A Snapshot of Urban Green Finance in Two Indian Cities

Case Studies of Hyderabad and Kolkata

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CITIES CLIMATE FINANCE LEADERSHIP ALLIANCE

CLIMATE POLICY INITIATIVE

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ABOUT THE ALLIANCE

The Cities Climate Finance Leadership Alliance (the Alliance) is a coalition of leaders committed to deploying finance for city level climate action at scale by 2030. It is the multi-level and multi-stakeholder coalition aimed at closing the investment gap for urban subnational climate projects and infrastructure worldwide. Climate Policy Initiative (CPI) serves as Secretariat for the Alliance. Funding for the Alliance's activities is jointly made available through two German government ministries: The Federal Ministry for Economic Cooperation and Development (BMZ) and the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU)

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EXECUTIVE SUMMARY

Around 40% of India's population will live in cities by 2036, according to government projections, but climate change is already exposing these urban areas to extreme water and heat stress. At present, more than 40 Indian cities are listed in the world's 100 most vulnerable cities to environmental and climate related events (Verisk Maplecroft 2021). The COVID-19 pandemic has only intensified these issues, increasing food insecurity and unemployment among India's urban poor in recent years (Bhalotia et al. 2020).

The governing bodies that oversee India's cities and states face formidable and complex challenges in bridging the urban development gap in this context. Addressing these challenges will require a systematic and comprehensive assessment of the current levels of urban green finance directed to climate change mitigation, adaptation and other environmental activities. This will help to map the role of relevant stakeholders and enhance understanding of governance and financing structures.

Increasing the transparency and accountability of urban climate governance in this way will serve as a starting point for identifying investment gaps and exploring opportunities for mobilizing new resources. It will also help to identifying ways to mainstream climate change and environmental objectives at central-, state-, and city-level through a well-defined sectoral planning and budgeting process.

With these aims in mind, this study examines the landscape of urban green finance in two Indian cities, Hyderabad and Kolkata. It maps the flow of green finance from public and private sources towards sectors contributing to climate change mitigation and adaptation in these two cities.

The sectors included in this study are:

- Clean Energy and Energy Efficiency
- Sustainable Transportation
- Waste and Water Management
- Air Quality
- Disaster and Risk Management
- Urban Green Coverage, Conservation and Biodiversity

The key findings of this report are as follows:

- **State governments are key players in Indian climate policy and finance.** Under India's multi-level governance structure, states dominate policy implementation and financing of projects in sectors relevant to climate change action in cities. Understanding the role of state governments, sometimes more than city governments, is crucial to the analysis of urban climate action and finance in this country.
- **Cities require support to tap into broader climate priorities and financing pools**. A conducive environment for policy, institutional and financial support, will help urban local bodies (ULBs) to build synergies with national- and state-level climate priorities, and explore new and innovative financing mechanisms to drive climate action.

- **More robust data collection processes will support implementation and tracking.** A number of national and state policies, schemes and missions provide strategic guidance for cities pursuing climate action. Harmonizing and centralizing data collection will help track progress on their implementation.

The COVID-19 pandemic has increased pressure on governments to ensure that scarce public financial resources create long-term sustainable impacts. This is particularly important for countries such as India, where rapid urbanization and climate change are stretching resources even further.

India should tap into a mix of domestic and international sources of capital and use innovative financial instruments to build resilient infrastructure for sustainable urban development. As this study shows, this will require clear, coordinated action by national, state and local government bodies.

1. INTRODUCTION

The urban population in India is set to grow from 470 million urban dwellers in 2021 to 600 million by 2036, or about 40% of India's population, according to 2020 projections from the Ministry of Health and Family Welfare, Government of India.

At the same time, climate change is making Indian cities vulnerable to high water and heat stress. Extreme weather events such as droughts and floods are happening with increased frequency and intensity across India, causing severe economic losses. More than 40 of the world's 100 cities most vulnerable to environmental and climate-related threats are in India (Verisk Maplecroft 2021). The country also ranks 7th out of 181 countries in terms of exposure and vulnerability to the impacts of climate change (Eckstein et al. 2021).

The recent outbreak of the COVID-19 pandemic has further exposed deep fault lines in India's urban centers. Studies have suggested a positive correlation between urbanization and the spread of the infection due to high population density, travel, exposure to infected individuals, and inadequate sanitation (Gupta et al. 2021; Perappadan 2020). The urban poor from India's informal sector faced food insecurity and unemployment in both the first and second waves of the pandemic, which exacerbated pre-existing inequalities (Bhalotia et al. 2020).

In order to meet the social and economic needs of a growing urban population, Indian states and cities should integrate sustainable urban development policies and practices in their governance structures. This will require an assessment of India's readiness to face the formidable and complex challenges involved in bridging the urban development gap.

India's Nationally Determined Contributions (NDCs) seek to:[1]

- reduce the emissions intensity of its GDP by 33% to 35% below 2005 levels
- achieve 40% of cumulative electric power installed capacity from non-fossil fuel sources
- enhance forest and tree cover to create additional carbon sinks equivalent to 2.5 to 3 billion tons of carbon dioxide by 2030

Meeting these targets will require annual investment of about USD 157 billion from 2015 to 2030. With such a high number of urban dwellers, India's NDCs can only be achieved through strong partnerships between the national and sub-national governments.

Two estimates are available for India's urban infrastructure financing needs. According to the High-Powered Committee on Indian Infrastructure and Services, total investment of INR 39.2 trillion (USD 827 billion at 2009–2010 rates) is required from 2012 to 2031. This is roughly equivalent to 1.1% of India's GDP by 2032. It would provide the growing

1 As on October 30, 2021

urban population with better services, a clean and healthy environment, and world-class infrastructure (MoUD 2011).

The National Infrastructure Pipeline (NIP) 2020 estimates that INR 15 trillion (USD 215 billion) was invested in urban India from financial years (FY) 2013 to 2019[2] and projects an expenditure of INR 19 trillion (USD 271 billion) to FY 2025. This covers services like water, sanitation, pollution control, transportation and land use control (DEA 2020). Devolution of these financial resources will be a critical enabler for mainstreaming climate change action in cities and advancing other environmental and social goals.

Many attempts have been made to map India's urban financing landscape through a number of schemes and policies. These studies have also provided detailed analysis of challenges and opportunities in the sector (Mathur 2018; ORF 2019; Jain & Joshi 2015). A systematic assessment to track the current levels of urban green finance is missing, however. A comprehensive city-level analysis of finance flows to climate change mitigation, adaptation and other environment-related activities could help map the role of relevant stakeholders and improve understanding of governance and financing structures. This would increase the transparency and accountability of urban climate governance.

Additionally, it could serve as a starting point in identifying investment gaps and exploring the opportunities for mobilizing new resources. It could also help to identify ways to mainstream climate change and environmental objectives at the central-, state- and city-level through a well-defined sectoral planning and budgeting process.

This study attempts to understand the existing nature of green investments and analyze actual disbursements towards low-carbon and climate resilient development. It seeks to understand the urban green finance landscape in two Indian cities, Hyderabad and Kolkata.

The sectors included in this study are:

- Clean Energy and Energy Efficiency
- Sustainable Transportation
- Waste and Water Management
- Air Quality
- Disaster and Risk Management
- Urban Green Coverage, Conservation and Biodiversity

In mapping the flow of green finance to these sectors from both public and private sources, this study has made the following findings:

- **State governments are key players in Indian climate policy and finance.** Under India's multi-level governance structure, states dominate policy implementation and financing of projects in sectors relevant to climate change action in cities. Understanding the role of state governments, sometimes more than city governments, is crucial to the analysis of urban climate action and finance.

2 The financial year in India runs from April to March.

- **Cities require support to tap into broader climate priorities and financing pools**. A conducive environment for policy, institutional and financial support, will help urban local bodies (ULBs) to build synergies with national- and state-level climate priorities, and explore new and innovative financing mechanisms to drive climate action.
- **Data collection must be strengthened to support implementation and tracking.** A number of national and state policies, schemes and missions provide strategic guidance for cities pursuing climate action. Harmonizing and centralizing data collection will help track progress on their implementation.

This study is structured as follows:

- **Introduction:** An outline of the scope of the study and definitions for urban green finance. This chapter provides information on an extensive literature review of primary and secondary sources, along with the data gaps and challenges encountered during this study. More detail on the methodology for the selection of the cities is provided in the Annexure.
- **Urban Climate Governance in India:** A detailed summary of the multi-tier urban governance structure in India. This chapter describes the division of responsibilities among various stakeholders with respect to the administration and financing of the case study cities of Hyderabad and Kolkata. It also illustrates how various key policies and programs being undertaken in these cities align with national and state priorities on climate mitigation and adaptation.
- **Case Study 1: Hyderabad**
- **Case Study 2: Kolkata**
- Both case studies are organized into similar sections:
    - Section I provides context to the socio-economic significance of each city and its vulnerability to climate change
    - Section II is a sectoral analysis of urban green financial flows. It provides the context of the relevant policies for the sector at the national, state and city level, the implementing agencies involved, examples of activities, and the estimates of disbursements for the financial year 2018 and 2019 (where available).
    - Section III provides a brief summary of each city's progress on financing environmental objectives and the various challenges and opportunities observed during the course of this study.
- **Concluding Observations:** The findings of this study and recommendations for how policymakers can enhance their urban green financing efforts.

1.1 SCOPE AND METHODOLOGY

DEFINITIONS AND TAXONOMY

As a starting point for the analysis, this study uses three definitions on urban climate finance in an Indian context:

1. **What is urban?** The Census of India 2011 defines a city or urban agglomeration (UA) as "a continuous urban spread constituting a town and its adjoining outgrowths, or two or more physically contiguous towns together with or without outgrowths of such towns. A UA must consist of at least a statutory town and its total population (i.e., all the constituents put together) [and] should not be less than 20,000 as per the 2001 Census".
   India's ULBs are decentralized governing institutions that are primarily responsible for providing basic civic services to the urban population such as health, primary education, water, and waste management.

2. **What are green activities?** The Climate Smart Cities Assessment Framework developed by India's National Institute of Urban Affairs (NIUA) classifies green end-use sectors into five main categories (see Table 1), with sub-sectors to address mitigation and adaptation (NIUA 2020).

   The sectoral scope and list of activities included in this report's case studies vary for both cities based on the availability of data and the priority areas for climate action. More details on some of the key activities under each sector are provided within the case studies in Tables 2 and 5.

Table 1: Sectoral Coverage

SECTORS	SUB-SECTORS
Energy and Green Buildings	Clean Energy
	Energy Efficiency (Street Lighting)
	Green Buildings
Mobility and Air Quality	Sustainable Transportation (Metro and Electric vehicles)
	Air Quality Management (Industrial Pollution)
Urban Planning, Green Cover and Biodiversity	Parks, Squares and Green Spaces
	Disaster Risk Reduction
	Rejuvenation & Conservation of Water Bodies & Open Areas (Wetlands Management)
Water Management	Water Supply
	Sewerage and Drainage Management
Waste Management	Waste Collection, Disposal, Sanitation

3. **What is green finance?** This study aligns its definition of green finance with two Climate Policy Initiative studies: “Building a Consensus on the Definition of Green Finance” and “Accelerating Green Finance in India: Definitions and Beyond”. These publications define climate, green and sustainable finance as follows:

    - Climate finance refers to “local, national or transnational financing, drawn from public, private and alternative sources of financing, that seeks to support mitigation and adaptation actions that will address climate change”
    - Green finance covers finance for climate and other environmental objectives that support sustainability, particularly aspects such as biodiversity and resource conservation
    - Sustainable finance covers a broader swathe of the investment universe that aims to build an inclusive, economically, socially, and environmentally sustainable world

To define urban green finance, this study also refers to the definition and taxonomy of urban climate finance developed by the Cities Climate Finance Leadership Alliance for its 2021 State of Cities Climate Finance Report. It defines urban climate finance as climate finance committed to benefit city dwellers exclusively, or almost exclusively, independent of geographical location being within a city’s physical boundaries.

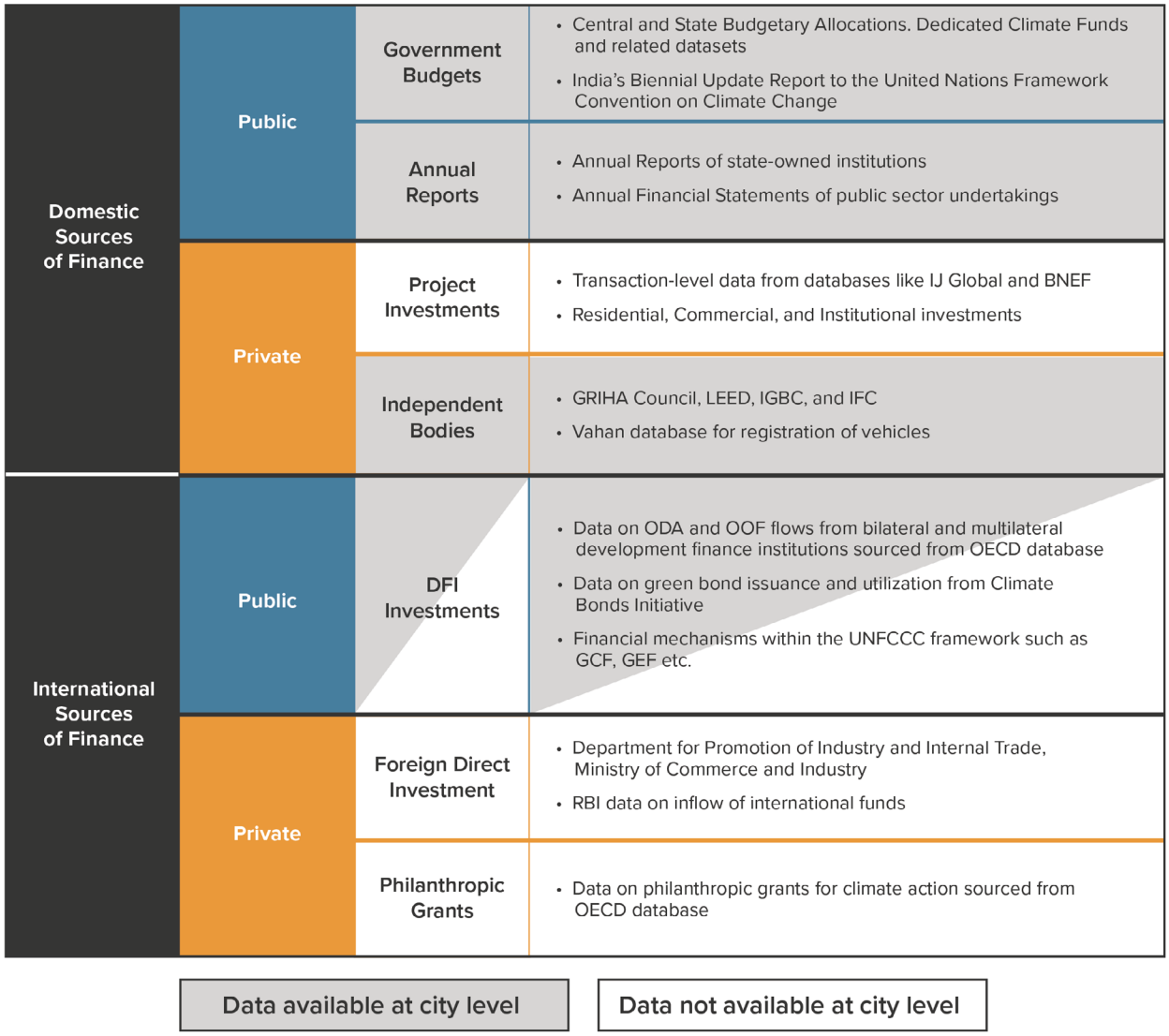
The study also recognizes the importance of tracking actual disbursements, primary expenditure or spending on green activities, where available – not just commitments by public and private actors. This is a retrospective study, tracking green finance disbursements for FY 2018 and FY 2019.

DATA SOURCES AND AVAILABILITY

Climate action in Indian cities is largely driven by program grants-in-aid routed through central, state, and municipal corporation budgets. Many national and state policies are implemented at the city level by programs run by the public sector enterprises e.g., the Street Lighting National Program (SLNP), which is operated by Energy Efficiency Services Limited (EESL). Though cities have limited technical and financial capacity, they can access other private sources of finance including resources raised from financial markets through issuance of green bonds and municipal bonds. Other public and private sources of finance include official development assistance from bilateral and multilateral development finance institutions, foreign direct investment and project investments by public sector enterprises, and philanthropic grants.

Figure 1 summarizes the key sources of green finance in India, the instruments used to disburse these funds, and the data sources this study uses for information on disbursement:

Figure 1: Sources of Green Finance and Disbursement Data



Source: CCFLA

1.2 DATA GAPS AND LIMITATIONS

It is not always possible to find high-quality, comprehensive data in the public domain. This study, therefore, has the following limitations:

1. **Data availability and reporting:** The focus on disbursements as opposed to commitments of green investment increased the challenge of finding disaggregated data at the city level. This was especially true for sectors like clean energy or disaster management where state grants are the primary source of funds. Attempts to obtain information from national and state agencies through measures such as filing applications under India's Right to Information Act 2005 were unsuccessful. This study also found that state agencies, which are responsible for implementing the Government's clean energy programs, make little to no data available on their websites about implementation at a disaggregated level.

2. **Identification of green investments from budgetary sources:** The lack of a harmonized framework for identifying and apportioning green expenditure made it difficult to standardize the methodology across the two case study cities. The differences in reporting data between the state and municipal budgets of Hyderabad and Kolkata also made interstate comparison difficult. The problem was exacerbated by a time lag in reporting budget actuals that made it difficult to establish causality with other sectoral developments.
3. **Mapping roles and responsibilities for sources of finance:** India has a multitiered governance structure at the federal, state, and city level. In 1992, the 74th constitutional amendment formally recognized ULBs as the third level of government by assigning them responsibilities such as urban planning, land use and construction, water, health, and sanitation. This change was not backed with additional financial and technical capacity, however, so state governments have functional and financial dominance over ULBs and central government provides strategic direction. As a result, this study found it difficult to track the entire value chain of the urban green financial flows from financing source to end user.

1.3 URBAN CLIMATE GOVERNANCE IN INDIA

Various national and state schemes and policies provide an enabling framework for cities to carry out climate action activities. Municipal corporations receive intergovernmental transfers from the national and state governments. These are earmarked for different sectoral policies and schemes, which may or may not have specific urban focus. For example, the SLNP, funded by EESL, contributes indirectly to urban climate action in Hyderabad. Other programs have a specific urban focus and contribute directly to urban climate action. For example, the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) administered by the Ministry of Housing and Urban Affairs, Government of India, or the state-level Green City Mission under the Department of Urban Development and Municipal Affairs, West Bengal.

Multilevel governance plays an important role in urban climate action in India. Strategic guidance for urban climate action is provided by policies, missions and legislation at the national level. To adapt to the national vision, the states prepare State Action Plans for Climate Change (SAPCCs) based on their own priorities and approaches to climate change. The state governments then delegate responsibility for implementing SAPCCs to local governments, along with the necessary funds. Municipal governments are tasked with providing only basic services to city dwellers and have limited financial and technical capacity. The level of autonomy at the municipal level to pursue climate action differs significantly depending on the states and sector. As different sectoral policies are funded and implemented by a multitude of organizations at the national, state, and city level, urban green finance flows require the integration of both vertical and horizontal levels of governance.

2. CASE STUDY 1: HYDERABAD

2.1 CONTEXT

Hyderabad is the capital of Telangana state and its largest city, at 650 square kilometers. It is also the fourth most populous city of India, with 7.75 million inhabitants, according to the 2011 Census of India. As the seat of the Government of Telangana, Hyderabad houses the state's legislature, secretariat and high court. It is a city of political, economic and strategic significance for the country.

Hyderabad is among the top 10 fastest-growing cities in the world (Wood 2018). In 2018, it had an 8.47% GDP growth rate and a USD 50.6 billion economy, which is poised to grow to USD 201.4 billion (in 2018 terms) by 2035. The Greater Hyderabad Municipal Corporation (GHMC) is primarily responsible for providing infrastructure services to the city and includes six zones under its jurisdiction (see Figure 2).

Figure 2: Area Under Jurisdiction of Greater Hyderabad Municipal Corporation

Source: Greater Hyderabad Municipal Corporation

Hyderabad is vulnerable to urban flooding, drought, environmental pollution, water scarcity and industrial disasters, among other adverse events. These risks have increased further due to rapid urbanization and development activities. Between 1989 and 2001, Hyderabad lost about 3,245 hectares of its water bodies (CSE 2016).

In 2016, a study created a vulnerability index for Hyderabad using geographical, social, economic and environmental parameters such as elevation, industries, and natural vegetation cover (Boori et al. 2016). It classified the central and northern parts of the city as "extremely vulnerable" to climate change due to alteration of the city's hydrological cycle and drainage pattern, poor waste management, construction over lake beds, and land degradation.

In 2020, Hyderabad witnessed the highest recorded rainfall for October since 1903. The high-intensity downpour flooded a large part of the city and led to widespread death and destruction. Preliminary estimates put financial losses due to these floods at USD 714 million (Rajeev 2020).

GOVERNANCE IN HYDERABAD

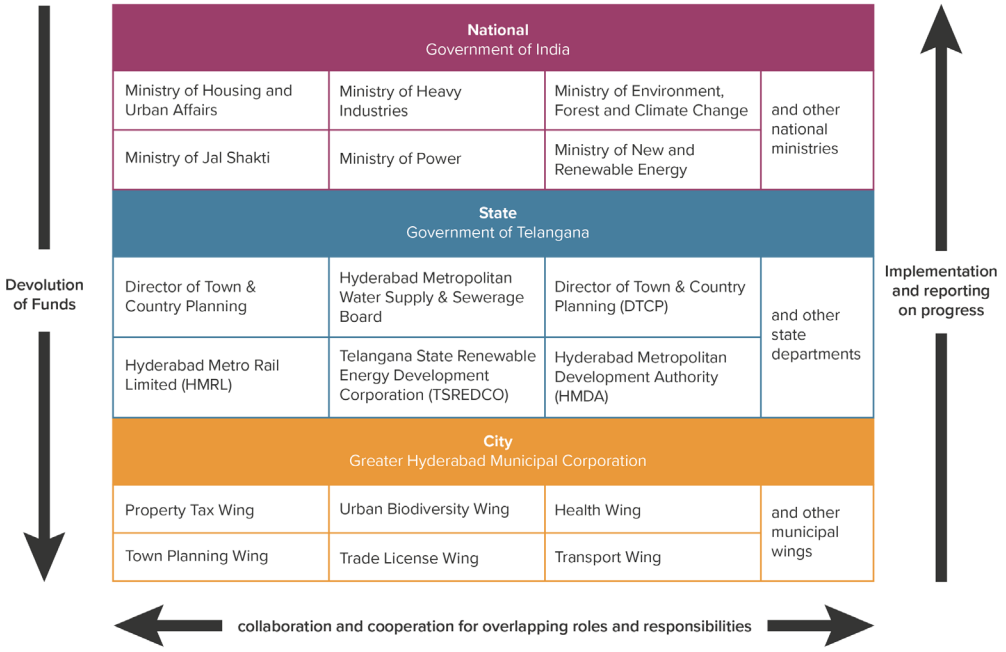
The GHMC is tasked with providing the following basic services to the city's inhabitants[3]:

- Public health, sanitation, street lighting
- Provision and maintenance of infrastructure – roads, storm water drainage, parks
- Regulatory activities – building construction, trade licenses
- Resource mobilization
- Implementation of urban poverty alleviation program

Climate action in Hyderabad is financed and implemented through coordination across a number of national, state and local government departments and institutions (see Figure 3).

3 Greater Hyderabad Municipal Corporation (GHMC), Government of Telangana

Figure 3: Multilevel Governance Framework for Climate Action in Hyderabad



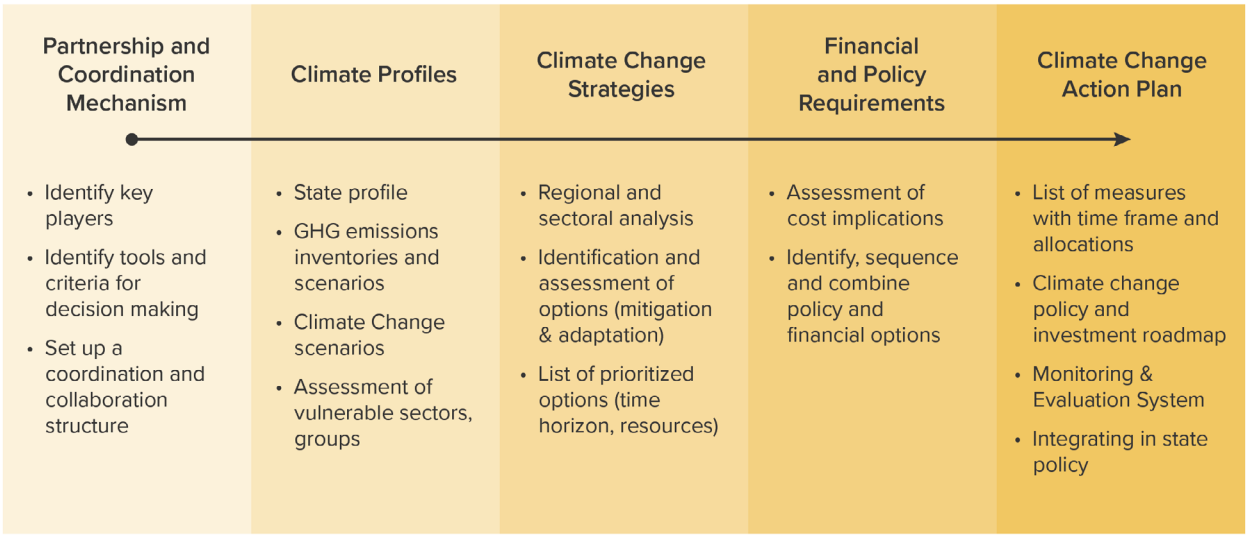
Source: CCFLA

The Telangana State Government's SAPCC aims to ensure coherence between strategies and actions at national and sub-national levels, and to address existing and future climate risks and vulnerabilities. Its key objectives are:

- Ensure inclusive and sustainable development of the state and protect the vulnerable from the adverse effects of climate change
- Improve ecological sustainability
- Provide a framework to undertake actions that deliver growth and development benefits, while mitigating and adapting to climate change
- Prioritize adaptation and mitigation options for the state and identify finance
- Engineer new and innovative policies or mechanisms to promote sustainable development

Telangana's SAPCC advocates a participatory approach to harmonize national and state actions and integrate state-level variations in ecosystems, geographic conditions, socio-economic scenarios, and other factors. Figure 4 shows the process for preparing Telangana's SAPCC:

Figure 4: Logical Framework for Preparing Telangana SAPCC



Source: State Action Plan on Climate Change for Telangana State

The different institutions involved in city-level governance and the resulting multiplicity of legislation often constrains the efficient functioning of civic administration. For instance, there are about 20 different pieces of legislation covering the city's transportation sector, leading to structural overlaps and fragmented distribution of responsibilities. Table 2 outlines the key initiatives implemented by these institutions, which are discussed in more detail in the next section.

Table 2: Hyderabad's Key Initiatives and Implementing Agencies, By Sector

SECTOR	KEY INITIATIVES IN HYDERABAD	IMPLEMENTING AGENCY
Energy and Green Buildings	• Clean Energy • Solar Energy Program a. Solar Grid-Connected Rooftop Systems b. Solar Off-Grid Rooftop Systems c. Solar Hot Water Systems d. Solar Street Lighting System • Wind Energy	• Telangana State Renewable Energy Development Corporation Limited. (TSREDCO) • Greater Hyderabad Municipal Corporation (GHMC) • Telangana State Pollution Control Board • Bureau of Energy Efficiency (BEE) • Energy Efficiency Services Limited (EESL)
	• Energy Efficiency • Energy Conservation Program • Unnat Jyoti by Affordable LED for All (UJALA) • Street Lighting National Program (SLNP) • Perform Achieve and Trade (PAT) Scheme	

SECTOR	KEY INITIATIVES IN HYDERABAD	IMPLEMENTING AGENCY
Energy and Green Buildings	• Green Buildings Certification of Green Buildings	• Green Rating for Integrated Habitat Assessment (GRIHA) Council • Leadership in Energy and Environmental Design (LEED) • Excellence in Design for Greater Efficiency (IFC EDGE)
Mobility and Air Quality	• Hyderabad Metro Rail • Telangana Electric Vehicle and Energy Storage Policy 2020-2030 • Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme	• Hyderabad Metro Rail Limited • Telangana State Renewable Energy Development Corporation Limited (TSREDCO) • Ministry of Heavy Industries & Public Enterprises
Waste Management	• Biogas and National Biogas Manure & Management Program • Biomass Energy • Industrial Waste to Energy • Waste Management and Recycling • Biomedical Waste Management • Municipal Solid Waste Management • Waste Management • Hazardous and Other Waste Management	• Telangana State Renewable Energy Development Corporation Limited (TSREDCO) • Greater Hyderabad Municipal Corporation (GHMC) • Telangana State Pollution Control Board
Urban Planning, Green Cover and Biodiversity	• Provision of safe footpaths, cycle tracks to promote non-motorized transport • 100% coverage of sewerage and sanitation for the urban population • Atal Mission for Rejuvenation and Urban Transformation (AMRUT) Smart Cities Mission	• Greater Hyderabad Municipal Corporation (GHMC) • Ministry of Housing and Urban Affairs
Water Management	• Protection and restoration of existing water bodies in urban areas • Creation of new water bodies in urban areas • Rainwater Harvesting • Wastewater Management	• Greater Hyderabad Municipal Corporation (GHMC)

2.2 SECTORS

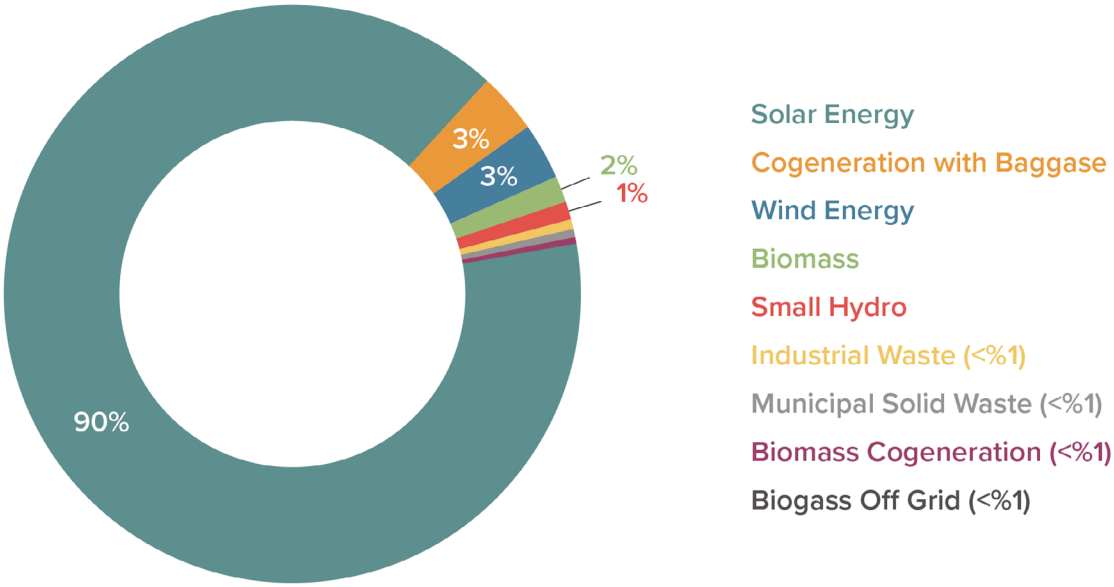
2.2.1 ENERGY AND GREEN BUILDINGS

CLEAN ENERGY

Telangana has a vast solar potential, estimated at 20.41 gigawatts (GW), and a wind energy potential of 4.2 GW. The government has made rapid strides in the implementation of renewable energy projects since the formation of the state in 2014. Total installed capacity has increased from about 35 megawatts (MW) in 2014 to 4,059 MW in 2019.

Around 90%, or 3,636 MW, of this installed capacity is solar energy. This is largely due to strong government support for adoption of a decentralized model to crowd in private capital to establish solar production plants across the state (Prasad 2017). Instead of concentrating projects at one location, as with solar parks, the government has encouraged projects across more than 180 locations in the state. It has also adopted a solar power policy designed to create an enabling environment for prospective solar power developers. It uses a single-window clearance system to encourage faster execution of projects.

Figure 5: Renewable Energy Capacity in Telangana, April 2019



Source: CCFLA

Hyderabad is increasingly adopting clean energy to meet its energy requirements locally and mitigate its per capita greenhouse gas emissions. A recent study estimates Hyderabad's total rooftop solar potential at 1.73 GW, with the residential category accounting for a potential of about 1.2 GW (GERMI 2018). Indeed, households are increasingly becoming power producers, not just consumers. Several distributed solar rooftop energy projects were commissioned in Hyderabad between FY 2018 and FY 2019. In FY 2018, the Telangana State Renewable Development Corporation (TSREDCO)

invested USD 21.14 million in rooftop solar programs in Hyderabad and added a total capacity of 23.3 MW. In FY 2019, it invested USD 2.4 million in its solar energy program and added a total capacity of 3.9 GW[4]. Table 3 provides details of these projects:

Table 3: Renewable Energy Projects Undertaken by TSREDCO in Hyderabad

YEAR	NAME OF PROJECT	CAPACITY (KILOWATTS)	COST OF PROJECT (USD)
2017-18	Implementation of aggregated capacity of 5 MW at Government buildings in the state of Telangana under Market Mode and RESCO Mode	4,989 kW	USD 4.56 million
2017-18	Implementation of aggregated capacity of 25 MW at residential buildings in the state of Telangana under Market Mode	18,276 kW	USD 16.54 million
2018-19	Implementation of aggregated capacity of 15 MW at residential buildings in the state of Telangana under Market Mode	3,935 kW	USD 2.41 million

In addition to this, a number of private developers have commissioned rooftop solar projects in Hyderabad. For instance, Fourth Partner Energy installed 717 kilowatts (kW) of rooftop solar capacity at Professor Jayashankar Telangana State Agricultural University (PJTSAU), Hyderabad (Verma 2019). Similarly, L&T Metro Hyderabad Rail Limited is currently installing about 14 MW of rooftop solar to power 64 metro stations in the city (Kumar 2018). In September 2018, Hyderabad-based Photon Energy Systems commissioned an 800 kW rooftop solar plant for IKEA. The Airports Authority of India has contracted the development of a 1 MW grid-connected solar photovoltaic project at Begumpet airport in Hyderabad at an estimated cost of USD 0.79 million (Prateek 2018).

To offer suitable incentives and promotional benefits to developers in a rapidly expanding renewable energy sector, the state government is planning to come out with a new solar policy. Similarly, it is planning a comprehensive policy framework to encourage wind energy projects.

ENERGY EFFICIENCY AND CLEAN BUILDINGS

Several initiatives promote energy conservation and energy efficiency in Hyderabad under the provisions of the Energy Conservation Act 2001. These initiatives are coordinated by TSREDCO and supported by the Bureau of Energy Efficiency, Ministry

4 This information was requested from TSREDCO, Government of Telangana and the Ministry of New and Renewable Energy (MNRE), Government of India under the Right to Information Act 2005. MNRE's response to the application was NIL for both FY 2018 and FY 2019.

of Power and the Telangana State Government. In FY 2018, TSREDCO invested USD 27,000 on energy conservation programs in Hyderabad [5]. In FY 2019, these investments increased by 77% to USD 48,000.

Demand side management interventions can be used to alter electricity consumption. Hyderabad has replaced more than 400,000 traditional streetlights with energy efficient LED streetlights, lowering the city's energy demand by 40 MW. Under the SLNP, EESL invested USD 2.23 million in Hyderabad in FY 2018 (data for FY 2019 not available)[6]. Similarly, the GHMC invested USD 0.73 million and USD 0.77 million in FY 2018 and FY 2019 respectively for the installation of streetlights in the city. To provide energy efficient appliances to consumers at affordable prices, TSREDCO is implementing the 9W LED Bulb Program and EESL is implementing the Unnat Jyoti by Affordable LED to All (UJALA) scheme in Hyderabad.

The energy efficiency sector also includes investments in construction of green buildings (built infrastructure), as well as retrofits, renovation and modernization of existing building stock. The Energy Conservation Building Code is mandatory for commercial buildings and other non-residential buildings in Hyderabad that have a plot area of more than 1,000 square meters or a built-up area of 2,000 square meters[7]. This study has calculated investments in green buildings certified by Green Rating for Integrated Habitat Assessment (GRIHA) Council, Leadership in Energy and Environmental Design (LEED), and IFC-EDGE. These investments totaled USD 22.14 million in FY 2018 and USD 6.69 million in FY 2019.

2.2.2 MOBILITY AND AIR QUALITY

SUSTAINABLE TRANSPORTATION

Hyderabad is a densely populated economic powerhouse in southern India. A burgeoning middle class, the concentration of economic activities in the city, and increased ownership of private vehicles are together exerting pressure on its transport systems.

To reduce fuel consumption and congestion in the city, the development of a planned, sustainable urban transport system has become an imperative. For instance, it is estimated that environmental damage at a cost of about USD 5 million could be avoided by reducing harmful emissions through increased use of Hyderabad Metro Rail. This is the city's rapid transit system and one of the world's largest public-private partnership metro projects.

Investments in Hyderabad Metro Rail increased by 11% from USD 514 million in FY 2018 to USD 570 million in FY 2019. There are several aspects that make Hyderabad metro a

5 As reported by TSREDCO in response to an application filed under the Right to Information Act 2005.

6 Founded in 2009, EESL is promoted by Ministry of Power, Government of India as a Joint Venture of four reputed public- sector undertakings NTPC Limited, Power Finance Corporation Limited, REC Limited and Powergrid Corporation of India Limited. It enables consumers, industries and governments to effectively manage their energy needs through energy efficient technologies. (https://eeslindia.org/en/home/)

7 Telangana Energy Conservation Building Code is a code is to provide minimum requirements for the energy efficient design and construction of buildings. To streamline and modernize compliance to the code, the Greater Hyderabad Municipal Corporation (GHMC) has developed an online city-wide ECBC compliance system. (https://tsredco.telangana.gov.in/PDFs/ECBC/4_TS_ECBCGuidelines.pdf)

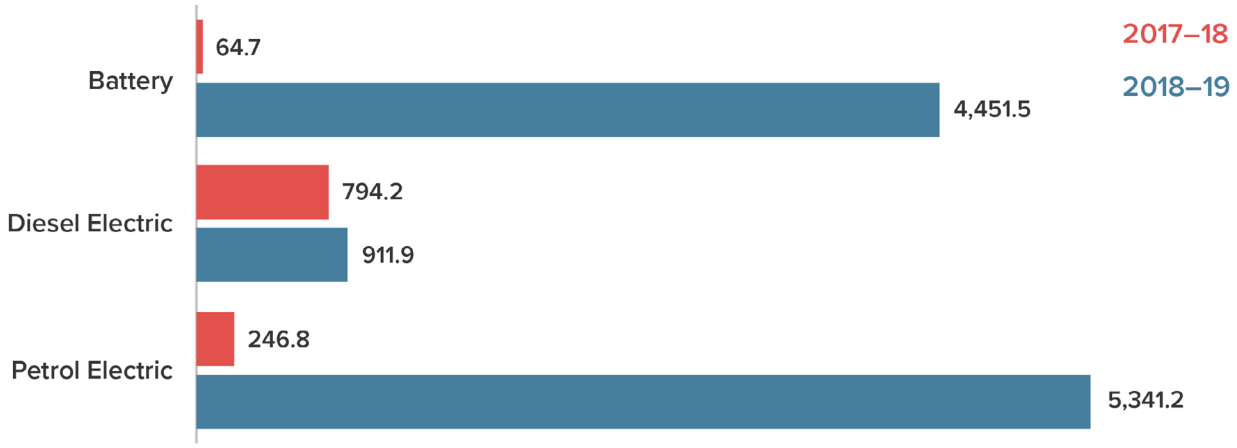
"green" transportation system[8]. For example, a rainwater harvesting scheme on metro premises recycles 100,000 liters of water per day, while eco-friendly chemicals are used for housekeeping. The project aims to eliminate 10,000 tons of CO2 and reduce the emission of 200 tons of volatile organic compounds (including 12 tons of particulate matter) from the environment over a period of time.

In addition to this, the state government has formed a special purpose vehicle – Hyderabad Airport Metro Rail (HAML) – to build the 31 km Airport Express Metro Corridor at an estimated cost of up to USD 714 million.

To promote a shift from dependence on fossil fuels to electric and hybrid vehicles, the state government has recently developed the Telangana Electric Vehicle and Energy Storage Policy 2020-2030. Hyderabad is home to several electric vehicle (EV) sector players that are undertaking research and innovation in EVs and energy storage systems to reduce the total cost of electric mobility and drive EV adoption.

This study has used the sale of battery and hybrid vehicles registered with the Hyderabad Road Transportation Authority as a proxy for investments in the electric mobility sector. It found that between FY 2018 and FY 2019, investment increased from USD 1.1 million to USD 10.7 million. This includes the sale of mopeds and motorized cycles, motor cars, motor cabs, and omnibus[9].

Figure 6: Investment in Electric Vehicles in Hyderabad, FY 2018 and 2019



Source: CCFLA

The sharp increase in EV sales can be attributed to the demand incentives provided by the Government of India under the first phase of the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME-India) scheme[10]. In March 2019, Telangana State Road Transport Corporation inaugurated its first fleet of 40 electric buses in Hyderabad. With this, Hyderabad became the first city in the country to run electric buses sourced under the FAME-India scheme. A 100% road tax and registration fee

8 Green Metro, L&T Metro Rail (Hyderabad) Limited (https://www.ltmetro.com/green-metro/)
9 Sale of unregistered battery rickshaws in grey markets has not been considered.
10 The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME-India) Scheme is the flagship scheme of the Department of Heavy Industries (DHI) announced in the Union Budget 2015-2016 as part of the National Electric Mobility Mission Plan (NEMMP) 2020 with an initial outlay of INR 795 crores (USD 114 million).

exemption for the first 0.2 million electric two-wheelers purchased and registered within the state is likely to encourage large-scale EV adoption in Hyderabad.

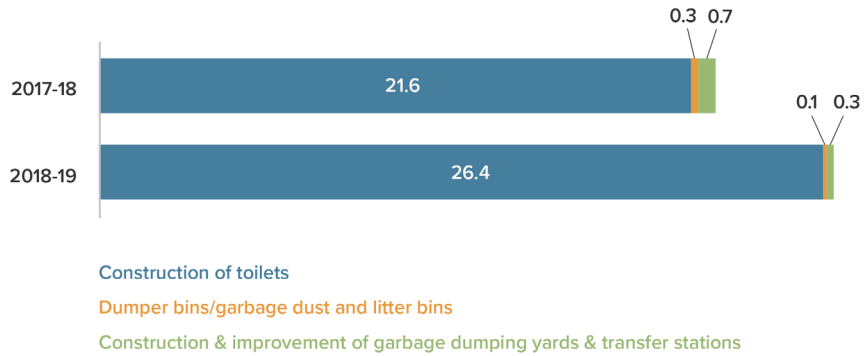
2.2.3 WASTE MANAGEMENT

Hyderabad has one of the most advanced municipal solid waste collection, transport, and treatment systems in the country. The city produces about 4,500 metric tons of garbage and 450 metric tons of construction and demolition waste every day. The GHMC is responsible for the management of the waste generated in the city, including biomedical waste, municipal solid waste, e-waste and hazardous waste.

GHMC actions in this area include laying roads using 6.34 metric tons of recycled plastic waste and encouraging the cement industry to co-process non-recyclable plastic waste as an alternate fuel. These activities help bring about improvements in sanitation, supplement fertilizer availability by turning waste into nutrient-rich manure, and keep the environment clean. Indeed, Hyderabad was declared open defecation free (ODF) in August 2017 (IE, 2017). In 2019, the city ranked 35th out of 425 cities in the Swachh Survekshan (Cleanliness Survey) Rankings released by the Ministry of Housing and Urban Affairs, Government of India (MoUA 2019).

This study found that expenditure on construction and improvement of garbage dumping yards and transfer stations, construction of toilets, and other waste management activities increased by 19% from USD 22.5 million in FY 2018 to USD 26.7 million in FY 2019. This includes investment in deployment of a modern, technology-enabled fleet of high-capacity waste collection, containment, and transport vehicles in the city. This also encompasses the expenditure on decentralization of waste transfer stations for more effective collection and transportation of municipal waste.

Figure 7: Investment in Waste Management Activities In Hyderabad in FY 2018 and 2019



Source: CCFLA

2.2.4 URBAN PLANNING, GREEN COVER AND BIODIVERSITY, AND WATER MANAGEMENT

Hyderabad faces governance challenges that are common in most major cities. It is further constrained by the amount of legislation and administrative bodies involved in delivering these services in a seamless and time bound manner. The central

government, the Telangana State Government and the GHMC have introduced several initiatives to develop physical infrastructure in the city and make it more accessible to its citizens. Table 4 summarizes the major components of these programs.

Table 4: Recent National, State and Municipal Initiatives to Develop Physical Infrastructure in Hyderabad

COMPONENTS	KEY INTERVENTIONS
Water Supply	• Developing water supply systems, including augmentation of existing water supply, water treatment plants, and universal metering • Rehabilitation of old water supply systems, including treatment plants • Rejuvenation of water bodies specifically for drinking water supply and recharging of ground water • Implementing special water supply arrangements for difficult areas such as hillside and coastal cities, including those with water quality problems (e.g., arsenic, fluoride)
Sewerage	• Building decentralized, networked underground sewerage systems, including augmentation of existing sewerage systems and sewage treatment plants • Rehabilitation of old sewerage systems and treatment plants • Recycling of water for beneficial purposes and reuse of wastewater
Storm Water Drainage	• Construction and improvement of drains and storm water drains in order to reduce and eliminate flooding
Urban Transport	• Creating footpaths/ walkways, sidewalks, foot over-bridges, and facilities for non-motorized transport (e.g., bicycles) • Building multi-level parking
Green Spaces	• Development of green space and parks with special provision for children, senior citizens, and disabled-friendly components

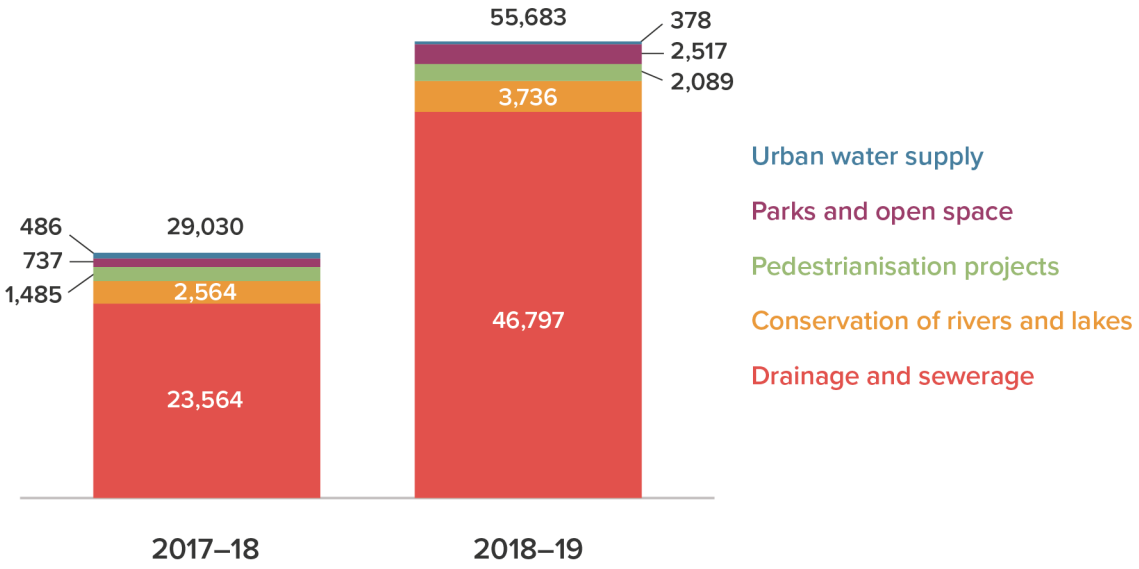
This study found that the budgetary expenditure of the GHMC on providing the above-mentioned civic services increased by 92% from USD 29 million in FY 2018 to USD 55.7 million in FY 2019. The largest share of this expenditure was incurred on the construction and improvement of drainage and sewerage systems in the city. Hyderabad produces nearly 1,400 million liters per day (MLD) of sewage but its treatment plants only have a 700 MLD capacity at present. The city also has a poorly integrated urban flood management system. The existing stormwater drainage system cannot handle a rainfall of more than 20 millimeters per hour, making the city vulnerable to devastating urban floods.

Under the Mission Kakatiya initiative, the GHMC has come up with an action plan for the restoration and comprehensive development of urban lakes in Hyderabad. The project, valued at about USD 41 million, aims to build walkways and chain-link fencing, improve

lakebeds, and construct islands, sewage drains, and silt traps. Hyderabad has become only the second city in the country after Mumbai to have a dedicated disaster response force called the Directorate of Enforcement Vigilance and Disaster Management (EVDM). It will handle rescue and relief operations in the immediate aftermath of a disaster (ANI 2018).

In 2018, as part of its greening drive, the GHMC launched an initiative to grow vertical gardens on the city's flyover pillars (Vadlamudi 2018). It planted shade-tolerant plant varieties like amaranthus, peperomia and money plants for beautification and air purification. It is also building eco-friendly footpaths using permeable concrete, and plastic paver blocks instead of the traditional concrete and cement (Adivi 2018). These footpaths not only make Hyderabad a pedestrian-friendly city, but also help in harvesting rainwater by allowing water to penetrate and reach the groundwater table.

Figure 8: Investments in Urban Planning and Green Cover by GHMC in FY 2018 and 2019



Note: Some values are included in the investment totals but are too small to be reflected in the graph. These values are as follows: Green cover, $113 in 2018-19; Rainwater harvesting, $193 in 2017-18 and $53 in 2018-19.

Source: CCFLA

2.3 SUMMARY

A number of institutions are involved in city-level governance and climate action in Hyderabad. Both the GHMC and TSREDCO have made rapid strides in implementing renewable energy projects in Hyderabad since the formation of Telangana in 2014. Total installed renewable energy capacity has increased from about 35 MW in 2014 to 4,059 MW in 2019 as a result.

To lower the consumption of fuel and emissions of greenhouse gases, Hyderabad is revamping its urban transport system. It is developing its metro infrastructure and promoting the adoption of electric vehicles to reduce congestion in the city and make urban transport more sustainable.

Under the provisions of the Energy Conservation Act 2001, TSREDCO has launched several initiatives to promote energy conservation and efficiency in Hyderabad. These include distribution of LED bulbs, installation of LED streetlights, and construction of green infrastructure.

Hyderabad has been declared an ODF city and the GHMC is implementing a number of municipal programs to further improve sanitation, turn waste into nutrient-rich manure, and keep the city's environment clean. Hyderabad is also only the second city in India, after Mumbai, to have a dedicated disaster response force, the EVDM.

Despite these interventions, Hyderabad faces several governance challenges. There are many layers of legislation and overlapping mandates among the large number of institutions and administrative bodies involved in urban climate action. This case study highlights a clear need for more institutional clarity, inter-agency coordination, and multi-disciplinary expertise to solve urban challenges.

3. CASE STUDY 2: KOLKATA

3.1 CONTEXT

Kolkata, the administrative capital of West Bengal is the third-largest metropolis in India with a growing population of 4.5 million as per the 2011 Census of India. The city and surrounding suburbs under the Kolkata Metropolitan Area (KMA) had an estimated population of 14.5 million in 2018, making it the 16th-largest UA in the world (U.N. DESA 2018).

KMA consists of the three municipal corporations of Kolkata, Howrah, and Chandanagar, which cover 6 districts, 38 independent municipalities, 77 towns, and 445 villages. The Kolkata Metropolitan Development Authority (KMDA) is the statutory planning authority for the area.

The city itself is administered by the Kolkata Municipal Corporation (KMC), which provides basic urban services. The oldest municipal corporation in India, KMC was formed under the British Raj in 1911. To this day, Kolkata remains the hub of political, commercial, industrial, and financial activities for Eastern India. In 2020, West Bengal was the fourth-largest state in terms of net state domestic product and Kolkata was one of the largest contributors to state GDP.

Figure 9 shows the administrative jurisdiction of KMDA and KMC, which have areas of 1,886.67 square kilometers and 205 square kilometers, respectively.

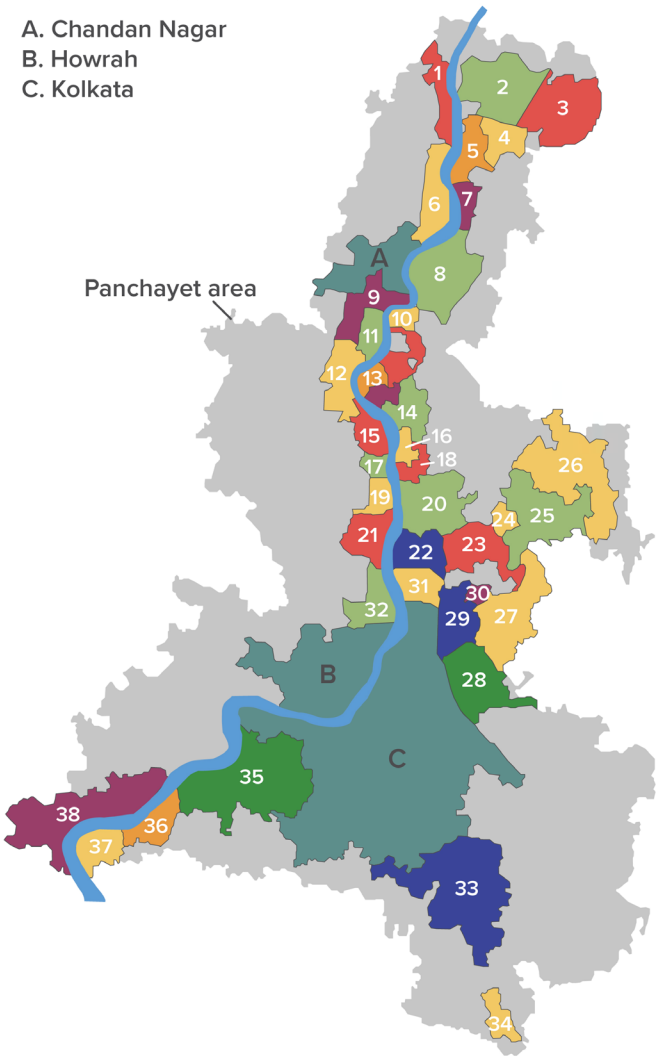
Figure 9: Area Under jurisdiction of KMDA and KMC

MUNICIPALITIES

1. Bansberia
2. Kalyani
3. Gayeshpur
4. Kanchrapara
5. Halisahar
6. Hooghly Chinsura
7. Naihaty
8. Bhatpara
9. Bhadreswar
10. Garulia
11. Champdani
12. Baidyabathi
13. North Barrackpur
14. Barrackpore
15. Srirampur
16. Titagarh
17. Rishra
18. Khardah
19. Konnagar
20. Panihati
21. Uttarpara
22. Kamarhati
23. North Dumdum
24. New Barrackpur
25. Madhyamgram
26. Barasat
27. Rajarhat
28. Bidhan Nagar
29. South Dum Dum
30. Dum Dum
31. Barabagar
32. Baly
33. Sonarpur / Rajpur
34. Baruipur
35. Maheshtala
36. Budge Budge
37. Pujali
38. Uluberia

MUNICIPAL CORPORATIONS

A. Chandan Nagar
B. Howrah
C. Kolkata



Source: Adapted from Rahaman et.al., 2019

Various studies have also ranked Kolkata as one of the most vulnerable cities in the world in terms of flood risks and natural hazards. Indeed, the Bay of Bengal region is one of the most vulnerable areas to climate change in India. In 2019 and 2020, Kolkata suffered estimated damages of more than USD 14 billion due to two extremely severe cyclones, Cyclone Bulbul and Cyclone Amphan (Singh 2020). This supports the findings of recent Ministry of Earth Sciences studies indicating a significant increase in the frequency of very severe cyclonic storms (VSCSs) over the last two decades from 2000 (Krishnan 2020). This same report also concluded that "there is compelling scientific evidence that human activities have influenced these changes in regional climate".

Kolkata is located in a low coastal region, in a river basin with flat terrain. Poor drainage makes it susceptible to climate impacts of increased precipitation and sea level rise. Unrestrained migration from surrounding states due to the concentration of economic activity and settlement in formerly unhabitable marshy wetlands has caused additional man-made vulnerability (ADB 2019).

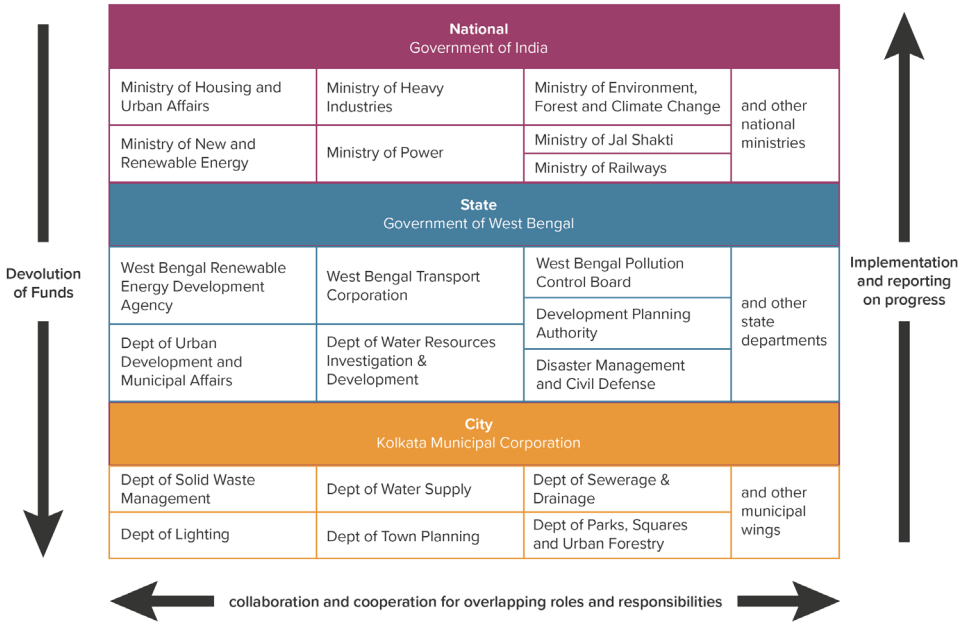
A project undertaken in 2017 by KMC and the U.K. government prepared a "Roadmap for Low-Carbon and Climate Resilient Development of Kolkata" and strengthened the institutional capacity within KMC to implement the program (PwC 2017). UKAid provided GBP 1 million in technical assistance to implement this unique initiative. The roadmap documents a number of challenges and opportunities for KMC in building sustainable infrastructure across various sectors. It proposes many key interventions and highlights investment opportunities worth USD 53 million over a 10-year period.

GOVERNANCE IN KOLKATA

Climate action in Kolkata is financed and implemented by various organizations through an amalgamation of functions performed at central, state, municipal and local level. The KMC is divided into 144 administrative wards that are grouped into 16 boroughs. The borough committees under KMC maintain schools, hospitals and municipal markets and participate in urban planning and road maintenance. Various departments of the KMC are responsible for providing key services, grouped into broad categories as per the budget allocation of funds:

- Water supply, sewerage and drainage
- Roads development and maintenance (including public lighting provision and tree planting)
- Civic services provision for bustees and slums
- Commercial services provision to municipal markets
- Solid waste management
- General (including primary education, health care, and land use control such as laying of parks and squares, and maintenance of heritage monuments)

Figure 10: Multilevel Governance of Climate Action in Kolkata



Source: CCFLA

The first State Action Plan for Climate Change (SAPCC) for West Bengal was prepared in 2012 and revised in 2017 due to rapid developments in climate science, technologies, and national and international climate priorities. The SAPCC 2017-2020 aims to make West Bengal "climate resilient and carbon neutral".

The SAPCC aligns with the national and international priorities of climate change mitigation and adaptation. It also considers the climate vulnerability profile of West Bengal. As a result, it suggests adapting to the impacts of climate change by prioritizing action in the following areas:

- Water
- Agriculture
- Fisheries
- Forests
- Wetland and mangrove conservation
- Health
- Sustainable habitats

The state government of West Bengal has given significant autonomy to the KMC to pursue its own waste management strategies. In sectors like renewable energy, energy efficiency, transportation, disaster risk reduction, and water management, however, the state retains significant dominance in terms of implementation and financing. This study encountered challenges in finding disaggregated data for finance flows at the city level for these sectors as a result.

Table 5 details the climate-related initiatives that are undertaken by various agencies and departments at the municipal, state and central level in Kolkata.

Table 5: Kolkata's Key Initiatives and Implementing Agencies, by Sector

SECTOR	KEY INITIATIVES IN KOLKATA	IMPLEMENTATION AGENCIES
Mobility and Air Quality	• Kolkata Metro Rail	• Metro Railway, Kolkata, Ministry of Railways, Government of India • Kolkata Metro Rail Corporation Limited (KMRCL), Ministry of Railways, Government of India
	• Uptake of E-Buses	• West Bengal Transport Corporation
	• Air Quality Action Plan for Kolkata • Capacity Building for Industrial Pollution Management (CBIPM)	• Air Quality Monitoring Committee (AQMC) • West Bengal Pollution Control Board (WBPCB)

Waste Management	• Battery-Operated Environment and User-Friendly Hydraulic Dumpers • Modern Scientific Waste Compactor Stations • Conversion of Organic Market Waste into Bio-CNG, Bio-CO2 & Compost • Mission Nirmal Bangla (Urban)	• Solid Waste Management Department (SWM) of KMC • West Bengal Pollution Control Board (WBPCB)
Urban Planning, Green Cover and Biodiversity	• Green City Mission • East Kolkata Wetlands Management Plan • Atal Mission for Rejuvenation and Urban Transformation (AMRUT)	• Sewerage and Drainage Department of KMC • Parks and Square Department of KMC • East Kolkata Wetlands Management Authority (EKWMA)
	• City Disaster Management Plan	District Disaster Management Authority (DDMA)
Water Management	• Kolkata Environmental Improvement Project (KEIP) • Jal Dharo Jal Bharo Project • Tolly Nallah Project • National Mission for Clean Ganga	• West Bengal Department of Water Resources Investigation & Development • Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, Government of India • Water Supply Department of KMC • Sewerage and Drainage Department of KMC
Energy and Green Buildings **Green Buildings**	• Renewable Energy Policy of West Bengal, 2012	• West Bengal Renewable Energy Development Agency • West Bengal Green Energy Development Corporation Limited (WBGEDCL)
	• Solar Lighting	• Lighting and Electricity Department of KMC • Energy Efficiency Services Limited (EESL)
	• Certification of Green Buildings	• Green Rating for Integrated Habitat Assessment (GRIHA) Council • Leadership in Energy and Environmental Design (LEED) • Excellence in Design for Greater Efficiencies (IFC EDGE)

3.2 SECTORS

3.2.1 MOBILITY AND AIR QUALITY

SUSTAINABLE TRANSPORTATION

Kolkata has one of the most complicated but robust public transport systems in India. It was the first city in Asia to introduce electric trams in 1902. Nowadays, railway, underground metro, trams, buses, three-wheelers, and ferries ply the city alongside private cars and two-wheelers.

Different undertakings provide the city's various transport services. West Bengal Transport Corporation (WBTC) is in charge of state buses, trams and ferries, operating about 40% of Kolkata's bus routes. Metro Railway, Kolkata and Kolkata Metro Railway Corporation (KMRC) own and operate the underground metro in Kolkata. Both are overseen by the national Ministry of Railways. Kolkata Suburban Railway is operated by the Eastern Railway and South Eastern Railway zones, also under the Ministry of Railways.

From 2012 to 2015, the number of registered vehicles in Kolkata grew by 20%, compared to 5% in Delhi and 9% in Bengaluru. The sudden increase in personal vehicles, especially diesel cars, has greatly contributed to vehicular pollution and emissions, which is compounded by the old age of the fleet (TERI 2020).

As diesel buses are the major contributor to pollution in the city, WBTC conducted a feasibility study for adoption of electric buses. It created a strategic roadmap with the help of a USD 250,000 grant from the Energy Sector Management Assistance Program (ESMAP) of the World Bank (World Bank 2021). In 2018, WBTC procured 80 e-buses under the Government of India's FAME I scheme at an annual expenditure of USD 1.7 million. The Government of West Bengal has decided to not procure new diesel buses on principle, aiming to build a fleet of 5,000 e-buses in Kolkata by 2030 instead. This would reduce cumulative CO2 emissions by 782,560 tonnes. This initiative saw Kolkata win the C40 Cities award for "Low Carbon Commute Transition" in 2019 (C40 2019).

Kolkata Metro is one of the oldest metro systems – and the only underground metro – in India. Its operating company spent USD 60 million in FY2018 and USD 108 million in FY2019 to develop new lines[11]. This includes a connection between Kolkata and the neighboring city of Howrah.

Financing public transport is a barrier for low-carbon transport in Kolkata. There are some options available to KMC to raise funds, however, including budgetary and tax rationalization, and raising advertisement fees and taxes via travel demand management measures (higher taxes on personal vehicles, parking fees). It could also use cross -subsidies from other sectors (Roychowdhary et al. 2018).

11 As a substantial part of the metro route lies within the KMC boundary, we will consider the entire capital expenditure by the Metro Railway, Kolkata within the scope of this study.

AIR QUALITY MANAGEMENT

In 2018, an Air Quality Monitoring Committee (AQMC) was constituted for Kolkata comprising members from relevant departments and ministries, including the Departments of Environment, Transport, and Industries, as well as KMC, the Kolkata Police and the West Bengal Pollution Control Board (WBPCB). The Air Quality Action Plan for Kolkata includes many actions being undertaken by KMC such as compliance with the Government of India's Bharat Stage IV emissions norm[12] for vehicles and traffic management, as well as construction of underground parking areas, and pavements for walking and cycling. It also covers the prevention of open burning of coal and wood, and sapling planting programs.

In 2010, the World Bank approved a Capacity Building for Industrial Pollution Management (CBIPM) project which supported rehabilitation of highly polluted, hazardous waste and municipal dump sites by building institutional, technical and human capacity at state-level pollution control agencies like the WBPCB. It aimed to develop frameworks or methodologies to reduce risks to communities, livelihoods and the environment from old and damaged sites. In West Bengal, the project focused on remediating the Dhapa dumping site, which is the oldest in KMC and close to the East Kolkata Wetlands.

An Environmental and Social Impact Assessment of the site found high concentrations of methane and carbon dioxide in the landfill gas, and contamination of upper ground water, surface water and topsoil. Leaving the closed dumping site unattended would have severe environmental consequences, according to the assessment. Detailed assessment of site contamination and remediation plans were prepared under the CBIPM project and institutional capacity within WBPCB was developed to address remediation. A total of USD 12.5 million was spent in FY2018 and FY2019 by the WBPCB, comprising finance from the World Bank and the state government according to an 85:15 split.

3.2.2 WASTE MANAGEMENT

In FY 2018 and 2019, KMC disposed of 3.55 million metric tonnes (MT) of garbage at the Dhapa Landfill, Kolkata's only waste disposal site. KMC is currently undertaking various projects to develop its solid waste management practices. This includes installing road-side waste collection bins, and using battery-operated hydraulic dumpers and modern scientific waste compactor stations. It is also placing portable and stationery compactors throughout the city. A pilot project to reroute organic market waste from Dhapa will convert about 5 MT per day into Bio-CNG, Bio-CO2 & compost. The Government of West Bengal sanctioned USD 0.15 million for this project.

Mission Nirmal Bangla (Urban) or Swachha Bharat Mission (Urban) is a nationwide project that aims to improve sanitation provisions for the urban poor and make cities ODF. The mission approved one project in Kolkata for strengthening primary and

12 Bharat Stage (BS) emission standards were implemented by the Government of India to regulate the output of air pollutants from internal combustion engine equipment. The Auto Fuel Vision and Policy 2025 recommended a nationwide rollout of BS-IV norms from 2017, but it has faced challenges and delays in various states.

secondary solid waste management systems, at a total cost of USD 21.5 million in FY 2018

In 2016, Kolkata won the C40 Cities award for improvement in solid waste management. This was achieved under the Kolkata Solid Waste Management Improvement Project (KSWMIP), funded by the Japan International Corporation Agency (JICA) with a loan of USD 20 million.

3.2.3 URBAN PLANNING, GREEN COVER AND BIODIVERSITY

GREEN SPACES

In 2016, the Urban Development and Municipal Affairs Department of the Government of West Bengal launched the Green City Mission with a long list of broad themes. Among other issues, this included:

- Increasing green areas
- Cleaning and beautifying public spaces
- Conserving water bodies
- Improving sewerage and drainage systems
- Providing sustainable public transport services such as cycle tracks
- Constructing modern bus stands
- Building eco-friendly parking spaces
- Building adequate subways
- Ensuring better quality of city life
- Implementing grievance management

The KMC received USD 2.98 million in FY 2018 and USD 27.55 million in FY 2019 for these initiatives. The Parks, Squares & Urban Forestry Department of KMC undertook construction of new parks over these two years with a total outlay of USD 2.5 million.

REJUVENATION AND CONSERVATION

The East Kolkata Wetlands, situated on the eastern fringes of the KMC, is one of the city's most significant natural resources. It can treat more than 900 million liters of sewage and also acts as a buffer against urban flooding. The Wetlands spans almost 8,000 hectares, is rich in biodiversity, and doubles up as an oxidation basin for sewage recycling. It also provides employment opportunities for up to 0.12 million people in communities in the surrounding area.

The East Kolkata Wetlands Development Plan aims to tackle the challenges of unplanned development in the low-lying areas of the Wetlands. The ambitious

plan combines conservation and development objectives, while empowering local communities to manage natural and ecological processes that reduce pollution.

The East Kolkata Wetlands (Conservation and Management) Act 2006 appointed the East Kolkata Wetland Management Authority (EKWMA). This state-level implementation agency under the Department of Environment, Government of West Bengal manages water bodies, wastewater treatment, ground water recharge, land use, and provides other ecosystem and socio-cultural services. In 2021, EKWMA drafted the East Kolkata Wetlands Management Action Plan 2021-2026.

Key projects to be undertaken include:

- Desilting of sewage canals
- Recommendations and financial support to KMC for the demolition of illegal constructions
- Monitoring and research
- Wetland delineation
- Communication and outreach

The plan has attracted grants from the Department of Environment of USD 0.55 million in FY 2018 and USD 0.33 million in FY 2019. It also has budgeted funds of USD 0.08 million for FY 2018 and USD 0.065 million for FY 2019 for a Wetland Interpretation Center to raise awareness about the Wetlands among school children. The National Mission for Clean Ganga under the National Plan for Conservation of Aquatic Ecosystems of the Ministry of Environment, Forestry and Climate Change, Government of India will fund about 60% of the Plan, with the rest coming from the State Government.

DISASTER RISK REDUCTION

In 2020, the KMC prepared a District Disaster Management Plan to undertake a comprehensive study of risks, vulnerability and disaster management in Kolkata. It lists the roles, responsibilities, training and capacity building needs for all relevant stakeholders. The list of stakeholders spans municipal, state and central levels of government, including various departments of KMC such as Water Supply, Drainage, Health, and Buildings. Other stakeholders include Kolkata Police, Fire and Emergency Services, as well as the Water Resources and Transport departments of the Government of West Bengal National Disaster Response Force (NDRF).

The plan outlines many initiatives being undertaken as disaster prevention and mitigation measures across sectors. For example, Kolkata's Flood Forecasting and Early Warning System (FFEWS) is the first comprehensive city-level early warning system in India. It gives real-time data on rainfall, street inundation, pumping stations and canal water levels by monitoring more than 400 sensor nodes across the city. The plan also provides detailed information on response, relief, rehabilitation, and recovery measures, as well as the roles assigned to responsible stakeholders.

The State Disaster Response Fund is the primary source of funding under the Disaster Management Act 2005. Central and state governments contribute to this fund in a ratio of 75:25. In the case of a disaster, the funds are allotted to the affected districts. In 2018, State Disaster Mitigation Fund , created under the Disaster Management Act 2005, undertook various structural (engineering) and non-structural(awareness) mitigation measures. However, detailed information on transfer of funds from state to district level is not available. KMC spent USD 0.05 million in FY 2018 and USD 0.07 millions in FY 2019 on the Disaster Management Program.

CROSS-CUTTING SCHEMES

In 2016, the Ministry of Housing and Urban Affairs of India launched the Atal Mission for Rejuvenation and Urban Transformation. It aims to use capital expenditure, reforms and capacity building to provide basic services in cities across water, sewerage and drainage, transport and green cover. It is particularly focused on marginal and disadvantaged populations[13].

West Bengal is supposed to allocate approximately 40-45% of the funding for this initiative, with KMC contributing 10%. The state used allocations from the central government's 14th Finance Commission to meet its 45% commitment. Participating cities like Kolkata proposed to meet operation and maintenance costs through loans, property tax increases and revision of valuations. KMC spent USD 3.28 million in FY 2018 and USD 8.95 million in FY 2019 under the AMRUT scheme.

3.2.4 WATER MANAGEMENT

In 2002, the Asian Development Bank initiated the Kolkata Environmental Improvement Project (KEIP). It aimed to improve the provision of basic services and protect the environment from the adverse impacts of unplanned development in the outer areas of KMC. The project cost USD 0.25 billion, of which the Asian Development bank loaned USD 0.15 billion. The remainder was financed by the state and national governments. The project ended in 2013.

Based on the success of KEIP, the Kolkata Environmental Improvement Investment Program (KEIIP) was established in 2014 to continue improving climate resilience and urban services in the city. It used a three-tranche financing facility loan of USD 400 million. In FY 2018 and 2019, the KMC spent USD 0.1 billion under this project. About 77% of this comprised loans from the central and state government, which were redirected from an Asian Development Bank loan. A further 6% was received as a budgetary grant and about 16% was contributed by KMC. This project will end in 2025.

Another program, Jal Dharo Jal Bharo, was launched in the year 2011-12 in the state of West Bengal by the Department of Water Resources Investigation & Development. Its objective was to conserve and revive freshwater bodies. It had a dual goal of providing

13 The AMRUT Mission covers 500 cities in India, 55 in the state of West Bengal, including Kolkata. The states are asked to prepare State Annual Action Plans (SAAP) covering consolidated information on all city-level Service Level Improvement Plans (SLIPs). Allocations to the ULBs are made based on the priority sectors identified through funding gap analysis.

both sustainable water provision for agriculture and fisheries, and rural employment through the Mahatma Gandhi National Rural Employment Guarantee Scheme.

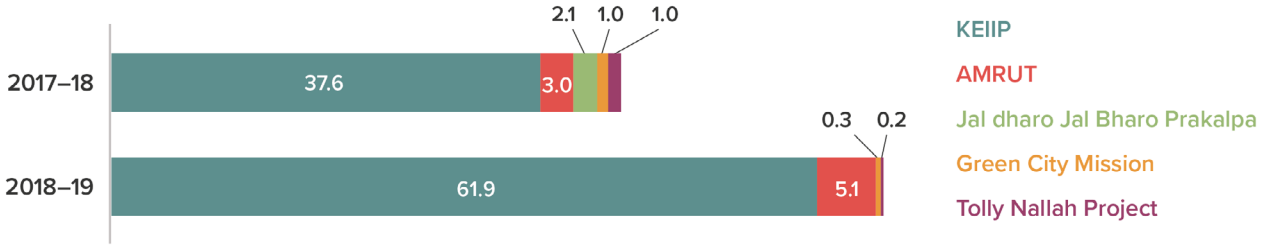
It involved construction of water detention structures, dams checks, installing water harvesting tanks, re-excavating ponds, and other micro-irrigation works. Some 60,300 water bodies and detention centers were created or renovated under this program during FY 2018 and FY 2019.

There are about 3,500 ponds in Kolkata city, of which only 100 are under the jurisdiction of KMC. KMC received a total USD 2.44 million as budgetary grants for this project and spent USD 2.11 million on reviving these ponds in 2018 and 2019.

A third program focuses on the rehabilitation of the Tolly's Nullah canal, one of the most significant drainage channels in the KMC area. The canal is in a moribund state. Unplanned construction on the embankment and disposal of untreated hazardous wastewater and municipal solid waste has caused water logging and flooding in the region.

The National Mission for Clean Ganga under the Ministry of Jal Shakti (Department of Water Resources, River Development & Ganga Rejuvenation), Government of India sanctioned USD 44 million for 15 years for this project. Operation and maintenance works are to be implemented on the basis of a hybrid annuity based public-private partnership model. Some minor works were undertaken by KMC during 2018 and 2019, with a total outlay of USD 10 million.

Figure 11: Source-wise Breakdown of Expenditure in Water Management in Kolkata



Source: CCFLA

3.2.5 ENERGY AND GREEN BUILDINGS

CLEAN ENERGY

West Bengal ranks the lowest among India's 29 states in terms of renewable energy potential based upon availability of land and solar radiation (MNRE, 2020). The Ministry of New and Renewable Energy (MNRE), Government of India, has set a target of 40,000 MW of rooftop solar installations in the country by 2022. West Bengal's share of this target is 2,100 MW and it was one of the first states in India to issue a regulation for the development of rooftop solar. Very limited progress has been achieved on this front, however, with only 2 MW installed by 2017 (PwC 2017).

West Bengal Renewable Energy Development Authority and the West Bengal Green Energy Development Corporation Limited are the state-level implementing agencies for Kolkata's renewable energy policies. Disaggregated information for city-level renewable energy projects and related investments are not available, however.

Some of the examples of activities undertaken by the Lighting and Electricity Department of KMC in FY 2018 include a 15KW grid-connected solar project at Deshapriya Park, a 6KW project at Jatin Das Park, and a 7.8KW project at Maddox Square. In 2018, KMC also announced plans to use solar lights in all of its buildings under the Green Energy Development Initiative (Nandi, 2018). Again, exact details on implementation and investment for this initiative are not available.

ENERGY EFFICIENCY AND GREEN BUILDINGS

The Lighting and Electricity Department of KMC has undertaken various initiatives to improve the energy efficiency of public services in Kolkata. This includes using solar power to illuminate advertisement boards and improving the operation and maintenance of electric crematoriums and their air pollution control systems. The KMC has been planning to replace all 270,000 metal halide lights in the city with LED ones and has requested a grant of USD 11.5 million for this from the state government under the Green City Mission. This would cover phase 1, which would replace 30,000 bulbs (Ray 2018). The available information shows KMC spent USD 2.15 million in FY 2018 and 2019 under this program.

Under another program, the SLNP, EESL spent USD 17,000 in FY 2018 and FY 2019 to replace some of Kolkata's conventional street lights with smart and energy efficient LED streetlights.

The energy efficiency sector also covers investments in green building construction (built infrastructure), as well as retrofits, renovation and modernization of existing building stock. These investments totaled USD 22.14 million in FY 2018 and USD 6.69 million in FY 2019. Compliance to Energy Conservation Building Code 2017 is mandatory in West Bengal for "building complexes that have a connected load of 100 kW or greater or a contract demand of 120 kVA [1,000-volt amps] or greater and are intended to be used for commercial purposes".

Additionally, this study has calculated investments in green buildings certified by the two standards with a footprint in Kolkata: GRIHA Council and LEED. A total of USD 17 million was invested in Kolkata's green buildings under these standards in FY 2018 and 2019.

3.3 SUMMARY

Many institutions are involved in city-level governance and climate action in Kolkata. Even in this complex environment, Kolkata is making progress in pursuing climate action in sectors like sustainable transportation. It is struggling in other sectors like renewable energy, however.

Kolkata has one of the most complicated but robust public transport systems in India. KMC and the West Bengal Transport Corporation have made rapid strides in the uptake of e-buses in the city. The Government of West Bengal has decided not to procure new

diesel operated buses on principle, instead aiming to build a fleet of 5,000 e-buses in Kolkata by 2030. It was for this reason that Kolkata won the C40 Cities award for “Low Carbon Commute Transition” in 2019.

On the other hand, the state of West Bengal and Kolkata have achieved limited progress on the national priority of renewable energy development. Lack of clear mandates in energy governance, lack of coordination between relevant departments like the West Bengal Renewable Energy Development Authority (WBREDA) and the West Bengal Green Energy Development Corporation Limited (WBGEDCL) at the state level, and the Department of Lighting and Electricity at the city-level, has hindered progress.

This case study highlights the need for greater integration at both vertical and horizontal levels of governance to support the sectoral and cross-sectoral development of a resilient and low-carbon Kolkata. The city needs greater access to grants and funding from the state and national level. It should also explore ways to enhance its own revenues.

4. CONCLUDING OBSERVATIONS

This study aims to understand the landscape of urban green finance in two Indian cities, Hyderabad and Kolkata. It attempts to map green finance disbursements from public and private sources of finance at both national and international levels towards sectors contributing to climate change mitigation and adaptation, and other environment-related activities.

The study is based on an extensive literature review, collection of data from primary and secondary sources and consultations with relevant stakeholders at city and state level. It has found that the municipal corporations of both Hyderabad and Kolkata are heavily dependent on the central and state governments for financing. This is in line with findings from other reports (Udas-Mankikar 2018).

In March 2020, the COVID-19 pandemic hit the world. The restrictions put in place by across much of the world to control infection spread had a negative impact on the financial resources of state and central government budgets. India's GDP contracted by up to 7.7% in FY 2021, tax collection slowed in 2019-20 according to the Centre for Budget and Governance Accountability, and central government spending dropped as the nation's scarce resources were used to fight the pandemic (CBGA 2021).

The impact of COVID-19 is yet to be addressed in a big way in the West Bengal and Telangana State Government budgets. Reports suggest that Hyderabad Metro and Kolkata Metro may have lost about USD 140 million and USD 22 million in revenues respectively during the lockdown. Kolkata Metro's loss, at 82%, was the highest in the country in relative terms (Gulankar 2021; PTI 2021). There have been promising signs of recovery after a general easing of lockdown restrictions, but the actual impact remains to be seen amid the subsequent waves of the pandemic (IE 2021).

On the other hand, the pandemic has amplified the need to undertake sustainable activities at the city level. As such, this study has devised the following recommendations:

- **National governments should build processes and capacity for harmonized climate budgeting**

Various policies, missions and schemes provide strategic direction for climate action at the city level. An annual tracking exercise embedded in the budgeting process to measure the volume of green finance flows from source to end use at the city-level would improve transparency and accountability. Harmonization and centralization of data collection in specified reporting formats will help determine the 'greenness' of activities and estimate total flows. This will support policymakers in assessing the success of policies and governance initiatives to mitigate the adverse effects of climate change. It will also build investor confidence.

- **State governments should create an enabling environment for enhanced urban climate action**

The success of local climate action at the city level is highly dependent on the overall extent of decentralization of governance in the state. The level of autonomy of ULBs differs significantly across the relevant sectors for climate governance. Active integration and coordination across departments is required at both horizontal and vertical levels, as well as the devolution of funds from states to ULBs. For instance, Kolkata has adopted fewer renewable energy targets due to a lack of clear mandates, a lack of co-ordination with state-level entities, and a lack of funding compared to other sectors like urban planning or water management. State governments can play a proactive role in providing conducive policy, institutional and financial support to the municipal governments to build local capacity for incorporating climate change into urban development processes.

- **Local governments should:**

Mainstream climate change objectives into existing finance flows

Municipal corporations are largely spending their resources on providing urban civic services such as water supply, sanitation, sewerage, roads and street lighting, and parks. By building synergies between local spending, and national and state environmental objectives, municipal bodies can create a sustainable environmental impact. They can play a proactive role in climate change mitigation and adaptation, as well as meeting other environmental objectives like reducing air pollution and improving waste management.

Explore new and innovative financing mechanisms

Both Hyderabad and Kolkata have a long way to go to address the issues arising from multi-level governance. They have limited technical and financial capacity to raise funds due to poor governance, financial health and lack of autonomy (PRS, 2017). There is clearly a need to better exploit their own revenue sources through value-capture financing such as property taxes, land monetization and car parking fees.

These cities could also explore alternatives such as raising debt through the use of innovative financing mechanisms (Udas-Mankikar 2020). Initiatives like the Global Innovation Lab for Climate Finance has mobilized more than USD 2.4 billion in sustainable investments globally and has presented innovative, catalytic and sustainable financial solutions for mitigation and adaptation measures in cities.

A recent report, “An Analysis of Urban Climate Adaptation Finance”, elaborates on the use of financial instruments in the urban adaptation context. It details resilience bonds, disaster risk insurance pooling, public-private partnerships, and catastrophe bonds (CPI 2021). If such innovative instruments are being used elsewhere, they should be studied further in the Indian context. Indeed, a 2017 IFC study, “Climate Investment Opportunities in South Asia”, estimated a total climate-smart investment opportunity of USD 3.1 trillion in India from 2018 to 2030 (IFC 2017).

Risk pooling and risk transfer mechanisms are picking up in some parts of the world as effective instruments for disaster management and could also benefit cities like Kolkata (ACT Alliance 2020). India became the second-largest market for green bonds in 2020

(Joshi 2020). There is a need for concerted effort and strategic intervention to improve the creditworthiness of cities and develop an enabling environment to mobilize capital markets for sustainable urban infrastructure (CBI 2018).

5. ANNEXURE

FRAMEWORK FOR SHORTLISTING CLIMATE VULNERABLE CITIES IN INDIA

To shortlist the cities for this study, a weighted average score was calculated using four different parameters. A weight of 0.25 was then assigned to each of the following parameters, and the two cities with the highest weighted score were selected.

1. **Total population of the city (w1=0.25):** This study referred to the Census of India, 2011 for the total population of each City/Urban Agglomeration (UA). We identified the top 16 City/UA with the highest population.
2. **Credit Rating of the city municipal corporation (w2=0.25):** Credit rating is an assessment of city municipal corporation's ability to pay its financial obligations. Credit ratings are assigned based on municipal assets and liabilities, revenue streams of urban local bodies, availability of resources for capital investments, practice of double entry accounting and other governance practices. Based on these factors, 14 grades of credit rating are provided: AA+, AA, AA-, A+, A, A-, BBB+, BBB, BBB-, BB+, BB, BB-, B+, B. The city credit rating of the city municipal corporation was used for each of the 16 cities shortlisted on the basis of their total population.
3. **City Vulnerability Profile for climate resilient urban development (w3=0.25):** To rank the cities on their climate vulnerability and resilience capacities, the Vulnerability Matrix published in the study (Parikh et al., 2016) was referred to. The matrix entails the role of urban services and socio-economic factors in shaping the cities' exposure to mishaps. This framework was used to classify the 16 cities as High, Medium, and Low vulnerable.
4. **Annual Revenue (in INR) of the city municipal corporation for the year 2018-19 (w4=0.25):** Annual revenue is an important indicator of a state municipal corporation's financial health. It can be categorized into: (a) tax revenues, (b) non-tax revenues, (c) assigned (shared) revenue, (d) grants-in-aid, (e) loans and (f) other receipts. To rank the cities on their financial health, the annual financial statements of the state municipal corporations for the year 2018-19 were referred to.

SCORING

The process of linear transformation was used to calculate the scores based on the data for each of the parameter, using the equation: $y = ax + b$, where:

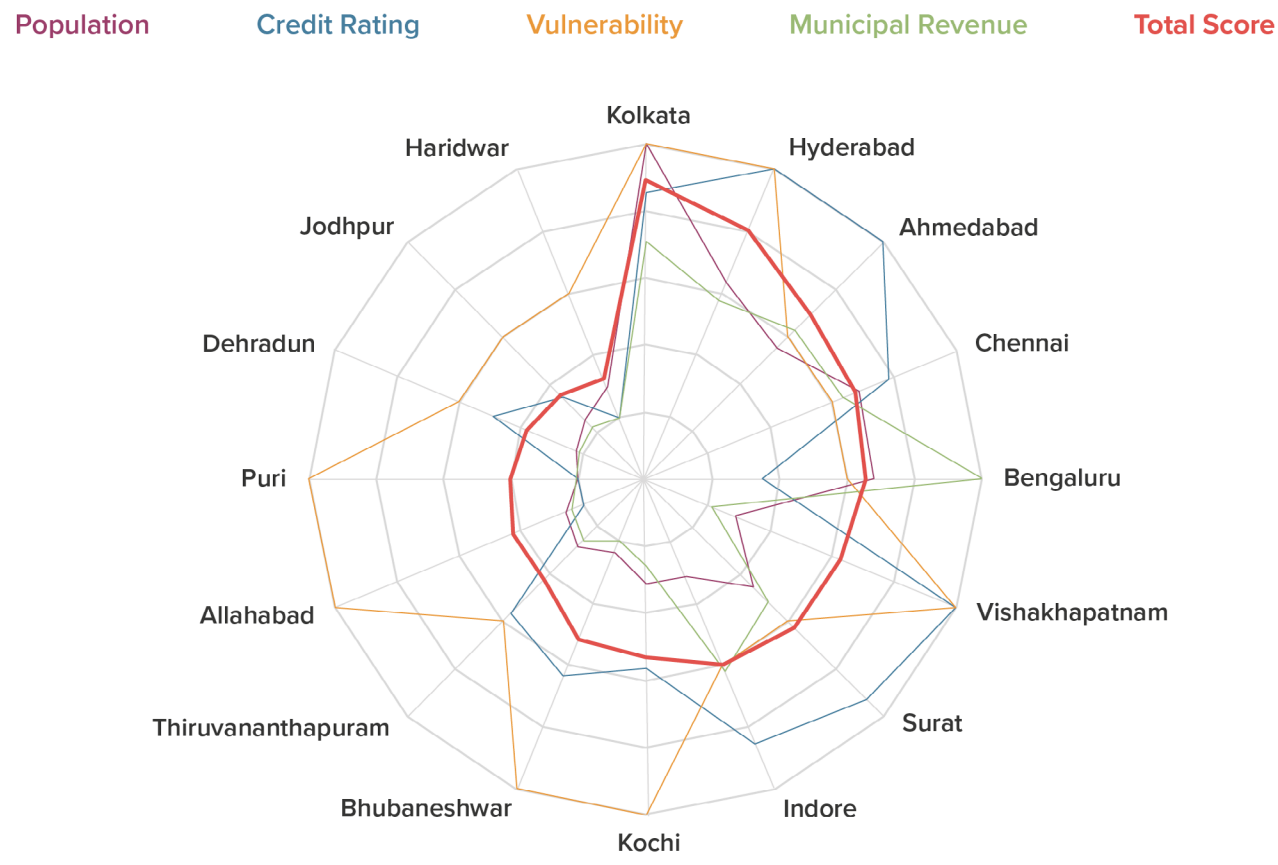
- y is the dependent variable that corresponds to the score for each city.
- x is the independent variable, a is the slope of the curve, and b is the y-intercept.

The maximum and minimum values in each dataset were set as the upper and lower limits, respectively. To maintain parity in the units of the scores, each city was scored on a scale of 1-5 by fixing the maximum value as 5 - the upper limit, and the minimum value as 1 - the lower limit. Thus, the score ranges from one to five for each of the scoring parameters. Further, it may be noted that the maximum and minimum value depends on the nature of the parameter, such as:

- Positive indicators: The higher the value, the higher the score (Credit Rating of the city municipal corporation, say)
- Negative indicators: The lower the value, the higher the score (City Vulnerability Profile for climate resilient urban development, say)

Next, the weights assigned to each of the parameters were used and multiplied with the calculated score to arrive at the final weighted score for each city. **Kolkata emerged on the top with a total score of 4.45 followed by Hyderabad with a score of 4.01.**

Figure 12: Framework to shortlist cities for the case studies



Source: CCFLA

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