs
- Global learning
- KPI-driven spending
- Awareness creation
- Citizen Engagement
- Promotion of Circular economy

This exercise is also a part of the Ministry's focus and objective on Quality of Life. The focus is clearly on the community, the neighbourhood and the citizen; and tangible steps that can be taken towards clear impacts.

Lastly, being first-of-its-kind and aspirational, the ClimateSMART Cities Assessment Framework as seen here is an initial attempt. It does not profess to be the ideal or most comprehensive, and indeed, it will only be proven on various counts as it is taken up and implemented on the ground by the cities. Changing climate and development aspects will also have significant impact on the indicators that are being measured. Hence, it is expected to evolve over time; and that includes continued inputs from all the stakeholders, who have been part and who would like to contribute. The additional outcomes of this assessment, such as actual actions on ground, informing awareness creation, citizen participation, surfacing learning & capacity building needs focussed investments and promotion of circular economy, will be the true contribution and worth of this effort.

01
INTRODUCTION

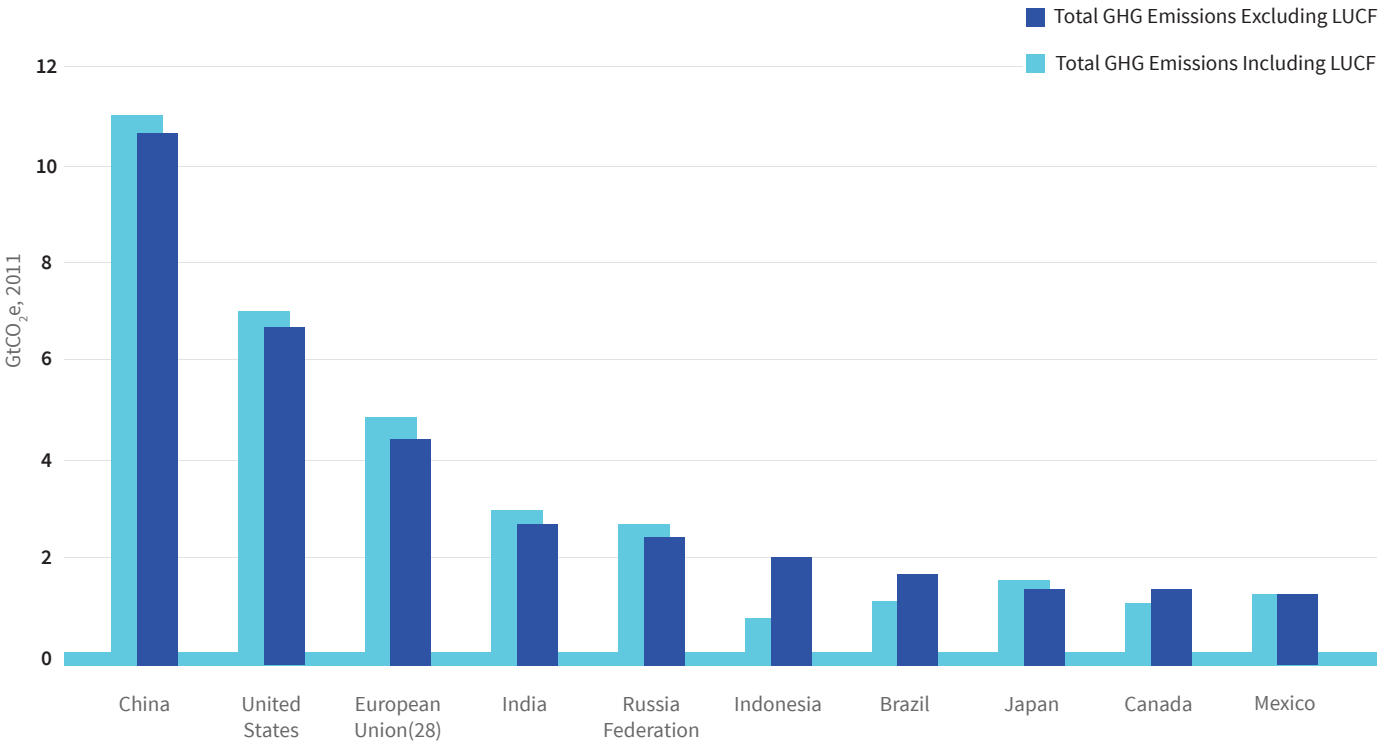
01 Introduction

Climate Change is a reality the present Governments can ignore at their own peril. While the political debate on root causes and origins continue, the fact remains that the consequences are felt by everyone in different measures. Cities, which increasingly account for most of the global population, face aggravated Climate Change impacts due to their densities and locations. Those in vulnerable zones, such as coastal cities, often face intense 'shocks' in the form of tsunamis and typhoons, while the changes in temperature, precipitation, evaporation and other aspects, lead to increased 'stress' on existing infrastructure, scenarios like urban flooding and disruption of critical services very often in many cities.

1.1 Global Urban Green House Gas Scenario

Developing countries such as China and India, with large populations, rank 1st and 4th respectively in terms of GHG emissions in the world (Figure 1). Half of the world's population lives in cities, a share that is likely to reach 70 percent in 2050 (World Bank, 2010). This is as cities consume as much as 80 percent of energy production worldwide and account for a roughly equal share of global greenhouse gas emissions. As development proceeds, greenhouse gas emissions are driven less by industrial activities and more by the energy services required for lighting, heating, and cooling (ibid).

Figure 1: Top Global GHG emitters

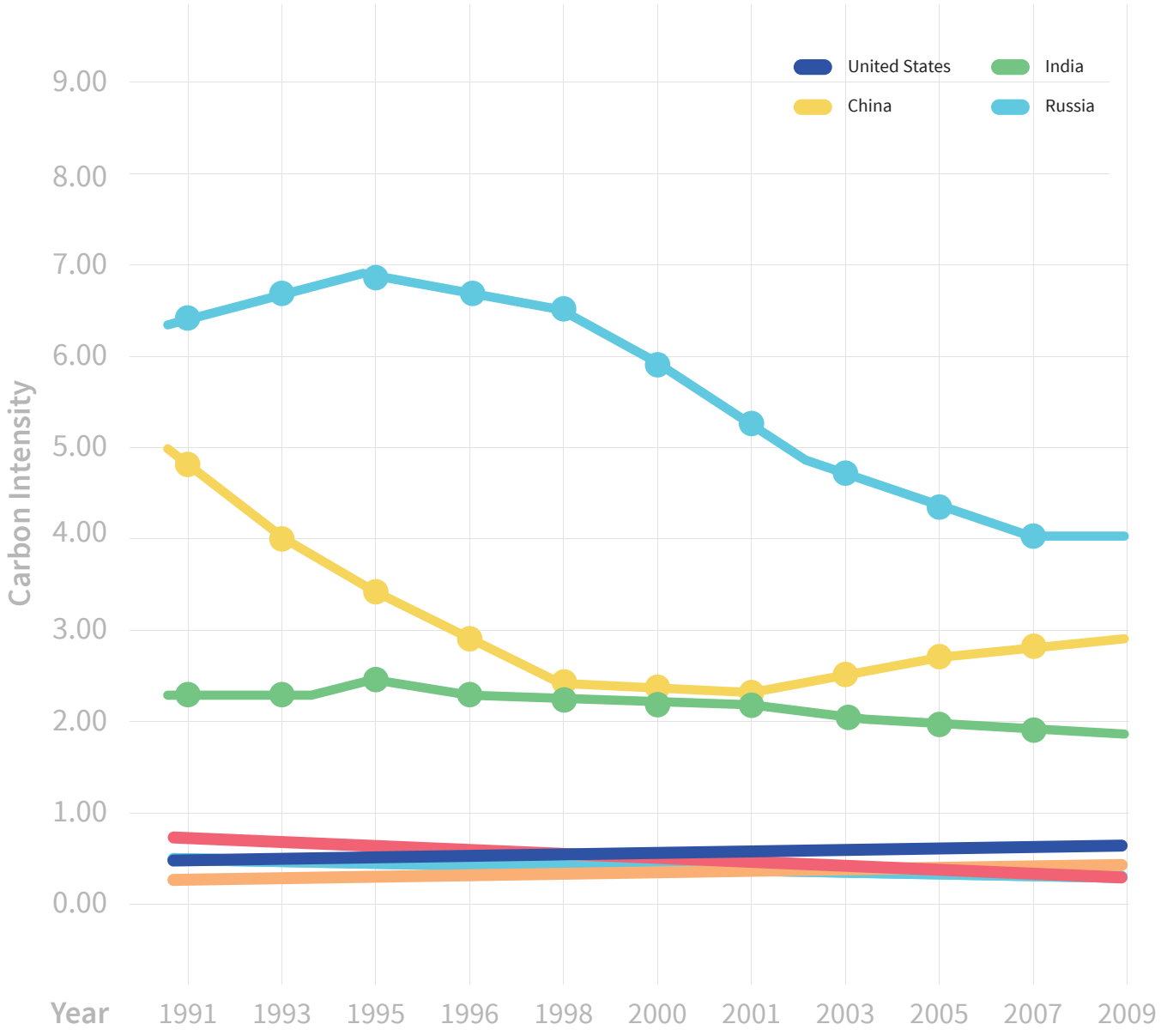


Source: November 25, 2014, Graphs Explain the World's Top 10 Emitters, WRI

Therefore, how cities grow and meet energy demand is critical to climate change. Energy use and carbon emissions are mostly driven by how electricity is produced and how energy is used in buildings and transit (Kamal-Chaoui 2009). Cities meet approximately 72 percent of their total energy demand from coal, oil, and natural gas—the main contributors to greenhouse gas emissions. Globally, cities also use about 70 percent of the energy generated from renewable sources; however, these sources still make up just a small share of total energy consumed (World Bank, 2010).

The International Energy Agency (IEA) estimates that urban areas currently account for over 67 percent of energy-related global greenhouse gases, which is expected to rise to 74 percent by 2030. Further, it is estimated that 89 percent of the increase in CO_2 from energy use will be from developing countries (IEA 2008).

Figure 2: Carbon intensity by country (kg CO_2/constant USD)



Source : Ramachandra, T.V. et. al. (2014). Sector-Wise Assessment of Carbon Footprint Across Major Cities in India. S. S. Muthu (ed.), Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, EcoProduction

Internationally, cities have used different methodologies to determine GHGs across their jurisdictions or urban regions:

- Greenhouse Gas Regional Inventory Protocol (GRIP), 2010, http://www.grip.org.uk
- International Local Government GHG Emissions Analysis Protocol (IEAP) (2009). Local Governments for Sustainability (ICLEI) www.iclei.org/fileadmin/user.../GHG/LGGHGEmissionsProtocol.pdf
- International Standard for Determining Greenhouse Gas Emissions for Cities (2010). UNEP, UN-HABITAT, World Bank http://www.unep.org/urban_environment/PDFs/InternationalStd-GHG.pdf
- Baseline Emissions Inventory (BEI)/Monitoring Emissions Inventory Methodology (2010) European Commission Covenant of Mayors Initiative (EC-CoM) http://eumayors.eu/mm/staging/library/seap_gl/docs/001_Complete_version.pdf
- U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, ICLEI USA (2012)
- PAS 2070: Specification for the assessment of greenhouse gas emissions of a city, BSI (2013)

The IPCC report (2014) shows that globally, the top sectors contributing to GHG Emissions are Electricity and Heat production (25%), Industry (Manufacturing & related) (21%), and Transportation (14%). It must be noted that 24% of emissions (both CO_2 & non-CO_2) actually emerge from Agriculture, Forestry and other Land-use (i.e. other than building) (AFLOU), arising from cultivation, livestock, and negative aspects of deforestation and soil degradation. Globally, the largest off-setters of emissions come from the sectors of Biodiversity and Forestry, Renewable Energy, and Methane Capture; but this is a changing figure as it is often set against the emissions in each year.

TOP SECTORS CONTRIBUTING TO GHG EMISSIONS

25% Electricity and Heat production

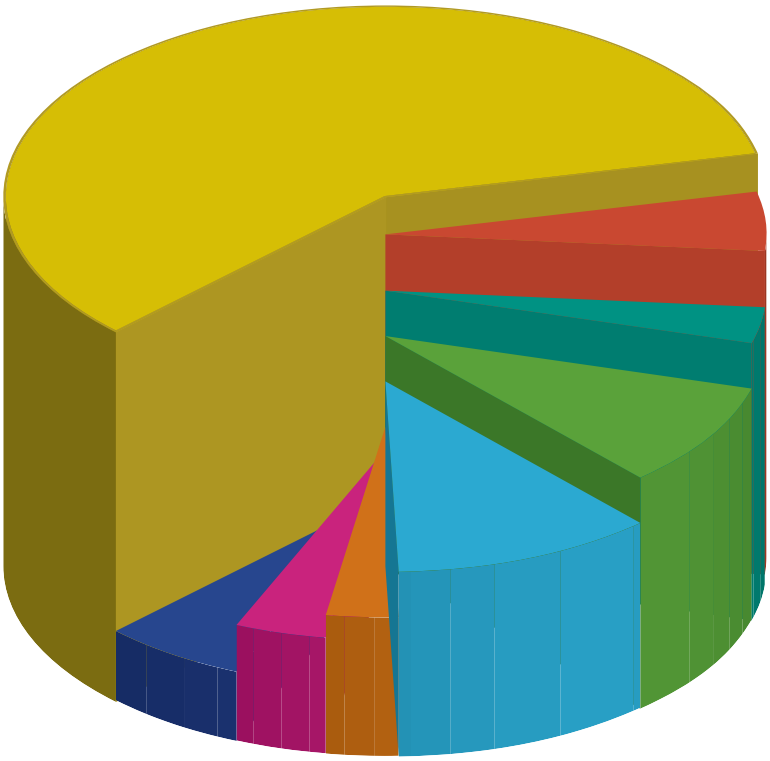
21% Industry (Manufacturing & related)

14% Transportation

1.2 Indian Urban Green House Gas Scenario

India accounts for about 6.5% of the global GHG (2379.16 out of 45261.25 million tonnes CO_2 equivalent in 2018), thereby playing a crucial role in combating climate change. Government of India declared in their Intended Nationally Determined Contribution (INDC) in October 2015 to reduce the emission intensity by 33-35% compared to the 2005 levels by 2030. i. e. 605 million tonnes CO_2 equivalent (35% of 1727.71 million tonnes CO_2 equivalent in 2005). Urban measures contribute significantly to several of the mitigation and adaptation measures highlighted in the contributions. It is evident from the third NATCOM Report to the UNFCCC, apart from Electricity Generation (59%), the top three sectors contributing to Emissions that lie under Urban domain are Transport (6%); Waste (5%); and Residential (4%, which deals with Energy in residential & commercial sectors).

Figure 3: Contribution to National GHG Emissions – across broad Sectors



59% Energy: Electrical Power

5% Waste

3% Industry Other

9% Industry: Iron & Steel

11% Industry Cement

3% Other Energy: (Coal, Biomass, etc.)

4% Residential

6% Transport

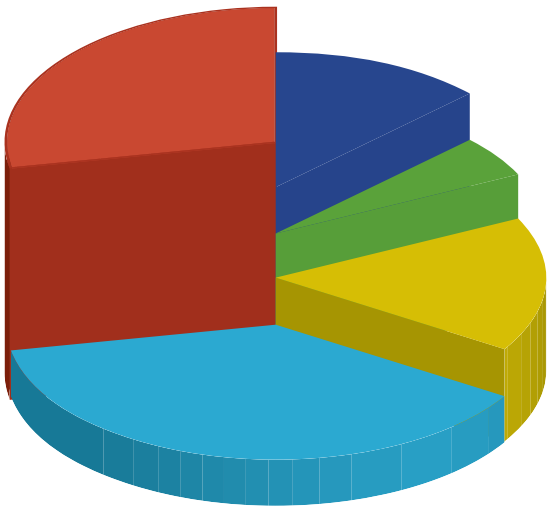
Source : Climate Change Impacts, Vulnerability and Adaptation in Urban Settlements; Draft Report: Preparation of India's Third NATCOM to the UNFCCC, NIUA, 2013

If we examine the urban and rural generation of GHG emission scenario in India, urban areas contribute 87%, while rural areas are only at a meagre 13% (Figure 4). Even within the urban areas the mega cities, million + cities and class I cities together contribute 59% of total GHG emissions. Most of the Smart Cities fall in this category. So, it is time that cities take remedial actions to decrease their emissions.

It is further stated that nearly 44% of India's rapidly growing carbon emissions have urban origins, emanating from transport, industry, buildings and waste contributing towards climate change (TERI; 2015).

In a first step to assess GHG mitigation from urban infrastructure projects, the Ministry did a study on quantification of the Greenhouse Gas mitigation potential of the various missions undertaken, namely, Smart Cities Mission, AMRUT and Swachh Bharat Mission. The estimated impact of Urban Infrastructure Schemes on Mitigation of Green House Gases (GHG) Emission is given in Table 1. The report further stresses upon the green spaces, water and energy sectors which has the maximum potential for GHG Mitigation (million tonnes CO_2 equivalent) (Table 2).

Figure 4 : Contribution in Urban – Rural GHG Emissions



13% Rural

38% Class I- Cities (Excluding Million+ or Megacities)

28% Class I - Class VI Census/Towns/Cities

16% Million + Cities

5% Megacities

Source : Climate Change Impacts, Vulnerability and Adaptation in Urban Settlements; Draft Report: Preparation of India's Third NATCOM to the UNFCCC, NIUA, 2013

Table 1: GHG Mitigation Potential from Urban Missions[1]

Mission Name	GHG Mitigation (million tonnes CO_2 equivalent)	
	2021	2031
AMRUT	122	220
SBM	06	19
Smart Cities	05	31
Total	**133**	**270**

[1]*Source: TERI (2015); Draft Report on the "Study on quantification of the Greenhouse Gas mitigation potential of the various development initiatives undertaken by Government of India."*

Table 2: GHG Mitigation Potential from various Sectors[2]

Sector	GHG Mitigation (million tonnes CO_2 equivalent)	
	2021	2031
Integrated Water Management (Water Supply, Sewerage, Septage and Rainwater harvesting)	27.08	55.36
Energy Management (Rooftop Solar PV, Green Buildings & energy efficiency)	59.43	151.86
Green Spaces and Parks (with 15% increase)	41.80	45.00
Solid Waste Management	5.35	19.0

India, with its rapidly growing cities, needs to know and document its emission sources and devise an abatement plan. To some extent GHG accounting has been done at national, sub-national level and city level in India, however a single coherent approach is still desired across Indian cities.

The Smart City Mission has also been looked at as an important step towards focussing and planning actions towards sustainability, climate resilience and indeed quality of living of the cities. From the perspective of planned investments in infrastructure from the Smart City Mission itself and the other urban missions such as AMRUT, Swachh Bharat Mission, a well-informed and reliable system of assessing urban India's steps towards Climate Action are necessitated.

[2]*Source: TERI (2015); Draft Report on the "Study on quantification of the Greenhouse Gas mitigation potential of the various development initiatives undertaken by Govern*

1.3 Impacts on Urban Areas due to Changing Climate

India is ranked 6th among the 10 most affected countries in the world as per Global Climate Risk Index 2016 (Germanwatch; 2018). In the last two decades (1998-2018), 73,200 human life losses and 256 Billion USD loss (calculated in purchasing power parity terms) has been reported. India is second worst in extreme weather deaths in 2017 (2736 deaths and 13.8 bn USD loss) after Puerto Rico. In 2016 alone, India lost human 2119 lives and over USD 21 billion worth of properties.

The changing climate makes our cities vulnerable and imposes huge risks towards increased water stress, heat island effect, increased frequency and severity of extreme weather events such as urban floods/ droughts. Further, curbing air quality deterioration poses serious challenges for city administrators as 43 out of 100 smart cities in India is already facing poor air quality (NCAP; 2018).

Major cities in India have witnessed loss of life and property, disruptions to transport and power, incidences of epidemics due to floods during the monsoons, most notable amongst them being Mumbai in 2005, Surat in 2006 and Kolkata in 2007; Chennai 2017; Kerala 2018 the recent ones. The changing pattern of rainfall due to climate change and a variety of other associated factors of urbanization were key attributors to these incidents. These incidences also highlight the associated loss of life, public property and inconveniences particularly due to traffic snarls.

Composite Water Management Index (CWMI)- A national tool for Water Measurement, Management & Improvement, released by NITI Aayog, revealed that Twenty-one cities, including Delhi, Bengaluru, Chennai and Hyderabad will run out of groundwater by 2020, affecting 100 million people. As per a Down to Earth news article released in June 2018, 360 million people will be exposed to extreme heat in 142 Indian cities by 2050. Changes in precipitation patterns and water cycle will increase the already existing problems of water supply and quality in urban areas, especially in big cities, therefore, directly impacting the sanitation. Lack of sanitation and potable water will increase contaminated water and food-borne diseases like cholera, typhoid, diarrhoea, hepatitis, and gastroenteritis. Warmer cities will also induce an increase in respiratory diseases due to pollution whose effects are reinforced by higher temperatures. Extent of environment-related diseases will increase. Warmer and/or wetter period of breeding will provide ideal conditions for expansion of mosquito-borne diseases as puddles, in which malaria carrying mosquitoes breed, are created either by excessive rainfall or by droughts in rivers.

Keeping the above issues in mind, it is therefore time that some concentrated action is taken by the cities to not only solve the impending crisis but also to plan in a comprehensive manner for the future.

1.4 Actions in the context of Urban India

Cities are responsible for the climate-sensitive development of their urban areas. While they are a significant contributor to climate change, they are also particularly vulnerable to its consequences. By taking appropriate measures, cities can make a significant contribution to mitigating climate change and increase their resilience to climate-related shocks.

These key activities can be expected to emerge or to be highlighted from this ClimateSMART Cities Assessment Framework. Envisaged outcomes of the framework include benchmarking, peer-learning, capacity building, global learning, KPI-driven spending, awareness creation, citizen engagement and promotion of circular economy, among many others. This exercise is also a part of the Ministry's focus and objective on Quality of Life, clearly involving communities, neighbourhoods and citizens, to develop tangible steps that lead towards clear impacts.

1.5 Existing Frameworks/Certification Programs:

Frameworks have been developed by various national and international organizations to rate the environmental sustainability or "greenness" at the scale of existing and developing cities. They are usually linked to ongoing and proposed green policy interventions and the extent of implementation of green initiatives in cities. Among the most prominent and comprehensive frameworks are the ones shown below in the table. The key areas they look at comprise energy, green buildings, urban planning, green cover, resilience, biodiversity, mobility, air quality, water management and waste management.

All the frameworks are robust in themselves and have different objectives (varying from simple energy efficiency to resilience to urban planning), and hence vary in their scope, methodology and ambits (see Table 3).

Table 3: Focus areas of reviewed, existing frameworks

Existing National and International Frameworks	Energy	Green Building	Urban Planning	Green Cover	Resilience	Bio-Diversity	Mobility	Air Quality	Water Manage-ment	Waste Manage-ment
"City keys indicators for Smart City Projects and Smart Cities"-EU	✓		✓	✓	✓		✓		✓	✓
LEED v 4.1; Cities and Communities Existing 2018- US Green Building Council	✓	✓	✓	✓			✓		✓	✓
The Green City Index - Siemens and Economist Intelligence Unit	✓	✓		✓			✓	✓	✓	✓
Green Cities "(For existing cities)- CII		✓	✓		✓		✓	✓	✓	✓
Green Rating for Integrated Habitant Assessment for Cities- GRIHA	✓	✓		✓			✓	✓	✓	✓

Aspects of sustainability and climate resilience are also captured under various programmes and codes of Indian Ministries such as the Energy Conservation Building Code (ECBC) of the Bureau of Energy Efficiency (BEE; Ministry of Power); the National Clean Air Programme (Ministry of Environment, Forest and Climate Change) and the National Solar City Programme (Ministry of New & Renewable Energy). Furthermore, climate relevant aspects have also been incorporated into the National Building Code (NBC) of the Bureau of Indian Standards of the Ministry of Consumer Affairs, Food & Public Distribution.

As the above frameworks, codes and programmes vary in nature and scope, each has been reviewed to provide the base for developing the present CSC framework.

1.6 ClimateSMART Cities Assessment Framework

The Government of India's "Smart City Mission", launched in 2015, focuses on the entire urban eco-system, namely, Liveability, Economic-ability and Sustainability. All the selected 100 smart cities, with a total population of 10 crores, face multiple challenges comprising among others: adequate water supply, efficient public transport, assured electricity supply, safety and security, affordable housing and good governance. Therefore, a comprehensive, smart development of institutional, physical and economic infrastructure has to be striven for.

To assess the liveability of cities, Government of India developed the Ease of Living Index in 2017. The Swachh Survekshan survey captures the status and development of infrastructure in Indian cities. Yet, the sustainability, especially in respect to climate resilience of Indian cities is not yet focused on.

Against this backdrop, Ministry of Housing and Urban Affairs has initiated this "ClimateSMART Cities Assessment Framework" to incentivize a holistic, climate responsive development. This is a first-of-its-kind public assessment framework on climate relevant parameters.

The objective is to provide a clear roadmap for the cities and in effect, urban India as a whole, towards combating Climate Change (mitigation and adaptation) while planning their actions including investments.

The Framework is not a "grading" or "ranking" system comparing the cities, nor is it intended as a sub-mission or strategy for funding activities or projects. However, tangible and effective actions will be apparent after conducting the assessments for the index. These actions then will have a clear climate focus and be more credible when submitted to various sources of funding, national & international.

The framework has been developed after a rigorous process of discussions and consultations with various experts in the fields of Climate Change and Urban Governance. Where possible, the framework uses data sets that are already being captured in other indices or missions, but by virtue of being selected and brought together, get focussed on Climate Action.

Clearly in terms of mitigation, sectors such as transportation, waste, energy consumption and green cover become more important, while for adaptation, sectors such as water, bio-diversity, and urban planning and land-use play an important role. The CSC Framework, hence attempts to address both the mitigation and adaptation sides and evolves the weightage of the sectors across both the above for the Indian urban context. This includes an acute understanding of the particular sectors that the city authorities can control themselves.

The CSC assessment framework has 30 indicators across 5 sectors, which are not only functional, but also doable in the current context of Indian Smart Cities, (i) Energy and Green Buildings; (ii) Urban Planning, Green Cover and Biodiversity (iii) Mobility and Air; (vi) Water Resource Management (v) Waste Management (See Figure 5 and Table 4).

Figure 5 : ClimateSMART Cities (CSC) Assessment Framework

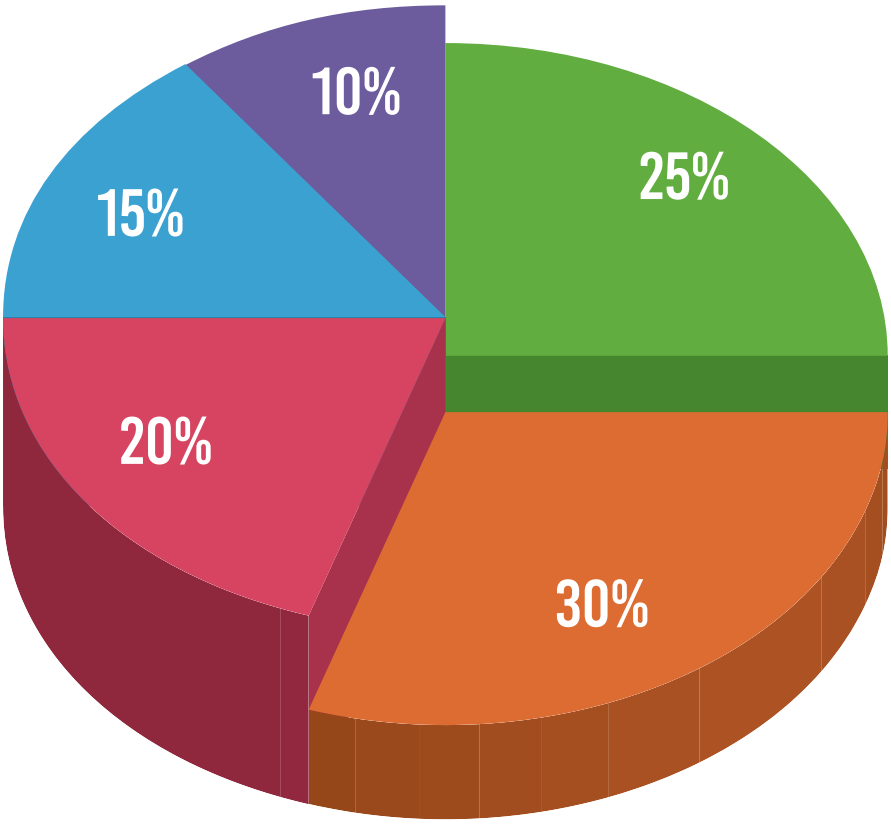
Table 4: List of Indicators across each category

Energy & Green Buildings	Urban Planning, Green Cover & Biodiversity	Mobility & Air	Water Resource Management	Waste Management
1. Percentage of electrical power in city derived from renewable energy sources	1. Climate Action Plan	1. Low Carbon Mobility	1. Water Resources Assessment and Management	1. City demonstrates reduction of waste generation in last 5 years
2. Per capita and per area electricity consumption for municipal services	2. Disaster Resilience	2. Low carbon buses	2. Extent of Non-Revenue Water	2. Extent of recyclables recovered and SCF/RDF Utilized
3. Per capita fossil fuel (Diesel, Petrol, CNG, LPG) consumption for municipal services	3. Rejuvenation and Conservation of Urban Environment (water bodies, open spaces and built-up area)	3. Extent of increase in Public Transport Ridership	3. Flood risk assessment and management	3. Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA) derived from City Construction and Demolition (C&D) waste are utilized.
4. Energy-efficient street lighting in the city	4. Proportion of Green Cover	4. Percentage of coverage of Non-Motorized Transport network (pedestrian and bicycle) in the city	4. Wastewater recycle and reuse	4. Greenhouse Gases (GHGs) emission reduced due to improved Municipal Waste processing and treatment facilities
5. Level of compliance procedures in place for green buildings	5. Proportion of native tree species	5. Clean Air Action Plan (Pollutant Monitoring, Planning and Implementation)	5. Energy-efficient wastewater management system in the city	5. Scientific Landfill is available with city as per SWM Rules, 2016
6. Percentage of buildings securing third party green building certification upto minimum level at completion stage	6. Urban biodiversity	6. Level of Air Pollution	6. Energy-efficient water supply system in the city	6. Scientific landfill closure considers landfill gas management

As with other SMART indicators, this assessment framework aims to be Specific, Measurable, Actionable, Relevant and Time-bound. The additionality is that the progressive indicators will now provide each city with a roadmap so that they can chart their own progress and devise relevant actions.

The assessment framework gives the highest weightage to indicators under "Energy and Green Buildings" and "Green cover, Biodiversity and Urban Planning"- 30% and 25% respectively, considering the extent of impact that aspects of these sectors have directly on building climate resilience in Smart Cities (See Figure 6). The indicators are progressive in nature so that cities can assess where they stand in their current state and can already know the actions that will enable better ranking in the future and consequently an increase in climate resilience.

Figure 6: Weightages of the sectors for ClimateSMART Cities Assessment Framework



30% Energy and Green Building

25% Urban Planning, Green Cover & Biodiversity

10% Waste Management

15% Water Resource Management

20% Mobility and Air

02
METHODOLOGY

02 Methodology

The set of 30 indicators that form the ClimateSMART Cities Assessment Framework are a combination of metrics that have varied nature and specifications. So, a series of steps have to be followed to standardize the data for comparability across the indicators. These have been outlined in this section. We begin with the process of data collection.

2.1 Data Collection

Since 100 Smart cities across India show wide variations in population sizes, it was deemed fit to bifurcate them into different tiers for better comparison. The classification of the cities are as follows:

Table 5: Classification of the Cities

Tiers	Population Range
Tier 1	POPULATION HIGHER THAN 10 LAKHS
Tier 2	POPULATION BETWEEN 5 LAKHS AND 10 LAKHS
Tier 3	POPULATION LESS THAN 5 LAKHS

The cities are required to access this assessment framework on the web portal and upload all relevant documents online. The data collection and analysis will be done for all the cities across the three tiers. It is recognized that hill towns, and others with very unique geo-physical contexts would have different issues. However, the Framework is not intended for benchmarking between the cities and allows for many contextual approaches to be adopted in the Action Plans that are required, within the indicators. Since the assessment is for Climate Change that must be measurable in objective terms, most of the other indicators have universal application and must be attempted by all cities in their contexts. However, any particular inputs or challenges faced by particular cities would be taken into account suitably in the assessment finalization process.

Any learnings gathered from the process in the initial years of implementation will be used to improve upon the existing framework in the forthcoming year of assessment.

2.2 Scoring Methods

The indicators formulated are progressive and aspirational in nature. Each indicator not only assess but also provide a step wise guidance to progress and achieve the highest levels. The various aspirational/ progressive stages are from 0-4. The city will be assessed based on the existing situation and is also provided guidance and action to be taken to move to the next stage, once the city aspires for the next phase of assessment.

The nature of the indicator determines the nature of the data that is collected, and its units of measurement. This may vary considerably across categories. Each kind of indicator will have a different scoring mechanism, but the following are the different types used in this framework currently.

A. PERCENTAGE

Several indicators mark the performance of a city in terms of coverage of services or amenities provided or achieved or natural offsetting means available, marked against a larger total, e.g. the total population or per capita figures or total area. These indicators will, therefore, take the form of percentages. Examples are apparent in the indicators explained below.

B. RATIO

Similarly, to weigh the data for comparability some indicators will be obtained in the form of ratios of one aspect against the other, and the higher the ratio, the better.

C. BINARY MARKING

Some indicators take the form of yes or no questions to the municipalities, and the levels go directly between 0 and full or 4. e.g. has city conducted a water resource assessment or Does the city have a storm water drainage plan.

D. BENCHMARKING

Some indicators fix an ideal or optimal value (either 100% or a certain unit of universal achievement) as benchmarking, while others take the best (or worst) performing city in the same tiers of comparison as a benchmark to be measured against. There are no indicators that use a deviation from mean as measurement, as they all have prog ressive marking across levels

E. NORMALIZATION

This is usually required to make the indicators comparable with each other, and to bring in standardisation or data aggregation across different units of measurement, which can enable a single ranking amongst cities. However, in the case of the ClimateSMART Cities Assessment Framework, the value for each indicator is assigned on the selected criteria in terms of performance evaluation levels (level 0 to level 4), hence the issue of different units does not arise. The values of performance level ranges from 0-4, and the levels are defined such that there is no scope of outlier or extreme value, therefore, this exercise does not require the normalization process.

F. AGGREGATION

The aggregation methodology of the ClimateSMART Cities Assessment Framework is based on three elements i.e. category, indicators, and performance level. Presently, each category is given weightage based on the rational discussed in the previous sections and each indicator is assigned weightage in proportion to the category it belongs to. The category wise score is calculated by summing the weighted scores against each indicator. The category wise list of indicators and maximum score allocated is as per the Table 6.

Table 6: Scoring Methodology

Category	Category Score	Indicators	Maximum Assigned Score	Score Obtained	Aggregate Category Score
Energy & Green Building	300	Total electrical power in city derived from renewable energy sources	40	Z_1	$A=(Z_1+Z_2+Z_3+Z_4+Z_5+Z_6)$
		Per capita and per unit area electricity consumption for municipal services	30	Z_2	
		Per capita fossil fuel consumption for municipal services	60	Z_3	
		Energy-efficient street lighting in the city	50	Z_4	
		Level of compliance and implementation procedures in place for green buildings	60	Z_5	
		Percentage of buildings securing third party green building certification upto minimum level at completion stage	60	Z_6	

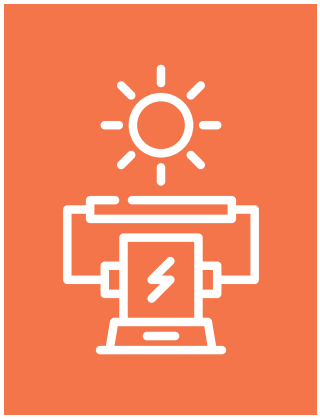
Urban Planning, Green Cover & Biodiversity	250	Climate Action Plan	80	Z_1	B= $(Z_1+Z_2+Z_3+Z_4+Z_5+Z_6)$
		Disaster Resilience	40	Z_2	
		Rejuvenation and Conservation of Urban Environment (water bodies, open spaces and built-up area)	40	Z_3	
		Proportion of Green Cover	40	Z_4	
		Proportion of Native Tree Species	20	Z_5	
		Urban Biodiversity	30	Z_6	
Mobility and Air	200	Low Carbon Mobility plan	40	Z_1	C= $(Z_1+Z_2+Z_3+Z_4+Z_5+Z_6)$
		Low Carbon Buses	20	Z_2	
		Public Transport Ridership Index	25	Z_3	
		Percentage of coverage of Non-Motorized Transport network (Pedestrian and bicycle) in the city	25	Z_4	
		Clean Air Action Plan (Pollutant Monitoring, Planning and Implementation)	50	Z_5	
		Level of Air Pollution	40	Z_6	
Water Resource Management	150	Water Resources Assessment and Management	25	Z_1	D= $(Z_1+Z_2+Z_3+Z_4+Z_5+Z_6)$
		Extent for Non-Revenue Water	25	Z_2	
		Flood risk assessment and management	25	Z_3	
		Wastewater Recycle and Reuse	25	Z_4	
		Energy-efficient wastewater management system	25	Z_5	
		Energy-efficient water supply system in the city	25	Z_6	
Waste Management	100	City demonstrates reduction of waste generation in last 5 years	10	Z_1	E= $(Z_1+Z_2+Z_3+Z_4+Z_5+Z_6)$
		Extent of recyclables recovered and SCF/RDF Utilised	25	Z_2	
		Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA) derived from City Construction and Demolition (C&D) waste are utilised	25	Z_3	
		Greenhouse Gases (GHGs) emission reduced due to improved Municipal Waste processing and treatment facilities	10	Z_4	
		Scientific Landfill is available with city as per SWM Rules, 2016	10	Z_5	
		Plan prepared and implemented for scientific landfill/dumpsite closure considering GHG emissions	20	Z_6	
Total Maximum Assigned Score			**1000**		

ClimateSMART City Score = (A+B+C+D+E)

03
INDICATORS

Indicators

3.1 ENERGY AND GREEN BUILDINGS



Indicator 1: Total electrical power in city derived from renewable energy sources

Rationale: Fossil fuels such as coal, natural gas and oil are the major sources of energy in our country. Green House Gases (GHG) are emitted while producing energy from fossil fuels thereby causing environmental issues. Production of energy from cleaner renewable energy sources (solar PV, solar thermal, wind energy, hybrid, hydel power, small hydro, geo-thermal energy, tidal energy) would minimize GHG emission.

Description: The indicator encourages the replacement of existing power demand from fossil fuels with cleaner, renewable energy sources.

Methodology: Identification of current power generated and supplied from all grid connected renewable energy sources, as well as installed capacity of renewable energy sources for self-consumption as against the total power consumption in the city and total connected load, in the last year before assessment (based on bi-annual assessment).

Formula:

$$\left[(0.4x \frac{\text{Cumulative power generated from all grid connected renewable energy sources in the city}}{\text{Total power consumption in city from electrical power"}} \right) + (0.4x \frac{\text{Cumulative power supplied (in KwH) from all grid connected renewable energy sources to the city}}{\text{Total power consumption (in KwH) in city+total number of units (in kWh) lost due to AT\&C loss}}) + (0.2x \frac{\text{Cumulative installed capacity(KW) from renewable energy sources for self consumption}}{\text{Total connected load (in KW) in the city}})] \times 100$$

Unit: Percentage(%)

Maximum Score: 40

Performance Evaluation Levels:

	0	1	2	3	4
Criteria/ Sub-indicators/ Progression Levels	No power generated from renewable sources	1% - <5% of the city power demand is from renewable energy	5% - <10% of the city power demand is from renewable energy	10% - <25% of the city power demand is from renewable energy	25% and above of the city power demand is from renewable energy
Evidence/ Data Sources	• Data on total power consumption can be obtained from local power distribution companies (DISCOMs) • Data on grid-connected renewable energy supplied incl. RPOs, verified by Energy Development Agencies giving any subsidies • Installed renewable energy capacity in the city				
Responsible Agency/ Department	DISCOMs, ULB	DISCOMs, ULB	DISCOMs, ULB	DISCOMs, ULB	DISCOMs, ULB
Score	0	10	20	30	40

Indicator 2: Per capita and Per area electricity consumption for municipal services*

**Water supply, sewerage, street lights, waste treatment, fire services, municipal schools, parks and gardens, govt. Hospitals/clinics, community halls, cremation facilities, municipal buildings*

Rationale: Growing urban areas and urban population are increasing the electricity demand in cities. Fossil fuel consumption is increasing in order to cope with this growing demand for electricity, leading to higher GHG emissions. Controlling the per capita and per area consumption of electricity for municipal services will lead to lower GHG emissions.

Description: The indicator assesses the amount of electricity that is used by the city for its municipal services (water supply, sewerage, street lights, waste treatment, fire services, municipal schools, parks and gardens, govt. Hospitals/clinics, community halls, cremation facilities, municipal buildings) and encourages lower consumption in comparison to the best performing cities.

Methodology: City(s) with the lowest consumption (amongst cities in the same Tier) will be treated as a benchmark (referred to as "X") to calculate the total electricity consumption against the density of the city. Consumption figures would be taken for the last year before assessment (financial year for June assessment, Oct-Sep for December assessment).

Formula:

$$\frac{\textit{Total electricity consumption(KwH) for municipal services}}{\textit{Density* of the city}}$$

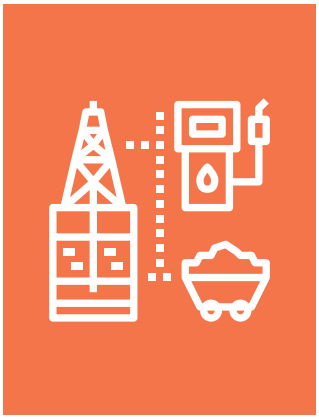
**Density = Total population of the city /total area in sq.km*

Unit: kwh per capita per sq.km

Maximum Score: 30

Performance Evaluation Levels:

	0	1	2	3	4
Criteria/ Sub-indicators/ Progression Levels	Above 10x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Above 4x & upto 10x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Above 2x & upto 4x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Above 1.1x & upto 2x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Upto 1.1x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)
Evidence/ Data Sources	• Municipal Electricity bills • Municipal Budget document • Total area of the city • Census of India population figures indexed with average annual growth rate for the year 2018 as per SCP				
Responsible Agency/ Department	ULB				
Score	0	5	10	20	30



Indicator 3: Per capita fossil fuel (Diesel, Petrol, CNG, LPG) consumption for municipal services*

**Water supply, sewerage, street lights, waste treatment, fire services, municipal schools, parks and gardens, govt. Hospitals/clinics, community halls, cremation facilities, municipal buildings*

Rationale: Diesel, Petrol, CNG and LPG are the major source of energy for municipal services in India, leading to increasing GHG emissions. This indicator aims to incentivise cities to lower their per capita CO_2 emission while encouraging them to switch to alternative cleaner fuel sources for municipal services.

Description: The indicator will assess the amount of fossil fuels i.e. Petrol, Diesel, CNG, LPG utilized for undertaking the daily municipal services (water supply, sewerage, street lights, waste treatment, fire services, municipal schools, parks and gardens, govt. Hospitals/clinics, community halls, cremation facilities and municipal buildings).

Methodology: City(s) with the lowest per capita fuel consumption on municipal services (amongst cities in the same Tier) will be treated as benchmark (referred to as "X"). The consumption of diesel, petrol, CNG and LPG will be calculated against the total population of the city in the last year before assessment (financial year for June assessment, Oct-Sep for December assessment).

Formula:

$$\frac{\text{Total } TCO_2e^* \text{ of fossil fuel (diesel+petrol+CNG+LPG) consumption by the city for municipal services}}{\text{Total population of the city}}$$

**Total TCO_2e = (Total diesel consumption x2.62694 + Total petrol consumptionx2.20307 + Total LPG Consumption x1.51906 + Total CNG Consumption x0.48066)*

Unit: Tons CO_2 equivalent per capita

Maximum Score: 60

Performance Evaluation Levels:

	0	1	2	3	4
Criteria/ Sub-indicators/ Progression Levels	Above 10x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Above 4x & upto 10x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Above 2x & upto 4x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Above 1.1x & upto 2x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)	Upto 1.1x as compared to the city with the lowest per capita consumption (amongst Tier I, II & III)
Evidence/ Data Sources	• Separate Petrol, Diesel, CNG & LPG consumption bill from Municipal budget for each category • Census of India population figures indexed with average annual growth rate for the year 2018 as per smart city proposal				
Responsible Agency/ Department	ULB				
Score	0	15	30	45	60

Indicator 4: Energy-efficient street lighting in the city

Rationale: Street lighting is a major contributor to the city's electricity consumption. energy-efficient Street Lighting systems will reduce the dependence on electricity from fossil fuels thus indirectly reducing GHG emissions in the city.

Description: The indicator will assess the extent to which cities have shifted to use of energy-efficient street lights and encourages the higher use of energy-efficient systems.

Methodology: The number of energy-efficient street lights in the city will be assessed against the total number of street lights in the city, as per the existing on-ground & commissioned status at the time of assessment.

Formula:

$$\frac{\textit{Total number of energy-efficient street lights in the city}}{\textit{Total number of street lights in the city}} \times 100$$

Unit: Percentage(%)

Maximum Score: 50

Performance Evaluation Levels:

	0	1	2	3	4
Criteria/ Sub-indicators/ Progression Levels	0 streets lights in the city are energy-efficient	Upto 25% streets lights in the city are energy-efficient	Upto 50% streets lights in the city are energy-efficient	Upto 75% streets lights in the city are energy-efficient	Upto 100% streets lights in the city are energy-efficient
Evidence/ Data Sources	• Total number of street lights in the city • Municipal records/documentary evidence for the number of street lights replaced with energy efficient street lights				
Responsible Agency/ Department	ULB				
Score	0	5	15	30	50

Indicator 5: Level of compliance procedures in place for green buildings

Rationale: Buildings, throughout their life cycles, are one of the prime contributors of GHG emissions in the city. In order to encourage the construction and use of green and energy-efficient buildings, there are a number of compliances and implementation procedures that need to be in place from the city's side. This indicator checks the readiness of the city with regard to these compliance procedures for subsequent promotion of green and energy-efficient buildings

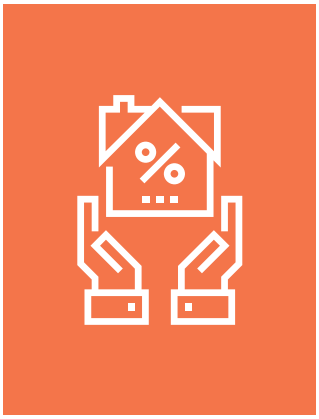
Description: Extent of compliance and implementation procedures at city level for various systems of green buildings like adoption of the National Building Code (NBC) 2016, mention in the General Development Control Regulations (GDCRs), or pre-certification as per rating systems such as Energy Conservation Building Code (ECBC) and the Star Rating for Buildings both by the Bureau of Energy Efficiency (BEE), Leadership in Energy & Environmental Design (LEED) of the Green Building Certification Inc. (GBCI); Green Rating for Integrated Habitat Assessment (GRIHA) of The Energy Research Institute (TERI), Green Building Rating System of the Indian Green Building Council (IGBC), upto minimum level i.e. 1-star (ECBC, BEE Star, GRIHA) or basic certified (LEED, IGBC)

Methodology: This indicator measures the inclusion of provisions of Codes & Regulations for 'green buildings' as indicated above for Level 1 & 2 below, and pre-certifications achieved for 'green buildings' third-party pre-certifications given to new buildings sanctioned in the city. For Level 1 & 2, the status of compliance at the time of assessment will be taken, and for Level 3 & 4, the pre-certifications acquired in the last year before assessment (bi-annual assessment) will be considered.

Maximum Score: 60

Performance Evaluation Levels:

	0	1	2	3	4
Criteria/ Sub-indicators/ Progression Levels	Compliance procedures available only at state level	Inclusion of energy conservation building codes (commercial & residential) and other certified green buildings in notified city Development Control Regulations (DCRs)	Third party Pre-Certification given to upto 5% of new buildings sanctioned in city under any green building certification	Third party Pre-Certification given to 6-10% of new buildings sanctioned in city under any green building certification	Third party Pre-Certification given to more than 10% of new buildings sanctioned in city under any green building certification
Evidence/ Data Sources	NBC compliance available at state level (Yes/No)	Compliance procedures available at city level	ULB records		
Responsible Agency/ Department	ULB, Town Planning Dept., Green Building agencies.				
Score	0	15	30	50	60



Indicator 6: Percentage of buildings securing third party green building certification upto minimum level at completion stage

Rationale: In continuation to the previous indicator, this one encourages the construction of new buildings as per the green building norms as defined in the ECBC and BEE.

Description: It assesses the actual Built-up Area (BUA) of "green buildings" that are certified (as per different existing norms and incentivises the city for promoting green building) in a given year with respect to the total BUA, as a means of knowing the impact on GHG emissions in the city.

Methodology: Amount of Built up area (BUA) of green buildings third-party certified upto minimum level i.e. 1-star (ECBC, BEE Star, GRIHA) or basic certified (LEED, IGBC), at completion stage; compared to the BUA of all the buildings completed in a city, in the last year before assessment (financial year for June assessment, Oct-Sep for December assessment).

Formula:

$$\frac{\textit{BUA of Green buildings certified in the base year}}{\textit{BUA of all buildings completed in the base year}} \; x100$$

Unit: Percentage(%)

Maximum Score: 60

Performance Evaluation Levels:

	0	1	2	3	4
Criteria/ Sub-indicators/ Progression Levels	No green buildings certified	Upto 10% BUA in the base year are certified	Upto 40% BUA in the base year are certified	Upto 60% BUA in the base year are certified	All buildings in the base year are certified
Evidence/ Data Sources	• List of buildings certified with Green building certificate along with BUA, as per the methodology. • List of all buildings along with total BUA completed in the base year, as per the Completion Certificates issued.				
Responsible Agency/ Department	ULB, Town Planning Dept., Green Building agencies.				
Score	0	20	30	40	60

3.2 URBAN PLANNING, GREEN COVER AND BIODIVERSITY

Indicator 1: Climate Action Plan

Rationale: As part of the Paris Agreement on climate change (2015), many nations committed to take immediate action to keep the global temperature rise below 2°C of pre-industrial levels. 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; to achieve about 40% cumulative electric power installed from non-fossil fuel based energy resources by 2030 and to create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through addition al forest and three cover by 2030.

With much of India's development dependent on cities, consistent with the objectives of the Paris Agreement, cities urgently need to plan and implement climate actions in an integrated and inclusive way through the following measures: mitigation of greenhouse gas emissions and adaptation to climate change impacts to foster wider social, cultural, economic and environmental benefits.

Description: Climate Action Plan (mitigation and adaptation) has to be prepared and implemented by the city. It should be developed in a comprehensive manner covering all sectors, including waste management, integrated water management, mobility and air pollution, energy and green buildings; biodiversity, green cover, disaster risk preparedness and urban planning. The plan has to propose actions for both climate change mitigation and adaptation based on a GHG emissions inventory and on a climate change vulnerability assessment, addressing all sectors listed above. Regular monitoring, reporting and verification (MRV) of the plan is essential to qualify and quantify the measures implemented for achieving accountability, and improved impact.

Methodology:

Climate Change Mitigation: GHG emission inventory to be prepared for all sectors on the basis of the Global Protocol for Community Scale GHG Emissions (GPC).

Climate Change Adaptation: *Vulnerability Assessment for the city*: The Intergovernmental Panel on Climate Change (IPCC) identifies three components of climate change vulnerability: exposure, sensitivity and adaptive capacity. Manifold toolboxes and collections of methods to evaluate impacts, vulnerability and adaptation to climate change exist. Requested is the development of a vulnerability assessment and identification of gaps, undertaken based on the United Nations Framework Convention on Climate Change (UNFCCC) methodology.

Climate Action Plan: Based on the GHG inventory as well as on the vulnerability assessment, a Climate Action Plan for the city addressing all issues of mitigation and adaptation has to be developed. The Guiding Principles for City Climate Action Planning from UN-HABITAT could be referred to, however the sectors to be covered under the plan should at least include all sectors as covered under the ClimateSmart Cities Assessment Framework.

Formula: NA **Unit:** NA **Maximum Score:** 80

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	Climate Action Plan not considered	Institutional Mechanism Established	Plan Prepared	Implementation	Regular Monitoring & Streamlining
Evidence/ Data Sources		• ULB Level Climate coordination cell established • City Level Stakeholder Committee constituted and consulted regularly	• GHG emissions inventory prepared (based on GPC) and critical sectors for mitigation identified for the city. • Climate Change Vulnerability assessment (see indicator no 2 Disaster Risk Preparedness) • Identification and mapping of encroachment (see indicator no 3 Rejuvenation and Conservation) • City heat island map (see indicator no 3 Rejuvenation and Conservation) • Climate Action Plan (mitigation and adaptation) prepared for the city in a participatory manner	• Funds/ Municipal Budget of last financial year shows allocation • Framework for Monitoring Reporting and Verification (MRV) prepared (sector-wise) • Implementation of measures initiated (at least one of the following: utilisation certificate; by-law, DPRs)	• MRV system implemented for the city - regular monitoring (bi-annual) of climate relevant actions indicated in the action plan • Updated Climate Action Plan available (if older than 5 years) and prepared in a participatory manner • Relevant features from the Climate Action Plan incorporated in master plan to ensure sustainability
Responsible Agency/ Department	ULB, State/City Transport Department, State Disaster Management Authority, State Revenue Department; State Irrigation Department; Development Authority, Town Planning Department, National Remote Sensing Agency, State Remote Sensing Agency; Forest Department				
Score	0	25	40	65	80

Indicator 2: Disaster Resilience

Rationale: In urban areas the brunt of any kind of disaster (Human or nature induced) is borne by the urban inhabitants and also by the urban infrastructure. As effects of climate variability leading to extreme events are becoming more severe and frequent, the incidents of damage to urban infrastructure are also increasing. Therefore, it is important that all cities, especially Smart Cities, should not only be able to identify their potential hazards, vulnerabilities and risk but also be prepared for prompt response during disaster situation as well as have robust plans in place to "Build Back Better" including recovery, reconstruction and rehabilitation.

Description: To what extent the city is prepared and resilient to tackle natural and man-made disasters.

Methodology:

Disaster Management Plan: The National Disaster Management Act, 2005, the National Policy on Disaster Management 2009 (NPDM) and the National Disaster Management Authority (NDMA) provide direction and a framework to the government agencies at all levels (National, State and Local) to prepare for all phases of disaster management cycle i.e. a) mitigation (prevention and risk reduction), b) preparedness, c) response and d) recovery (immediate restoration to long-term betterment reconstruction).

In accordance with the provisions of the Disaster Management Act and the policy a National Disaster Management Plan (NDMP) is prepared, which is a dynamic document and it need to be periodically updated. Similarly, each State, District / City level plans has to be prepared in line with the NDMA Guidelines (2014) issued by the National Disaster Management Authority.

Emergency Management Plan: Emergency Management Planning results in organized and coordinated courses of action with clearly identified institutional roles and resources, information processes and operational arrangements for specific actors at times of need. Based on scenarios of possible emergency conditions, it allows key actors to envision, anticipate and solve. Requested is the development of a vulnerability assessment and identification of gaps, undertaken based on the United Nations Framework Convention on Climate Change (UNFCCC) methodology.

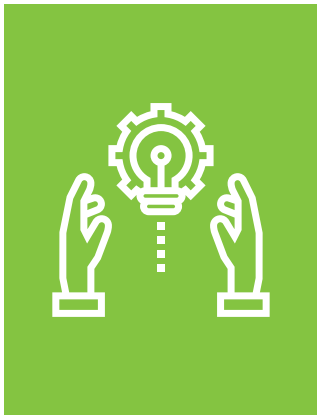
Ward-level Hazard Risk, Vulnerability and Capacity Assessment: The municipal administration along with the ward level officers shall initiate a participatory process among the community groups and the representatives of ULBs to assess the vulnerabilities and risks to various hazards in their respective areas. Wherever possible the disaster management (DM) teams shall be involved in the process. Please refer to the National Policy Guidelines, National Disaster Management Authority.

Early Warning Systems: An effective Early warning System needs to be end-to-end, people-centred, across sectors and multiple levels with a continuous feedback mechanism for improvement.

Formula: NA **Unit:** NA **Maximum Score:** 40

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**No Consideration of Disaster and Risk Reduction**	**Disaster Management Plan I**	**Disaster Management Plan II**	**Implementation**	**Monitoring, Updating Mainstreaming**
Evidence/ Data Sources		• Disaster Management Plan, prepared as per NDMA Guidelines including community participation, vetted by State DMA • Report showing city level loss and damage data (last 5 years)	• Ward-level Hazard Risk, Vulnerability and Capacity Assessment prepared in a participatory manner (based on NDMA guidelines, 2014) • Institutionalising and establishing of dedicated Disaster Management Cell/ Emergency Operation Centre (EOC) within ULB	• Emergency Management Plan prepared by main departments within the ULB • Trained task force or volunteers for disaster response in place (including conduction of annual mock drills) • Functioning Early warning systems installed incl. helpline	• Early warning systems and Weather Forecasting System are linked to Integrated Command and Control Centres (ICCC) for regular monitoring and managing emergency situations • Disaster management plan is updated yearly • The States/City level Building Bylaws/ Development Controls/ Codes address hazard and vulnerability identified at level 2 • Mainstreaming disaster risk reduction in departmental plans within the ULB
Responsible Agency/ Department	ULB in coordination with District administration, State Disaster Management Authority, State Revenue Department; State Irrigation Department				
Score	0	10	20	30	40



Indicator 3: Rejuvenation and Conservation of Urban Environment (water bodies, open spaces and built-up area)

Rationale: Urban Environment consists of many aspects including water bodies, open spaces and built-up area. From climate adaptation and mitigation perspective all three aspects play a critical role.

Rejuvenation of water bodies is significant to combat water crises. Water bodies are essential as reservoirs for drinking, as retention basins for groundwater recharge, for protection in case of floods and for maintaining biodiversity. Having local sources of fresh water decreases the dependence on energy for pumping purposes.

Open spaces, namely recreational spaces, organised green and other common open spaces in any city play a critical role in terms of climate mitigation and adaptation aspects by decreasing local temperature, acting as carbon sinks as well as recharge areas for groundwater. Increase in build-up areas and decrease of water bodies and open spaces lead to an increase in the local temperature within a city.

Description: To what extent (Percentage and area) is the city rejuvenating and conserving Urban Environment (water bodies, green cover and build-up area) and manages to decrease the heat-island effect.

Methodology: The information concerning the current status and status 10 years ago of the area and percentage has to be derived from satellite images. This figure has to be compared with the existing masterplan (percentage and area). As area border the municipal boundary has to be considered. Open Spaces are defined as recreational spaces, organised green and other common open spaces as per URDPFI Guidelines section 8.4.5. For generating the areas as indicated in level 1 below, current municipal boundary has to be considered for both the cases.

Urban Heat Island: An urban heat island is an urban area or metropolitan area that is significantly warmer than its surrounding areas/ rural areas due to human activities.

Formula: Assessment of Urban Environment (Water Bodies and Green Cover):

Level 1:

$$\frac{\textit{open space in sq.km (current year)+Water Bodies in sq.km (current year)}}{\textit{open space in sq.km (10 years ago)+Water Bodies in sq.km (10 years ago)}} \; x\,100 = \%\ \textit{(within current municipal boundary)}$$

$$\frac{\textit{open space in sq.km + Water bodies in sq.km of existing masterplan}}{\textit{open space in sq.km + Water bodies in sq.km of previous masterplan}} \; x\,100 = \%\ \textit{(within current municipal boundary)}$$

Level 4:

$$\frac{\textit{open space in sq.km (current year)+Water Bodies in sq.km (current year)}}{\textit{open space in sq.km (10 years ago)+Water Bodies in sq.km (2019)}} \; x\,100 = \%\ \textit{(within current municipal boundary)}$$

Unit: sq.km, %

Maximum Score: 40

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**No Rejuvenation conducted**	**Assessment of Urban Environment (water bodies, green cover and built-up area, Unbuilt open spaces)**	**Strategy for Rejuvenation and Conservation of Urban Environment**	**Allocation of Budget and Implementation**	**Increase in Area and Percentage**
Evidence/ Data Sources		• Comparative Map prepared based on satellite images (current status and 10 years ago) plus indication of area • Comparative map of existing land use maps as per last two notified masterplans plus indication of area • Identification and mapping of encroachment • City heat-island map (2019)	• Strategy developed based on documents developed in level 1	• Funds/ Municipal Budget allocated for conservation and rejuvenation • Implementation of strategy is initiated (at least one of the following: utilisation certificate; by-law, notification of the area, constitution of a committee, DPRs)	• Percentage and area (sq.km) of rejuvenated and conserved Urban Environment increased from 2019 levels based on strategy prepared in level 2
Responsible Agency/ Department		ULB, Development Authority, Town Planning Department, National Remote Sensing Agency, State Remote Sensing Agency			
Score	0	10	20	30	40

Indicator 4: Proportion of Green Cover

Rationale: Sufficiently large and protected greenspaces reduce the impact of human activities on climate. The ecosystem services provided by the urban greenspaces help the city in general and its citizens to adapt to the adverse effects of climate change and disasters

Description: To what extent is the city developing and increasing its green cover. Green Cover, defined as natural or planted vegetation covering a certain area of terrain, functioning as protection against soil erosion, protecting the fauna, and balancing the temperature.

Methodology: Data available on area of urban greens can be analysed from satellite imagery. Recent imagery can be procured from the state or National Remote Sensing Centre (NRSC). Baseline year: 2019. Comparative analysis using the formula given below on a yearly basis will help to understand the increase/decrease over time.

Formula: $\frac{\textit{Green Cover in sq.km}}{\textit{municipal area in sq.km}} \textit{ x 100 = \%}$

Unit: Percentage(%) **Maximum Score:** 40

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**0% to < 5% Green Cover**	**5% to < 9% Green Cover**	**9% to < 12% Green Cover**	**12% to < 20% Green Cover**	**≥ 20% Green Cover**
Evidence/ Data Sources	The evidence will be comparative satellite images of the city.				
Responsible Agency/ Department	National Remote Sensing Centre, State Remote Sensing Centre, Urban Planning or Development Authority, Forest Department				
Score	0	10	20	30	40

Indicator 5: Proportion of Native Tree Species

Rationale: Native tree species are more resilient to changes in local environment- as compared to exotic tree species, and therefore have a greater ability to adapt to climatic stress. This resilience also results in low maintenance costs for the local administration. Further, being part of the ecosystem for longer time, native tree species have highly intricate food webs and ecological network and contribute towards ecosystem stability and resilience. Thus, a high proportion of native tree species means more stable and resilient ecosystem, which can support higher biodiversity. High species numbers and high proportion of native tree species in an urban area can serve as a proxy indicator for high biodiversity and ecosystem resilience.

Description: To what extent is the city acting towards developing and maintaining its green cover using an ecological approach, specifically focusing on native tree species. Native tree species contributing to climate change mitigation and adaptation, such as avoidance of erosion, mitigation of air pollution, reduction of water usage, regulation of microclimate, reducing the risk of disasters.

Methodology: Data on species planted can be obtained from the Forest Department, Horticulture Department. Species survey data can be obtained from local Universities, NGOs and Forest Department. The performance evaluation can be on the basis of incremental level of dominance that native tree species occupy in a given urban ecosystem. For this, the basic measure is the percentage (by species numbers) of native tree species, i.e. how many tree species exist in the ecosystem (species richness), and out of these how many are native species. However, the actual proportion of native species can be measured by assessing the actual population (number of trees) of native species.

Formula:

Level 1: $\frac{\textit{number of native tree species}}{\textit{Total number of tree species}} \times 100 = \%$;

Level 2-4: $\frac{\textit{number of individuals of native species}}{\textit{total number of individuals of all tree species}} \times 100 = \%$

Unit: Percentage(%) **Maximum Score:** 20

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**No information is available**	**Percentage of native species vs total species richness in an urban area**	**Proportion (by population) of native tree species <20%**	**20 to ≤ 50% native tree species (by population)**	**> 50% native tree species (by population)**
Evidence/ Data Sources	Existing documentation of ecosystems and species in the city (including IUCN listed)- all forms of technical reports/ studies done on biodiversity in the city, tree census				
Responsible Agency/ Department	ULB, Forest Department, Universities, PWD, Horticulture Department Environment Department				
Score	0	5	10	15	20

Indicator 6: Urban Biodiversity

Rationale: Urban biodiversity provides significant ecosystem services contributing to climate change mitigation and adaptation, such as carbon sequestration, air and water purification, mitigation of impacts of environmental pollution, noise reduction, and regulation of microclimate. High biodiversity increases the resilience of the city.

Description: To what extent is the city acting for protection, conservation and management of urban biodiversity.

Methodology: Data on biodiversity can be obtained from the Biodiversity Management Committee and the people's Biodiversity register (instituted based on the Biological Diversity Act, 2002)

Formula: NA **Unit:** NA **Maximum Score:** 30

Performance Evaluation Levels:

Progression Levels	0	1	2	3	4
Progression Levels	**No consideration of biodiversity takes place**	**Institutional Set-Up**	**Baseline Assessment**	**Plan**	**Implementation**
Evidence/ Data Sources		• Establishment of City Level Biodiversity Management Committee (as per Biological Diversity Act, 2002; City council resolution; announcement to State Biodiversity Board)	• People's Biodiversity Register (based on the Biological Diversity Act, 2002, Letter of State Biodiversity Board validating register) • Inventory (all forms of technical reports/ studies) of urban ecosystems and species (including International Union for Conservation of Nature, IUCN listed ones)	• Funds/ Municipal Budget allocated • Identification of measures to increase biodiversity within master plan/ greening plans/ rejuvenation plans (see indicator no. 3)	• Calculation of City Biodiversity Index (Report with the calculated index) • Implementation of measures initiated (defined in level 3)
Responsible Agency/ Department		ULB; Biodiversity Management Committee, State Horticulture Department, State Forest Department			
Score	0	5	10	20	30

3.3 MOBILITY AND AIR

Indicator 1: Low Carbon Mobility

Rationale: The Low Carbon Mobility Plan (LCMP) provides a long-term vision for sustainable mobility for people, and the movement of goods in cities. The LCMPs advocates an integrated approach – e.g. looking at land use and transport planning, social inclusion, and the integration of safety, environment and CO_2 mitigation

Description: To what extent does the city show preparedness towards low carbon mobility during various stages i.e. strategy development, planning, funding and implementation

Methodology: In order to reduce its emission and control the pollution levels connected to mobility, the city must plan, initiate and implement low carbon mobility actions based on a City Mobility Plan (CMP)/ Low Carbon Mobility Plan (LCMP)/ Comprehensive Traffic and Transportation Studies (CTTS) based on the MoHUA toolkit on 'Comprehensive Mobility Plan', 2014 or latest update.

Formula: NA **Unit:** NA **Maximum Score:** 40

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**No consideration of Low Carbon Mobility**	**Citywide assessment/ plan for mobility exists**	**Plan with specific focus on low carbon mobility**	**Allocation of budget and monitoring framework**	**Implementation of measures**
Evidence/ Data Sources		• City-wide document with mobility status assessment (CDP, SCP, Masterplans)	• CMP/LCMP/CTTS as per the latest toolkit of MoHUA • Notification of plan under relevant regulation/act	• Allocation of municipal budget as per the plan • Establishment of implementation & monitoring framework for the plan	• 50% of projects implemented as planned under • CMP/LCMP/CTTS. 50% of Policies implemented as per plan.
Responsible Agency/ Department	Municipal Corporation, City Development Authority, Smart City SPV's, UMTA				
Score	0	10	20	30	40

Indicator 2: Low Carbon Buses

Rationale: Since conventional fuel burning vehicles release an enormous amount of intoxicants to atmosphere, cities must put efforts to introduce a more non-fossil fuel based public transport fleet.

Description: Percentage of low carbon buses (CNG, LPG, Hybrid, Biofuels, Electric) of the total public transport bus fleet regulated and controlled by the government. Public transportation fleet incorporates all urban buses under the control of state/city level Government (either direct or under any contractual framework)

Methodology: Annual number of low carbon buses and buses in total can be obtained from the State/ Municipal Corporation, the SPV's - Public Transport companies, the City Development Authority, and the Smart City SPV's. Data has to be collected by type of fuel.

Formula: *Percentage share of low carbon fleet (%) =*

$$\frac{\text{no.of CNG Buses + no.of LPG Buses + no.of Hybrid Buses + no.of Biofuels Buses + no.of Electric Buses + no.of any other non-fossil fuel Buses in city}}{\text{Total no.of buses in the fleet under Public Transport in the city}} \times 100$$

Unit: Percentage(%) **Maximum Score:** 20

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**Low Carbon Fleet not available**	**Low Carbon Fleet Share >10%**	**Low Carbon Fleet Share >20%**	**Low Carbon Fleet Share >35%**	**Low Carbon Fleet Share >50%**
Evidence/ Data Sources	Annual fleet data from public transport agencies companies/corporations categorized by type of fuel				
Responsible Agency/ Department	State/ Municipal Corporation, SPV's - Public Transport companies, City Development Authority, Smart City SPV's				
Score	0	5	10	15	20

Indicator 3: Public Transport Ridership Index

Rationale: Under Smart City initiatives most of the selected cities are planning for organized public transport system. Increase in public transport ridership can be a key factor to evaluate the modal shift from private transport to public transport, which in turn helps tremendously to reduce emissions from the transport sector.

Description: Total Public Transport Ridership (Metro, Tram, Buses, Ferries) per 1,000 population.

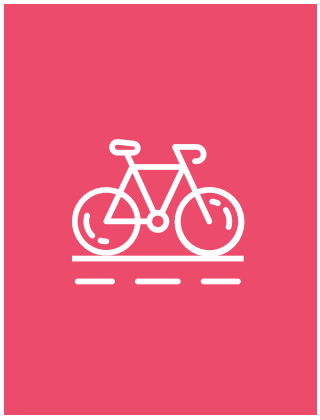
Methodology: Total average daily ridership of public transport will be the summation of number of boardings by all public transport modes in the city. This should include trips made by ticket issued passengers as well as concessional pass holders. In case where assessment of trips made by concessional pass holders is not possible, it should be done by multiplying with a factor of "2.5" with number of passes in circulation.

Formula: Ridership Index (RI) = $\frac{\textit{Total average daily ridership x 1000}}{\textit{Population of current year}}$

Maximum Score: 25

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**RI (<100)**	**RI (100-250)**	**RI (250-350)**	**RI (350-500)**	**RI (>500)**
Evidence/ Data Sources	Annual Boarding data from public transport companies including pass holders, concessional rides				
Responsible Agency/ Department	SPVs - Public Transport companies, Smart City SPVs and PMCs				
Score	0	5	10	20	25



Indicator 4: Percentage of coverage of Non-Motorized Transport network (pedestrian and bicycle) in the city

Rationale: Developing the Non-Motorized Transport (NMT) network in a city addresses the problems related to the high consumption of non-renewable energies, thus addressing air pollution and GHG emission production. Furthermore, it promotes aspects like health, traffic safety, traffic congestion and equal mobility-options for all income brackets.

Description: This indicator assesses the network length for dedicated cycle and pedestrian lanes in the city on major road network (all arterial, sub-arterial roads and public transport corridors).

Methodology: Calculate the length of the major road network and multiply it by two (since footpaths and bicycle lanes should be provided on both sides of the road). Calculate the total length of footpath and bicycle lanes and multiply by 2 if available on both sides. Footpath minimum width: 1.2m; Cycle lane minimum width: 2.5m, both designed as per the street design guidelines of MoHUA.

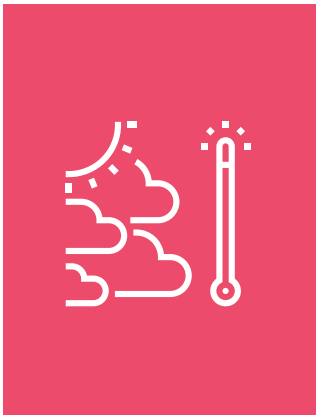
Formula: *% of NMT=*

$$0.5 \times \left[\frac{\text{length of footpath in a city (x2 if on both sides)}}{\text{length of major road network x2}} \times 100\right] + 0.5 \times \left[\frac{\text{length of cycle network in a city (x2 if on both sides)}}{\text{length of major road network x2}} \times 100\right]$$

Unit: Percentage(%) **Maximum Score:** 25

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**NMT Coverage: <10%**	**NMT Coverage: 10% to < 20%**	**NMT Coverage: 20% to < 37.5%**	**NMT Coverage: 37.5% < 62.5%**	**NMT Coverage: > 62.5%**
Evidence/ Data Sources	• NMT Network plan of city • Annual completed list of NMT and Pedestrian projects of Public Works department and Municipal Corporations • By-cycle lanes constructed by Public Works department in city				
Responsible Agency/ Department	ULB, Public Works Department, City Development Authority, Transport Authority, Smart City SPV's and PMC's				
Score	0	5	10	20	25



Indicator 5: Clean Air Action Plan (Pollutant Monitoring, Planning and Implementation)

Rationale: Unsustainable urban planning, lack of proper waste management, obsolete technology in industries and urban transport have all led to increase in air pollution in cities in India. According to the World Health Organisation (WHO), seven million people die prematurely from health risks every year owing to air pollution. The Smart city Mission sets out to bring in its fold the urban policy design of public transit oriented urban mobility, smart parking, intelligent traffic management and integrated multi-modal transport, prioritising non-motorised transport, digitalisation of public services, and waste management e.g. reduction of C&D (construction and demolition) waste, all of which are good practices for better air quality. These are also actions that need to be emulated in the entire city.

Description: Cities should take onus for providing healthy air quality to the citizens. Clean Air Action Plans mandated by the National Clean Air Programme of Government of India integrate the cumulative city level actions for better air quality. For a city to be climate smart it should be able to address the issues of reducing air pollutants since both air and climate pollutants arise from similar sources and addressing one has a direct co benefit to the other. Clean Air is integral for achieving climate smartness by a city.

Methodology: This indicator assesses to what extent the city has made efforts to improve the air quality, to generate/collate data on the key pollutants through enhanced monitoring mechanisms, to identify sources through scientific methods and subsequently to develop and implement sectoral strategies and projects that are components of the clean air action plan. This has to be done in close co-ordination with the State Level monitoring authorities and other stakeholder departments. The clean air action plan needs to be reviewed and monitored to assess improvements in air quality.

Formula: NA **Unit:** NA **Maximum Score:** 50

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**No Pollutant Monitoring**	**Basic Pollutant Monitoring**	**Pollutant Source Identification and Clean Air Action Plan**	**Implementation of Clean Air Action Plan**	**Monitoring**
Evidence/ Data Sources		• Monitoring Stations for measuring Ambient Air Quality (please indicate number of stations, differentiate between manual stations or continuous ambient air quality monitoring stations (CAAQMS) and continuous emission monitoring system (CEMS)	• Rapid study for identification of sources of pollution including hot spot identification • Clean Air Action Plan (as per national Clean Air Programme, NCAP) developed based on scientific data captured	• Implementation of at least 2 measures under the domain of the ULB as specified in Clean Air Action Plan (eg. Low carbon mobility, NMT, C&D waste management, waste management) • Scientific CPCB/SPCB led source Apportionment Studies and Emissions Inventories	• Air Quality Monitoring mechanism linked with ICCC • Impact assessment study for implementing Clean Air Action Plan
Responsible Agency/ Department	SPCB	SPCB, ULB, SPV	SPCB, ULB, Transport Dept, Smart city SPV, Environment Dept		
Score	0	10	25	40	50

Indicator 6: Level of Air Pollution

Rationale: Climate change and air pollution have a common origin- the current energy model. Both are worsened by the burning of fuel and increase the CO_2 emissions. Sound urban planning and clean technologies are now recognised as solutions to air pollution. The smart cities present a unique opportunity to adapt to advanced air-quality-monitoring technologies. Cities are encouraged to adopt affordable technologies by introducing low-cost air-quality sensors and linking the latter to the Integrated Command and Control Centres. This approach can complement the Pollution Control Board's existing monitoring system to provide further data on localised areas, hot spots and help generate real-time information for cities to take corrective action as well as gauge improvements. Air pollution data will not only help the government in framing policies and measures but allow citizens to make informed decisions that can improve the quality of their lives.

Description: The city is encouraged to assess to what extent it has achieved national and international air quality standards. The National Clean Air Programme sets a target of 20 -30 percent reduction of air pollution levels with 2017 as the base year. A city level air-quality monitoring grid is important to generate holistic data, helps to assess the risks, implements control measures and assesses other climate smart strategies adopted by the city.

Methodology: The indicator assesses the city-level air quality monitoring mechanism, its strengthening requirements and availability of air quality data on public domain. The city will be further assessed on its additional pollutants monitoring, its reduction strategies, its implementation and compliance to the National as well as International standards.

Formula: NA **Unit:** according to CPCB & WHO standards **Maximum Score:** 40

Performance Evaluation Levels:

	0	1	2	3	4
Progression Levels	**No Consideration**	**Basic Monitoring and Publishing of Data**	**Advanced Monitoring**	**Compliance with national pollution targets**	**Compliance with International pollution targets**
Evidence/ Data Sources		• Capture present levels of - PM10, PM2.5, NOx, SOx (as per Central Pollution Control Board, CPCB guidelines) and public display of the same	• Additional pollutants monitored (WHO standards) • Hourly city air quality data in relation to national AQI is available in public	• Reduction according to National Clean Air Programme, NCAP target	• Achieve WHO Air quality standards
Responsible Agency/ Department		ULB, SPCB, SPV			
Score	0	10	20	30	40

3.4 WATER RESOURCE MANAGEMENT

Indicator 1: Water Resources Assessment and Management

Rationale: Climate change is expected to impact the water resources and subsequently the water availability. It is therefore, important to take stock of the water availability and demand equation in context of climate change so that adequate action can be taken if required.

Description: This indicator is to assess whether the City is on course to meet the future water demand. The indicator requires an assessment of both current and future water availability; and corresponding current and future water demand. Given that many cities depend significantly on ground water resources to augment piped water supply, it is expected that both surface and groundwater assessments would have been conducted.

Methodology: The water resource assessment should look at both surface and groundwater, wherever required, and quantify both availability and demand using scientific techniques.

Formula: NA **Unit:** NA **Maximum Score:** 25

Performance Evaluation Levels:

	0	1	2	3	4
Status of water resources assessment and management in the city	**City has not conducted a water resource assessment**	**City has taken stock of existing water resources, its uses for various sectors; projected future water demand and water availability for at least five years using reference standards and other formulae**	**City has considered climate change scenarios in estimating future water availability**	**Water Resource Management Plan is prepared with Short, Medium- and Long-Term Actions**	**City is on target to meet the water demand in future (2035-2040)**
Evidence/Data Sources	• No assessment is carried out	• A Report/study/ plan that indicates stock of existing water resources and its uses for various sectors with projections	• A Report/study/ plan that considered climate change scenarios in estimating future water availability	• Water Resource Management Plan; covering resources such as ground water, surface water and rainwater	• Work Orders issued/ Utilization Certificates for executed works specified in the water resource management plan • A Report/ study reviewing the actions taken as part of the Water Resources
Responsible Agency/ Department	ULB/ Water Utility				
Score	0	10	15	20	25

Indicator 2: Extent of Non-Revenue Water

Rationale: Reducing Non-Revenue Water (NRW) is a powerful demand management instrument, which decreases the stress on existing water resources. Given that climate change is expected to create an additional pressure on the existing water resources, reducing NRW is considered as a robust climate smart solution. Reduction in NRW will enhance resilience by reducing both the water losses as well as demand for electricity required for pumping, thereby mitigating GHG emissions.

Description: This indicator highlights the extent of water produced which does not earn the utility any revenue. NRW comprises - a) Consumption which is authorized but not billed, such as public stand posts; b) Apparent losses such as illegal water connections, water theft and metering inaccuracies; c) Real losses which are leakages in the transmission and distribution networks.

Methodology: NRW is computed as - Difference between total water produced (ex-treatment plant) and total water sold expressed as a percentage of total water produced.

Formula:

$$\left\{ \frac{\textit{Total water produced and put into the transmission and distribution system- Total water sold}}{\textit{Total water produced and put into the transmission and distribution system}} \right\} x\ 100$$

Unit: Percentage (%) **Maximum Score:** 25

Performance Evaluation Levels:

	0	1	2	3	4
NRW reduction	**Most recent NRW reported by the city during 2016-19 is > 50% or NRW is not reported during this period**	**Most recent NRW reported by the city during 2016-19 is > 40% to 50%**	**Most recent NRW reported by the city during 2016-19 is > 30% to 40%**	**Most recent NRW reported by the city during 2016-19 is > 20% to 30%**	**Most recent NRW reported by the city during 2016-19 is < 20%**
Evidence/Data Sources	Water metering records at the supply side and the consumption side (as explained in methodology) will provide information on the quantum of water supplied and consumed. *Documentary evidence in one year over a period of last three years will be considered*				
Responsible Agency/ Department	ULB/ Water Utility				
Score	0	5	10	20	25

Indicator 3: Flood risk assessment and management

Rationale: With increased urbanization and high densities, cities are inherently vulnerable to flooding events. Climate change will only intensify the problem. A flood risk assessment is the first step in developing robust flood management strategies and plans.

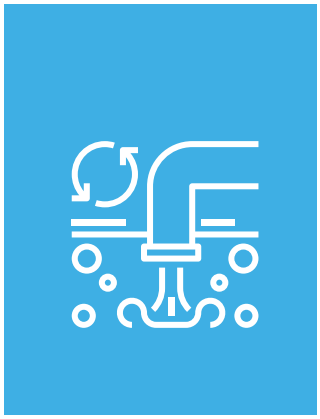
Description: This indicator assesses the preparedness of the city to address the flooding risk, if it exists.

Methodology: There are generally two types of flood risk assessment. First is a rapid flood risk assessment that uses simple techniques to determine the likely impacts of a flooding event. Second is comprehensive flood risk assessment that is expressed as a function of vulnerability and hazard.

Maximum Score: 25

Performance Evaluation Levels:

	0	1	2	3	4
Status of flood risk in the city and how it is being addressed (if there is a risk)?	**City has not carried out any flood risk assessment**	**City has conducted a rapid flood risk assessment using simple techniques to ascertain flood levels, flooding hotspots, threats to life and property, etc.**	**City has conducted a comprehensive flood risk assessment incorporating vulnerability, hazard, exposure with different climate change scenarios. [If the outcome of comprehensive flood risk assessment reveals "no risk", the city would be considered at level 4.]**	**If there is a flood risk, the city had prepared a plan to address the risk. The plan presents tangible strategies of how the risk will be the mitigated.**	**The city is implementing the flood management plan.**
Evidence/Data Sources		• Rapid flood risk assessment report or a similar document	• Comprehensive flood risk assessment report	• Flood management plan; Drainage Master Plan; Stormwater Management Plan	• Work Orders issued/ Utilization Certificates for executed works specified in the flood management plan
Responsible Agency/ Department	ULB/ Water Utility				
Score	0	5	10	20	25



Indicator 4: Wastewater Recycle and Reuse

Rationale: Recycling and reuse of wastewater reduces the stress on the existing water resources, which are expected to be impacted by climate change.

Description: Wastewater recycling is a process of converting wastewater into water that can be reused for other purposes by adequate secondary and tertiary treatment. Reuse may be in diverse avenues such as non-potable domestic use; horticulture, agricultural, power plants, industries among others.

Methodology: This indicator highlights what percentage of the wastewater generated is being recycled and reused. It is important that the wastewater treatment meets the approved CPCB standards.

Formula:

$$* \left\{ \frac{\textit{Secondary / Tertiary Treated wastewater recycled and reused in million litres per day (or) month}}{\textit{0.80* water supplied to the city in million litres per day (or) month}} \right\} \textit{ x 100}$$

Unit: Percentage(%) **Maximum Score:** 25

Performance Evaluation Levels:

	0	1	2	3	4
Percentage of wastewater reuse	**No reuse**	**< 5% Treated wastewater recycled and reused**	**5 to < 10%Treated wastewater recycled and reused**	**10 to < 20% Treated wastewater recycled and reused**	**> 20% Treated wastewater recycled and reused**
Evidence/ Data Sources	• Water supply records for last six months • Records for secondary/tertiary reuse for last six months				
Responsible Agency/ Department	ULB/ Water Utility				
Score	0	10	15	20	25

Indicator 5: Energy-efficient wastewater management system in the city

Rationale: Energy-efficient equipment for wastewater pumping in the city leads to reduction in Green House Gas emissions (CO_2 emissions) per KwH of electricity consumed, thereby contributing to climate change mitigation.

Description: There are a number of equipment that use energy in a wastewater management system. However, wastewater pumps account for the maximum usage of energy. Therefore, energy-efficient pumps have been considered here to be a representative of energy-efficient equipment. An energy-efficient pumps are defined as pumps that have BEE rating ≥ 3stars.

Methodology: This indicator aims to quantify the percentage of the total volume of wastewater that is pumped through pumps with BEE rating ≥ 3 Stars.

Formula:

$$\frac{\textit{Total Wastewater Volume pumped by energy-efficient pumps}}{\textit{Total volume of wastewater received at treatment plants}} \times 100$$

Unit: Percentage(%) **Maximum Score:** 25

Performance Evaluation Levels:

	0	1	2	3	4
Criteria	**< 10% of total wastewater is pumped through energy-efficient pumps** **If wastewater is managed completely by gravity without the need for pumping, the city would be considered at level 4.**	**10 to < 40% of total wastewater pumped is through energy-efficient pumps***	**40 to < 70% of total wastewater pumped is through energy-efficient pumps**	**70 to < 100% of total wastewater pumped is through energy-efficient pumps**	**100% of total wastewater pumped is through energy-efficient pumps**
Evidence/ Data Sources	• Data on total number and capacity of wastewater pumps with details of BEE star ratings (last six months) • Pumping schedule for the energy-efficient wastewater pumps (last six months) • Calculation sheet for wastewater volume pumped by energy-efficient wastewater pumps (last six months) • In case of systems run completely by gravity, a certification from the Commissioner should be provided.				
Responsible Agency/ Department	ULB/ Water Utility				
Score	0	10	15	20	25

Indicator 6: Energy-efficient water supply system in the city

Rationale: Energy-efficient equipment for water supply in the city leads to reduction in Green House Gas emissions (CO_2 emissions) per KwH of electricity consumed, thereby contributing to climate change mitigation.

Description: There are a number of equipment that use energy in a water supply management system. However, water pumps account for the maximum usage. Therefore, energy-efficient pumps have been considered here to be a representative of energy-efficient equipment. An energy-efficient pump is defined as pumps that have BEE rating ≥ 3 Stars.

Methodology: This indicator aims to quantify the percentage of the total piped water volume that is pumped through pumps with BEE rating ≥ 3 Stars.

Formula:

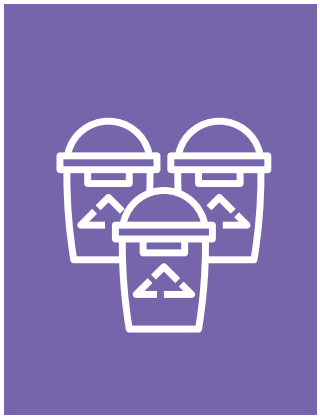
$$\frac{\textit{Total water supply volume pumped by energy-efficient pumps}}{\textit{Total volume of water supplied in the city}} \; x100$$

Unit: Percentage(%) **Maximum Score:** 25

Performance Evaluation Levels:

	0	1	2	3	4
Criteria	**<10% of total piped water is pumped through energy-efficient pumps** **If water is supplied completely by gravity without the need for pumping, the city would be considered at level 4.** .	**10 to < 40% of total piped water is pumped is through energy-efficient pumps***	**40 to < 70% of total piped water pumped is through energy-efficient pumps**	**70 to < 100% of total piped water pumped is through energy-efficient pumps**	**100% of total piped water pumped is through energy-efficient pumps**
Evidence/ Data Sources	• Data on total number and capacity of water supply pumps with details of BEE star ratings (last six months) • Pumping schedule for the energy-efficient water supply pumps (last six months) • Calculation sheet for wastewater volume pumped by energy-efficient water supply pumps (last six months) • In case of systems run completely by gravity, a certification from the Commissioner should be provided.				
Responsible Agency/ Department	ULB/ Water Utility				
Score	0	10	15	20	25

3.5 : INTEGRATED WASTE MANAGEMENT



Indicator 1: City demonstrates reduction of waste generation in last 5 years

Rationale: The relationship between waste and Greenhouse Gases (GHG) emission is well established. GHGs can be avoided though scientific management of waste. The first principal of the Integrated waste management hierarchy is reduction of waste at source. The intend of this indicator is to encourage cities to take actions in order to manage problems associated with increased waste generation. As generation and consumption patterns of waste vary across cities, all Cities are encouraged to conduct regular waste audit programmes for assessing their generation/consumption patterns and characteristics and evolve city specific actions to reduce increasing loads to the existing SWM infrastructure.

Description: "Increase in waste generation with urbanisation" is an accepted phenomenon and in case of Smart Cities; with increasing economic-ability and liveability aspects, this increase is expected to be more as compare to the other urban centres of the country. Therefore, it is important that Smart Cities prioritise certain actions for waste reduction and accordingly plan their future waste management operations and infrastructure requirements. Waste reduction activities are very open–ended and very difficult to assess comprehensively. Though the feasibility of waste reduction is in the entire life cycle of a product; this indicator is assessed on the municipal and citizen centric approaches adopted for waste reduction at source. Municipal authorities are encouraged to evolve and adopt such approaches and with implementation of waste reduction-oriented actions. These actions may be aligned to the National policies and programmes. The indicator highlights the importance of such interventions to halt or demonstrate decline in the increasing rate of waste generation per-capita through identified methods and incentives to reduce the waste generation at source.

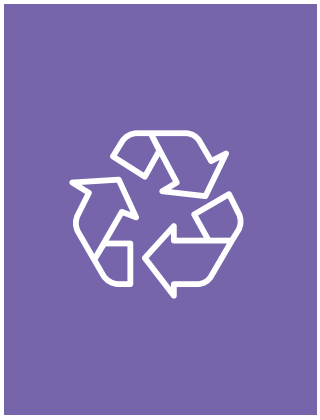
Methodology: This indicator assesses the reduction in waste generation on per capita basis. Cities are scored based on the percentile method. The cities are requested to share their latest and five year earlier records of waste generation. If no previous studies are conducted, the calculation to be arrived as per the guidance provided in the Municipal Solid Waste Management Manual, 2016 published by Central Public Health and Environmental Engineering Organisation (CPHEEO). The scoring will be done on tier basis among cities.

Formula: *Reduction in per capita waste generation: (B – A) (As indicated in the evidence/data sources)*

Unit: Grams per capita **Maximum Score:** 10

Performance Evaluation Levels:

	0	1	2	3	4
Reduction in Per capita waste generation	**No reduction**	**1st Quartile**	**2nd Quartile**	**3rd Quartile**	**4th Quartile**
Evidence/ Data Sources	• ULB records pertaining to waste generation, qualitative and quantification including DPRs for SWM projects, augmentation of SWM infrastructure; Waste Quantification and characterisation study report conducted by educational institutes/ Universities/Technical Organisations pertaining to 2014 or before and in 2018 or 2019 • Per capita waste generation in January 2014 (A) • Per capita waste generation in January 2019 (B)				
Responsible Agencies	ULB/ Studies				
Score	**0**	**2**	**5**	**8**	**10**



Indicator 2: Extent of recyclables recovered, and Segregated Combustible Fractions (SCF)/ Refused Derived Fuel (RDF) Utilised

Rationale: This indicator highlights the city's commitment towards circular economy and adherence to Integrated Solid Waste Management principles. The indicator intends that Material Recovery Facilities (MRF) with provision for sorting recyclables and facility for producing SCF/RDF are available and operational in cities as per SWM Rules, 2016. The indicator addresses the GHGs mitigation aspects due to resource efficiency.

Description: Reuse and Recycle are the next levels of waste management hierarchy after Reduce and cumulatively known as 3R's. This indicator envisage that Smart Cities take scientific and formalised actions for resource recovery and promotes waste recycling. Waste recovery and recycling systems are yet to be 100% formalised by all Smart Cities authorities and in most of the cities the informal sector takes care of the resource recovery from SWM value chain and its recycling operations. The indicator promotes integration of the informal system and encourages scientific recycling of resources recovered. For example, in an environmental point of view, the city efforts on SCF/RDF production are wasted if/ SCF/RDF derived from municipal waste is utilised in brick kilns with no pollution control instead of a cement kiln or stacked on-site without a clear utilisation plan.

Methodology: The indicator assesses the efficiency of city's waste management systems under two aspects. (i) extent of recyclables recovered from the total city waste and further processed by authorised recycling industries/units. (ii) utilization of non- recyclable inorganic waste having Calorific Value more than 1500 Kcal/kg in the form of SCF/RDF sent to cement kiln or any industry authorised by CPCB as per the Guidelines on Utilisation of Refused Derived Fuel in Various Industries, 2018.

Formula:

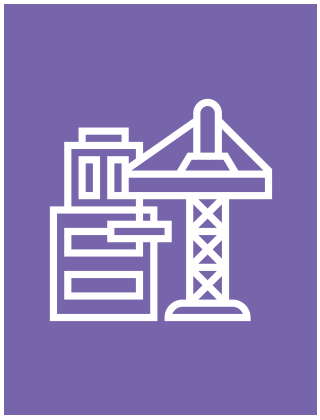
$$\frac{\textit{Waste recovered and recycled (TPA)} + \textit{SCF/RDF utilised (TPA)}}{\textit{Total Waste generated (TPA)}} \times 100$$

Unit: Percentage(%)

Maximum Score: 25

Performance Evaluation Levels:

	0	1	2	3	4
Criteria	No Facility exists	Material recovery with provision for sorting recyclables exists and facility for producing SCF/ RDF exists (in same premises or separate unit)	Up to 10% of total annual city waste generated is sold to approved / authorised collectors or/and sent to SPCB authorised recycler/ recycling facility and SCF/RDF is sent to cement Kilns /Waste to Energy Plants	10-20% of total annual city waste generated is sold to approved /authorised collectors or/and sent to SPCB authorised recycler/recycling facility and SCF/RDF is sent to cement Kilns / Waste to Energy Plants	>20% of total annual city waste generated is sold to approved / authorised collectors or/ and sent to SPCB authorised recycler/recycling facility and SCF/RDF is sent to cement Kilns / Waste to Energy Plants
Evidence/ Data Sources		• MRF exists (centralised or Decentralised facility) for paper/board/plastic/glass/metal) • SCF/RDF facility (for high calorific value, non-recyclable, non-biodegradable waste) – exists	• Waste Quantification and characterisation study report within last three years • Sale receipts/records of recyclables to authorised recycling (Monthly records of last 12 months) • Sale receipt/records of SCF, RDF (Monthly records of last 12 months) • SPCB authorisation for all Recycling Facilities to whom Recyclables and SCF/RDF is sold		
Responsible Agency/ Department	ULB/ MRF Operator Agency/ Formal or Informal Recyclers				
Score	0	10	15	20	25



Indicator 3: Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA) derived from City Construction and Demolition (C&D) waste are utilised.

Rationale: The indicator addresses the Greenhouse Gases (GHG) mitigation aspects due to Construction and Demolition Waste recycling and utilisation. The indicator intends that C&D Waste Management facilities are available and operational in cities as per C&D Waste Management Rules, 2016

Description: The Construction and Demolition (C&D) waste is a major component of all the waste generated by the construction boom. To reduce the pressure on the exploitation of natural resources, cities need to focus on finding greener ways to produce concrete, encouraging the reuse of recycled materials to replace virgin materials. Scientific evidence exists about reduction of GHG by reuse of recycled materials. "ClimateSmart Cities" encourages scientific processing of C&D waste as per Rules and BIS Standard IS 383. 100% utilisation of Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA) can be achieved through State/city level policies.

Methodology: This indicator assesses the extent of decentralized and centralized management of C&D waste generated. The indicator also assesses the extent of utilization of recycled C&D waste in a city. The total C&D waste generated in the city would be as declared in the latest Swachh Survekshan.

Formula: *The total C&D waste generated in the city would be as declared in the latest Swachh Survekshan*

$$* \left\{ \frac{\text{Total C\&D Waste Transferred to Processing Facility or designated dumping point}}{\text{Total C\&D Waste Generated in City}} \times 100 \right\} \quad \text{expressed as percentage}$$

$$** \left\{ \frac{\text{Total C\&D Waste transferred to Processing Facility which is converted to Recycled Products}}{\text{Total C\&D Waste Transferred to rocessing Facility}} \times 100 \right\} \quad \text{expressed as percentage}$$

Unit: Percentage(%) **Maximum Score:** 25

Performance Evaluation Levels:

	0	1	2	3	4
Criteria/ Sub-indicators/ Progression Levels	**Formal System for C&D Waste Management Exists**	**Dedicated storage and Collection Mechanism for C&D Waste exists**	**Dedicated Transport and Disposal Mechanism for C&D Waste exists**	**Processing of C&D Waste**	**Reuse of Recycled Waste**
Evidence/ Data Sources	No formal system for C&D Waste Management Exists	• Notification of User Charges • Notification of notified dumping points (Primary & Secondary bins) • Private agency/ ULB department assigned (contract copy) • Helpline no. exists	• Private agency/ ULB department assigned for transport (contract copy) • Data Records/Log books • Vehicle list delicately assigned for transportation • >70 % of city C&D waste generated is sent for processing facility (ULB owned or tie up with any other agency/ city) or dumped in designated point authorised by ULB*	• Processing Facility Exists or tie up with C&D waste processing facility (contract copy) • Log books of waste Processing for the last three months • >50 % of city C&D waste reaching processing Facility is recycled**	• City mandate on using recycled products (document) • 100 % of city recycled C&D waste is reused- Sale record /receipts of last three months
Responsible Agency/ Department		ULB/ Private Agency	ULB/ Private Agency	Private Agency	ULB/ Private Agency
Score	0	5	15	20	25

Indicator 4: Greenhouse Gases (GHGs) emission reduced due to improved Municipal Waste processing and treatment facilities

Rationale: The Greenhouse Gases (GHG) emission can be avoided with scientifically operated and managed waste processing facilities in cities as per Solid Waste Management Rules, 2016

Description: This indicator assesses the avoided GHG emissions, as a result of waste processing in the city.

Methodology: GHG emissions avoided will be calculated as per the Methane Commitment Model provided in the Global Protocol for Community Scale GHG Emissions (GPC, V2.0). The Methane Commitment method takes a mass-balance approach. It calculates landfill emissions based on the amount of waste disposed in a given year, regardless of when the emissions actually occur (a portion of emissions are released every year after the waste is disposed). GHG emissions reduction will be calculated by the evaluation team, based on the following information provided by the city:

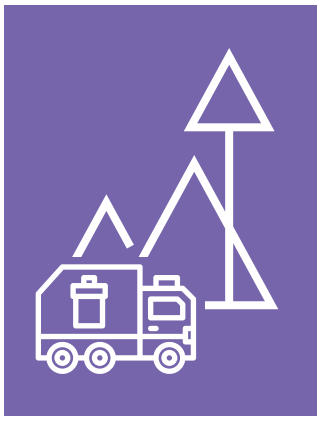
- Total amount of waste generated in the city
- Quantum of Waste treated through Biological processes like composting, bio-methanisation
- Quantum of Waste treated through incineration processes like waste to energy
- Total waste recycled and recovered
- Total quantum of MSW sent to landfill/dumpsite in inventory year
- Total amount of waste processed (Compost, RDF/SCF/ Bio-methanisation, Waste to Energy in Centralised/ decentralised model)
- Type of landfill/dumpsite that is used in your city:
    - > Anaerobic managed solid waste disposal sites: These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following:
      (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste.
    - > Semi-aerobic managed solid waste disposal sites: These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system.
    - > Unmanaged solid waste disposal sites – deep and/or with high water table: All SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 metres and/or high-water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste.
    - > Unmanaged shallow solid waste disposal sites; All SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 metres.
- Characterization of waste generated in your city (%):
    - > Paper/cardboard
    - > Textiles
    - > Food waste
    - > Wood
    - > Garden/Park waste
    - > Nappies/Sanitary waste
    - > Rubber and Leather
    - > Average annual rainfall in your city

Formula: *Based on the above information the formula given below will be used by the evaluation team to calculate GHG emissions avoided as a result of processing:*

Unit: Percentage(%) **Maximum Score:** 10

Performance Evaluation Levels:

	0	1	2	3	4
Percentage of GHG emission avoided because of city's processing facilities	**No reduction**	**≤25%**	**25 to ≤50%**	**50 to ≤75%**	**>75%**
Evidence/ Data Sources	• Consent to Establish and Operate for all processing facilities based on various technological options followed either/or centralised or decentralised waste management principals i.e. Composting, RDF, Waste to Energy, Bio-methanisation **For each processing facility (compiled sheet):** • Weigh bridge records of waste sent to processing in all processing facilities for the last 12 months • Records of quantum of product (Compost/ Electricity / bio gas) produced from such processing facilities for the last 12 months • Records of quantum of rejects from each processing facility, that are disposed in the dumpsite/sanitary landfill • Waste Characteristics as in Methodology				
Responsible Agency/ Department	ULB/ Processing Facility Operator				
Score	0	3	5	7	10



Indicator 5: Scientific Landfill is available with city as per SWM Rules, 2016

Rationale: The Greenhouse Gases (GHG) emission can be avoided if the waste disposal facility is scientifically operated and managed as per Solid Waste Management Rules, 2016

Description: The scientific landfill should conform to the SWM Rules, 2016 and Guidance given in the Municipal Solid Waste Management (MSWM) Manual, 2016 (CPHEEO, 2016) and any other updated criteria published by CPCB/ State PCB for Solid Waste Disposal Facilities.

Methodology: There are certain parameters and conditions suggested in SWM Rules, 2016 and Guidance given in the MSWM Manual, 2016 (CPHEEO, 2016) and Environmental Clearance is provided based on these parameters and conditions as applicable. Environmental Clearance for such facilities is provided by the State Environmental Impact Assessment Authority or as applicable for the state. Furthermore, the landfill operation and management are assessed based on Solid Waste Management Rules, 2016.

Benchmark: Landfill is sited, operated and managed as per the SWM Rules, 2016 and guidance provided under MSWM Manual, 2016

Formula: NA **Unit:** NA **Maximum Score:** 10

Performance Evaluation Levels:

	0	2	4
Scientific Landfill is available as per SWM Rules, 2016	No	Yes, and sited as per SWM Rules, 2016	Yes, and under operation as per SWM Rules, 2016
Evidence	Only dumpsite exist	• Environmental Clearance (EC) form SEIAA or as applicable for the State	• Concessionaire agreement of the contractor appointed if on PPP model • Weigh bridge records for waste input, output (product-compost/ electricity) and rejects from processing facility of last 6 months • Weigh bridge records of inert/ waste disposed in the landfill in last 6 months
Score	0	5	10

Indicator 6: Plan prepared and implemented for scientific landfill/ dumpsite closure considering GHG emissions

Rationale: The scientific closure and post closure maintenance of engineered landfills and dumpsites avoid significant GHG emissions. Bio-mining of dumped waste and/or making windrows over dumpsites do not mitigate GHG emission and hence have not been considered under this indicator.

Description: Landfill gas (LFG) is a natural by-product of the decomposition of organic material in landfills. LFG is composed of roughly 50 percent methane (the primary component of natural gas), 50 percent carbon dioxide (CO_2) and a small amount of non-methane organic compounds. Methane is a greenhouse gas which has 28 to 36 times more potential than CO_2 for trapping heat in the atmosphere over a 100-year period, hence it is important to mitigate Landfill gases. Methane recovered from landfills can either be flared or used as an energy resource.

Methodology: This indicator assesses the city's readiness to capture and use Landfill gas in its quest to avoid GHG emission.

Benchmark: Gas collected from Landfill is reused or No gas exists in the landfill after use/ Flaring Recovered or/and capped land has been converted into green space for public/ multi-use e.g. for setting up solar parks.

Formula: NA **Unit:** NA **Maximum Score:** 10

Performance Evaluation Levels:

	0	1	2	3	4
	No Plan/ report for scientific landfill/ dumpsite closure exists	**Plan/ Detailed project Report for scientific landfill/dumpsite closure along with post closure maintenance exists**	**Scientific capping executed and collected gas is flared/ no gas is available after flaring**	**Scientific capping executed, and gas collected is reused or No gas exists in the landfill after use and scientifically capped area is maintained as per post closure conditions of Environmental Clearance**	**Scientifically capped land has been converted into green space for public/ multi-use after post maintenance period**
Evidence		• Copy of DPR; Concessionaire agreement if Project on PPP Model • Design Layout	• Evidence of the scientific closure and gas flaring- Utilization Certificate for Executed works; certificate from Municipal commissioner /Independent Engineer for executed works through concessionaire if PPP project • Flaring record of gases in last 6 months of Operation	• Evidence of post closure maintenance works; certificate from Municipal commissioner/ Independent Engineer/ for executed works through concessionaire if PPP project • Records on the quantity of gas generation and reused	• Certificate from Municipal Commissioner/ Independent Engineer, if PPP project on landscaping of closed landfill and its access to public
Score	0	5	12	17	20

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REFERENCES

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Ministry of Housing and Urban Affairs
Government of India