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ROADMAP FOR LOW CARBON AND CLIMATE RESILIENT KOLKATA

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ACKNOWLEDGMENTS

We are eternally grateful to Mr. Sovan Chatterjee, Hon'ble Mayor-KMC, Mr. Manish Gupta, Hon'ble Minister-in-Charge, Department of Power and Non-Conventional Energy Sources, GoWB, Dr. Sudarshan Ghosh Dastidar, Minister-in-Charge, Department of Environment, Government of West Bengal, Mr. Iqbal Ahmed, Hon'ble Deputy Mayor-KMC, Ms. Mala Roy, Hon'ble Chairman and Speaker of the House, KMC, Mr. Satchidananda Banerjee, Hon'ble Ex-Chairman and Speaker of the House, KMC, Mr. Debashis Kumar, MMIC-Parks and Mr. Swapan Samaddar, MMIC - Bustee and Environment, KMC, for lending their immense support and cooperation to interventions under this programme.

The project team wishes to thank Mr. Gopal Krishna (IAS), Additional Chief Secretary and Principal Secretary, Department of Power and Non-Conventional Energy Sources, Mr. Debashis Sen (IAS), Principal Secretary, Department of Urban Development, GoWB, Mr. B P Gopalika (IAS), Principal Secretary, Department of Municipal Affairs, GoWB, Mr. Alapan Bandhopadhyay (IAS), Principal Secretary (Transport), GoWB, Mr. Malay De (IAS), Home Secretary and former Principal Secretary (Health), GoWB, Mr. Chandan Sinha (IAS), Principal Secretary, Department of Environment, Mr. Khalil Ahmed (IAS), Municipal Commissioner, KMC, Mr. Narayan Swarup Nigam (IAS), Chairman and Managing Director, West Bengal State Electricity Distribution Company Ltd (WBSEDCL), Mr. Surendra Gupta (IAS), Chief Executive Officer Kolkata Metropolitan Development Authority (KMDA), Dr. Debal Ray (IFS), Chief Conservator of Forests, Headquarters, GoWB, and Md. Ghulam Ali Ansari (IAS), Project Director, Kolkata Environmental Improvement Investment Programme (KEIIP) for their invaluable support to the programme.

We wish to thank Dr. Kalyan Rudra, Chairman, West Bengal Pollution Control Board (WBPCB), Mr. R N Sen, Chairman, West Bengal Electricity Regulatory Commission (WBERC), Mr. Jose Mathew, Former Chief Environment Officer, Department of Environment, GoWB, Dr. A. N. Biswas, Joint Secretary, Department of Power and Non-Conventional Energy Sources, Mr. Ranjan Chattopadhyay, Addl. Director (Planning), KMDA, Dr. Dipanjana Maulik, Senior Scientific Officer, Department of Environment, GoWB, Mr. Kalyan Roy, Director, CREDAI-Bengal, Mr. Shyamal Kr. Adhikari, Chief Engineer, WBPCB, Mr. Harihar Prasad Mandal (WBCS-Exe), Municipal Secretary, KMC, Mr. Anindyo Karforma, DG (Buildings), KMC, Dr. Snehanshu Chowdhury, Chief Medical Health Officer, KMC, Mr. Sanjoy Bhowmik DG, Electrical, Mr. Subhasish Chattopadhyay DG, SWM, Mr. B. K. Maiti, DG (Water Supply), Mr. Pantu Kumar Dhua, DG(Civil), Mr. Saumen Maulik, Chief Manager, Car Parking Department, Mr. Debatosh Dasgupta, Controller of Municipal Finance and Accounts, Mr. Subhasish Bakshi (W.B.A & A.S), Chief Municipal Auditor, Mr. Debashis Kar, DG, Institute of Urban Management, Mr. Shankarlal Mukherjee, Deputy Secretary, KMC, Mr. Nabarun Sarkar, Executive Engineer, KMC, Members of the Megacity Association, Administrative Training Institute (ATI), New Kolkata Development Authority (NKDA), Institute of Town Planners of India (ITPI), All India Institute of Health and Public Hygiene (AIIH&PH), Institute of Public Health Engineers, Kolkata, Indian Medical Association, Prof. Sujay Basu, Prof. Sugata Hazra, the School of Oceanographic Studies, Jadavpur University, Indian Institute of Technology, Kharagpur, Indian Institute of Technology, Bombay, CDE Asia, Sampurn, Mr. Digbijoy Bhowmik, Team Leader, Technical Assistance Support Unit to Kolkata Urban Services for the Poor (KUSP), Ms. Reema Banerjee, Program Director, CEE, Mr. Dipayan De, Chair, SAFE-INCH, Ms. Ananya Bhattacharya, BANGLANATAK.COM, Prof. A K Ghosh, Director, Society for Environment and Development (ENDEV), Mr. Ajoy John and Mr. Kunal Deb, OWLSPIRIT, and members of the print and electronic media, for their valuable inputs and cooperation.

We remain grateful to Mr. Scott Furssedonn-Wood, British Deputy High Commissioner, Kolkata, Ms. Sandy Sheard, Head, Energy, Climate and Growth Unit, British High Commission-DFID India and Mr. Frances Hooper, First Secretary, Energy, Climate and Growth Unit, British High Commission-DFID India, for their guidance to the programme.

We strongly believe their coordinated efforts and cooperation hold the promise of ensuring sustainability and replicability of the efforts made beyond this project duration.

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FOREWORD

During the visit of the UK Prime Minister, The Rt Hon David Cameron MP to Kolkata on 14 November 2013, the UK Government signed a Memorandum of Understanding (MoU) with the Kolkata Municipal Corporation on low carbon and climate resilient Kolkata. Through this first-of-its-kind multi-sectoral programme in India, KMC aspires to reduce greenhouse gas emissions, respond to the impacts of a changing climate, and generate new sustainable economic opportunities while contributing towards green growth of the city. UKAid is providing technical assistance of up to £ 1 million to implement this unique initiative.

The MoU covers the following three broad areas:

i. Preparation of a Roadmap for low carbon and climate resilient development of Kolkata
ii. Strategies to strengthen institutional capacity of KMC to implement the Roadmap and improve overall governance in response to the challenges and opportunities of climate change
iii. Sensitisation programme for key stakeholders within KMC (Hon'ble Members of the Mayor-in-Council and Councillors) on green growth of the city

We urge you all to join hands in our endeavour to turn this great city into a greener one.

Sovan Chatterjee
Mayor, Kolkata Municipal Corporation

Scott Furssedonn-Wood
British Deputy High Commissioner, Kolkata

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BACKGROUND TO THE ROADMAP

Section A1: Prelude

With the 2015 floods in Chennai and Mumbai fresh in the collective memory and the ink barely dry on the landmark December 2015 'Paris Agreement' signed at the United Nations Paris Climate Change Conference (COP21), the 'City of Joy' now has one more reason to feel proud because Kolkata, led by its pioneering Municipal Corporation, is the first city in India to prepare a ground-breaking, comprehensive Roadmap to move the city towards a low carbon and climate resilient future.

This Roadmap is seen as a timely intervention to mitigate and adapt the city's urban environment, to prepare it for the impending climate change challenges and ensure that the city's future urban development and growth is sustainable and future-proofed for subsequent generations.

The Roadmap:

- Has been prepared in alignment with international and national development frameworks, climate protocols, policies and programmes;
- Is a document that identifies and summarises various multi-dimensional, multi-sectorial and cross-cutting interventions/ actions with numerous co-benefits that will be required over different time periods to deliver a cohesive approach to make Kolkata a climate-smart city;
- Has been prepared on the principles of inclusive growth and participatory development where the Kolkata Municipal Corporation and other state government departments and agencies would work in tandem with civil society and other private sector stakeholders;
- Would enable the city to maintain buoyant economic growth, while embracing greener options for urban development and municipal service delivery; and
- Has been prepared to promote sustainable and innovative urban practices, incorporating whenever appropriate, climate change 'best practice' from other Indian and international cities.

Section A2: Climate Change and Kolkata

Introduction to Climate Change

We live in a world that is constantly changing, although not always for the good. Whereas humans previously could ignore many of the issues that urban growth instigated, today city authorities do not have that luxury.

> The Roadmap provides an excellent opportunity for the city of Kolkata to embark on a path towards a Greener Economy

For many years, there has been a growing awareness that human activities were having a negative effect on our planet and one of the manifestations of this was in the phenomenon known as climate change. Once dismissed, principally because it was not fully understood, it is now fully accepted that the concepts of:

Global Warming – the recent and on-going rise in global average temperatures caused predominantly by increasing concentrations of greenhouse gases in the atmosphere; and

Climate Change – significant changes in climate over an extended period of time, including changes to temperature, precipitation or wind patterns;

are real and unless action is taken in the short term to 'future proof' our ever-expanding urban growth centres from the potential natural disasters that are predicted to occur, significant damage, in terms of financial cost and the cost to human life, is likely to follow.

Global Impacts

Global impacts associated with climate change include:

- Since the 1950s, the rate of global warming has been unprecedented compared to previous decades and millennia.
- Increasing concentrations of greenhouse gases in the atmosphere due to human activities have been the dominant cause of observed warming since the mid-20th century.
- Extreme and unpredictable climate induced disaster is causing illnesses, deaths and mass displacement.
- If the world continues to emit greenhouse gases at current rates, average global temperature could rise by 2.6–4.8°C by 2100 (highest emissions scenario – business as usual).

South Asia and India

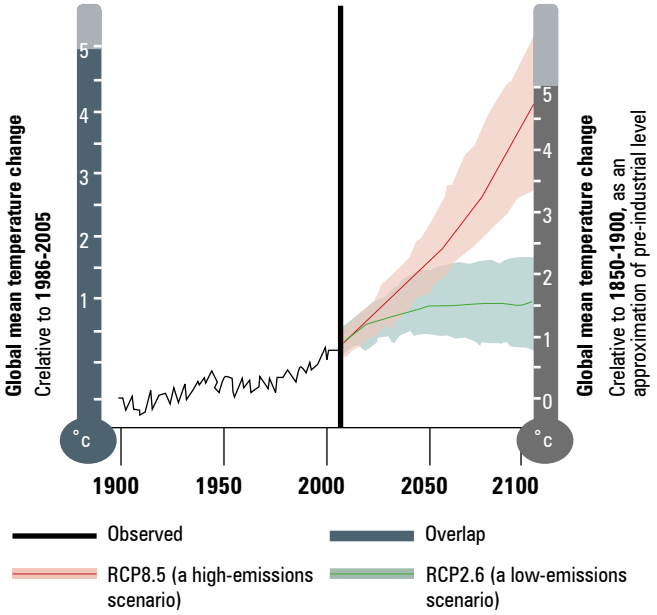
Impact of climate change in South Asia include:

- Warming of most of South Asia over the 20th century and early 2000's with more temperature extremes.
- The Asia region as a whole experienced the most weather-related disasters in the world (2000–2008) and suffered almost 30% of the total global economic losses.
- Globally, the risk of deaths due to flooding is highly concentrated in Asia.
- Rainfall trends, including extremes, are characterised by strong variability, with both increasing and decreasing trends observed in different parts of (South) Asia.
- Heat stress is affecting South Asian populations and putting more children's lives at risk, especially in cities

Impacts of climate change in India include:

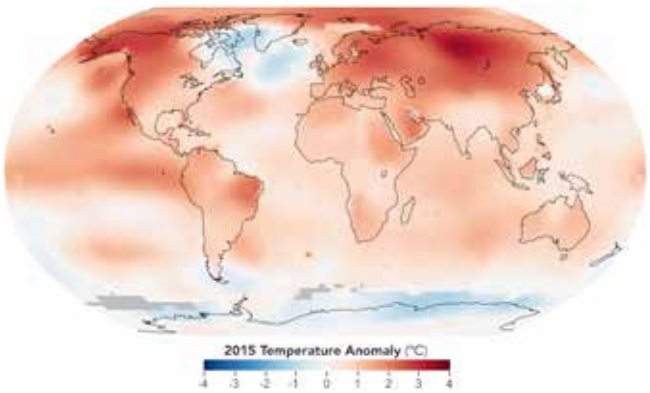
- In 2015, severe floods have affected more than 6 million people across the country, with over 250,000 people evacuated.
- Over 12,300 Indian farmers committed suicide due to drought and crop failures in 2014.
- 18 out of India's 36 states and UTs have been hit by drought, including our top grain-producing states – Punjab, Haryana,

Figure 1: Increasing Global Temperatures



Source: IPCC 5th assessment report

Figure 2: Hottest Year on Record



To reinforce the point, NASA reported that June 2015 was the hottest month on record (tied with 1998); pitching 2015 as the hottest year on record, and by a wide margin — as what increasingly appears to be one of the strongest El Niños in 50 years that boosts the underlying global warming trend.

Bihar and UP.

- **Tropical cyclone Aila** formed over the Bay of Bengal on 23 May 2009 and caused extensive damage and devastation in India and Bangladesh. At least 18 of the 45 fatalities in West Bengal were in Kolkata. All transit systems in the city were stopped. At least 100 river embankments were breached by storm surge. The storm displaced more than 2.3 million climate migrants, as 175,000 homes were destroyed and 270,000 damaged.[1] Effects of high salinity caused by saltwater ingress during Cyclone Aila are still seen some six years later, as rice cultivation amongst the villages in the Sunderbans continues to decline.

According to a recent World Health Organisation study however, of the top 20 most polluted cities in the world, 13 are located in India, with all 20 to be found in South Asia. Delhi tops the list with its air polluted by fine particles at a concentration of 153µg/m³. This is close to three times the Beijing mean and 15 times the WHO guideline[2] of 10µg/m³. Kolkata is ranked 25th on this list.

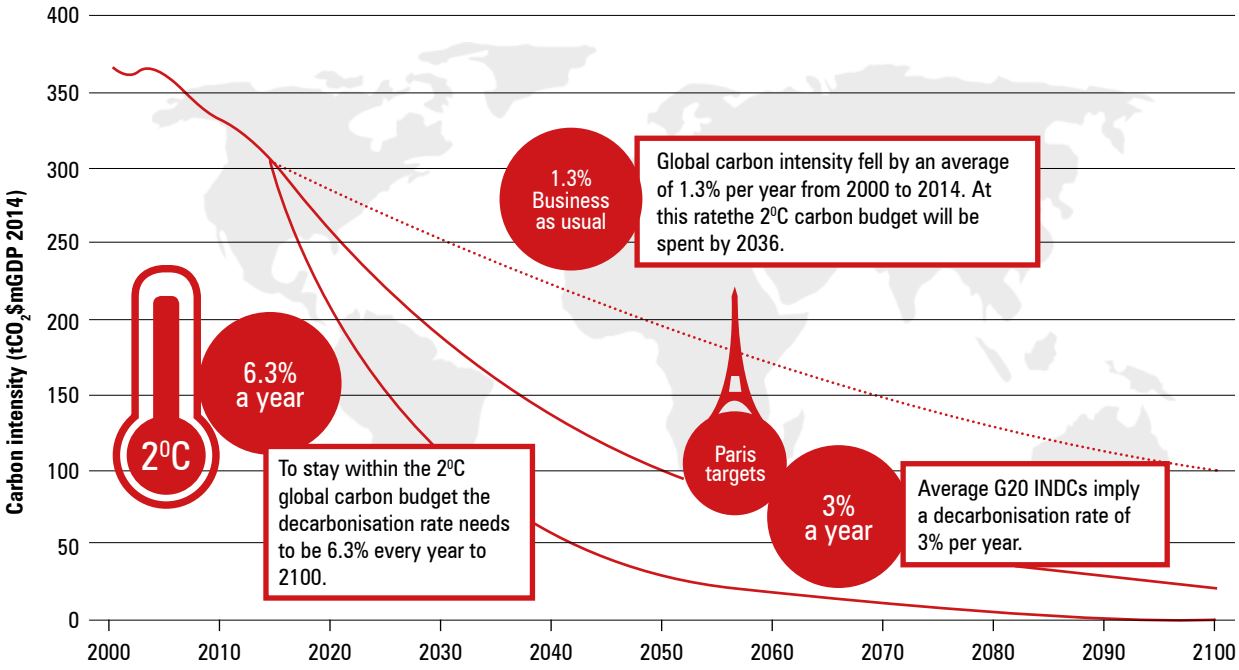
The Need for Change

In 2015, three separate long-term global sustainability initiatives were debated and signed.

- In March, in **Sendai Japan, the Sendai Framework for Disaster Risk Reduction** 2015–2030 laid out a voluntary pathway for the next 15 years of disaster risk reduction, following on from the initial 10 years approved as part of the Hyogo Framework for Action 2005–2015.[3]
- In September, the United Nations met in New York to ratify the **Sustainable Development Goals** (SDGs); these are also voluntary and are the successor to the Millennium Development Goals (UN 2000), which ran from 2000 to 2015.
- In the December **Conference of Parties (COP 21) Paris**, France, the United Nations Framework Convention on Climate Change (UNFCCC) pursued a legally binding treaty

[1] Associated Press, Reuters
[2] http://www.theguardian.com/cities/2015/dec/02/where-world-most-polluted-city-air-pollution
[3] UNISDR 2015

Figure 3: Low Economy Carbon Index 2015



Source: PwC Analysis

for dealing with climate change. The focus was on climate change mitigation efforts, which means reducing greenhouse gas emissions and increasing sinks.

The Paris Agreement 2015

The Paris Conference sought a climate deal, which all countries could sign up to. It was the culmination of four years of negotiations where every country made compromises, but some got more than others.

Many wanted a reduction of global average temperature rise to under 1.5°C. However, the final wording was "… well below 2°C above pre-industrial levels and to pursue efforts to limit the increase to 1.5°C." Estimates, however, suggest that pledges from 148 countries made prior to the Convention in Paris are likely to increase the average global temperature by about 3°C; this is, however, an improvement on a business-as-usual rise of about 5°C by the end of the century.

Implications for India

India will have to make considerable efforts to implement the Agreement, especially the progressive review of goals, monitoring frameworks and the revised wording of Common but Differentiated Responsibilities (CBDR). In particular, the way in which India's "national circumstances" will be interpreted for financial flows, technology transfer, or capacity-building are not clear since India is a large country with high GDP, although millions still live in poverty[4].

And there is also the issue of sharing the carbon space. If this is not done equitably, there could well be a race for this 'space', where developed countries continue to swallow up the remaining carbon budget. If this happens, India would have to prepare itself to lift millions out of poverty, while also trying to claim its share of development space, especially in light of its significant links with fossil fuels.

India will need to be concerned about providing human services in a sustainable manner to its large and predominantly poor population. This will require a significant domestic social and economic transformation, which will be difficult to undertake. This does, however, give India a great opportunity to create an innovative future.

In **India's 'Intended Nationally Determined Contribution' (INDC)** to the United Nations Framework Convention on Climate Change (UNFCCC), the country has made a voluntary commitment to lower the intensity of its emissions (emissions linked to GDP) by 33% to 35% below 2005 levels by 2030.[5]

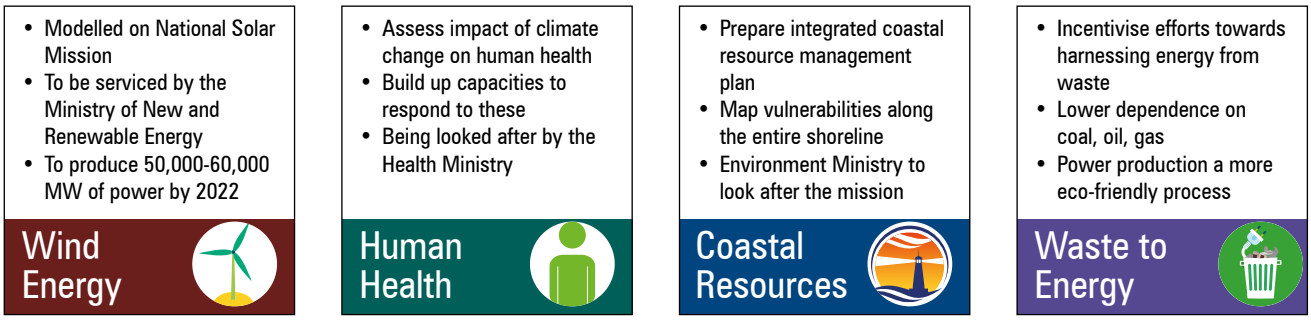
To achieve this target, INDC 2015 highlights India's commitment towards developing climate resilient urban centres. This is significant in light of the expected rise of India's urban population (estimated to be 40% by 2030).

Currently, eight Missions are operational under the **National Action Plan on Climate Change (NAPCC)**, with each being a sectoral response to the impacts of climate change. Three of these

4 http://www.thehindu.com/news/international/winners-and-losers-in-the-paris-climate-pact/article7986619.ece?ref=relatedNews
http://www.thehindu.com/opinion/op-ed/paris-agreement-at-paris-something-for-everyone/article7987957.ece?ref=relatedNews

5 http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf

Figure 4: Additional Missions proposed under the National Action Plan on Climate Change



— on solar energy, afforestation and energy efficiency — seek to slow down the growth of India's emissions. Another three — on agriculture, water and Himalayan eco-systems — are about initiating measures to adapt to the effects of climate change. The remaining two — on sustainable habitat and strategic knowledge — are service missions that seek to create more knowledge on useful climate responses.

In light of its commitment, the national government is seeking to broaden India's response to climate change, by undertaking four new missions. These are indicated in Figure 4 above.

State Action Plan on Climate Change

The West Bengal State Action Plan for Climate Change (SAPCC) was prepared by a Committee led by the Government of West Bengal in 2011. The SAPCC highlights the criticality of Kolkata as a region prone to flood expansion during cyclonic storm surges due to inadequacies in the area's infrastructure, land-use, socio-economic and environmental conditions, and drainage capacity of existing sewerage systems. Evidence of salt-water intrusion has been seen in the form of enhanced soil salinity tested up to 40 kilometres from Kolkata after the cyclonic storm Aila[6].

Introduction to Kolkata

Kolkata, the capital city of West Bengal, is the third most populous urban agglomerate in India and is ranked in the top 20 most populous cities in the world. The city sits on the eastern bank of the River Hooghly, a distributary of the River Ganges that flows south past the city towards the northern tip of the Bay of Bengal some 90 kilometres away.

Kolkata was, until 1911, the capital of India. This was a significant period for the city, making the most of its 'capital' status through architectural innovation and the introduction of modern infrastructure, including underground sewers and drainage networks, a strong public health system, modern education techniques such that, in its prime, Kolkata was considered to be the birthplace and focus for modern Indian literary, artistic and scholastic thought; it is still spoken of as being the 'cultural capital' of the country. The city is home to India's oldest and now second largest stock exchange – the Calcutta Stock Exchange.

The city has other 'claims to fame' apart from once being the nation's capital. The city is, for example:

- Home to India and South Asia's first city metro rail network, which is currently undergoing expansion;
- The only city in India to have a tram network and an extensive river transport system; and
- The first city to accommodate the Indian Meteorological Department (1975).

In recent years, Kolkata has developed into the prime business, commercial and financial centre for eastern India and the gateway to the foreign markets of Bangladesh to the east and both Nepal and Bhutan to the north. New initiatives such as 'Look East' and the more recent 'Link East', envision that Kolkata will become a major transit and economic hub for the wider region, through the provision of dedicated freight corridors, which in themselves could increase intra-regional trade by up to 60%[7] acting as a gateway to the wider markets available to the west and south in India and beyond. The National Waterways Development Mission and improved sub-regional transport connectivity would augment this potential.

These initiatives come after an extended period of apparent industrial stagnation. However, more recently, the IT and telecom sectors have given a major impetus to the city's business environment with other industrial sectors like automobiles, pharmaceuticals and banking all contributing to the growth of the city's economy. It is estimated that the GDP of Kolkata has grown to a value of $150 billion to make it the 42nd largest in the world, in economic terms[8].

The city, which is managed by the Kolkata Municipal Corporation (KMC), covers an area of some 200.71 km^2 and is divided into 16 boroughs comprising 144 wards. It has a current population of some 4.5 million,[9] of whom about one-third live in low-income neighbourhoods and a population density of 24,250/km^2 – making it one of the most densely populated cities

[6] West Bengal SAPCC, April 2012
[7] http://indianexpress.com/article/india/india-others/sub-regional-road-connectivity-pacts-from-looking-east-to-linking-east/#sthash.qc4HXoBT.dpuf
[8] http://m.siliconindia.com/news/business/World-GDP-Index-Top-10-Developed-Cities-of-India--nid-182275-cid-3.html/2
[9] Government of India Census, 2011

Air pollution mitigation strategies for Kolkata

Air pollution scenario in Kolkata

Kolkata is the fifth highest amongst major cities in India emitting 14.8 million tons of greenhouse gases (GHG)[I]. It is also the second highest contributor in terms of per capita CO_2 emission producing 3.29 tons of CO_2 per capita[II]. Emissions in Kolkata are projected to increase by some 54% by 2025 based on 2014 level. Around 70% of Kolkata's 15 million inhabitants suffer from some form of respiratory problems caused by pollution from the city's transport sector. An article published by 'Times of India' earlier in year 2015 suggests that Kolkata is the only other Indian city, other than Delhi, which is predicted to record the highest number of deaths through inhalation of polluted air by 2050.

A study conducted by the West Bengal State Pollution Control Board (WBPCB) forecasts a decline in the share of pollution from industrial sources, but an increase in pollution from automobiles[III] that affects the human beings maximum and conversion of open spaces (10% to total city area)and water bodies into built-up areas (78% to total city area). Road vehicles also contribute significantly to particulate matter of size class of 1.1 micron. Further studies carried out by the World Bank in a variety of cities have proved that nearly half of the total exposure to particulates that make people ill, can be linked to pollution emanating from road vehicles.

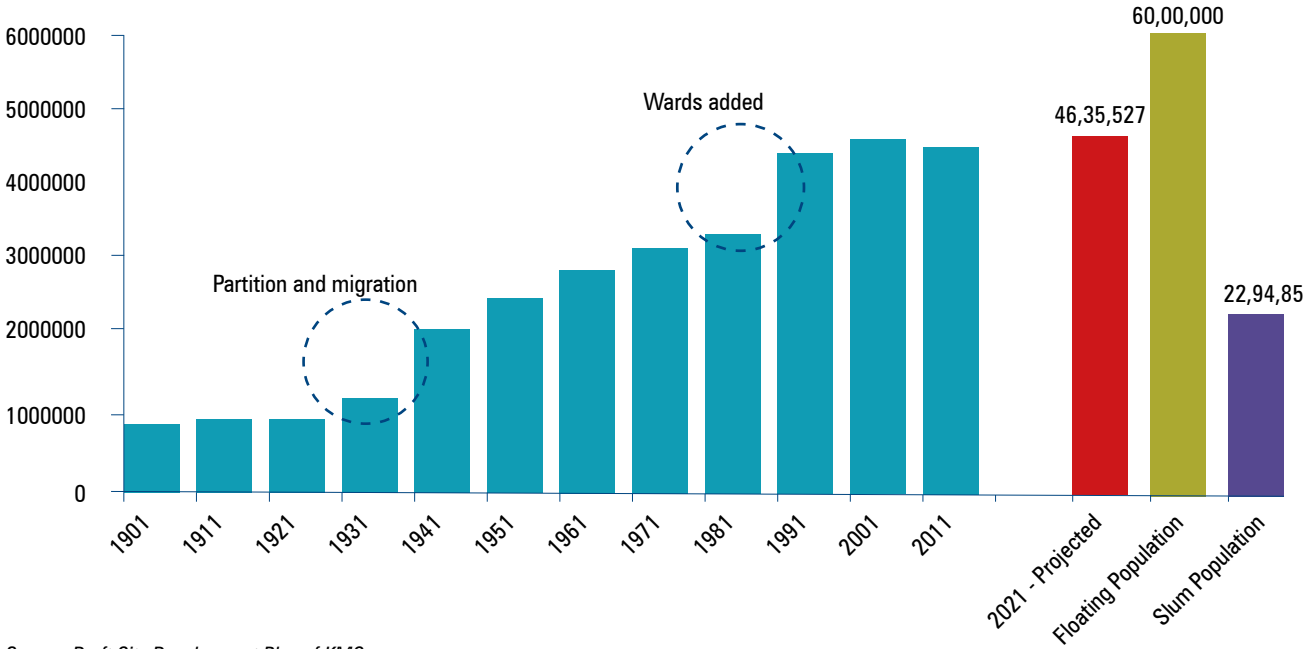
- Major sources of air pollution include automobile exhausts (50%), industrial emissions (48%) and cooking (2%)[IV] .
- Automobile exhausts include sulphur dioxide, nitrogen dioxide, carbon monoxide, carbon dioxide, hydro-carbons and particulates PM2.5 and PM10 that constitutes Green House Gas Emissions resulting into Urban Heat Island Effect, Global Warming, respiratory, pulmonary and nervous disorders.
- Transportation itself contributes 18% to the total CO_2 emissions of Kolkata.
- The area under road is only 6% of the total area of the city, less than the national average of 15% whereas the annual growth of new vehicles on the road is as high as 7% per annum resulting into traffic congestion, lower vehicle speed and subsequent air pollution.
- Estimated emissions from the vehicles on the roads in 2008 was 378 tons/day which is projected to be 749 tons/day in 2025 primarily from buses (55% of public bus transportation that are more than 15 years of age), 3 wheelers and old trucks.
- 65% of the commercial vehicles in city are older than 15 years and their compliance to emission standards is poor.
- Emissions from waste sector in Kolkata are higher than the national average with generation of 4.3 million m^3 of landfill gas[V] (CH_4 & CO) every year; Dhapa landfill site is estimated to contribute approximately 250,000 tons CO_2 equivalent for the period 2013-2022[VI].

Mitigation Measures

Mitigation Measures already undertaken	Proposed Interventions
• Introduced Bharat Stage IV norms for vehicles in 2010. • Two-stroke auto-rickshaws banned in 2009. • Selling of pre-mixed 2-T oil made mandatory within Kolkata Metropolitan Area since November 2001. • Ban on supply of loose 2-T oil. • Introduced 50 ppm sulphur fuels. • Up gradation of PUC emission testing centres. • Unleaded petrol introduced since February 2000. • Benzene content in petrol reduced to 3% from 2001 subsequently to 1%. • Only LPG driven three wheelers are registered in Kolkata since June 2003. • Petrol blended with 5% ethanol mandatory since January 2003	• KMC can work together with relevant State Departments to establish and enforce auto fuel quality guidelines and emission standards, as well as vehicle age, to lower pollution. • Introduce a Congestion Tax for vehicles entering central Kolkata to reduce pollution and city congestion; demarcate an appropriate inner zone and procure new technology required for developing appropriate infrastructure. • Develop a parking policy for the city with the aim to decongest city roads • Feasibility assessment to explore options for introducing energy efficient public transit options (mass transit as well as paratransit), for reducing use of private vehicles and overall per capita emissions. • Developing infrastructure to support non-motorised transport • Develop publicity campaigns to promote NMT and low carbon modes of public transport (such as trams and waterways) • Improve public information systems to increase use of public transport • A Landscape Strategy for Kolkata should be prepared to develop a hierarchy of 'green spaces' to increase city leaf index, enable carbon sequestration and reduction of urban heat island effect through avenue plantations, rooftop and vertical gardens. • Advanced mechanisms for dust suppression at construction sites, industrial exhausts and other point sources within/around the city • Improvement of city-wide solid waste management services through improved technology options for decentralised waste management, dry waste collection and recycling operations, eco-friendly management of landfills to minimise landfill gas emissions.

[I] Renewable and Sustainable Energy Reviews Report, 2015
[II] http://www.thehindu.com/sci-tech/energy-and-environment/iisc-chennai-highest-per-capita-emitter-of-greenhouse-gases/article7007913.ece
[III] Centre for Science and Environment (CSE), 2011
[IV] Baijanta Kumar Majumdar, Amit Dutta, Shibnath Chakrabarty & Subhabrata Ray, 2008
[V] Dhapa Dumpsite Environmental And Social Assessment Report, February 2014
[VI] Assuming 1:1 proportion of methane and carbon di-oxide in landfill gas, and considering GHG potential of methane as 20-25 times higher than carbon di-oxide

Figure 5: Population projection



Source: Draft City Development Plan of KMC

in the world. The average per capita daily income of the poor in Kolkata is estimated at INR 27, lower than the nation average in cities of INR 32[10].

The Kolkata Metropolitan Area (KMA) covers an area of approximately 1,850 km^2 and has a population approaching 15 million. Administrative control of this large urban area rests with the Kolkata Metropolitan Development Authority (KMDA), which is responsible for statutory planning and the overall development of the KMA. The KMA includes a large suburban hinterland as well as the urban core, which is controlled by the KMC. The population of the KMA is projected to increase to 23 million by 2030, at a growth rate of 6-7% per annum.

Kolkata is the only metropolitan city in the world where the state government has introduced development controls to conserve the wetlands, with these water bodies doubling up as a wastewater treatment/ recycling process. The East Kolkata Wetlands (EKW) span almost 8,000 hectares and serve as a natural sponge absorbing excess rainfall and helping to reduce pollution. The area comprises intertidal marshes including salt marshes and salt meadows with significant wastewater treatment areas such as sewage farms, and settling ponds. The oxidation basin is a rare example where environmental protection and development management have combined and where a complex ecological process has been adopted by the local farmers to master resource recovery activities. It contains the

Figure 6 Oxidation Basin in the East Kolkata Wetlands

largest collection of sewage fed fish ponds in the world. The East Calcutta Wetlands were designated as a Ramsar Site in November 2002.

Kolkata is the first city to have a Metropolitan Planning Committee (KMPC)

[10] Times of India

The City and its Vulnerability

The growth of its population and its economy has not occurred without a cost and in parallel there has been an identifiable increase in environmental degradation and an upsurge in susceptibility to climate change hazards. Combined, these have made the city more vulnerable to natural and man-made disasters.

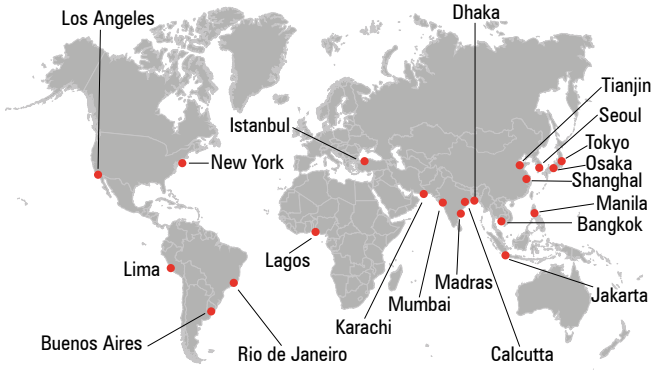
Today, Kolkata is considered to be **third on the list of the world's most flood prone coastal cities** according to a recent World Bank report on South Asia.[11] This also indicates that the city is at risk from regional earthquakes, as well as suffering from a number of anthropogenic contributors to climate change, including increasing levels of air pollution and increases in localised urban heat island effects; the latter due to the loss of natural vegetation and traditional water bodies from the urban area to be used to cater to the increased demand for housing and infrastructure and supporting social and employment facilities.

KMC is responsible for administering and providing basic infrastructure to the city, including the provision of water supply; sewage treatment and disposal; solid waste management; building and maintenance of city roads; maintenance of parks and open spaces; conservation of heritage sites; and disease control, including immunisation.

KMC has undertaken a number of reforms that are targeted at sustainable practices. These include measures such as the incorporation of solar power and rainwater harvesting systems in building byelaws. KMC has also introduced solar lighting systems in urban parks and other energy efficient lighting systems in public spaces.

Participating in the current project highlights the intent of the city authorities to increase their understanding of climate change, the impacts that this could have on the city and the actions required by city/state institutions to future-proof the city.

Figure 7: Coastal Cities Threatened by Flooding



The Kolkata Municipal Corporation (KMC), established in 1876, is responsible for the provision of civic infrastructure and administration of the city of Kolkata. KMC is divided into 144 wards and grouped into 16 boroughs, covering an area of 200. 71 km². Each of the 144 wards elects a councillor, who is responsible for local administration of KMC's activities. KMC discharges its functions through the Mayor-in-Council, consisting of the Mayor, a deputy Mayor and ten other elected Councillors.

A recent initiative by KMC towards creating low **Carbon Parks** has been to introduce solar powered LED lighting systems starting with Deshapriya Park in South Kolkata

Kolkata – Climate Change: Key Factors

The project seeks to address a number of challenges that have been on the increase in Kolkata and have now become areas of concern. However, before continuing to detail the remedial measures, it is first necessary to develop a picture of the issues as they currently affect Kolkata. This is done in the following section, where an overview is provided of a number of climate change parameters of relevance to the city.

Greenhouse Gas Emissions

In 2009-10, Kolkata emitted 14.8 million tonnes of greenhouse gases (GHG), the fifth highest among major cities in India[12]. In terms of emissions per capita, Kolkata is considered to be the second highest contributor producing 3.29 tonnes of CO_2 equivalent emissions per capita; Chennai is the highest emitting 4.79 tonnes of CO_2 equivalent per capita.

Unlike other cities, in Kolkata, the building sector is the greatest contributor to GHG, totalling some 6.3 million tonnes of GHG or 42.8% of total emissions (see Figure 8 on next page). Comparatively, the transportation sector contributed considerably less with 1.97 million tonnes (13% of Kolkata's total); in other cities like Delhi, Bangalore and Hyderabad, the transportation sector's figures were 12.4 (32%), 8.6 (43%) and 7.8 (56%) million tonnes of GHG respectively.

Consumption in the Building Sector

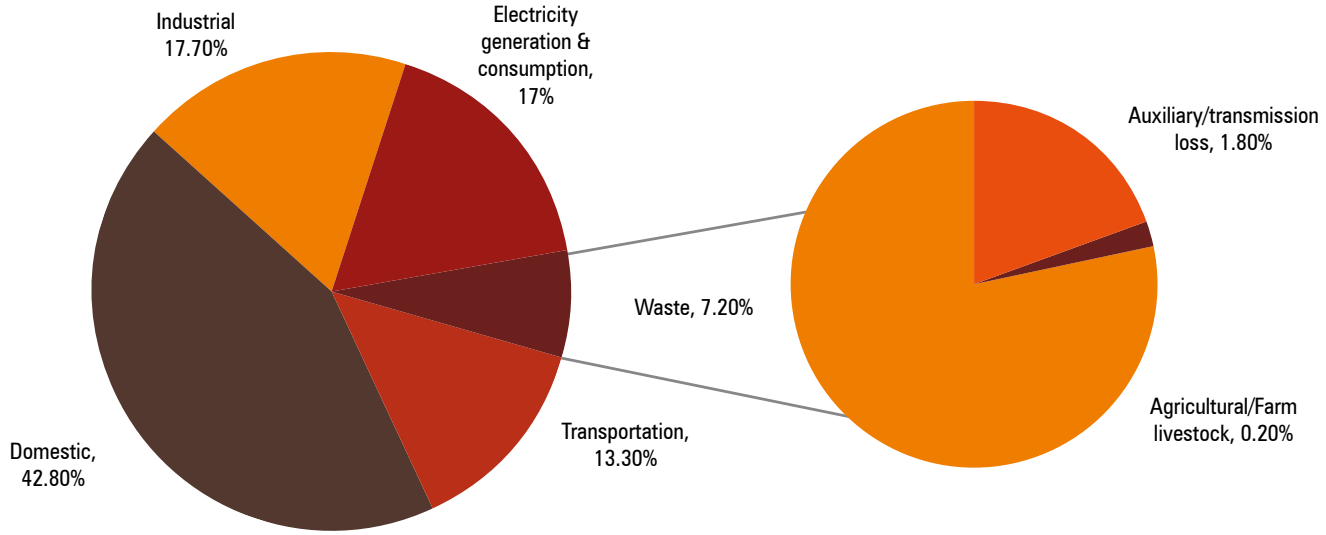
As noted in Figure 8, emissions from the building sector are the greatest contributor to GHG in Kolkata, due to the sector's energy consumption. The city's commercial and residential buildings consume some 38% to 40% of the total energy available, mainly due to different activities during and post construction.

According to the 2011 Census, the number of households in the city was 964,000 with a total energy bill equating to 9.1% of local GDP. As indicated in the figure, building activity and

[11] "Leveraging Urbanisation in South Asia" – World Bank Group, 2015
[12] Renewable and Sustainable Energy reviews report, 2015

Emissions in Kolkata are projected to increase by some 54% by 2025 based on 2014 levels

Figure 8: GHG Contributions by Sector in Kolkata



Kolkata airport recently became the first Indian airport to install rooftop solar PV systems.

- 2 MW rooftop solar plant installed
- INR12 crore spent
- INR2.15 crore annual benefit envisaged

therefore energy use in this sector is expected to rise at a rate of 3.31% per annum between 2014 and 2025 resulting in an increase in annual energy bills of some 111.6% on current value – the equivalent of INR357.9 billion.

The Transportation Sector

Cars in Kolkata carry 5% of the total number of people that travel every day, but take up 29% of the total road space available (which itself is about 6% of total land use – as against a national benchmark of 15%), making it less efficient than other Indian cities such as Chennai (9.5%/17%), Bangalore (8%/19%) and even Delhi (7.5%/ 30%). In the city, the area of land allocated for transportation purposes stands at 6% of the total available area, far less than in other metro cities like Delhi (21%) and Mumbai (10%). With the annual growth of new vehicles on the road standing at 7% per annum, this will result in increasing traffic congestion and lower speeds, although, as a positive, it does ensure that owning and driving private cars on Kolkata's roads is an unattractive option.

The modal split shows that public transport undertakes the greatest number of person-trips (54%) followed by walking and cycling. The share of Intermediate Public Transport (auto-rickshaws/ taxis) was 4% in 2008. Private vehicles have only a 12% share, making this modal split one of the best/greenest in the country (see Figure 9 on next page). The primary challenge for Kolkata is to retain these shares in spite of increasing economic development by creating supporting policies and plans for them.

Despite the climate-positive modal share, Kolkata has high polluting emissions; these have a severe impact upon public health. As well as economic loss caused by congestion, ***around 70% of Kolkata's 15 million inhabitants suffer from some form of respiratory problems caused by pollution from the city's transport sector.***

An estimate of emissions from vehicles on the roads in 2008 was 378 tons/day. By 2025, it is estimated that the rate will be 240% higher than in 2008 to stand at 749 tons/day. Much of this will be as a direct result of increased levels of commuting by buses and by 3- wheelers and an increase in the number of old trucks travelling through the city. Approximately 65% of the commercial vehicles on the city's roads are older than 15 years. There is scope for strengthening the existing system for monitoring of compliance to emission standards for vehicles (see Figure 10 on next page).

Waste Sector

Waste sector emissions from Kolkata are higher than the national average. Estimates suggest that around 1.3 million tons of un-

segregated solid waste is deposited daily (2014[13]) into the city's only waste facility, the already saturated Dhapa landfill site. An estimated **4.3 million m³ of landfill gas[14] (CH_4 & CO)** is generated every year from anaerobic digestion of the biodegradable waste in the area. The contribution to global warming from the **Dhapa landfill site is estimated at approximately 250,000 tons CO_2 equivalent** for the period 2013-2022[15] .

Urban Heat Island Effect

Figure 11 shows the impact of the changing land use pattern in Kolkata due to the various development activities that have taken place in the last two decades, during which the proportion of open space as a percentage of the total area has decreased significantly, from 25% in the early 1990s to approximately 10% now. Some estimates say it is even lower than this.

Much of the open space that has been lost has been used for new buildings, roads, infrastructure corridors and other population-supportive developments. In the city, commercial and residential land use in 2012 made up some 79% of the total area of the city, from 71% in early 1990s.

Despite providing necessary additions to the urban environment to cater to the growing population, the loss of this open space has disadvantages. Not only do the residents lose a potential recreational outlet, but the loss contributes to the creation of urban heat islands, where localised temperatures can be significantly higher (between 1 and 12°C) than in the surrounding rural areas, due to the replacement of greenery with concrete, tarmac and other hard surfaces.

Heat islands can affect communities by increasing:

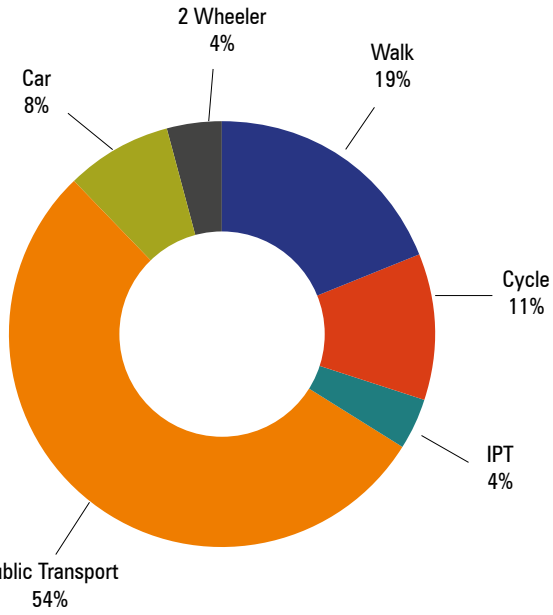
- summertime peak energy demand and air conditioning costs;
- air pollution and GHG emissions;
- incidences of heat-related illness and mortality; and
- by impacting upon water quality.

[13] Dhapa Dumpsite Environmental And Social Assessment Report, February 2014

[14] Dhapa Dumpsite Environmental And Social Assessment Report, February 2014

[15] Assuming 1:1 proportion of methane and carbon di-oxide in landfill gas, and considering GHG potential of methane as 20-25 times higher than carbon di-oxide

Figure 9: Urban Transport - Modal Share, Kolkata



Source: Study on Traffic and Transportation Policies and Strategies in Urban Areas in India, MoUD, 2008

Figure 10: Emissions from Kolkata's Transport Sector

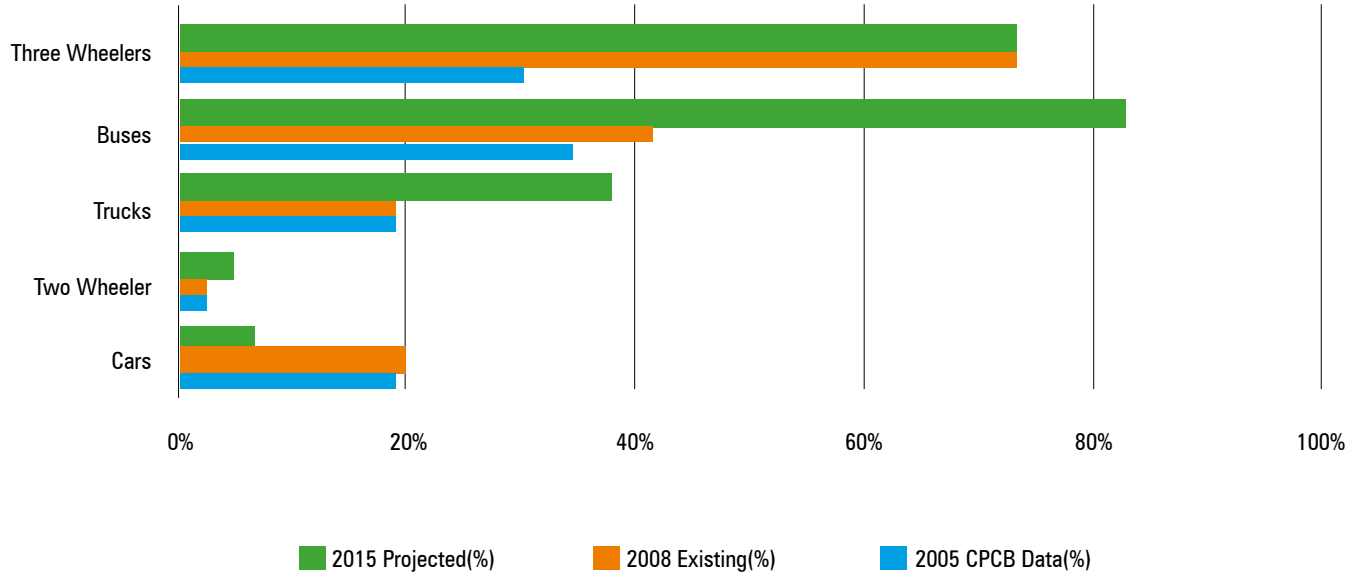
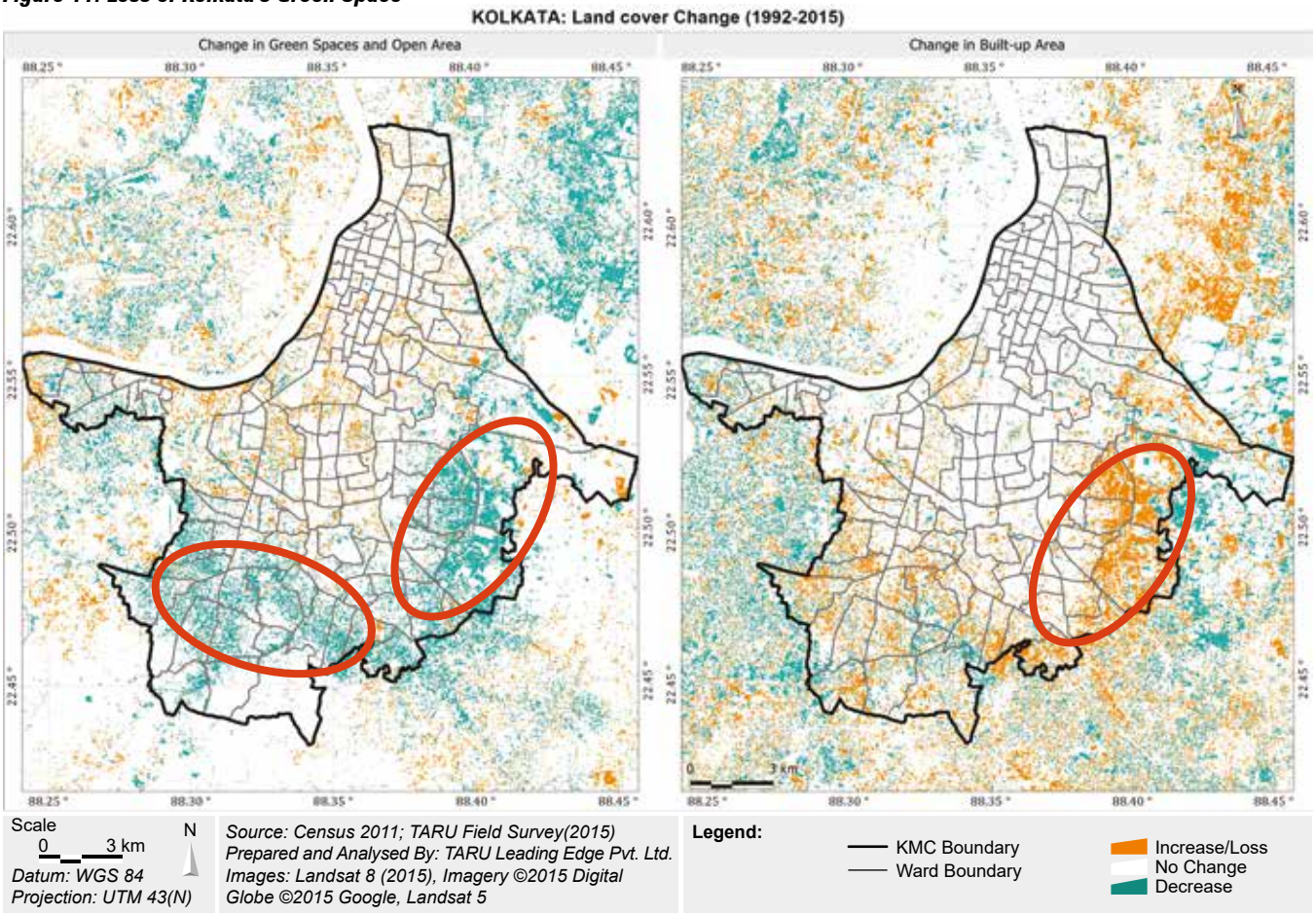


Figure 11: Loss of Kolkata's Green Space



Source: TARU Analysis 2015

Climate Induced Disasters and Public Health Hazards

Over the last 40 years, there have been noticeable climate variations, changes in rainfall, air temperature and extreme events like cyclones in Kolkata.

The average annual rainfall in the city has increased from approximately 1,510mm in 1901 to 1,750mm in 2011. A comparison of 10 yearly blocks between 1972 and 2011 shows that the average rainfall has increased considerably during the later half of this period (1992 to 2011).

A major reason for this is the increase in the surface air temperature within the city. Over the same period, the maximum temperature has increased slightly, whereas the minimum temperature has increased appreciably.

The rainfall has also been erratic in the same period. Although the total number of recorded heavy rainfall incidences is 78, with a mean of 2.2 incidences per year, there have been considerable variations, with none in some years and up to six in others.

Kolkata is exposed to a range of natural hazards, including floods, earthquakes, heat waves and cyclones. Its unique location and climatic conditions make the city vulnerable to various kinds of natural hazards. The presence of slums and the difficulty of accessing many places due to limited road width and congestion will exacerbate the risk in the event of a disaster.

A report by the Inter Agency Group on historical occurrences of tropical cyclones indicates that West Bengal has been hit 11 times by severe cyclonic storms between 1977 and 2011. The intensity and size of the storms have also increased during the last decade.

The population affected in Kolkata as a result of these cyclonic storms has been on the increase. If the status quo is maintained, this trend is likely to continue as:

- A recent World Bank study has ranked Kolkata as the third most at risk city globally with regard to exposure to flooding from climate change.
- Sea-level rise in this area of West Bengal is expected to be 25 cm by 2030. Given its location on the banks of the River Hooghly, this could severely affect the city.
- A flood depth of more than 25cm is expected to affect 41% of the city area and 47% of the population by 2050.

Vector-borne diseases, such as malaria, are expected to increase by 5-15% in developing countries as a result of climate change. Kolkata's water-logging during the monsoon exacer-

Figure 12: Rainfall – 1970 to 2010

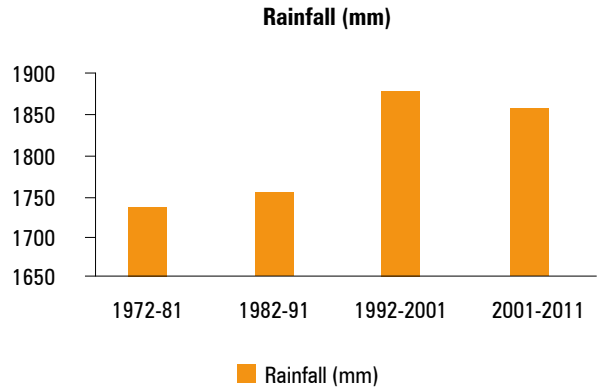
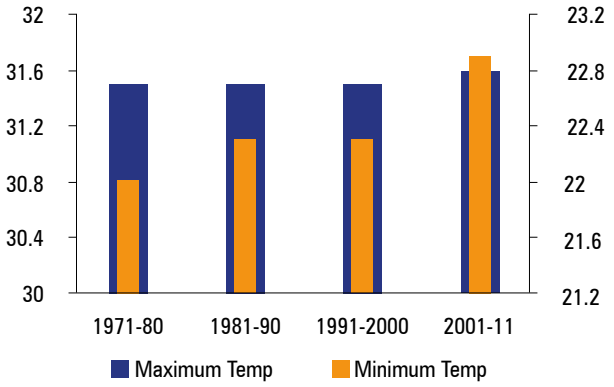


Figure 13: Temperature Change – 1970 to 2010



bates the problem by providing ideal breeding grounds.

KMC's Challenges – A Summary

KMC faces many challenges. Not only does it face the challenge of running India's third largest city, providing the services required by its 4.5 million residents, it also has to face the more recent and less understood challenges that can be directly attributable to climate change.

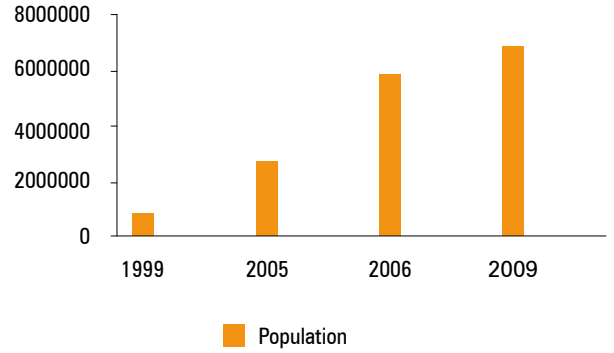
These challenges are multi-faceted. They are the same as those faced by many expanding cities, where the increase in urban population is not matched by increasing municipal budgets to provide the necessary housing and physical/ social infrastructure in a sustainable manner. As a result, the scale of the challenge is also increasing, making life more difficult for organisations such as the KMC.

A number of key challenges are identified on the preceding pages. Below, a summary of the many different but inter-related issues that contribute to the severity of the challenges faced is presented, hopefully showing the scale of effort needed to develop mitigating measures to safeguard the city.

Key challenges include:

- Increase in GHG emissions – Kolkata is the ***fifth highest GHG emissions contributor*** among major cities in India and the second highest contributor in terms of emissions per capita;
- The loss of open space and traditional water bodies, as these land areas are developed for residential/ mixed-use projects. Land under threat includes the East Kolkata Wetlands, a RAMSAR designated site. As a result of this change, urban heat islands within the city are on the increase;
- Although, positively, public transport is the dominant transport mode, the area of land allocated for transportation purposes is extremely low, even compared with other Indian mega-cities. Annual vehicle growth stands at 7%/ annum; this is likely to result in increased traffic congestion.
- Kolkata's transport sector is highly polluting. Its emissions impact public health. Emission levels are projected to increase by over 50% on 2012 levels by 2025.
- Over the last 40 years, there have been noticeable climate variations in Kolkata, including changes in rainfall, air temperature and extreme events like cyclones.
- ***Vector-borne diseases such as malaria and dengue as well as respiratory diseases due to increasing pollution levels, are expected to rise in the city.***
- Due to various behavioural, operational and institutional inefficiencies, KMC's indirect energy consumption profile leads to direct carbon emissions, with levels increasing as the city grows.
- The city faces a fast growing solid waste management challenge. It has only one landfill site at Dhapa. This site is already saturated. ***Dhapa will contribute towards global warming with an estimated emission of 250,000 tons of CO_2 equivalent between 2013 and 2022.***
- The city land area is increasing, although in a fairly haphazard, irregular manner.
- Institutional capacity to deal with climate change needs strengthening. There is need to improve awareness on issues and mitigation measures available to deal with them.

Figure 14: Population affected by Cyclones



Challenges of KMC due to Climate Change

Economic growth led to an increase in

- Domestic energy consumption
- Individual vehicle ownership
- SWM generation
- Lack of space for waste disposal
- Increasing GHG emissions
- Erosion of natural heritage,
- Reduction in carbon sinks – water bodies, green and open spaces
- Lack of road space, old polluting vehicles, use of polluting fuel,
- Untreated dumping of waste, polluting industries within the city
- Pressure on urban infrastructure/ municipal services

Natural risk to climate induced hazards

- Proximity to sea and exposure to the impacts of coastal hazards
- Noticeable changes in precipitation pattern, temperature, humidity, frequency of cyclones etc.
- Frequent urban flooding
- Degraded carrying capacity in the outfall canals network

Urbanisation issues

- In-migration & floating population
- Uncontrolled urban growth
- Uncontrolled real estate development along the fringe of EKW affecting wetlands' ability to absorb additional runoff
- 'Climate in-migrants' establish slum & unauthorised squatter settlements along the banks of drainage outfall canals.

Public health concerns

- Pollution of River Hooghly and most canals
- Growth in outbreaks of vector borne, diarrheal and respiratory diseases.
- Increased incidence of malaria, dengue, cholera, typhoid, etc.

Governance issues

- Disaster under-preparedness
- Communication issues between the corporation, corporates, civil society and private sector
- Inter and intra departmental synchronisation of empirical data
- Smart/ ICT-enabled technology and innovation for climate-smart solutions

Section A3: MoU and the Work Programme

The Memorandum of Understanding

It is in this broad context that during the visit of the UK Prime Minister, the Rt. Hon. David Cameron to Kolkata in 2013, the UK government had signed a Memorandum of Understanding (MoU) with KMC to work together towards developing Kolkata as a low carbon and climate resilient city of the future. The UK agency tasked to administer this MoU and oversee the work to be undertaken was the UK government's international development ministry, the Department for International Development (DfID).

In February 2014, the Honourable Mayor of Kolkata, Mr. Sovan Chatterjee and Rt. Hon. Greg Barker, the UK Government's former Minister for Energy and Climate Change in 2014, launched the detailed Plan of Action and the UK Government announced

Technical Assistance of £1 million to implement the MoU.

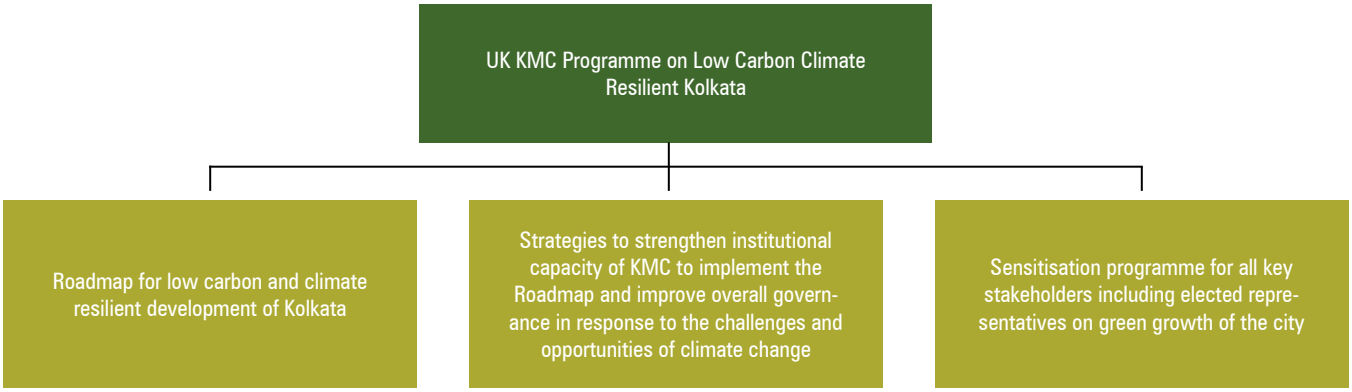
To achieve the MoU's Vision, DfID procured specialised agencies, comprising Indian and International firms, to prepare policies and guidelines towards an ecologically sustainable future for the city. This Roadmap Document brings together the key recommendations made under the different modules of this programme towards building climate resilience for the city of Kolkata.

The Work Programme

A multi-disciplinary programme of works comprising adaptive as well as mitigating strategies for climate resilience was devised, with the work to be undertaken by different international and national consultants as shown in a graphic on the next page.

A multi-disciplinary programme of works comprising adaptive as well as mitigating strategies for climate resilience was devised, with the work to be undertaken by different international and national consultants as shown in the following graphic:
Key features of the Programme are indicated below:

- A Municipality-led approach
- Principles of inclusivity, coordination and integration
- Both top-down and bottom-up approaches for better synchronisation
- Multi-disciplinary and highly-consultative
- Strong engagement with other State Government Departments through sectoral steering committees at State level
  - for ensuring synergy at policy level
  - for ensuring convergence at implementation level
- Takes into account local implementation context for sustainable urban centres - the latest trend in urban development
- Aims to stimulate local economic development through commercial activities, alternative livelihood options, research and innovation, skill and enterprise development
- Focus on Knowledge, Attitude and Practice (KAP)
- Replicability and sustainability
- Emphasis on knowledge exchange and technology transfer



ICLEI South Asia	• Sensitisation Programme for all Elected Representatives and Senior KMC Officials
IPE Global	• Knowledge Exchange Programme involving exposure visits to other Indian cities for KMC Officials and Elected Representatives • Setting up of the Kolkata Climate Change Cell within KMC, including a dedicated website and mobile application for taking forward programme objectives
Ashden India Renewable Energy Collective	• Policy Guidelines for Grid-connected Rooftop Solar (RTS) Panels • Energy Audit of parks • DPRs for 16 carbon neutral park projects
Meghraj Capital Advisors Pvt Ltd	• Options of study for suitable metering arrangement for implementing rooftop solar policy
Ernst and Young LLP	Energy Efficiency Policies and an Action Plan for KMC including: • Green procurement policy • Street lighting Master Plan • Scheme for rainwater harvesting • Climate-smart water supply and wastewater management strategy
	Climate-smart Solid Waste Management Strategy and Action Plan including: • Upgradation of city sanitation plan of KMC • Technology solutions for decentralised solutions, waste to energy, C&D waste, e-waste and waste transport route optimisation • Models for plastic waste management
PricewaterhouseCoopers India Pvt Ltd	Climate friendly interventions, policies, capacity building and sustainable governance for the city • Policy and Guidelines for the Promotion of Climate-smart Built Environment in Kolkata • Strategy and Guidelines for Climate-smart City Mobility in Kolkata • Strategy and Action Plan for Strengthening KMC's role to Address Climate-induced Public Health Hazards • Climate-induced Multi-disaster Management Plan for the KMC • City Business Plan for the Promotion of a Green Economy • Business Model for a Help Desk to Promote Low Carbon and Energy Efficiency Measures • Climate-friendly Ward Action Plans • Recommendations for Climate-smart Land Use Control and Development • Citizen Interface Plan • City Investment Plan • Coordination and preparation of the Programme's final Roadmap.

IN 2009-10, KOLKATA EMITTED 14.8 MILLION TONNES OF GREENHOUSE GASES (GHG), THE FIFTH HIGHEST AMONG MAJOR CITIES IN INDIA. IN TERMS OF EMISSIONS PER CAPITA, KOLKATA IS CONSIDERED TO BE THE SECOND HIGHEST CONTRIBUTOR, PRODUCING 3.29 TONNES OF CO_2 EQUIVALENT EMISSIONS PER CAPITA. CHENNAI IS THE HIGHEST, EMITTING 4.79 TONNES OF CO_2 EQUIVALENT PER CAPITA

SOURCE: RENEWABLE AND SUSTAINABLE ENERGY REVIEWS REPORT, 2015

The Roadmap

The Roadmap is a document that summarises the work undertaken during the course of the multi-module UK-KMC Programme. Further, it identifies the actions that will be required over differing time periods to deliver a cohesive approach for KMC to meet the challenges set and to achieve the target of becoming a low carbon and climate resilient city.

Following this introductory section, the components of the Roadmap have been structured into four main sections. They are:

Part B – Strategic Components;
Part C – Creating a Green Economy;
Part D – Spreading the Message; and
Part E – Action Summary

Part B deals with issues at a strategic level; those that require a 'top-down' approach and a number of actions by KMC. The modules propose changes or additions to existing policies, which will have an impact on the development of the city. This section covers the following eight broad subjects:

1. Climate Induced Disaster Management
2. Climate Induced Public Health Hazards
3. Energy Efficiency Action Plan for KMC
4. Grid-connected Rooftop Solar policy
5. Climate Smart Mobility
6. Climate Smart Built Environment
7. Climate Smart Solid Waste Management
8. Climate Smart Land Use

Each section will provide an overview of the topic; identify key issues that need to be addressed; provide recommendations on actions required; and identify how KMC could proceed towards implementing these. Where achievable, recommendations have been divided into short-term actions (within 2 years), medium-term actions (2 to 5 years) and long-term (5 years plus).

The contribution of each module has, out of necessity, been reduced to a brief overview. An extended report on each issue has been prepared.

Part C looks at the creation of a 'Green Economy' in Kolkata through preparation of a City Business Plan. This looks at the different sectors of the economy, especially those that are directly linked to climate change proposals and identifies the types of green jobs that can be created.

The City Business Plan is supported by the City Investment Plan, which looks at the different projects that have been identified by the different modules. Here there is an emphasis on green projects and the potential sources of funds to implement these activities; it does not try to look at all the existing sectors.

In addition, this section of the Roadmap provides details of an on-going project that supports the agenda being proposed by the City Business Plan and the green livelihoods that could be created. Work has been progressing under the UK-KMC Programme to improve living conditions in low income areas and supporting the ability of residents to involve themselves more directly in fee-earning work.

Part D identifies activities that seek to articulate the 'climate change message' through work undertaken as part of the UK-KMC Programme. Much of this is aimed at ensuring that members of the KMC – Councillors, executive staff and administrators – are fully aware of the actions required of them to adapt the city to being climate-smart.

This section of the Roadmap also contains details of the Ward Action Plans that have been prepared for five pilot Wards located throughout the City. These Action Plans are short-term plans that are led by the elected Councillors and are intended to identify actions and programmes that can be of direct benefit to the residents of each ward, especially those that can be implemented by them.

Finally, **Part E** aims to bring together the various recommendations/ actions that have been identified under each of the modules. The number is large, so to try to make them more understandable, the actions have been broken down by time as in each module, but they have also been split by the category of action proposed. Seven broad headings have been proposed, namely:

- Urban governance;
- Capacity building with a focus on the introduction of new units within KMC;
- Capacity building – general;
- Technical assistance, studies or pre-development activity;
- Operational improvements
- Development projects/ capital investment;
- Civil society initiatives and private sector partnerships.

PART B
STRATEGIC COMPONENTS

Section B1: Climate-induced Multi-Disaster Management Plan

KMC's land area is relatively flat and low-lying and its non-uniform slope generally trends away from the river towards the east and south-east[16]. The area that lies within the tidal reaches of the River Hooghly, was once a wetland, but now is the urbanised heart of KMA, a highly and densely populated area.[17]

The city initially grew in a roughly north-south direction along a stretch of the River Bhagirathi, but later extended eastwards to encroach upon the back swamps and wetlands. Growth has been accentuated by high in-migration, with many of the in-migrants having to live in low-income neighbourhoods across the city on marginal land that is located on the floodplain and along the natural drain paths and drainage channels, narrowing them and effectively reducing their capacity. Inadequate drainage of storm water run-off increases the frequency and severity of localised flooding.

The climate of Kolkata is considered to be tropical wet and dry, with an annual mean temperature of 28.3°C. Much of the rainfall is received from the south west monsoons during the months of June to September. In the last two decades the precipitation has been sporadic, with long dry spells, followed by heavy downpours towards the end of the monsoon season. This usually leads to flooding/water logging in various parts of the city.

Several studies[18] indicate that coastal urban areas, particularly mega cities located in low lying deltaic regions, are more prone to the risk of coastal flooding[19]. Kolkata is currently ranked as the third most vulnerable city in the world from coastal flooding[20]. The main impacts of these flood events, apart from damage to life and property is the deterioration in environmental health; a decrease in the wellbeing and living conditions for residents; and the impacts that flooding has on the livelihoods.

The Task

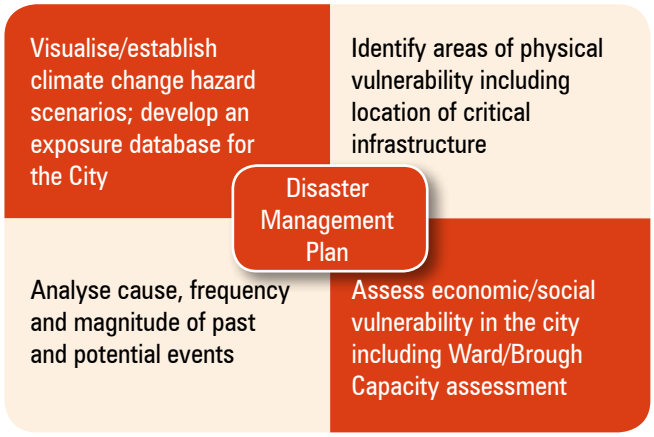
The purpose of this module was to prepare for the KMC area a Climate-induced Multi-Disaster Management Plan. There were a number of components, with the key activities being shown in Figure 16 opposite.

The main objectives were to:

- analyse the implications of climate change for extreme weather in the city;
- understand KMC's ability to prepare for and respond to extreme events; and
- provide recommendations on a variety of measures to reduce current and future vulnerabilities taking into account on-going disaster risk management efforts.

[16] Kundu, 2003
[17] Sarraf, Dasgupta, Roy, & Belle, 2011)
[18] Conducted by the Inter Governmental Panel on Climate Change (IPCC)
[19] IPCC, 2007
[20] Leveraging Urbanisation in South Asia, World Bank Group, 2015

Figure 15: Key Components of the Module



Key Findings

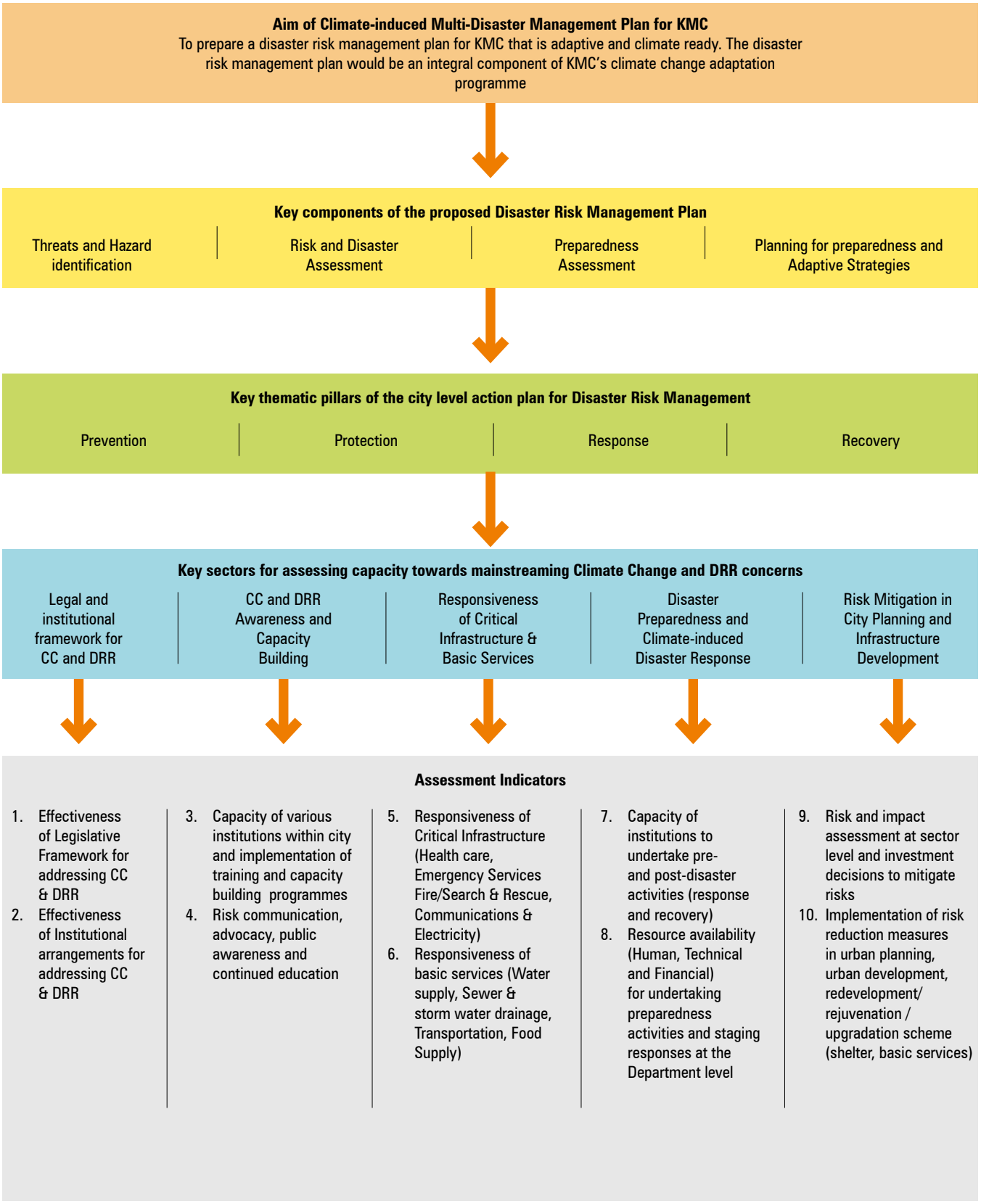
Summarised findings from climate variability and climate change studies indicate the following:

1. Over the last 63 years, instances of daily maximum temperature exceeding 40°C have increased; the highest maximum temperatures are in the pre monsoon season
2. Minimum/ maximum temperatures are projected to rise;
3. Mean annual maximum temperature (31.2°C) is projected to increase by between 1.0-1.6°C by mid-century and by 1.7-3.3°C by end-century.
4. Temperature increase will be more in winter.
5. Excess rainfall once every five years; deficient rainfall once every 6 years;
6. Positive trend in 1-day maximum rainfall (extreme events); extreme rainfall events are expected to increase.
7. Mean annual precipitation is projected to change by between -2.8%-1.0% by mid-century and by between 1.6%-1.7% by the end of the century;
8. Kolkata has experienced over 123 depressions/ cyclones in last 150 years. The number is likely to increase in the future.
9. There has been noticeable land use change from green spaces to impervious surfaces around south/ south-eastern parts of the city.
10. There is evidence of an increase in urban heat islands in these areas.

From these studies, a number of key issues relevant to the preparation of a Disaster Management Plan for Kolkata were identified. They are:

1. The eastern tidal creeks, as well as the River Hooghly, are susceptible to water level variations due to tidal actions. Extreme rainfall, due to tropical cyclonic activity/ depressions in the Bay of Bengal result in excess runoff within the city. The increase in the paved surfaces and the limited carrying capacity of the creeks during high tides, results in localised flooding.
2. The city's topography has low-lying areas. These are easily inundated and require time for the water to drain away. Population increase and a capacity deficit at ward level have led to im-

Figure 16: Framework used for conducting the study



Urban Heat Island Effect

Urban Heat Island Effect is a phenomenon whereby an urban area experiences increased air temperature due to anthropogenic activities, in comparison to its surrounding peri-urban/ rural areas. This results in increase in 'Heat Index' through heat waves and high humidity, delayed winter and monsoon, creation of prominent heat islands and respiratory disorders such as cough, sinus, wheezing breath, upper and lower respiratory symptoms due to increase in traffic congestion, air pollutants and SPM level. ***Heat Index is the apparent temperature that the human body feels when the relative humidity is combined with the air temperature which has important considerations for the human body's comfort***. (National Weather Service- NOAA).

The heat island effect is a measure of both:
a) Mean Radiant temperature (satellite imageries)- It is a measure of the net radiant heat gain and the heat loss by an object or human body which results in the feeling of comfort/ discomfort of human beings. Radiant temperature does not depend on the air temperature.
b) Ambient temperature (measuring temperature of point locations through thermometer) - It is an average air temperature surrounding an object or human body.

(Source- www.radianthomeheating.org

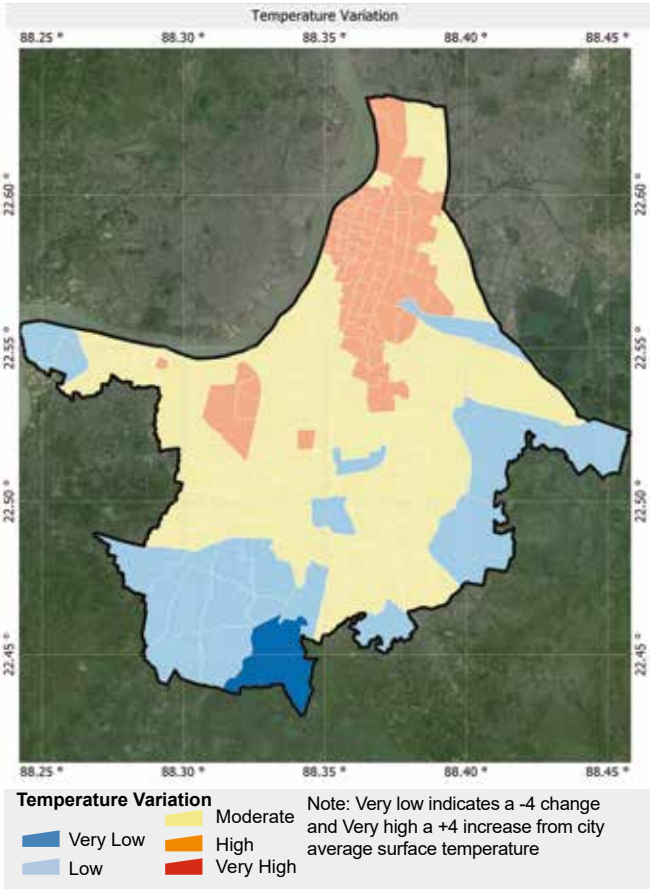
Mitigation Measures – The Roadmap proposed the following measures to combat impacts of urban heat island effect in Kolkata:

Public Health

Development of 'Heat and Health Action Plan' based on the 'Heat-Health Guidelines (2015)' published by WHO and WMO comprising of:

- Compilation of heat and health data.
- Integrated analysis and interpretation of the mortality and morbidity data and development of 'Heat Index'.
- Dissemination of data and advocacy through awareness campaigns and education drives.
- Designing and piloting a Heat and Health Action Plan comprising of formulating a Steering Committee for reviewing the planning and implementation of the Action Plan, assigning an Implementing Department, designing and implementing early warning systems, community education and outreach, etc.

Figure 17: Map of Kolkata showing areas facing the Urban Heat Island Effect



Landscape and Urban Design

- Installing green, cool and reflective roofs.
- Cool pavement (reflective or permeable) which would help in reflecting heat waves and infiltration of the surface runoff.
- Increasing street-side greenery through bio-swales and avenue plantations, walkways, medians and side-walks to lower surface temperature and reduce storm water runoff.
- Sustainable planning practices such as encouraging mixed land uses, compact building design, walkable neighbourhoods, conservation of open spaces and urban farmland, variety of transport choices, and community and stakeholder consultation in decision-making wrt urban planning.

proper land use patterns and the spread of habitation into these low-lying areas.

3. All the underground drains are combined sewers (sewer and storm water). Separate arrangements are required to drain storm water in the event of high precipitation.

4. Most of the city drains are old and were designed to carry lesser volumes of effluent than they are currently required to do. Existing drainage capacities need to be augmented to match demand resulting from rapid population and urban growth. They are often heavily silted, reducing water retention and drainage capacities and increasing time for storm water drainage.

5. The canals and rivers, which receive sewerage/ storm water, are in need of frequent desilting to avoid backwater thrust into the city drains.

6. Most canals, channels and rivers are susceptible to water level variations that occur in the Bay of Bengal. Tidal water enters

Floods in Kolkata

them during high tides/storm surges. Heavy precipitation during these times aggravates drainage problems. The existing system was based on a probable rainfall of 6mm/hour. It is often much more.

7. Kolkata's slums are highly vulnerable to floods and cyclones because of poor construction materials, weak social structures and their vulnerable locations. Some are located in highly vulnerable zones that were previously low-lying wetlands surrounded by vast water bodies into which sewage flows from the city. Squatter settlements on the banks of canals are not only vulnerable, but also spoil the ecological balance of the canals mainly because of dumping waste and eutrophication.

8. There is an urgent need for upgrading the capacity of the city Disaster Management Cell (DMC); city officials realise this urgency and are keen to learn how to strengthen it.

9. Ward level KMC staff need additional training on their responsibilities and procedures required for disaster prevention, mitigation, early warning systems, reporting of incidents and response mechanisms.

10. An Emergency Operation Centre (EOC) control room has been set up within KMC. Necessary technology must be introduced to monitor, predict and coordinate on-the-ground action. Staff needs training and capacity building to be able to perform their roles efficiently.

11. All relevant departments need to be involved in disaster risk planning, prevention and resilience activities. Coordinated/ integrated Emergency Support Functions (ESFs) and standard operating procedures (SOPs) require strengthening.

12. Information on hazard and vulnerability assessments from wards needs to be collated. A 2010 macro assessment may not be sufficient to take preventive steps in wards and a detailed assessment is prescribed. Pilot vulnerability assessments of wards were undertaken under this project.

Vulnerability Assessment

The objective of the Vulnerability Assessment was to assess the specific impact of water-logging and localised flooding on individuals, households and informal business establishments like shops, vendors and street hawkers.

Methodology

- Primary surveys were done in KMC wards 33, 58, 73 and 143.
- Information related to social profiles, economic patterns, means of livelihood, nature of employment, wage day loss due to flooding, access to public service, impact on those services during flooding, physical loss (repair and replacement), and structural and non-structural coping mechanisms adopted by households during flooding were collected.
- In-depth interviews/ focused group discussions were conducted with the community.
- With local representatives, wards were classified into four to five strata buildings stock, access to main roads, water logged areas and economic parameters.

Qualitative information was to be captured through focus group discussions and case studies.

Vulnerability findings

- Economically weaker groups reside in the most flood prone areas, often along the canals or in the floodplains.
- Low-income groups (34% of respondents) are exposed to weeks of waterlogging due to lack of drainage facilities and sewerage backflow.
- More than 25% of the residential buildings have their plinth below the road level.
- Majority of the households in the study area reside in semi-pucca houses (around 74%).
- 78% of high-income households have 2+ working members; it is only 10% among the lowest income category increasing economic vulnerability during natural disaster events.
- The impact of flood/water logging varies across the study wards; in Ward 143 on the fringe of the KMC area 60% had been affected, whilst in Ward 73, only 21 % had been affected.
- Over 33% of the employed population in the study area are daily wagers. They are most at risk of loss of income because of water logging disrupting their daily life. 53% of those surveyed had lost 2 to 21 man-days annually because of water logging.

Livelihood vulnerability from flooding during monsoons
Average loss of 21 working days
Income loss of INR 5250 per year per person

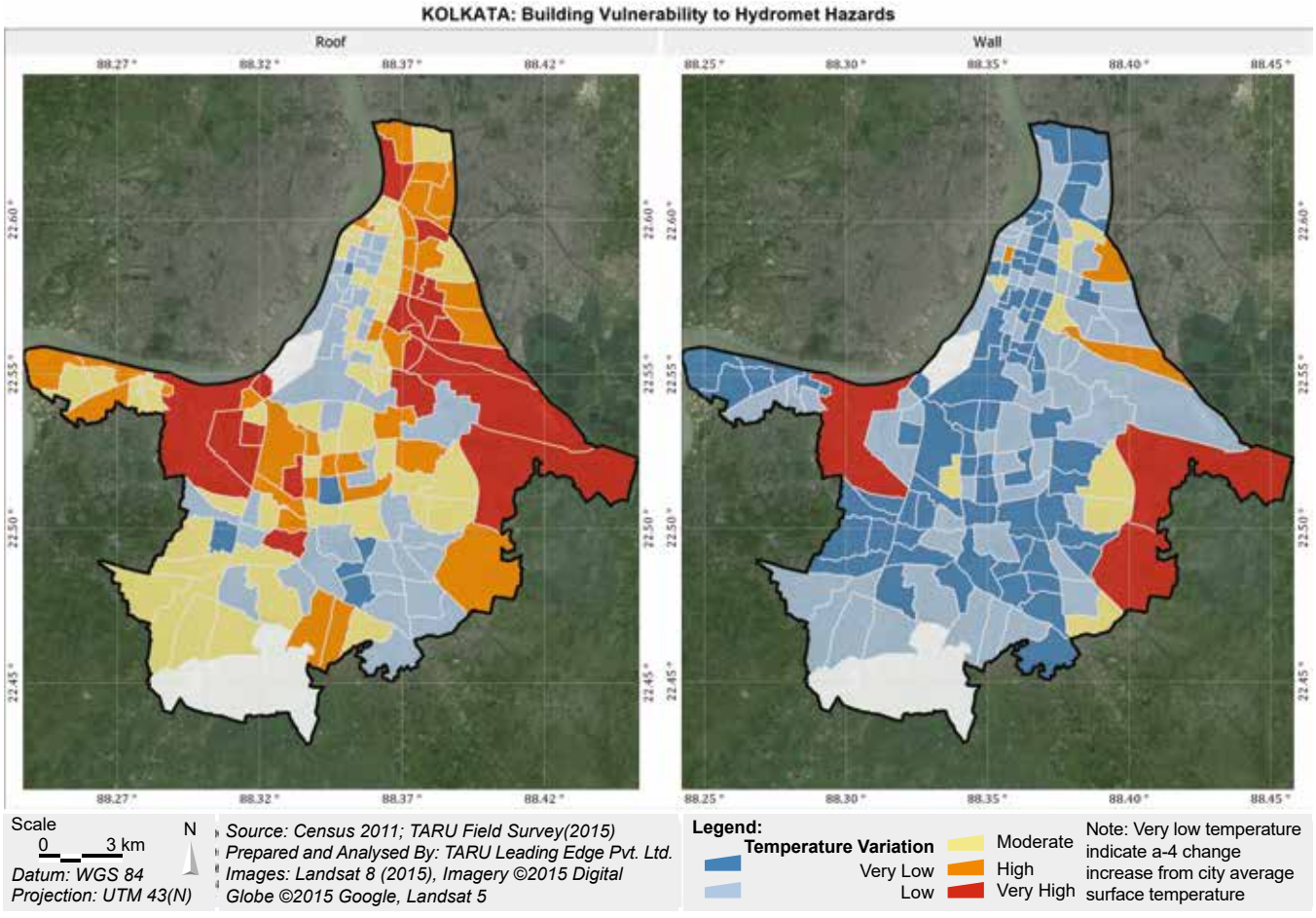
- Losing 21 working days results in an annual income loss of some INR 5250 per year. With minimum assets and resources and low to no savings, loss in income of daily wage earners increases their socio-economic vulnerability.

In late November 2015, whilst this study was being conducted, Chennai experienced an extreme rainfall event (1 in 100 year event) resulting in more than 300 deaths and several hundred thousand people having to be evacuated from their homes. The water level in certain parts of the city was over nine meters, inundating houses and forcing many residents to take shelter on their rooftops. Given the extent of the impact, the state government had to seek the help of the National Disaster Rescue Force to assist them in the rescue and relief operations. The rainfall experienced was more than twice the normal rate. Several states and cities in India have witnessed similar extreme events over the last decade.

Given its location at the top of the Bay of Bengal, Kolkata has experienced similar events in the past, with the most recent being in September 1978. On 28th of September the city witnessed rainfall amounting to 369.6 mm leading to several parts of the city being affected. The climate prognosis for West Bengal indicates that monthly average rainfall will be experienced in just a few weeks or days. This suggests the likelihood of extreme events of a similar magnitude to 1978, or greater, in the future.

Flood simulation results indicate that more than 90% of Kolkata is likely to get flooded in an extreme rainfall event akin to what Chennai witnessed this year. The western, southern and northern parts of the city would be most affected.

Figure 18: Map showing building vulnerability of Kolkata to Hydromet hazards



Source: TARU Analysis 2015

Heavy rainfall accompanied by cyclonic winds and storm may worsen the situation.

To understand the potential impact on Kolkata of an event of a similar magnitude to that experienced in Chennai, several flood and storm surge simulations were conducted. The result of one such simulation is presented in the figure above. The results indicate that more than 90% of the city will be flooded. The most affected regions will be the west, south and northern parts.

Recommendations and Implementation Action Points

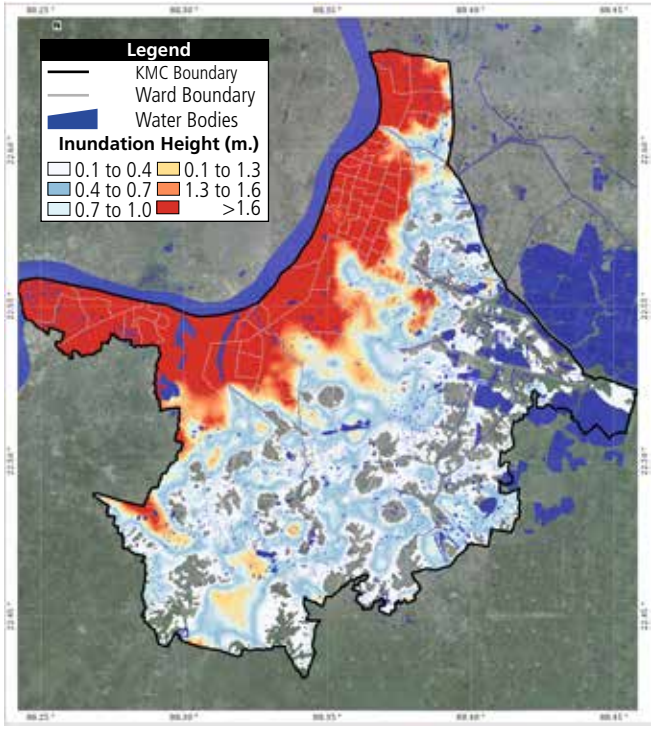
Improved institutional capacity and preparedness: The high density of population and the presence of critical infrastructure will require strategic intervention from KMC to address safety, security, prevention and mitigation of emergencies. In addition, there needs to be an enhancement of preparedness mechanisms by government stakeholders; improved capacity to respond during emergencies; and speeding up the process of stabilisation in a post-disaster situation. KMC happens to be a major stakeholder within the city so will need to ensure that it can upgrade itself from the perspective of Disaster Management.

The KMC is currently implementing several infrastructure projects within the city. In the short term, climate and risk informed planning and strengthening of existing infrastructure to cope with future climate changes will help the city be more resilient to extreme events. The difference between water logging and urban flooding has developed a false sense of security among the residents. Given the current situation, many do not acknowledge the future risks of flooding.

Micro-level data on vulnerability: Systems built to address the day to day stress experienced by the residents will help the corporation built advanced systems for managing shocks (extreme weather events). While many studies have been conducted in the past to analyse the risk at a macro scale (city level) limited risk assessment information is available at micro level (ward level). In the mid-term, sensitisation and realisation of the risks through data & systems, mapping and modelling initiatives at ward level will ensure larger ownership of the disaster risk reduction challenges and initiating coordinated actions on the ground through community involvement.

Ensuring coordinated action: Sensitisation of the members of the urban local bodies on the current threats, future risks and possible loss through an informed modelling approach will help generate more cohesive and coordinated action. In the mid-term, there is a need for the formation of a disaster risk management committee for the city, which should include personnel from all key departments at regional, state and city levels. This should also include members from the research community and ward level councillors to initiate coordinated actions in the areas of planning and risk reduction activities. In addition, as a long-term sustainable measure, the KMC should establish an emergency operation centre with state of the art technology so as to monitor, plan and coordinate disaster response actions at all levels within the city.

Figure 19: Potential Flood Risk in Kolkata based on Chennai's Rainfall (December 2015)



Source: TARU Analysis 2015

Figure 20: Water ATM in Kolkata – useful to minimise heat stress during peak summers

The following broad recommendations/actions are put forward to manage potential disasters within Kolkata. These have been split into short-term (0-2 years), medium-term (2-5 years) and long-term actions (5 years plus). The actions under this module have also been split into those that should be applied across the city and those that are ward specific.

Short-term Action Plan (actions to be completed in 0-2 years)	
DM	**Short-term Actions (Disaster Management)–City-wide**
1	Coordinated and integrated ESFs may be made operational in relevant KMC departments. ESFs and SOPs may be formulated for each department.
2	Staff employed in various KMC departments to combat disasters may require additional training. Municipal employees may be trained in disaster management activities at regular intervals.
3	There could be a Disaster Management Cell within KMC. The Fire Department could be strengthened to address major disasters in addition to fire-fighting activities.
Prime implementing agency: KMC/Fire Department	
4	The State EOC, KMC, the Fire Department and Kolkata Police's DMC may need to improve coordination; a rigorous training regime and 'mock' exercises may need to be established.
Prime implementing agency: City Authorities	
5	Utility infrastructure departments may consider disaster prevention and resilience when designing the layout of their infrastructure networks.
6	KMC data may be made accessible through an online portal. Improved access could lead to better coordination and improved techniques to reduce the risk from disasters.
7	KMC may be allowed to access the State Disaster Response Fund (SDRF) for the procurement of essential search, rescue and evacuation equipment.
Prime implementing agency: KMC unless otherwise stated	
DM	**Short-term Actions (Disaster Management) – Ward Specific**
	User Need Assessments, Training Need Assessments together with Awareness Training and Capacity Building may all require considerable strengthening.
	Ward contour maps that indicate low lying areas that are susceptible to flooding may be prepared. Detailed Preparedness Plans may also be prepared.
	Populations living within a 4-kilometre radius of a specific environmental hazard may be moved or compensated provided.
	Kolkata may need greater awareness of solid waste management issues to prevent blockages in the drains/ drainage system.

Prime implementing agency: KMC

Medium-term (2-5 years) Action Plan	
DM	**Medium-term Actions (Disaster Management)–City-wide**
1	Early warning systems and emergency operation centres may be functional.
2	KMC may increase the number of automated weather monitoring stations and river gauge stations across the city.
3	To prevent tidal backflow, automated tidal flow prevention valves may be installed at locations where the storm water drains/ sewage channels connect with the canals/ river.
4	KMC may review planning byelaws and restrict construction in low-lying areas. It may be made compulsory for plinth levels of all new buildings to be above the highest expected flood level.
5	Treatment of sewage may be undertaken to prevent the flow of untreated sewage into the open drains.
6	Low-income groups may be compensated when water-logging causes loss of income/increased stress. KMC may consider provision of welfare benefits/ subsistence allowances.
7	Effective drainage planning requires coordination for drainage in urban and peri-urban areas. The planning system may need to ensure adequate coordination.
DM	**Medium-term Actions (Disaster Management) – Ward Specific**
	Rainwater harvesting may be made compulsory for all multi-storied buildings.
	Disaster management plan may be made available to councillors, junior engineers and community leaders at the ward level

Prime implementing agency: KMC

Long-term (more than 5 years) Action Plan	
DM	**Long-term Actions (Disaster Management) – City-wide**
1	KMC may upgrade its computerized emergency response activities, through the use of state-of-the-art technology.
2	KMC's proposed Disaster Management Cell may need to ensure that procedures, systems and dedicated human resources are capable of handling all potential disasters.
3	KMC's Building Department may enforce building byelaws for new development. Where feasible, these byelaws may be applied to all old buildings.
4	KMC may identify major arterial roads within/just outside the city limits that can be used as emergency corridors in the event of a disaster.
	KMC may include the results of the new and improved flood modelling results within their building bylaws.

Prime implementing agency: KMC

DM	Long-term Actions (Disaster Management) – Ward Specific
1	Widening of specific roads may be undertaken to provide access for emergency vehicles. Parking and use of road corridor for other commercial activities may be avoided.
2	Structural stormwater management strategies may need strengthening. These may include physical interventions and investment in engineering infrastructure for improved drainage.
3	Ward-level stormwater management measures could encourage preventative action, including behavioural change amongst residents so as to encourage the safe disposal of waste.

Prime implementing agency: KMC

Key Messages and Key Projects

Key Messages

- There may be an enhancement of mechanisms by government stakeholders that ensure 'preparedness'; the improved capacity to respond during emergencies; and acceleration in the process of stabilisation in a post-disaster environment.
- KMC may strengthen its systems and ensure its personnel are full capable of dealing with all disasters. It needs to play a leading role in the city Disaster Management Cell.
- New infrastructure projects need to be 'climate future-proofed' through proper risk-informed planning and design; existing infrastructure needs to be strengthened.
- Sensitisation of the ULB members on current threats, future risks and the potential scale of losses will help generate more cohesive and coordinated action.
- Limited risk assessment information is available at ward level; this needs to be corrected and assessments incorporated into Ward Action Plans. Greater coordination of localised actions can be achieved through community participation.
- The Emergency Operation Centre needs to be equipped with state-of-the-art technology to monitor, plan and coordinate actions that will be required in the event of a natural disaster; EOC manpower to be fully trained and integration with other services (fire, police, army, etc.)
- Outreach through possible integration with the KMC Climate Change Cell, city based Ham radio operators, etc.
- Actions to prevent building or encroachment onto canals/ drainage channels to be enforced and relevant city documentation modified to legalise enforcement measures. Disaster shelters should be identified in city plans and properly maintained.
- Proper and regular maintenance of the city's drainage system needs to be enforced.
- Revision of the LUDCP and master plans and stricter enforcement of regulatory measures for safeguarding natural drainage contours and outfall basins system adopting a trans-municipal basin approach for integrated riverfront development.

Key Projects

1. Smart Information/ communication system (Mobile App) to warn residents of local floods, water logging and heat waves

Objective: 24 to 48 hours warning to people on possible locations that will be affected by heat waves, local floods and water logging. The broader objective is to build city resilience by creating a safe and liveable environment where economic and the loss of human life due to natural events can be prevented.

Key features: design of heat wave forecasting system for Kolkata; design of local water logging modelling system; establish control centre for collation/ processing information; communicating warnings/ advisories to people via (multi-lingual) mobile app and other means, linked to KMC Climate Change Cell

Implementation: KMC, linked to Indian Meteorological Department/ Regional Engineering Institute

2. Tidal back flow prevention system

Objective: installation of reduced pressure zone assemblies to prevent tidal back flow in storm water drainage and sewage system. The broader objective is risk reduction by preventing local flooding and water logging due to tidal effects.

Key features: technical study on the effect of tidal systems on the city's storm water drainage and sewage systems; installation and maintenance of the reduced pressure zone assemblies/ smart sensors at select locations; initial evaluation and implementation of the same across all major outlets which drain into the canals and rivers.

Implementation: KMC in association with West Bengal State Water Resource Department. This needs to be coordinated with the proposed riverfront project indicated in the Land Use section.

Section B2: Preparation of a Strategy and Action Plan to Address Climate-induced Public Health Hazards

In Kolkata, climate change has meant climate variability and volatility, resulting in an increased risk of vector-borne disease (VBD) epidemics. With rising average temperatures and a larger variation in precipitation, increased vector survivability rate, as well as parasite transmission, is becoming more prolific. The situation is likely to deteriorate with there being more pronounced changes in spatio-temporal dynamics and the distribution of vector borne diseases.

Trying to establish a basis to develop an early warning system for diseases like malaria has been complicated. Rainfall serves as an important indicator,[21] but what is also clear is that with changes to the climate, there will be corresponding changes in the distribution, range and occurrence of outbreaks of vector-borne diseases. Similarly, with a rise in local temperatures, there is likely to be an accompanying rise in illnesses and deaths that will occur as a direct result of an increase in severe heat waves.[22]

> "Waterlogging during monsoons breeds a lot of mosquitoes. Health issues such as dengue, malaria and typhoid have been rampant in our area"– *Joba Ora, resident of a low income settlement*

[21] Government of India (2014): National Health Profile 2013 (Jan-Dec), DGHS, Central Bureau of Health Intelligence, Ministry of Health and Family Welfare, New Delhi

[22] G Blashki (2007). 'Climate change and primary health care.' Aust Fam Physician. 2007;36:986–9

Moreover, at the start of every summer, when temperatures start to rise, cities in the region, like Kolkata, typically witness dusty squalls followed by thunderstorms and heavy rains. Though these bring temporary relief from the heat, such climatic conditions create an environment that is conducive to a high incidence, as well as persistence of diseases like diarrhoea and cholera. This is so true of Kolkata, that the city has been historically termed as the 'Cradle of Cholera'[23].

Timely and detailed climate and health vulnerability assessments are required to enable government authorities to practice targeted public health interventions, thereby preventing the potential adverse public health outcomes.

The Task

The current UK-KMC Programme is aware that climate change has an adverse impact upon public health, especially within Kolkata. The current study focuses on developing an understanding of KMC's existing health system and their traditional response to urban public health issues. From this study, options for strengthening KMC's ability to deliver health interventions, based on patterns of disease outbreak, their seasonality and their geo-spatial location can be identified and recommended as part of the Roadmap.

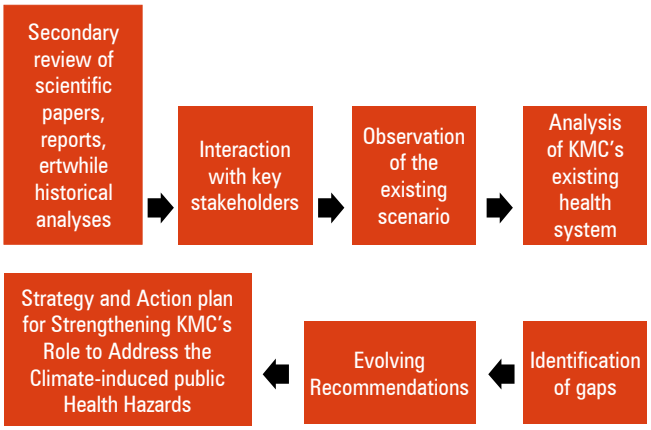
Current Situation in Kolkata

Below is a brief overview of key public health issues in Kolkata that have been identified as part of the UK-KMC Programme.

- The onset of the annual monsoon marks a rise in vector-borne diseases; fluctuations in temperature and excessive humidity are ideal conditions for the proliferation of disease-causing microbes.
- In July 2015, there was a large increase in the incidence of typhoid and gastrointestinal disorders, whilst at the same time the city witnessed a high occurrence of jaundice caused by the hepatitis A and E viruses. At times, the hospital authorities found it difficult to accommodate the large number of patients affected.
- In 2015, dengue fever was identified in different Indian cities, including Kolkata. From January to the end of September, some 170 dengue cases were reported in the KMC area, together with another 250 cases in adjoining KMDA areas including Salt Lake.
- An analysis of IMD data from 2010 to 2014 suggested that between April and May 2014, there were as many as six days when the maximum temperature in Kolkata was recorded between 41.1oC and 41.5oC. This was the first time that the city temperature touched 41oC. The city has recorded three deaths and 20 hospitalisation cases due to heat stress in 2015 (IDSP cell, 2015).
- The response time for vector control activities is difficult, as the life cycle of the vector is often complete before a vector control team can visit an affected area. The deployment of vector control teams in affected areas is impaired due to the lack of appropriately trained human resources.
- Every ward has a public health unit offering free medical services. However, due to demand, ensuring patient privacy is a challenge; this discourages female patients.
- KMC clinics are often overcrowded because the consultation timing is too short. It usually coincides with work timings of the main wage earners (10 am to 2 pm).

[23] U S De, R K Dube and G S Prakasa Rao (2005): 'Extreme Weather Events over India in the last 100 years'. J. Ind. Geophys. Union,, Vol.9, No.3, pp.173-187

Figure 21: Scope of Work and Approach for Public Health



Poor living conditions lead to health-related vulnerability

Key Findings

Service	Issues
Disease prevalence	Most dengue cases occur during the monsoon or in the post-monsoon period: September has the most cases.
Paper system	The current KMC approach to combat vector-borne disease epidemics is too dependent on a reactive manual paper-based surveillance of the outbreak.
Government programmes	KMC's health department has strong ties with programmes like Rashtriya Swasthya Bima Yojana, under which the department has paid insurance premium for about 17,000 low-income families.
Government services	Free dengue detection at five District Detection Centres and free laboratory service in all 144 Wards for vector-borne diseases like malaria. This ensures early and accurate diagnosis of infections and prevents future complications.
Data availability	While historical weather data is available, there is a paucity of historical health data which prevents the development of a conclusive weather-health correlation.
Monitoring and warning mechanisms	As per WHO guidelines, the two main components of a climate-driven disease warning system – disease surveillance and the monitoring of disease risk factors – are in place. However, a review of the existing system suggests the need for the third component in the form of model forecasting.
Infrastructure and Service Delivery Gaps	Addressing existing gaps in Kolkata's public utility (water supply, sewerage, drainage and solid waste management) infrastructure and service levels is critical to achieving sustainable public health results. Specific investment needs have already been identified; the principal challenges ahead relate to the financing of proposed infrastructure and shortages of operational staff.
Grievance Redressal Mechanism (GRM)	Current complaint registration options for utility services constrain systematic complaint profiling; the relay of this to appropriate individuals for action; resolution feedback and response analysis. Community interaction suggests there is a low awareness of the formal complaint registration process.
Quality of Community-level Engagement	Community interaction suggests there is limited public awareness of potential disease prevention measures and of the diagnostic/ treatment options available.
Institutionalisation of Inter-departmental Coordination Practices	Although practices are reportedly working well in some Boroughs, it remains unclear whether they have been taken forward with similar rigour throughout the KMC area.
Timely Health Information Dissemination and Action Planning	The collection and transmission of disease data in paper format before computer entry and reliance upon e-mail and telephone for data transmission post-entry, risks delay and omission in information sharing and inadequate prioritisation or tracking of mitigating action.
Un-assessed Potential for Civil Society and Private Sector Engagement	This could be constraining meaningful partnerships with stakeholders engaged in Kolkata's health sector.

Recommendations

Improved infrastructure and service provision will require:

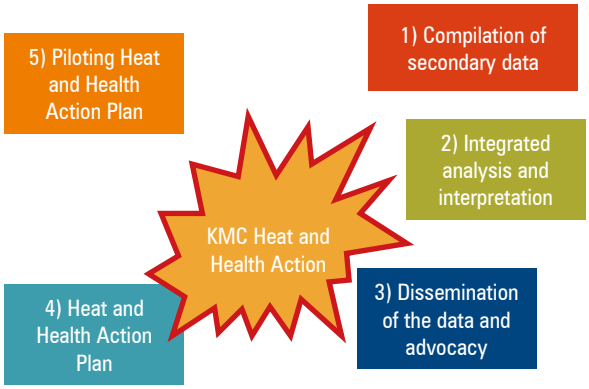
Investment Mobilisation – Given the KMC's current and projected capital expenditure on utility services, there is a case for pursuing other potential financing options, including central and state government programmes and partnerships with elements of the private sector. Investment mobilisation would need to be complemented by internal resource generation and operational efficiencies.

Planning – Area-specific micro-plans for known breeding hotspots may help with necessary preventative interventions and stop the mosquitoes' breeding cycle. Such action plans will ensure that the vector-control teams do not overlook any critical locations during their seven-day checking routine. These micro-plans should be combined to form Ward plans, Borough plans and ultimately one coordinated plan to cover the full KMC area. Such a process will also help to ensure central monitoring of all interventions that are taking place in Kolkata.

Heat and Health Action Plan – The city needs to have at its disposal a Heat and Health Action Plan which will integrate actions

Low-income settlements along canals with vulnerable population

Figure 22: Formulation of Heat and Health Action Plan



Source: UHCRC Analysis, 2015

to combat the impacts of weather variations influenced by climate change and air pollution. The World Health Organisation (WHO) and World Meteorological Organisation (WMO) have published the Heat – Health Guidelines (2015) that can help cities to plan their framework within their boundaries of geography, resource, climatic conditions (and the changes observed over the last few decades), administration, service systems and community specific adaptations.

Grievance Redressal Mechanism (GRM) – A toll-free phone/ text messaging based system that assigns every complaint a unique number, alerts concerned individuals about new and pending complaints, facilitates closure of feedback loops and escalates pending matters, should be implemented to address current gaps.

Data and Information Needs – In order to ensure a strong disease surveillance programme, high-quality disease-specific epidemiological data is required. There will be a need to improve the centralised database so that it can enable a strengthened surveillance system.

Early Warning Systems – Systematic development of a heat wave Early Warning System (EWS) is proven to reduce heat-related health risks to a considerable extent. Such a system provides meteorological and/or climate-prediction-based information on the possibility of imminent hot weather that can have some public health consequences. The information obtained thereon can be used to alert decision-makers as well as health services over and above the general public to activate timely action to minimise the health consequences of hot weather extremes.

Assessment of Manpower Needs – An assessment of manpower needs, using city-specific benchmarks, should be undertaken to ensure that more informed decisions are made and the correct mix of qualified staff are appointed to work for the KMC.

Improved prevention and management of disease outbreaks will require:

Streamlining Health Information Flow – An online system that permits daily entry at Ward level and offers instant updates, alerts and syntheses to nominated individuals could lead to more robust planning and monitoring and the prioritisation of mitigation action. A shift into electronic maintenance of health information is fundamental, with this needing to be initiated at the Ward level, preferably by KMC's health department, in collaboration with KMC's IT department.

Predictive Modelling for Prevention – A scientific modelling and prediction system should be developed. This will be beneficial so as to identify people and places that are more vulnerable to specific health effects that result from climate change. Such a system could also be used to target specific public health interventions to decrease or even prevent outbreaks of disease.

Assessment of Health Sector Manpower Needs – An assessment of the sector's manpower needs could lead to a more informed position and an understanding of the department's actual manpower requirements.

Framework for Civil Society and Private Sector Engagement – Discussions are needed with civil society and the private sector to establish a partnership arrangement with the KMC.

Institutionalisation of Departmental and Inter-utility Coordination Mechanisms – Guidelines are needed to facilitate the institutionalisation of several meaningful practices that have recently been introduced in the KMC.

> "People need to have access to toilets; children and sometimes even adults defecate in the open or along the roadside and the area needs community toilets." – *Shibani Chakrabarty, resident of a low income settlement*

Implementation of the Roadmap

The following actions are recommended to manage public health issues within Kolkata. These have been split into short-term (0-2 years) and medium to long-term actions (2 years plus). In keeping with the split indicated above, actions under this module have been split into two, namely;

- actions that are targeting improved infrastructure and service delivery; and
- actions that are directed at improving KMC's ability to prevent and manage disease outbreaks.

Short-term Action Plan (actions to be completed in 0-2 years)

PH	Short-term Actions (Public Health) – Improved infrastructure/ service delivery
1	KMC may review existing levels of municipal service delivery in line with service level benchmarks stipulated by MoUD, GoI.
2	KMC can identify potential financing agencies to deliver identified investment needs should be undertaken.
3	KMC can develop internal financial and operational efficiency improvement plans for the public health sector.
4	An engagement framework should be developed for working more closely with the private sector.
5	Manpower assessments may be prepared for relevant departments.
6	KMC may introduce an IT-enabled Grievance Response Mechanism (GRM).
7	Area-specific micro-plans within wards to be prepared, with these then combined into Borough plans and one to cover the whole city.
8	A central disease risk reduction master plan should be prepared for monitoring the various area interventions.
9	A Heat and Health Action Plan needs to be prepared for KMC in line with WHO/WMO 2015 guidelines.

PH	Short-term Actions (Public Health) – improved prevention/ outbreak management
1	KMC may develop an IT-enabled Health Management Information System (HMIS).
2	KMC may develop inter-departmental and intra-utility coordination guidelines.
3	KMC may assess operational needs to enable improved community engagement, including increased staffing if appropriate.
4	KMC may develop an engagement framework for civil society and private sector to enable greater coordination between sectors.

Prime implementing agency is KMC in collaboration with the State Health Department

Medium (2-5 years) and Long-term (more than 5 years) Action Plan	
PH	**Medium/ Long-term Actions (Public Health) – improved infrastructure/ service delivery**
1	Negotiation of results frameworks and engagement terms with funding agencies.
2	Anchoring project implementation, monitoring progress and investment outcomes.
3	Ensuring optimal utilisation of the GRM.
4	Engaging with issues revealed by manpower needs assessments.
5	Rolling out financial and operational improvement plans.
PH	**Medium/ Long-term Actions (Public Health) – improved prevention/ outbreak management**
1	Pursuing options for improved community engagement, including additional staffing.
2	Pursue civil society/ private sector engagement.
3	Ensuring inter-departmental coordination in line with envisaged guidelines.
4	Ensuring optimal utilisation of the HMIS.
5	Periodic monitoring to ensure that the vector control activities are being carried out in accordance with the micro-plan.
6	Develop centralised database of key disease prevalence across the city by encouraging all private hospitals and doctors to contribute relevant information.
7	Introduction of predictive models for water borne and vector borne diseases.

Prime implementing agency is KMC in collaboration with the State Health Department

Key Messages

- A sustainable citizen-friendly public health system will be heavily dependant upon the pace that investment can be mobilised for improvements in municipal services.
- Investment required to implement measures for the systematic monitoring and analysis of service quality/ health information; assessing/ addressing staffing constraints to service delivery; and realizing substantive partnerships with civil society and the private sector.
- The city may prepare and implement a Heat and Health Action Plan in line with WHO/WMO 2015 guidelines. Development of a heat wave early warning systems needs to be considered.
- Implementation of the proposed micro-plans can help to break the breeding cycles of disease vectors in all 144 wards. This will help reduce the prevalence of mosquito borne diseases.
- The recommended actions can lead to an improvement in disease surveillance systems, enabled by a comprehensive health database covering all 16 Boroughs.
- A web-based drug and vaccine inventory can facilitate improved arrangements for emergency medicine supply in all KMC's health facilities.
- A move towards electronic health record maintenance at ward level will help to develop an effective monitoring system at all levels, with this enabled by a comprehensive Health Management Information System (HMIS). The HMIS needs to be implemented in the short term.
- A Grievance Redressal Mechanism (GRM) for key urban services such as water supply, sewage and garbage disposal will increase service efficiency, increase user satisfaction and help to reduce the prevalence of disease. The GRM needs to be implemented in the short term.
- Improvements in the quality of health data will help to develop effective prediction models providing an effective climate-induced disease early warning system, including necessary response strategies.

Section B3: Energy Efficiency – Preparation of an Energy Policy and Action Plan for the KMC

As with most Indian cities, Kolkata has grown significantly in recent times and with this urban growth has come a corresponding growth in the demand for KMC's services. This demand has come from increases in the fixed, as well as the floating population and as a result the city's expenditure on the services it provides has increased dramatically, even though this can be partially offset by rising tariffs. The current pressure on the city's infrastructure and service capacities will only increase, especially in consideration of the proposed plans to expand KMC by merging it with neighbouring municipalities – Salt Lake and South Dum Dum municipalities to the north-east and Joka to the south-west.

As a result and assuming that there is no change in modus operandi, the indirect energy consumption of KMC (see adjoining figure), which leads to direct carbon emissions due to the consumption of electricity, can only increase.

During 2013-14, GHG intensity from KMC services has been estimated at 1.41-tCO_2/INR (Lakh) of municipal expend-

iture. This means that for each INR 1Lakh spend by KMC, 1.41 tCO_2emissions is generated.

The Task

Given the above, this element of the programme has sought to identify and incorporate low carbon, energy efficient interventions into the establishments, assets and municipal services that fall under the ownership and management of the KMC and to do this across several sectors including water supply, street lighting, sewerage and buildings. The work covers a variety of elements of KMC's operations as shown in Figure 25, with the approach followed in Figure 26.

Current Situation in Kolkata

Present Consumption of Electricity and Tariff Rates

About 18% of KMC's total expenditure is spent on electricity; energy efficiency has become a necessity.

The electricity tariff applied to the municipality by the Calcutta Electric Supply Corporation's (CESC) tariff structure is equivalent to the tariff applied to industry. According to the proposed 2015-16 tariff structure, the municipal tariff varies from INR 6.38/kWh to INR 6.93/kWh whilst the industrial tariff ranges from INR 6.48/kWh to INR 7.78/kWh.[24] CESC tariffs for municipal services have increased by about 47-48% over the last four years for all major services. While becoming more energy efficient is certainly a way for KMC to reduce their electricity cost, it would also be prudent for them to look at alternate sources of electricity, like renewables, in order to reduce their dependence on CESC and its unfavourable tariff structure.

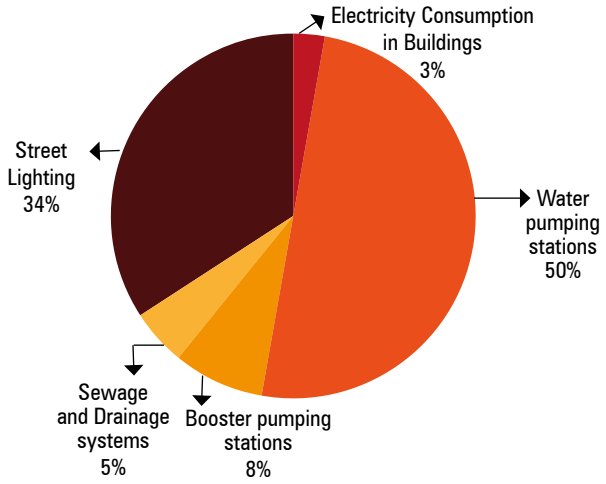
Water Supply Scenario in Kolkata

The Hooghly River and other surface water sources (82.7%)[25] are

[24] https://www.cesc.co.in/wp-content/uploads/tariff/TARIFF%20AND%20ASSOCIATED%20CONDITIONS.pdf

[25] Management of urban water cycle in Kolkata Municipal Corporation – B K Maiti, DG Water Services, Kolkata Municipal Corporation. 31 August 2012

Figure 23: Baseline CO_2 Emissions



Source: KMC electricity bills for 2014 and KMC) Budget

Figure 24: Components of the Energy Policy/Action Plan

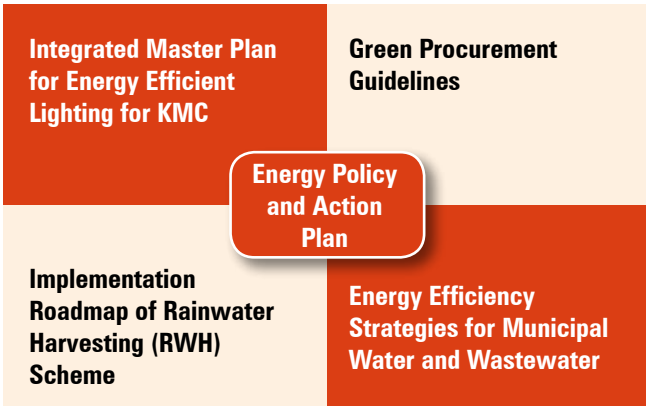
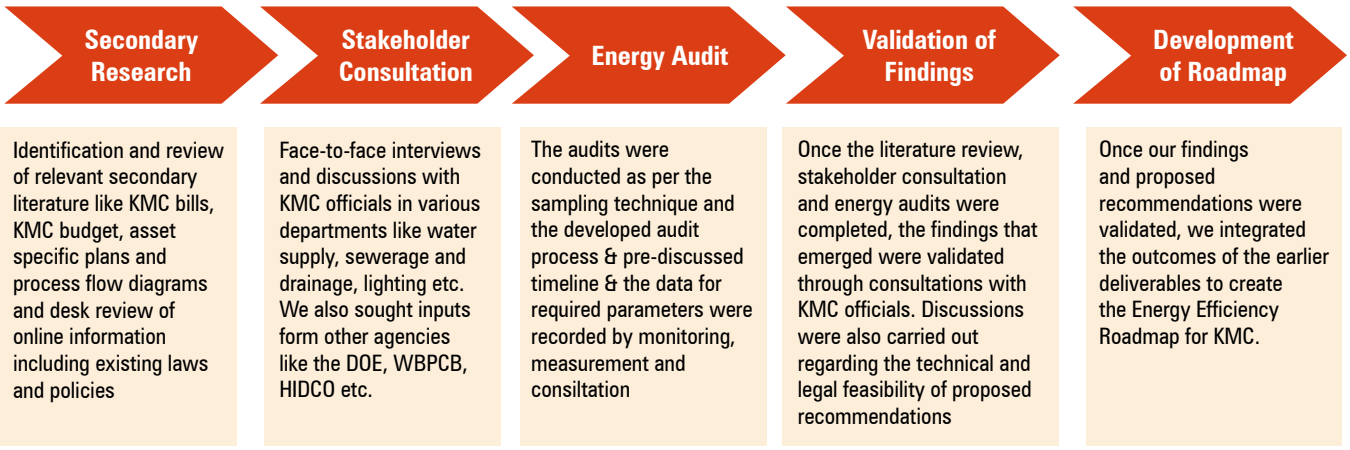


Figure 25: Approach Flow Diagram



53% of the boroughs show a groundwater level decline of 0.13 metres per year or greater

the primary source for municipal water supply with some reliance on ground water. Surface water accounts for 1161 million litres per day (mld) of water supply while ground water accounts for 305.2 mld[26].

Water supply in the city is from three main sources.

- Underground pipeline network which mainly provides water from the major pumping stations
- Roadside public bore wells that KMC has dug
- Innumerable private bore wells installed by residents of residential complexes

Challenges across Key Sectors

Being in the Gangetic delta, availability of surface or ground water is not a major challenge. However, the city does not have enough resources to adequately treat the water or to maintain and manage the distribution system. Currently, the city is witnessing a growth in the real estate sector, which is contributing to a depletion of ground water resources.

Most commercial and residential complexes get their water supply from bore wells, which in turn contributes to ecological vulnerability. As per KMC estimates, 97.46% of distributed water is non-revenue generating and 35% of the water supplied by KMC is unaccounted. ADB's pilot study under KEIP in wards 1 to 6 indicates a 65% water loss in these wards.[27] The water supplied is wasted due to leakages in the worn-out pipes, wastage by consumers, and at public taps and stand posts. Kolkata has around 17,000 stand posts and most of the water that these outlets supply is wasted. However, there is currently no viable alternative, as these stand posts are the only source of water for the poor.

Figure 27 on the following page gives an overview of the various challenges that face KMC's operations in key sectors.

The challenges facing KMC can be classified into four distinct categories (see also Figure 28):

- Behavioural issues;
- Economic issues;
- Operational issues; and
- Policy and Institutional issues.

Recommendations and Implementation of the Roadmap

In order to improve KMC's energy efficiency, it will be necessary for the organisation to implement a broad range of measures designed to tackle the in-built inefficiencies identified in their equipment and systems. However, before these measures can be introduced, one broad recommendation should be implemented, with implementation of three initial actions especially being required.

[26] Source: http://cgwb.gov.in/District_Profile/WestBangal/Kolkata%20Municipal%20Corporation.pdf

[27] Management of urban water cycle in Kolkata Municipal Corporation – B K Maiti, DG Water Services, Kolkata Municipal Corporation. 31 August 2012

Figure 26: Key Challenges for KMC Operations

Street Lights
- Procurement of street lights on the basis of initial investment cost instead of life-cycle costing or total cost of ownership
- Lack of regular cleaning affects efficiency
- Designing of poles and lighting fixtures
- Lamps with lower luminous efficacy

Existing Buildings
- Challenges in installation of central air-conditioning – old buildings, old wiring, etc.
- Behavourial issue - switching off electrical appliances
- Unrated appliances of low energy efficiency
- No solar panels or bio-gas plants installed

Markets
- Old wiring system and mostly non–air conditioned
- Incandescent and CFL lights, usually connected to a common meter
- Rampant un-authorized usage
- Markets devoid of natural light during the day

Procurement
- Energy efficiency is rarely considered as a parameter during procurement of equipment or appliances.

Water and Wastewater Treatment
- High expenditure (19% of annual budget), low cost recovery (18% of the expenditure) - the rest is subsidised
- Old/ inefficient pumps at water pumping and drainage stations
- Low skill level of contracted workers
- Manual operations decreases efficiency
- Rainwater harvesting is not mandated in KMC byelaws for stand-alone buildings or small housing societies
- Absence of water metering leads to rampant wastage

Crematoriums
- KMC's 7 crematorium primarily use electric furnaces
- Thermal insulation of furnaces is not regularly monitored
- Furnaces consume more electricity when idle - in every crematorium two furnaces are always kept 'ready' (idle time) for VIPs

RWH Potential in Kolkata

By considering the average annual rainfall (1,600mm) and the total area of the city which is approximately 200 km^2 the total water harvesting potential can be estimated as 320,000 million litres

The first two of these would be the creation of an Energy Management Cell (EMC) and institutionalising use of the Green Procurement Guidelines. The third major policy level intervention required is to amend the KMC Building Laws in order to include Rainwater Harvesting

Proposed Implementation Approach

In the last five years, the water works, buildings and street lighting systems within KMC were energy audited twice. The first energy audit was conducted under BEE's Municipal DSM programme, whilst the second study was commissioned by KMC and executed by Jadavpur University.

The recommendations made in the first study were accepted by BEE. However, no significant actions recommended by this study have been implemented; the audit findings were never disseminated to key staff. The second study was never completed as the study was suspended midway through its due process.

Figure 27: The Different Issues

Behavioural	Economic Issues	Operational Issues	Policy and Institutional issues
Neglect in switching off lights	Most municipal services are subsidised, hence low cost recovery	Old wiring infrastructure	Functional energy management cell with energy manager
Most of the shops are connected to a main meter and un-authorised connections are very common.	Departmental profit not linked to employee benefits, hence efficiency compromised	Higher lumens of street lights – safety vs energy efficiency	No mandate for RWH in KMC Building laws for old or new buildings less than 20,000 m^2
Rampant theft of lights and fixtures		Phase imbalance in lighting distribution	Procurement policy lacks energy efficiency parameters
Wastage of water since it is free of charge		Congestion in market areas	Absence of water-metering in households
			Lack of energy policy with targets

Figure 28: Potential of Rainwater Harvesting from KMC owned Buildings

Description	Unit	Particulars
Built-up Area of KMC Buildings	m^2	446,725
Assumption (Average number of floors in KMC Buildings)		4
Total Rooftop Area of KMC Buildings	m^2	111,680
Rainfall Kolkata	m	1.64
Run-off Coefficient		0.85
Co-efficient for evaporation, spillage and first flush etc.		0.80
Potential for Rainwater Harvesting in KMC Buildings	m^3	124,620

Source: EY Analysis

Figure 29: Benefits of RWH systems

Benefits of Installing RWH system with storage capacity

1. Rainwater harvesting technologies are simple to install and operate
2. Local people can be easily trained to implement such technologies, and construction materials are also readily available
3. Operating costs are almost negligible
4. Water collected form roof catchments usually is of acceptable quality for domestic chores like washing, gardening etc.
5. Although regional or other local factors can modify the local climatic conditions. rainwater can be a continuous source of water supply especially for the poor.

Benefits of Installing RWH system for artificial recharge

1. Little space is required for recharge structure
2. Cost of recharging is quite lower than the storage and proper maintenance cost at the surface
3. Sub- surface reservoir that is the aquifers can serve the "warehouse" for storing substantial quantity of water
4. Water and the aquifer serve as a distribution system also
5. Recharge allows eco-friendly storage not directly exposed to pollution or evaporation
6. Replenishment of ground water resource enhances sustainable yield from aquifer
7. Quality of water improves through dilution by rainwater

The detailed recommendations under this programme component are indicated below.

Short-term Action Plan (actions to be completed in 0-2 years)	
EE	**Short-term Actions (Energy Efficiency)**
Water Pumping	**Energy efficiency/ conservation through:** • controlling the valve opening at Indira Gandhi Water Treatment Plant (Palta); • running the intake pumps more during high tide; • controlling the valve opening at all pressure stations; and • replacing existing older pumps and older motors; installation of VFDs. *Prime Implementing Agency: KMC Water Supply Department and the proposed KMC Energy Management Cell; ESCO* *Potential savings equate to 15-20%*
Rainwater Harvesting (RWH)	**Promotion of RWH through:** • revision in building byelaws extending the mandate of RWH installations to buildings more than 300 sq.m; • making RWH mandatory in all public buildings; an • provision in Land Use Development Control Plan for installation of RWH in parks and public spaces. *Prime Implementing Agency: KMC Buildings Department and KMDA*
Sewerage	**Energy efficiency/ conservation through:** • improved maintenance of pumps, motors and the pipes. Avoidance of choking by plastics using appropriate nets and their maintenance; • conducting regular energy assessments and audits; and • replacing existing older pumps; replacing existing older motors, installation of VFDs *Prime Implementing Agency: KMC Sewerage and Drainage Department and the proposed KMC Energy Management Cell; Technical providers* *Potential savings equate to 20-40%*
Street-lighting	**A Lighting Master Plan has been prepared. Energy efficiency/ conservation through:** • replacement of inefficient lamps with LEDs; and • rationalising and improving street lighting situation. *Prime Implementing Agency: KMC Lighting Department; proposed KMC Energy Management Cell; ESCO* *Potential savings equate to 30-40%*
Buildings	**Energy efficiency/ conservation through:** • replacement of inefficient lighting fixtures with BEE star rated technology in all KMC buildings; • introduction of occupancy sensors into KMC offices; and • introduction of energy efficient building automation so that energy-consuming devices can be integrated under a centralised monitoring and control system. *Prime Implementing Agency: KMC Lighting and Building Departments; proposed KMC Energy Management Cell; ESCO* *Potential savings equate to 15-30%*
Crematorium	**Energy efficiency/ conservation through:** • monitoring and maintenance of furnaces' thermal insulation to prevent energy losses and improved management of the furnaces allocated for VIPs. *Prime Implementing Agency: KMC Lighting Department; proposed KMC Energy Management Cell* *Potential savings equate to 10-15%*

Therefore, past experiences would indicate that the traditional approach of undertaking an energy audit by a third party, followed by recommendation implementation by the KMC may not be the best approach to implement energy efficiency projects.

Alternative approaches like energy performance contracts (EPC) can be devised. Under an EPC agreement, an Energy Services Company (ESCO) will conduct the energy audit and implement the necessary remedial actions. The ESCO will guarantee the savings and will be paid for its effort as per the conditions of the EPC contract. Energy Efficiency Services Limited (EESL), a public sector undertaking is currently implementing similar energy efficiency projects in ULBs using this EPC mechanism.

Monitoring and Evaluation

The CMFA and EMC (KMC) may act as the internal 'monitoring and evaluation' body. Establishing a monitoring and evaluation (M&E) framework is important in order to assess the implementation process with respect to the targets envisioned, financial resources used and strategies accomplished.

To make the process cost effective, any project with investment of more than INR 10 million should follow the proposed M&E methodology. Projects with investment below INR 10 million can also follow this methodology, although this could be at the discretion of the competent authority. Further, measurable, reportable, and verifiable (MRV) frameworks for mon-

Medium and Long-term (more than 2 years) Action Plan	
EE	**Medium/ Long-term Actions (Energy Efficiency)**
Water Pumping and Sewerage	**Increased energy and operational efficiency through:** • improve system efficiency/ performance based on award of O&M contracts; • improve distribution services through introduction of booster pumping stations to supply water to the areas with low pressure; and • improve operational efficiency through preparation/ implementation of long-term upgrading strategy of technology, including future capacity enhancement. *Prime Implementing Agency: KMC Water Supply and Sewerage & Drainage Departments; proposed KMC Energy Management Cell; private contractor*
Street-lighting	**Increased energy and operational efficiency through:** • adoption of city-wide EE Lighting Plan including replacement of lighting fixtures/ lamps, upgrading infrastructure including wiring/ phase boxes and improved O&M using EESL model. *Prime Implementing Agency: KMC Lighting Department; proposed KMC Energy Management Cell; ESCO*
Buildings	**Increased energy and operational efficiency through:** • introduction of renewable technologies like roof-top Solar PV and RWH in KMC buildings to reduce dependence on conventional energy and to reduce GHG emissions; • introduction of block metering in KMC markets making consumption more transparent; • introduction of centralised air-conditioning systems in KMC offices to achieve efficiencies of 25-30%; and • compliance with the West Bengal Energy Conservation Building Code, 2014 to ensure energy efficiencies introduced into buildings from design stage onwards. *Prime Implementing Agency: KMC Buildings, Lighting and Market Departments; the proposed KMC Energy Management Cell.*

itoring adaptation and mitigation will be established at the beginning of the project and ideally these should comply with the latest International Performance Measurement and Verification Protocol.

Key Messages

- As a contribution to the national objective of climate resilient growth, KMC should target a reduction of about 30% in GHG intensity from the current (2013-14) level of 1.41- tCO_2/INR (in lakh) of municipal expenditure.
- KMC should consider to adopt and implement
  - the Energy Efficient Lighting Plan and improved O&M using EESL model;
  - the Green Procurement Guidelines for effective implementation of the recommendations;
  - the Street-lighting Master Plan; and
  - the phasing out of energy inefficient electro mechanical equipment and their replacement with BEE certified and star rated equipment.
- KMC should consider establishing an internal Energy Management Cell for monitoring interventions.
- The KMC building byelaws need to be amended to ensure inclusion of RWH systems in smaller commercial and residential establishments (reduction of cutoff limit from 20,000 m2 to 300 m^2).
- Block metering should be introduced into all KMC markets to make consumption more accountable.
- KMC should consider compulsory water metering for residential and commercial properties

Section B4: Policy Guidelines for Grid-connected Rooftop Solar Panels

The Ministry of New and Renewable Energy (MNRE), Government of India, has set a target for the country of 40,000MW of power to be generated by means of Rooftop Solar (RTS); West Bengal's contribution to this target is 2,100MW. West Bengal is one of the first States in India to issue a regulation for the promotion and development of RTS; however, progress has been limited with the total RTS capacity in the State standing at about 2MW.

The promotion of RTS in the State is aligned to India's global pledge of reducing GHG emissions and meeting at least 40% of its total electricity requirement from renewable energy and other low-carbon sources by the year 2030. ***Achievement of the 2,100MW target will contribute a 26.39 million tonnes reduction in the CO_2 gas emissions***. Further, this initiative is expected to result in the creation of some ***69,300 full time equivalent employment opportunities*** in the State, many of which will be in the 'green' employment sector.

The development of RTS will have a positive bearing on the transmission and distribution losses of supply companies, as power generated from RTS can be consumed locally. An additional benefit envisaged for distribution utilities would be a reduction in the amount energy that they would need to procure; reduced by the equivalent of the power generated through RTS.

The Task

In this context, the Task, commissioned as part of the UK-KMC Low Carbon and Climate Resilient Programme was to draft Policy Guidelines for Grid-connected Rooftop Solar (RTS) energy

- First-of-its-kind comprehensive and target-driven policy with a detail technical guideline at city level has been recommended
- A scheme has been designed to make rooftop solar popular in the city. institutional producers in Phase I
- Simple web-based process has been proposed for making the scheme user-friendly and hassle free
- With a generation target set at 350 MW for Kolkata (including newly amalgamated Bidhan Nagar MC) by 2022, the scheme is envisaged to attract investment upto 1750 crore which would generate about 6000 direct employment in the solar industry. This will also reduce 402412 tonnes of CO_2 emission on an annual basis

generation for Kolkata, Bidhan Nagar and Rajarhat New Town and to provide recommendations for the implementation of the policy, taking into account the interests of the different stakeholders.

The objectives of the proposed policy were deemed to include the following:

- Promoting rooftop solar power generation for Kolkata and adjoining areas to reduce dependence on coal based power;

Figure 30: Rooftop Solar Panels in Andhra Pradesh

- Harnessing solar power and enhancing its contribution in power generation;
- Contributing to citizen awareness of sustainable energy production and supply;
- Outlining institutional mechanisms for implementation of the grid connected Rooftop Photovoltaic (RTPV); and
- Encouraging core technical competence in professionals in the state to initiate sustainable use and effective management of applications in rooftop solar.

Key Findings

The study reveals the following key observations with respect to the installation of RTS in Kolkata:

- Solar rooftop installation can provide a significant amount of energy to cover in-house loads and can reduce peak energy demand during the day.
- Depending on the rooftop area available, it would be possible to optimise the available solar energy resource of the State;
- The retail tariff for some categories of consumers, such as, domestic, private utilities, etc. will be higher than the Levelised Cost of Energy (LCoE) of RTS; these consumers may not adopt RTS until provided with some form of financial support/ incentive.
- Distribution utility companies must agree to take/ purchase the power generated by RTS;
- A forecasting mechanism must be put in place, so that the utility companies do not face difficulties in maintaining grid stability.

Key Challenges

- Maintaining power grid stability for inclusion of RTS system
- Forecasting of solar power generation for power management of grid
- Proper upgradation of existing grid infrastructure by distribution utilities, considering that grid connected Solar PV is a distributed generation system
- Extensive grid planning
- Ensuring an able grid integration and management system to meet high solar demand

For a successful RTS policy, it is imperative to strike a balance between the interests of the distribution utilities and that of the consumers/ developers implementing the projects.

It is also important to assess the impact of RTS on the Government of West Bengal (GoWB), in the event that financial support needs to be provided by the State Government to either the distribution utilities or to the consumers.

Metering Options

The study analysed various models, with the aim of minimising the financial burden on distribution utilities and State Government, whilst ensuring the viability of RTS for consumers. In this context, different metering options were assessed, including options for 100% gross metering; 100% net metering and a mix of the two.

The assignment also took into consideration proposals for compensation for different categories of consumer by the GoWB, through implementation of a Generation Based Incentive (GBI). The different metering options assessed by this project are shown graphically in Figure 32.

Constraints in the promotion and development of RTS considering both gross and net metering options are shown in the following table.

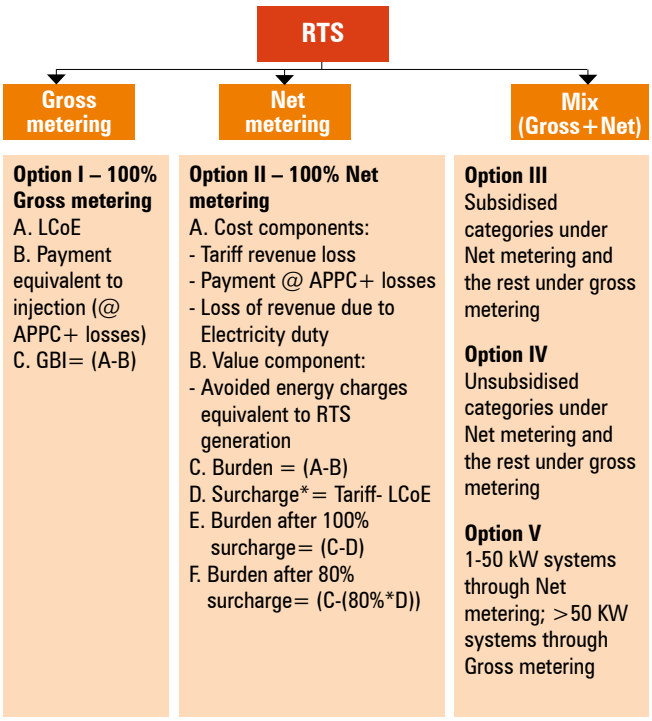
Constraint	Net Metering	Gross metering
Viability of project for the Consumer	• Retail tariff	• GBI
Loss to the distribution	• Tariff revenue loss • Payment for surplus power injection to the grid at the proposed rate of APPC+ losses	–
Burden on the Government	• Electricity duty loss, • Any other support required to support any entity	• GBI

Recommendations

For the successful operation of RTS in Kolkata, various recommendations can be put forward to develop a workable business model. These are indicated below.

- Options for ownership/ operation of the RTS installations include:
  - ➲ owned, operated and maintained by the consumer;
  - ➲ the distribution company can own, operate and maintain large size solar facilities, with power generation also being used for fulfilling their Solar Purchase Obligation (SPO).
  - ➲ owned by consumer and operated by a third party or the utility which in most cases would seem to be the preferred option as many would like to own.

Figure 31: Metering Options



A grid safety net and integration of infrastructure and operating practices for renewable energy interaction in the grid and associated ancillary services.

- State and private distribution companies must agree to purchase the power generated.
- A forecasting mechanism must be in place failing which utilities would face difficulties for maintaining grid stability. All the power plants must be equipped with proper grid stability measures.
- The RTPV systems shall be interconnected with the distribution grid for power banking. RTPV power generation can feed the grid during daytime peak solar power generation and the consumer can draw power during the day.
- An Empowered Committee (EC) needs to be constituted by the Department of Power, GoWB for approval of the RTPV projects.
- The West Bengal Renewable Energy Development Agency (WBREDA) and the West Bengal Green Energy Development Corporation Limited (WBGEDCL) would work as the nodal agencies for RTPV projects in Kolkata, Bidhannagar and New Town.
- Government agencies including the Department of Power, municipal bodies and distribution companies would also be encouraged to directly implement their own projects.
- To avail MNRE incentives or loans for installation of Rooftop

An energy audit survey was done to prepare a DPR for energy neutral parks in Kolkata under this technical assistance programme.

Based on the survey report, under the guidance of the High Powered Committee on Energy and Climate Change, KMC would implement the project for converting 16 short-listed parks into carbon neutral parks by introducing solar energy and LED lighting. This would lead to:

- Total generation in 16 parks = 172kWh
- Estimated energy generated annually = 282,800kWh
- Annual savings at current tariff levels = Rs2.26 million
- Annual CO_2 emissions reduction = 200,000kg

The Department of Power and Department of Environment, Government of West Bengal have agreed to provide financial assistance to implement the project.

Best Practice in India

Presently, 25 States have issued policies/regulations on RTS. Some of these are considered to be progressive States, as their policies appear to be market aligned, targeting quick investment from the outset. Some have preferred mixed metering, while others have made provisions for increased compensation for consumers in relation to the surplus energy injected to the grid.

States where existing policies are based on a mixed model of gross and net metering include Andhra Pradesh (AP), Karnataka, Telangana, Uttar Pradesh.

Policies are emerging in select States which are based on the market forces. Some examples are:

• Andhra Pradesh started with net metering but later made provision for both net and gross metering. The State has revised compensation to consumers. Now based on quantum of surplus power injected into the grid to Average Cost to Serve (ACoS) rather than Average Power Procurement Cost (APPC) based on market requirement.

• Uttarakhand has a high Feed in Tariff (FiT) in the initial years, that attracts quick investment. The FiT has been revised downward subsequently. The state has not linked the allowable capacity of the plant based on the sanctioned load of consumers, which is favourable to the consumers, until the time procurement price is more than LCoE.

• Punjab has net metering and has shown remarkable progress in terms of total installation of RTS. The State has allowed third party and leased based RTS. Further, the energy exported to distribution utility from RTS is set-off against the energy imported from the utility at the approved retail supply tariff applicable to the particular consumer category.

Solar PV Systems, MNRE rules as declared and notified from time to time should be strictly followed. Getting approval from MNRE would not qualify RTPV installers to become automatically eligible for state GBI.

- Authorities in the target could introduce the following to facilitate installation of RTPV systems:
  - ➲ Inclusion of all buildings for installation of RTPV systems, together with new constructions above 15.5 meter height or 3000 sq. ft. shadow free roof area, especially for urban areas
  - ➲ Different types of fiscal incentives in addition to other benefits (for example fast track approval of the building, concession on property tax, etc.)
  - ➲ Additional floor area ratio (FAR)
  - ➲ Permission for installation of shingles and building integrated panels
  - ➲ Introducing benefits to the installers regarding incentives as declared by Urban Department of Govt. of West Bengal from time to time

Proposed Installations

- Rooftop panels - buildings, sheds of new factory facilities and sitting areas in parks and gardens
- Pole top mounted installations - lamp posts to illuminate parks, roads, highways and coastal areas
- Floating solar PV plants - water bodies
- BIPV panels - modern constructions abiding green building norms at flat or pitched roofs, windows, skylights and facades

- Actions required towards or creating an enabling environment for RTS include:
  - ➲ Maintenance of the installed grid connected solar PV Systems
  - ➲ Government intervention to attract potential investors
  - ➲ Quick and hassle free government subsidies and clearance
  - ➲ Extensive public awareness campaign

Implementation of the Roadmap

A phase wise roadmap to fulfil the Rooftop Solar target for West Bengal has been devised entailing focus area, power generation, investment and job opportunities.

Short-term Target (up to 2019)

Focus Area	Generation Target (MW)
KMC, BMC, NKDA	136

Mid-term Target (up to 2022)

Focus Area	Generation Target (MW)	Employment Generation (Manpower)*	Potential Investment (in INR Cr)**
West Bengal (Scenario 1 – MNRE Target)	2,100	35,700	10,500
Within KMC, BMC, NKDA (Scenario II – Realistic approach)	350	5,950	1,750
Rest of Bengal • Smart cities • Industrial parks • WBIDC identified growth centers • Eco tourism facilities	150	2,550	750

Long Term Target (up to 2032)

Focus Area	Generation Target (MW)	Employment Generation (Manpower)*	Potential Investment (in INR Cr) **
West Bengal (including individual buildings and untraded rural areas)	2,500	42,500	12,500

** Considering 17 manpower/ MW of generation*
*** Considering Rs5Cr/ MW investment cost*

A Success Story – Deshapriya Park: Low Carbon Solar PV Street Lights

Introduce non-battery solar street lighting of Deshapriya Park, Kolkata has a number of advantages:

- High power lighting up to 180 watt LED could be used, giving light approximately as good as a 400 watt sodium vapour lamp.
- High illumination level matching with the park's need.
- Highly reliable – streetlights works with grid power during the night.
- No batteries – reducing recurring expenses to almost nil.
- Totally climate responsive.
- No additional infrastructure costs other than solar panels and micro inverter.
- Continuous monitoring of its carbon neutrality possible.

On an average, for the five month period between March and July 2015, the percentage savings in terms of electricity units has been 54%. The savings will be increased in the dry/ winter season. It is estimated that average annual savings will be in the region of 70%.

After observing the performance of Deshapriya Park's battery-less solar streetlights, KMC decided to introduve the concept of solar streetlights into 28 additional parks within Kolkata. DFID is involved in the preparation of the DPR for the project.

Section B5: Strategy for Climate-smart City Mobility

Greater Kolkata's population is projected to reach 23 million by 2030[28]. This increase will put tremendous pressure on the city's utility services and the need to allocate additional land for roads at the potential cost of other means of transport.

The city has been developed historically with a desire to be 'people friendly', focusing on pedestrians (the traditional narrow lanes), on non-motorised transport (hand-pulled and cycle rickshaws) and various modes of public transport, having the country's first metro rail network, whilst Kolkata's historical tram service still operates. However, there is a need to improve reliability of transit services and promote better intermodal connectivity of the public transport network.

Given the projected increase of population, energy demand will also rise significantly. A recent study on 'The Economics of Low Carbon Cities'[29] revealed that the total energy bill of the city in 2014 was INR 169.2 billion, equal to 9.1% of the city's GDP.

The Task

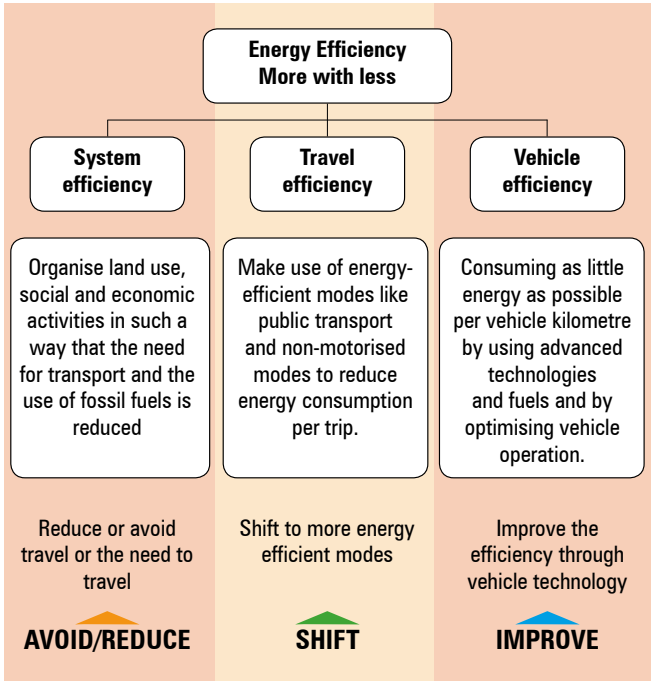
The scope of this module is, therefore, to prepare a strategy with accompanying guidelines for the development of a climate-smart city mobility system in Kolkata.

The strategy will also identify measures for reducing the sector's energy consumption through the introduction of energy efficient traffic operations, which will ultimately make mobility in the city more sustainable and climate friendly.

The task incorporates an understanding of the sector's institutional arrangements. Currently, transport and traffic management are not under KMC's control and multiple stakeholders are involved in trying to keep the city moving, although not always successfully.

Energy-efficient transportation needs to be encouraged on three different levels. There is potential to achieve greater energy efficiency for individual vehicles (vehicle efficiency) and trips (travel efficiency), as well as the whole transport system (system efficiency). Figure 33 below describes the objectives in brief.

Figure 32: Low Carbon and Climate Resilient Strategy for Urban Transport



The approach to low carbon mobility will be undertaken in 4 stages, as follows:

1. Review of how the system currently operates – land use planning, institutionally and the regulatory framework;
2. Develop 'business-as-usual' and alternate scenarios for low carbon mobility (LCM);
3. Prioritise a portfolio of infrastructures and technologies based on scenario assessments; and
4. Prepare policy measures, projects and institutional requirements to achieve LCM.

Alternate LCM scenarios will be developed based on the four strategic development typologies to illustrate the impact of decision-making on future emissions and transport efficiency. These strategic typologies are:

- ***Improving Public Transport*** – including infrastructural improvements such as bus lane reservations and new metro links;

[28] Ministry of Environment and Forests, Government of India (2012) India's Second National Communication to the United Nations Framework on the Convention for Climate Change. Available from <http://unfccc.int/resource/docs/natc/indnc2.pdf>

[29] University of Leeds and Jadavpur University, October 2014

improvements to the location and design of public transport stops; and operational improvements (optimising routes and scheduling).

- ***Improving Non-Motorised Transport (NMT)*** – development of a conducive environment to provide direct, continuous, comfortable, safe and secure movement for all forms of non-motorised transport.
- ***Urban Structure*** – How alternate urban development strategies can help to reduce intra-city trip lengths, decreasing travel times and vehicle emissions.
- ***Technological Changes*** – technological changes are generally determined at the national level; these will be included as an input to the city level scenarios.

The approach taken is comprehensive, using and combining existing instruments (planning, regulatory, economic, information and technology) to attain a balanced policy that produces the most sustainable and energy efficient results, through behavioural and technological changes.

Current Situation in Kolkata

- *Modal Share* – most trips are made by public transport or non-motorised transport, including walking.
- *Land Use Distribution* – The land area dedicated to the transportation sector in the city is a mere 5.4%.
- *Travel Expenditure* – As household income increases, monthly expenditure on transport increases. The percentage of income spent on travel decreases as household income increases.
- *Vehicular Ownership* – The average vehicle ownership rate in KMA is 0.51 vehicles per household.
- *Preferred Mode of Transport* – People with income less than Rs.5000/ month prefer to use buses; those in the Rs.5000-25,000/ month income group prefer to use the metro and auto rickshaws.

Figure 33: One of the stakeholder consultations held at ITPI Kolkata

54% of the total trips are made by various modes of public transport	Guidelines recommend 15% of the urban area should be dedicated to transport	23% households use bicycles; 49% households do not own vehicles	There are 42.6 km of navigable rivers and canals within the city

Kolkata needs to retain and encourage the good mobility practices prevailing in the city:

- Walking behaviour
- High use of public transport/ mass transit systems
- Trams
- Waterways
- Excellent paratransit modes for last mile connectivity

- *Average Trip Length* – 78% of the work trips are less than 5 kilometres; 84% of educational trips are below 3 kilometres.
- *Inland Waterways* – Optimal utilisation of waterways can help to significantly decongest city roads, through use of the river and parts of the inland waterway system for passenger travel as well as freight movement.

Key Findings

Various issues have been identified within the city's current transportation system as explained below.

Service	Issues
Circular Railway Line	The system runs over-capacity as demand is high. There are capacity constraints due to there being only a single railway track.
Metro Railway	The north-south and east-west metro rail corridors pass through highly populated areas; the system lacks the required level of dispersal facilities at stations.
Tram/ LRT	Need for maintenance in order to improve the operational capacity of the system. Better maintenance, provision of a dedicated route and properly delineated stations will encourage more passengers.
Ferry System	Low maintenance of the ferry ghats; safe crossings of the circular railway; and the absence of north-south passenger movement have led to the significant under-utilisation of the inland waterways.
Bus System	Institutional fragmentation in the provision of passenger bus services has led to unorganised and disintegrated city bus services. Old, poorly maintained private buses are a major cause of pollution/ accidents. There is a need for well-designed/ located bus stops and parking shelters.

Service	Issues
Four Wheeler – Private Vehicles	Road widening and construction of flyovers has increased private vehicular traffic. Sufficient land needs to be formally allocated for public parking.
Two Wheeler – Private Vehicles	Increase in the ownership of two wheelers is often a result of inadequate public transportation and the integration of individual networks.
Auto Rickshaw – IPT	The number of auto rickshaws has increased, due to huge demand, although this has led to increased traffic congestion in Kolkata. Shared auto rickshaw routes compete with other public transport modes.
Pedestrians	Lack of adequate pedestrian facilities and encroachment onto most of the existing footpaths by uncontrolled street hawkers forces pedestrians to walk on the roadway, reducing road capacity and potentially increasing accidents.

Recommendations

Following are the potential opportunities that can address the identified issues:

Service	Recommendations
Circular Railway Line	The service would benefit if the circular railway is upgraded to twin tracks and modernised. Intermodal integration can be planned at railway stations.
Metro Railway	Improved pedestrian and NMT infrastructure should be developed to upgrade the overall passenger experience and improve potential for system profitability. Intermodal integration should be encouraged at metro stations, bus stops, auto rickshaw routes, ferry ghats and tram halts.
Tram/ LRT	Trams can be developed as a heritage transport system that would not only conserve the existing system, but could boost tourism revenues.
Ferry System	The provision of passenger dispersal facilities at ferry ghats; the promotion of north-south passenger movement through the waterways; and integration with the internal canal system can help to rejuvenate the whole inland waterways transport system. Intermodal integration is to be encouraged.
Bus System	All the existing bus routes should be integrated under a single transport agency/ authority, improving the quality of bus systems and making the overall transportation system more efficient by the means of intermodal integration. Feasibility assessment to explore options for introducing energy efficient fleet of double decker/ articulated buses and trams (replacing old and polluting fleets), in selected suitable road/transit corridors in the city, for increasing use of public transport and lowering per capita emissions
Four Wheeler – Private Vehicles	An overall on/ off-street parking policy for the city, needs to be developed, inclusive of an increase in smart multi-level parking.
Two Wheeler – Private Vehicles	The majority of two wheeler trips can be transferred to public transport modes if integration among various public transport systems is progressed.
Auto Rickshaw – IPT	Shared auto rickshaw routes can complement public transport systems instead of competing with them. Autoricksaw services need to be rationalised by considering IPT modes under a new formal institutional system.
Non Motorised Transportation (NMT)	Routes to be established for NMT modes to connect to the public transport networks at major hubs such as metro railway stations, ferry ghats, circular railway stations, etc.
Pedestrians	Wider footpaths, dedicated routes and safe pedestrian crossings would decrease the potential for pedestrian accidents as well as encouraging more people to walk. Dependence on motorised modes for short trips will be reduced.

In general, a successful policy mix or package of measures for increasing energy efficiency can be devised to gain travel efficiency, system efficiency and vehicle efficiency.

Implementation of the Roadmap

Short-term Action Plan (actions to be completed in 0-2 years)	
CM	**Short-term Actions (City Mobility)**
1	KMC to prepare an integrated parking policy that demarcates parking supply and introduces dynamic parking charges and covering on/ off-street options. Revenues to go to new Urban Transfer Fund (UTF) or reallocated to make better public transit/ NMT infrastructure.
2	Introduction of a public Bike Sharing System. Transport Department to pilot a scheme, in partnership with a private operator. Operators/ KMC need to identify space for system.
3	Establishment and enforcement of auto fuel quality guidelines and emission standards to lower pollution levels. Vehicle age to be controlled. Penalties to be implemented.
4	Preparation of a NMT Master Plan for the city.
5	Preparation of a plan for intermodal connectivity including full integration of systems.
Prime implementing agency is KMC in collaboration with the State Transport Department and the Traffic Police; as well as private sector.	

Tangible outcomes

1. Parking Policy – Decrease in the use of private vehicles; increase in the parking revenue for UTF; increase mode share of PT and IPT.
2. Introduction of a Public Bike Sharing (PBS) System – Increase

in NMT trips; increase in PT mode share.
3. Stricter enforcement of auto fuel quality guidelines and emission standards – Decrease in carbon emissions (PM2.5 particulate matter).
4. Improving conditions for pedestrians and cyclists – Increase in pedestrian friendly routes through the city; increase in vehicle free cycleways; potential decrease in fatalities.
5. Promoting an Integrated Public Transit System – Increase in PT usage; decrease in pollution/ emissions.

Medium-term Action Plan (actions to be completed in 2-5 years)	
CM	**Medium-term Actions (City Mobility)**
1	Re-organisation of the different taxi services within Kolkata, including the setting grades, fares and services. GoWB needs to establish a Unified Metropolitan Transport Authority (UMTA) and a uniform set of regulations/ standards for the city.
2	Re-organisation of the auto rickshaw services, including establishment of route allocation/ tracking system. KMC/ Traffic Police to design/ designate stands, pickup points and support services. The UMTA to integrate routes with major public transit hubs.
3	Improving conditions for pedestrians and cyclists. Creation of designated 'safe' routes and supporting infrastructure. Routes to remain free of encroachment. KMC to create design guidelines to retrofit the roads for standardised NMT infrastructure. KMC to have a budget for NMT systems.

Prime implementing agency is KMC in collaboration with the State Transport Department, the Traffic Police and the proposed UMTA.

Tangible outcomes

1. Re-organising the taxi services – Increase in IPT mode share; decrease in private vehicles (especially cars).

Figure 34: Bike sharing system

Source: http://www.cyclesharing.in

2. Re-organising the auto rickshaw services – Increase in IPT mode share; decrease in private vehicles (especially 2-wheelers).
3. Improving Conditions of Pedestrians and Cyclists – Increase in NMT trips; potential decrease in road fatalities.

Long-term Action Plan (actions which will take more than 05 years)	
CM	**Long-term Actions (City Mobility)**
1	Implementation of a Congestion Tax in central Kolkata to reduce pollution and city congestion. KMC needs to demarcate an inner area boundary. New technology will be required as will enforcement. The congestion tax to be channelled into the UTF.
2	Promotion of an integrated public transit system. A UMTA should be created to formulate policies for schedules, transfers, routing, fares and information for all forms of public transport. The proposed UTF needs to be controlled by the UMTA to enable revenue sharing and cross subsidisation. A common mobility card should be launched.
3	Adoption of "Compact City" policies for all the new developments. The KMDA should ensure that all new developments of are compact, mixed use, have a reasonable degree of self-sufficiency' are pedestrian/ cyclist focused and have excellent transit connections. The UMTA, with KMDA/ KMC should develop a TOD policy for the city.

Prime implementing agency is KMC in collaboration with KMDA and the State Transport Department

Tangible outcomes

1. Congestion Tax – Reduction in vehicles during peak hours, revenue generation for UTF
2. Promoting an Integrated Public Transit System – Increase in PT mode share, less trip duration; improved experience for users; increase PT usage.
3. Adoption of 'compact city planning policies for all the new developments (focus on walking and transit oriented development) – Decrease the number of trips and trip lengths; increase coordination between all State Departments.

All the above recommendations/ actions have been provided in order to plan and implement a climate-smart city mobility system in Kolkata. To achieve this, the recommendations are based on three levels of climate smart interventions, namely:

- individual vehicles (vehicle efficiency);
- trips (travel efficiency); as well as
- the whole transport system (system efficiency).

This is a comprehensive approach, which uses and combines existing strategies so as to reach the optimum results in terms of

Road pricing in Singapore: In 1975, the year of the first road pricing scheme, the proportion of people using public transport to travel to work in the city was 46%. In 1998 it was 67%. Thus, there was a successful shift towards more energy efficient modes of transport and the travel efficiency of Singapore's transport system was significantly improved

sustainability and energy efficiency. The strategies used can be classified into four categories, namely:

- Planning strategies;
- Regulatory strategies;
- Economic strategies; and
- Technological instruments.

The approach is not prescriptive and will promote a transport mode only if this promotion suits the vision and goals pursued. Figure 36 illustrates the likely impact of the different strategies upon the three levels of climate-smart interventions indicated above.

Figure 35: Strategy Recommendations

Planning Strategies	System Efficiency	Travel Efficiency	Vehicle Efficiency
Compact City Policies	###	###	
Improving the conditions of pedestrians and cyclists		##	##
Promoting Integrated Public Transit System	##	##	
Regulatory Strategies			
Parking Policy	#	##	
Enforcement of auto fuel quality and emission standards	##		
Organizing Taxi Services	##	#-##	
Re-organisation of Auto Rickshaw Services	##	##-###	
Economic Strategy			
Congestion Tax	#-##	##	#
Technology Strategy			
Introduction of Public Bike Sharing System	###	##-###	

 # =Small contribution
= Medium contribution
= High contribution

Key Messages

- The transport sector in Kolkata needs to target a reduction in energy consumption and a reduction in congestion and emissions, whilst increasing trips by non-motorised and public transit modes.
- The future of the sector should be based on the principles of Avoid (unnecessary travel), Shift (from private motorised to public motorised mass rapid transit/ non-motorised transport) and Improve/ Create (public transport service quality; inter-transport mode connectivity; clean fuel usage/ promotion of alternative fuels (electric vehicles); safety and walking comfort on pedestrian walkways, designated bicycle tracks; etc.)
- A unified and simplified administrative/ regulatory body (UMTA) should be established for the advancement of a fully integrated public transport system in the city covering all existing networks – suburban rail, metro rail, circular rail, BRTS, water surface transport, trams, shared cycling and others that may in the future be promoted/ established.
- The city must upgrade its services so as to create a 'popular' public transport system – improving ride comfort, frequency, punctuality and predictability (smart transport app is recommended), safety and affordability.
- The city needs to investigate and establish the concept and principles of transit-oriented development (TOD), through formulation of a TOD policy, designed to encourage mixed-use development at transport hubs to reduce journeys by private vehicles. TOD will need to be supported by improved pedestrian/ cycling facilities to encourage journeys by these modes, especially for short trips.
- The city will need to introduce and enforce payment by motorists for specific services including increased parking charges and taxes for congestion/ polluting vehicles. Congestion tax in longer term could be channelled into proposed Urban Transport Fund (UTF) – to enable revenue sharing and cross subsidisation.
- Introduction of common mobility card is proposed.
- Creation of designated 'safe routes' for NMT, creation of design guidelines to retrofit roads with standardised NMT infrastructure is recommended.
- The city could initiate promotion of car free days and slowly make it a weekly/monthly feature

Section B6: Policy for Climate-smart Built Environment

The building sector accounts for, at least, one-third of all energy related CO_2 emissions worldwide. Enhancing resource (input) efficiency by reducing water and energy usage in this sector can be an effective move towards addressing issues linked to climate change. At present, the building and construction industry is one of the largest economic activities in India. It is estimated that built space in the country will increase 5-fold from 20,000 million ft2 in the year 2005 to over 100,000 million ft2 by 2030. This growth will put enormous pressure on various resources such as energy; water; materials; and it will have a discernible impact on the environment.

Figure 36: Operational benefits of a Green Building

- 50-70% reduction in the cost of energy
- 40% reduction in the use of potable water
- 100% wastewater treatment in line with tertiary standards
- Boost to the local economy (materials and products to be procured within a limited radius of the site
- Higher productivity/ improved quality of life
- Provision of energy security in mission critical applications
- Significant reduction in the emission of greenhouse gases

Faced with an increasing scarcity of resources, the construction sub-sector, which has a significant impact on the viability of the sector as a whole, needs to find alternative ways of operating for having a sustainable future. A paradigm shift towards the construction of 'green buildings' is one of the alternative way forward.

'Green Building' is one of the best solutions to restrict the on-going depletion of resources through a reduction in the use of water, the optimisation of energy usage, the conservation of scarce natural resources, the generation of less waste and the opportunity to create healthier living spaces for the occupants. Up to 2013, India had over 2,007 green buildings with a footprint of over 1.4 billion ft2. At the same time Kolkata had a green building footprint of over 26 million ft2. Both these figures are expected to grow.

Rooftop and vertical gardens are often associated with green buildings. Rooftop gardens can be efficient measures to incorporate into new or existing developments. Rooftops gardens help mitigate the negative impacts of cities on the environment, by conserving energy and water; improving air and water quality; assisting in storm water management; absorbing solar radiation; becoming a source of local food production; and providing habitat restoration. Green walls are not only a significant architectural feature, but also contribute to reduction in the local urban heat islands.

Figure 38: Rooftop Garden

The Task

The development authorities have been debating the issue of 'Green Buildings' in Kolkata for some time, so the timing of the UK-KMC Programme seemed an appropriate opportunity to contribute to this debate and develop relevant policies and guidelines that could be considered by KMC in order to promote a 'Climate-smart Built Environment' in the city. Work areas that were a part of the task are shown in Figure 40 (*opposite page*).

Figure 37: Salient features of a Green Building

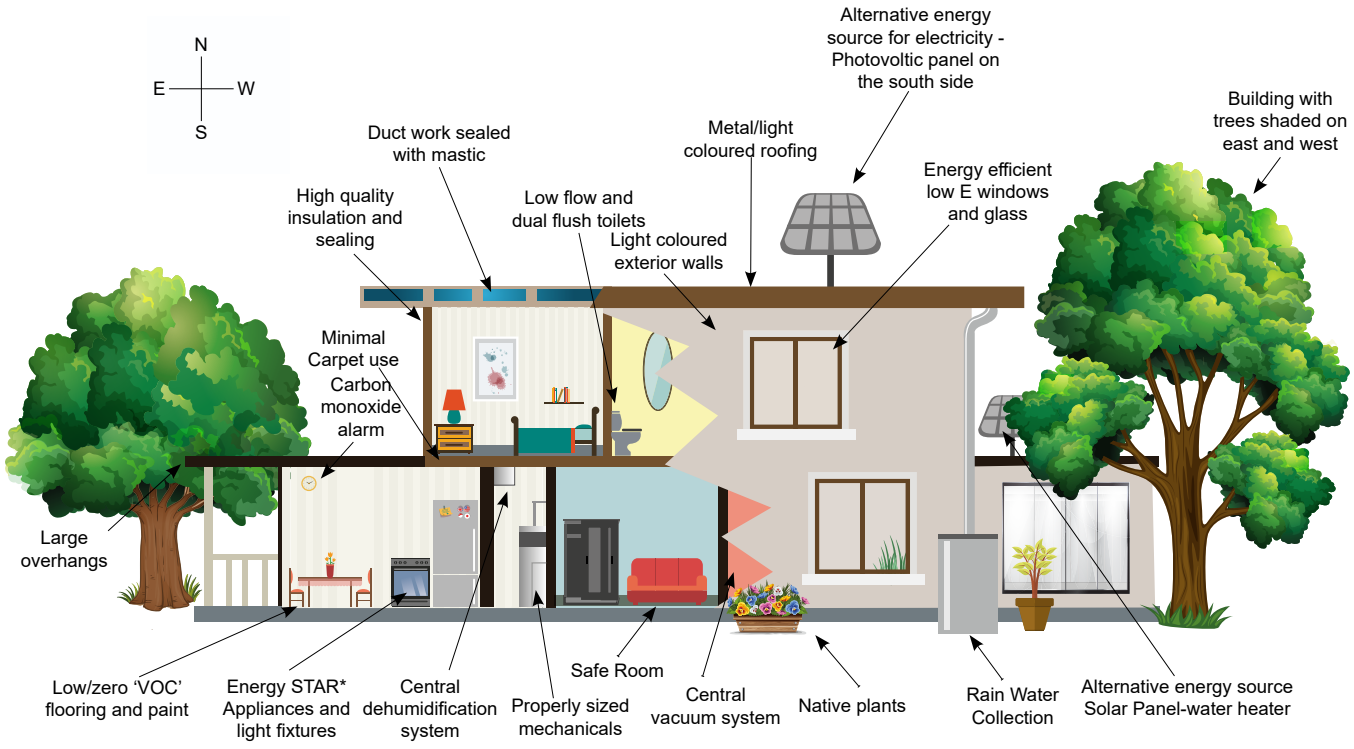
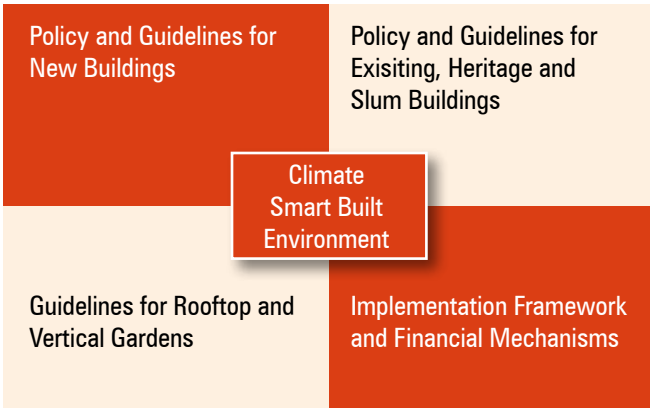


Figure 39: Components of the Built Environment Module



Relevant Policies:
- National Mission on Sustainable Habitat
- Building Byelaws for solar water heating systems, rainwater harvesting systems, etc.

Green Building Rating Systems:
- IGBC rating system (CII)
- GRIHA (TERI)
- BREEAM (UK accreditation system)
- LEED (Leadership in Energy and Environmental Design): created by US Green
- Building Council

Stakeholder's Comments on Green Building Guidelines
- It is required to develop user-friendly guidelines accompanied by a robust implementation and monitoring framework.
- The entire concept of green buildings should be tested as a pilot project in one of the wards of KMC and once learnings are gained, it could then be replicated in other wards.
- Fiscal instruments such as a Green Building cess/ other fiscal instruments need to be explored.

For New Construction
- The State Guidelines are in line with IGBC and GRIHA guidelines.

For Existing Construction
- There lies lot of potential of Going Green in existing buildings of Kolkata. To promote the same, an incentive programme for Existing Building is not available.

Rooftop & Vertical Garden
- Rooftop & Vertical Gardens are a feasible option for Kolkata although, there is potential for increased energy usage from dehumidification of the area; indigenous plants should be used.

Overall
- There lies no robust monitoring mechanism and technical capacity for Green Buildings in Kolkata.

The task was divided into two stages. First, a review was undertaken of the different systems that are being used both in India and internationally to guide and control the development of green buildings. This included a review of existing green building certification systems such as LEED, BREEAM from abroad and local systems such as IGBC and GRIHA, which are local rating systems.

Other issues of relevance were also reviewed including:
- existing byelaws, building rules and 'green building' guidelines;
- views and requirements of major sector stakeholders;
- Potential for developing rooftop gardens and vertical gardens to reduce urban heat islands within the city;
- feasibility for using renewable energy options for the city and within individual buildings;
- existing patterns of construction and materials usage; and
- necessary variations for new and existing buildings, heritage structures, old habitats, slums and the pattern of development in the city's core area.

The second stage was to develop relevant policies and guidelines for different buildings within the city. Given the need for consensus and 'buy-in' from both the public and private sectors, these draft recommendations were discussed with the stakeholders to ensure agreement.

Key Findings

For existing buildings, key findings were that:
- LEED and IGBC are the only two rating systems that were used in India for the green certification of existing buildings. Therefore, both rating systems could be used for the purpose of developing 'Green Building' guidelines for KMC (covering all types of buildings including the special cases of slums and heritage buildings).
- There are no incentive programmes for existing buildings that have the potential to be adapted to 'Green Building' guidelines.

Observations with regard to Rooftop and Vertical Gardens indicate that their introduction could lead to the following:
- The city's green leaf index might escalate significantly.
- Due to the high water table and water logging, terrace or rooftop gardens will reduce the run-off from terraces and further help reduce the water logging in local areas.
- There will be a general reduction in area 'glare' due to rooftop greenery and comfort lux levels might be optimised.
- There will be a reduction in air pollution in the surrounding area due to the presence of increased moisture.
- Traditional terrace gardens using soil may increase energy consumption due to increased AC energy load required for the dehumidification of the area. However this can be mitigated by use of soil-free and damp-proof technology such as hydroponics.

Recommendations

Recommendations for the development of a 'Climate-smart

Built Environment in Kolkata includes the following:

- Green building guidelines (for new construction and existing buildings) should be in line with IGBC and/ or GRIHA.
- Use of native plants for rooftop/ vertical gardens should be part of the recommended guidelines.
- Capacity building programmes need to be introduced to inform stakeholders.
- There should be a robust monitoring mechanism in place for the implementation of the green building guidelines. This should initially be run either by:
  - An in-house Green Building Cell within KMC; or
  - Empanel an external Green Building consultancy firm.
- A Green Building Fund (GBF) should be developed within KMC with this supporting a green building awareness campaign in the city, along with other promotions run by organisations such as IGBC's Kolkata Chapter.
- Banks should be encouraged to provide loans at lower rates to homeowners who plan to construct and/ or live in a green building, irrespective of any certification (KMC Guidelines, GRIHA, IGBC, or LEED).
- Green Building guidelines should include suitable provisions for slums encouraging measures such as:
  - Improved cooking stoves for better indoor air quality;
  - Rainwater harvesting measures for both roof and non-roof areas;
  - Multi-storied affordable housing schemes should try to incorporate provisions for in-house sanitation facilities, on-site wastewater treatment systems and decentralised waste management systems;
  - Use of innovative solutions for harnessing daylight using solar domes; and
  - Use of energy efficient appliances through relevant government schemes.

Implementation of the Roadmap

Short-term Action Plan (actions to be completed in 0-1 year)		
BE		**Short-term Actions (Built Environment)**
Finalisation of the Green Building Guidelines (0-6 months)	1	KMC to adapt draft green building and rooftop/ vertical garden guidelines.
	2	The implementation mechanism to be used with the guidelines to be finalised – the implementation plan needs to be agreed and the implementation strategy fully devised.
	3	Development of the Green Building Fund to support KMC with this initiative.
	4	When the strategy and the fund are operational, implement an awareness campaign to inform the public of the new guidelines.

BE		**Short-term Actions (Built Environment)**
Institutional Strengthening – Implementation of the Green Building Guidelines (6 – 12 months)	1	**Create a Green Building Cell (GBC) in KMC** – This should support the implementation and monitoring of the proposed green building guidelines. There are two options: • Short-term option– a GBC to be created staffed with external experts to provide initial 'handholding' and 'on-the-job' training for the nominated KMC team to be appointed during this initial period. This cell will be temporary in nature; it should only be operational for a short period of time, say 2 years. The technical experts will have to be engaged temporarily, either directly by KMC or through a technical assistance contract with a funding agency. • Long-term option– Create a permanent GBC cell, which employs external technical experts, to implement this programme. This cell will be a permanent feature within KMC.
	2	**Capacity building/ training of KMC officials** – Training programmes on implementation and monitoring mechanisms to be organised for KMC officials.
	3	**Develop infrastructure within KMC** – Suitable infrastructure and accompanying systems need to be developed within KMC to support implementation of the green building guidelines. This includes developing portals for reporting, relevant monitoring tools, database management systems, etc.
	4	**Initial Start-up** – It is recommended that in the first instance KMC should empanel expert third party agencies to support them in the implementation and monitoring of the green building guidelines.
Prime implementing agency is KMC in collaboration with the State Municipal Affairs and Urban Development Departments		

Medium (2-5 years) and Long-term (more than 5 years) Action Plan		
A two-phase strategy for implementation of Green Building guidelines in KMC area is proposed for the medium to long-term.		
BE		**Medium/ Long-term Actions (Built Environment)**
Phase I	1	KMC should initiate guideline implementation in a small pilot area. This would allow KMC to develop its in-house capacity. Once capacity is upgraded, the pilot can be expanded to cover the whole city.
Phase II	2	To devise a long-term strategy for large-scale implementation of guidelines in the KMC area.

Prime implementing agency is KMC in collaboration with the State Municipal Affairs and Urban Development Departments

Key Messages

The key messages that emanate from this module are indicated below.

- Rooftop and vertical gardens will improve the local green index and contribute to a reduction in local heat islands. The use of native plants should be encouraged to help with water conservation.
- Capacity building programmes need to be introduced to educate the stakeholders so as to maintain the integrity of the green buildings concept before, during and post construction. Relevant information needs to be disseminated to all stakeholders (Government officials, builders/ developers, occupants etc.)
- A Green Building Fund needs to be established within KMC to support green building activities. It should be separate from other allocated budgets and so fund a green building awareness campaign in the city.

Section B7: Preparation of a Climate-smart Solid Waste Management Strategy

Kolkata is the largest urban area in Eastern India. It is a city that has grown rapidly in recent years, attracting large numbers of people from rural areas and neighbouring states to migrate to the city. With a city population of some 4.5 million residents and an overall conurbation size approaching 15 million, Kolkata is the third-most populous metropolitan area in the country. Apart from increased pollution levels, traffic congestion, rising poverty and other socio-economic problems, the rapid pace of urbanisation has been posing a huge solid waste challenge for the city.

Estimates suggest that around 1.3 million tons of unsegregated solid waste is deposited daily (2014[30]) into the city's only waste facility, the already saturated Dhapa landfill site. An estimated 4.3 million m^3 of landfill gas[31] (CH_4 & CO_2) is generated every year from anaerobic digestion of the biodegradable waste in the area. The contribution to global warming from the ***Dhapa landfill site is estimated at approximately 250,000 tons CO_2 equivalent for the period 2013-2022***[32].

The city also generates large quantities of non-biodegradable waste every day. This often remains in the environment for extended periods, incrementally adding to overall pollution levels and often creating public health hazards through indiscriminate methods of disposal such as open burning or blocking storm water drains.

[30] Dhapa Dumpsite Environmental And Social Assessment Report, February 2014

[31] Dhapa Dumpsite Environmental And Social Assessment Report, February 2014

[32] Assuming 1:1 proportion of methane and carbon di-oxide in landfill gas, and considering GHG potential of methane as 20-25 times higher than carbon di-oxide

The Municipal Landfill Site at Dhapa

The Task

The specific objective of this element of the programme was to provide technical assistance to KMC to prepare a strategy for climate-smart solid waste management in Kolkata and to integrate this strategy with existing policies within KMC and the State Government. Work was required to cover a number of issues, once a thorough review of KMC's current practices had been completed and analysed. The primary work components are shown opposite in Figure 41.

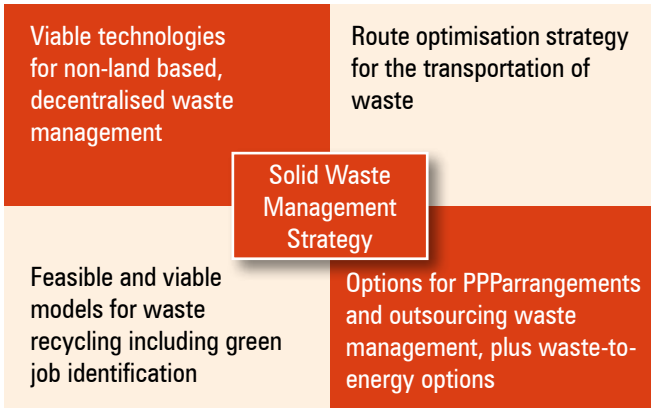
Current Situation

In total, the city generates approximately 4,500 MT of solid waste per day, with this figure including waste generated by the floating population. Bio-degradable waste is close to 51% of the total, whilst non-biodegradable waste, consisting of plastics, metals, inerts, rubber, paper, etc. constitutes the balance.

Some characteristics of the current KMC system are indicated below.

- *Source segregation* – There is no source segregation.
- *Primary collection from household and market* – 100% collection from households by sweeper/ KMC workers.
- *Rag-pickers* – They collect waste that is high in the value chain

Figure 40: The Solid Waste Management Module



Amount of solid waste generated approximately 4,500 MT/day (includes floating population)

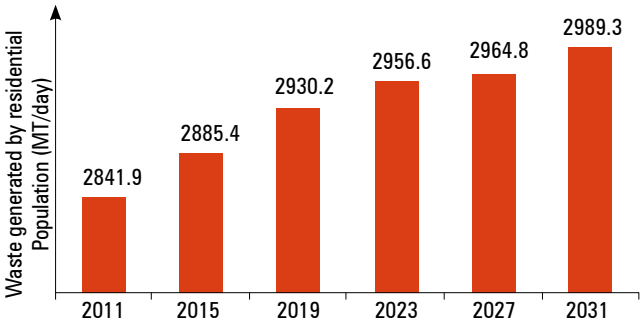
On analysis of the city's solid waste the average calorific value was found out to be high.

from the mixed waste stream. Non-biodegradable waste goes to landfill without segregation.

- *Secondary collection point* – There are 662 secondary collection points; 42 of these are compactor stations and the rest are open dump sites.
- *Transportation* – 70% of the total waste collected is transported by private vehicles, although some are KMC owned or leased.
- *Landfill* – Due to inadequate recycling/ treatment, most of the waste is taken to the already saturated landfill site at Dhapa.

The expected increase in domestic waste over the next 15 years is shown below in Figure 42.

Figure 41: Past Trends and Future Projection of Solid Waste in Kolkata



Key Findings

- Lack of source segregation during collection of solid waste;
- Absence of formalised associations for the rag-pickers, despite their large contribution in the plastic recycling value chain;
- Lack of decentralised solid waste management (SWM); all the collected waste sent to the landfill site, increasing emissions due to transportation;
- Deposition of unsegregated solid waste in almost saturated Dhapa landfill;
- Lack of enforcement of existing ban on usage of plastics of thickness below 40 microns;
- Rampant littering, blocking the sewerage system, resulting in flooding during the rainy season;

Key Challenges in SWM

- Lack of awareness for source segregation
- Lack of formalised rag-pickers association
- Lack of decentralised solid waste management system
- Lack of treatment and recycling making waste collection going to landfill
- Outdated, informal recycling units

ULBs such as Asansol and Durgapur have banned plastic bags below 40 microns thickness and size 12"x16"; levied penalty as 'Pollution Cost' for unauthorised usage

- Unregistered units manufacturing polybags: have trade license but no Consent to Operate;
- Illegal plastic recycling units using out-dated technology which emit GHG pollutants;
- Lack of integration in enforcement functions. Different agencies responsible for the enforcement of SWM rules, LUDCP guidelines and the pollution parameters governing SWM in Kolkata.
- Lack of integration in guidelines/ functions of departments.

Recommendations

The recommendations for an improved solid waste management system focus on the creation of decentralised clusters, which are based upon the mechanisms of collection, transportation and disposal and recycling. The map shown in Figure 43 indicates the clusters that are being proposed within KMC.

Collection: Solid waste is proposed to be collected from different facilities based on typology of use, for example residential, commercial, and institutional buildings, as well as markets. Wet waste should be collected on a daily basis by KMC, with dry waste being collected once a week by private operators. Suitable user fees may be considered for this service wherein waste would only be collected if properly segregated by conservancy mazdoors against SWM collection coupons.

A rapid willingness to pay survey by EY suggests a flat fee of approximately INR 20 per month[33] could be proposed, with commercial establishments paying their user fee as a component of their trade license renewal, whereas institutional facilities could have their charge included as a component of the property tax, based on an unit area assessment system.

Street-sweeping waste is to be collected daily by KMC; its segregation can be undertaken in the upper floors or side areas of planned compactor stations. The bin liners collected separately by conservancy mazdoors can be stored here before onward transmission for recycling.

Transportation: To facilitate a decentralised system, KMC has been divided into four clusters (see Figure 43).

- North East Cluster (Wards east of CIT Road from Ultadanga to Beliaghata);

[33] As estimated through willingness to pay survey

- South East Cluster (Wards to the east of Subodh Mallick Road and the crossing of Prince Anwar Shah Connector to Garia Bus Stand and south of P.A Shah Road Connector and the By-pass Crossing);
- South West Cluster (Wards south of Biren Roy Road East and west of Tolly Nala)
- North Central Cluster (remaining Wards).

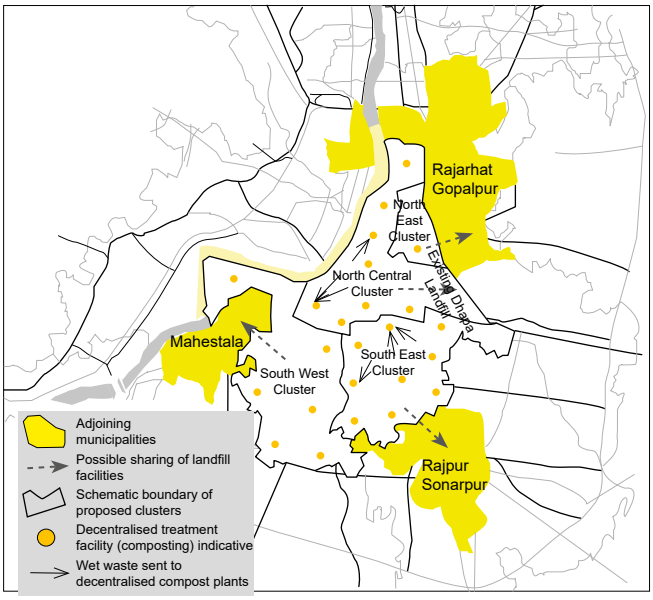
The first three clusters will require the identification of an appropriate landfill site. This can be shared with adjacent ULBs and Panchayats, whereas the fourth cluster will continue to use the existing landfill site at Dhapa. The landfill sharing agreement will be required at an early stage in consultation with the State Government. All the sites will be used for landfill, as well as having windrow composting facilities. Decentralised compost plants for treatment of wet waste would need to be investigated with the waste that remains to be used for landfill.

Recycling and Treatment: The dry waste covers a variety of items but generally includes glass, metals, plastic products, paper, e-waste and rubber. These should be segregated and sent for recycling at decentralised recycling units. Options of multi product recycling units, e-waste recycling units and plastics recycling units are proposed for management of dry waste in Kolkata.

The different technologies that could be used for recycling and the treatment of dry waste are: re-use through the manufacture of ***polymer blended bitumen; catalytic gasolysis; co-incineration; the manufacture of alternate products; construction demolition waste recycling to sand; and waste to energy.***

For treatment of wet waste, garden and tree waste, decentralised compost plants of capacity 2MT per day to 5MT per day should be explored to reduce the amount of waste going to landfill. Other technologies will also be required for animal and medical waste, some of which could be handled through private participation, as well as campaigns to induce behavioural changes amongst residents/ collection agents within Kolkata. All these options will lead to reduced emissions, making the system more climate-friendly.

Figure 42: The proposed clusters



Use of recycled products could be encouraged through existing KMC facilities such as the Entally workshop, as well as interested private partners with viable business models

Disposal: Considering that the existing Dhapa landfill site is saturated and operations should be curtailed there, it is proposed that alternate land is identified as an alternative landfill area. Since the availability of land in Kolkata is extremely limited, sharing of facilities and services, especially disposal of solid wastes, with adjoining ULBs is proposed. Landfill mining and the reclamation of landfill areas should also be investigated by KMC.

Options for PPP Initiatives for Kolkata: To implement a climate-smart waste management system as envisaged, KMC will require significant funding of about INR1000 crore. Given this, it is anticipated that the private sector will be able to play a role and will be able to facilitate the following elements of the system:

- Importing modern technologies for waste management and handling;
- Accessing private sector funding;
- Providing professional insight to project management; and
- Through formalisation of the informal recycling sector in Kolkata and creating employment opportunities.

Three major areas of operation where PPP can be considered are:

- Primary collection of non-biodegradable and its transportation to a secondary collection point;
- Transportation to respective treatment and recycling units; and
- Treatment of bio-degradable waste or the recycling of non-biodegradable waste.
- There are effectively two options for KMC to consider when adopting a PPP model to assist with the implementation of waste management measures in Kolkata, namely:
- *Option A: Decentralised Solid Waste Management System* – which requires the appointment of at least four concessionaires to serve each of the four clusters. Their role will cover responsibility for:

  ➲ the door-to-door collection of non-biodegradable waste,

- Waste sector emission in Kolkata is higher than elsewhere in India
- Dhapa landfill site is saturated and its close interface with the EKW is a potential threat to the local ecology
- Decentralised SWM and waste minimisation approach adopted in Roadmap
- Alternative livelihood models proposed for rehabilitation of waste pickers
- Restoration of existing waste dumps proposed through green capping of municipal landfill sites with the possibility of future reclamation.

Transportation to secondary collection point, waste segregation into different streams.

➲ transportation of non-biodegradable waste to respective processing unit

➲ installation and operation of recycling plants.

➲ treatment of biodegradable waste into compost

- *Option B: Centralised Solid Waste Management System* – which will require only one concessionaire who will undertake the above functions for the sole centralised unit.

Figure 43: Schematic of an Eco-restoration Project proposed for the Dhapa landfill site

Proposed Policy Measures

- Source Segregation to be made mandatory for waste collection
- Prohibiting usage and manufacturing of poly bags
- Buy back of recyclables or city compost and promotion of alternatives.
- Imposition of user fee and creation of a fund to give better services.
- Inclusion of compulsory composting for bigger commercial and residential establishments by amending Building Bye Laws.
- Landfill sharing possibilities with adjoining ULBs.

Under either arrangement, KMC's role will be to:

- provide land at a concessional rate or on lease;
- provide vehicles on lease or at a concessional rate to the concessionaire;
- create market linkages and promote the processed waste products; and
- ensure that the concessionaires receive the minimal amount of waste as decided between the two parties.

Implementation of the Roadmap

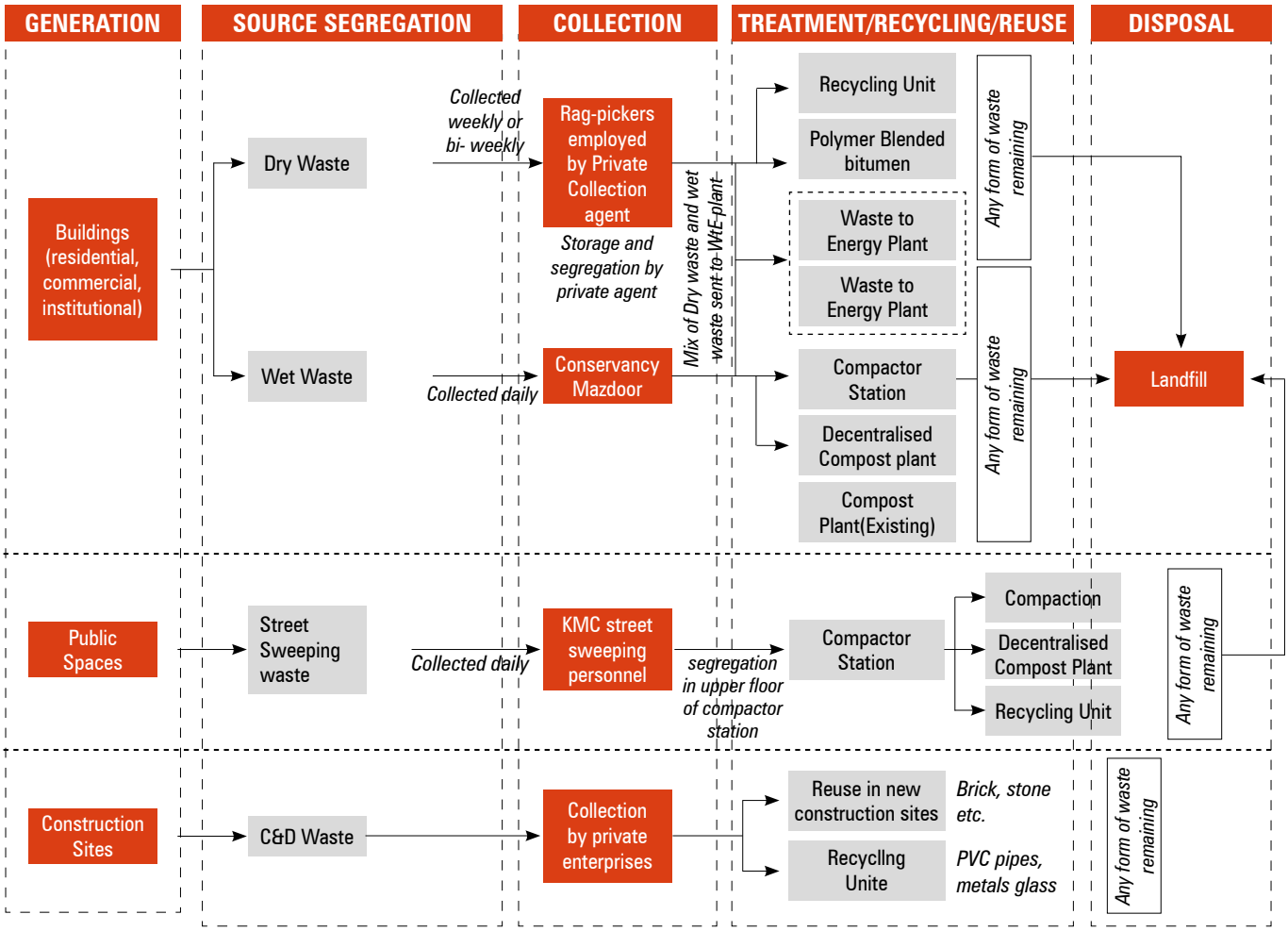
Considering the high levels of per capita generation of waste there is in Kolkata and the lack of targeted actions to combat SWM related issues, it is essential to develop an integrated SWM strategy and an appropriate enabling environment. To achieve this, different enabling policy measures are recommended below that will address the city's SWM issues.

Short-term Action Plan (actions to be completed in 0-2 years)

SWM	Short-term Actions (Solid Waste Management)
1	Non-issuance of trade license to companies if Consent to Operate from the West Bengal Pollution Control Board (WBPCB) is not produced.
2	Exploring possibilities of levying SWM user charges through coupons; through trade license renewal charges; or addition to property taxes through unit area assessment and creation of IT based database management system.
3	Collection of waste through 'source segregation'.
4	Enforcement of existing regulatory and punitive measures with regard to use of plastic polybags.

Prime implementing agency: KMC and the Urban Development Department, GoWB

Figure 44: Proposed Strategy for Solid Waste Management in Kolkata



Medium-term (2-5 years) Action Plan	
SWM	**Medium-term Actions (Solid Waste Management)**
1	Amendment in the KMC building byelaws to include mandatory setting up of mini compost plants in larger commercial and residential establishments.
2	Formation of a fund through user charges for the promotion of climate smart solid waste initiatives.
3	Strengthening partnership with NGOs for rehabilitation of ragpickers involving them in waste collection, segregation and decentralised treatment mechanisms.
4	Capacity Building: • Information and communication to people regarding source segregation • Information on stopping usage of poly bags below 40 microns • Sensitisation and awareness building workshops • Training for the rag-pickers/ health check-up camps • Awareness campaigns on 'Carry your own Bag'/ 'Don't throw Waste'.

The Prime Implementing Agency: KMC

Areas of Technical Assistance – Further Studies	
1	Detailed study and DPR preparation on decentralised SWM at Borough level.
2	Detailed land mapping study, using GIS for identification of land for decentralised solid waste management system and landfill.
3	Detailed feasibility study on decentralised mini-composting on a ward basis or beside markets.
4	Rag-pickers' rehabilitation and alternative livelihood development plan preparation involving NGOs.
5	Land mining and reclamation of landfill sites.
6	Landfill sharing facility with adjoining municipalities and ensuring sanitary landfill.

Long-term (more than 2 years) Action Plan		
SWM	**Long-term Actions (Solid Waste Management)**	
Industry promotion/ Access to finance	1	KMC to improve solid waste management services, through promotion/ provision of both dry waste recycling units and a PPP arrangement for dry waste collection/ operations as recommended by an earlier technical assistance study.
	2	KMC to consider the provision of incentives/ subsidies to make the price of compost competitive with chemical fertilisers so as to encourage community involvement in its production. Similar financial incentive packages should be considered for Self Help Groups (SHGs)/ plastic recyclers.

Prime implementing agency: KMC

Results Framework Summary		
Recommendation	**Targets**	**Performance Indicators**
Door to door collection, source segregation	100% collection efficiency and full segregation by 2031	User fee collection • Number of solid waste collection coupons submitted by households
	100% household level coverage of solid waste management services	• Total amount of user fee collected
Landfilling of waste	380MT per day by 2031	Regular monitoring and documentation of quantity of waste at landfill site using weighbridge
Treatment of waste	400 nos. 5MT/ day – decentralised compost plants by 2031	Regular update on: • Number of markets setting up compost plants • Number of residential complexes setting up compost plants • Number of compost plants registered with WBPCB
Recycling of waste	900 nos. 200MT/ year decentralised recycling units by 2031	Number of recycling units registered with WBPCB

Key Messages

- A decentralised solid waste management system has been proposed as part of the overall solid waste management strategy. A regional approach should be adopted for decentralised waste transportation and disposal.
- Waste going to landfills need to be minimised through use of decentralised treatment options.
- A user fee for waste management services needs to be considered. Segregation at source, already started in 07 pilot wards, will need to be implemented in other wards.
- Enforcement of regulations and punitive measures pertaining to use of plastic polybags would need to be implemented more cohesively.
- Feasible innovative technological options for waste to energy conversion, recycling of dry waste, restoration of existing landfills need to be explored.
- Decentralised mini composting units with a capacity of 5 MT per day should be located throughout the city.
- KMC will need to involve the private sector through some form of PPP arrangement. A private operator/ concessionaire will be required for each cluster.

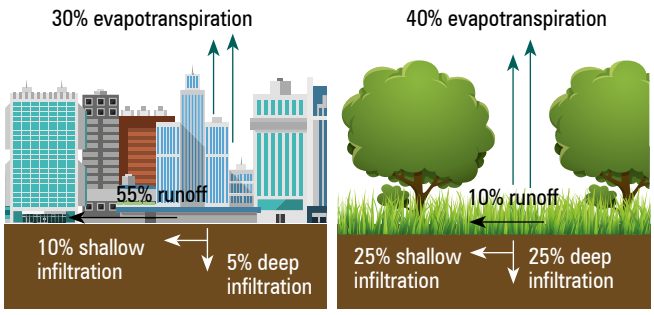
Section B8: Climate-smart Land Use Strategies

With the growth of many urban centres has come a climate change phenomenon known as the 'urban heat island' effect. It's not new, but it has grown in prominence with a better overall understanding of climate change. The heat island phenomenon is a direct result of the loss of open space and associated greenery combined with the construction of buildings to cater to increased demand for housing. As more 'hard' areas are created, the less open/green space is available to compensate and as a result temperatures in the area increase. In extreme cases, increased local urban temperatures (the heat island effect) can be between 1 to 3°C during the day and potentially up to 12°C at night in comparison to surrounding, more rural areas. As with many other mega-cities, Kolkata has seen the amount of land allocated to open space decline significantly in the last 25 years.

It is the same for the city's water bodies; a geographical feature that was once critical to the city's wellbeing. These have significant historical/ cultural importance to their communities as well as being environmentally linked to the sustainability of the city. The wetlands to the east of Kolkata have been declared a RAMSAR Site; this makes them an internationally protected area, although new development continues to threaten them.

The loss of these traditional environmental/ recreational assets has contributed to a general decline in the quality of the urban

Figure 45: The Urban Heat Island Effect



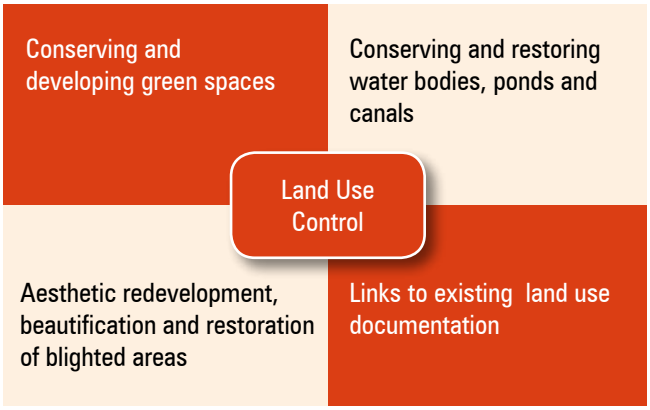
Source: US EPA

environment, with urban blight prominent in the city, especially in the older, more traditional areas of the city.

The Task

This module focuses on land use issues that are directly linked to climate change and specifically at the impact of the urban heat island effect and to a degree at urban blight. Key work items are shown opposite in Figure 47.

Figure 46: Components of the Land Use Module



Importantly, the strategies should seek to identify works/ activities that can help to reduce local heat islands.

Current Situation in Kolkata

Kolkata has developed gradually and organically. However, more recently urban expansion has predominantly been taking place over land previously considered as non-developable – consisting of marshland, wetlands and agricultural land in the south and eastern parts of the city.

A strategic review of issues in the city has identified:

- Urban expansion is predominantly taking place in the eastern, south-eastern and southern parts of Kolkata.
- Areas classified as either water bodies or open space have decreased.
- Many wards in the east and south are now largely devoid of natural open space due to the expansion of housing projects. Green cover is only found above 20% (UPDFI guideline) along the banks of the Ganges in the north and west of the city, where room for the expansion is limited.
- Major construction has taken place along the EM Bypass. This is one of the more eco-sensitive zones in Kolkata, being located adjacent to the internationally designated RAMSAR Site of the East Kolkata Wetlands; traditionally a drainage zone for the city which is considered susceptible to significant flooding.
- Urban water bodies account for some 10% of the total land area; this figure includes the River Hooghly, internal canals/ waterways, the East Kolkata Wetlands and several man-made lakes and ponds. The extent of these water bodies is decreasing as they are reclaimed for development projects. Those left are becoming waste sites for household and industrial waste.

Key Findings

Key findings from this module are as follows:

1. As open spaces/ water bodies within the urban area are decreasing, the local urban heat island effect increases. Open space has decreased in the last 25 years from 25% to 10% of the total urban area.
2. The loss of the urban water bodies within the city are significant. They have a historical role, being an integral part of the local community; a major recreational asset; as well as being a significant environmental asset.
3. Unplanned development in the restricted zones of low lying areas and wetlands is contrary to the development control regulations and the Conservation and Management Plan of East Kolkata Wetlands (2009).
4. Urban expansion is continuing in these low-lying peripheral zones to the east/ south-east in areas that are prone to flooding/

Urbanisation on agricultural land/wetlands

Water bodies used as local dumping grounds

water logging. Between 2004 and 2012, there has been drastic increase in the percentage of the city's built up area from 67% to 78%.
5. Urban expansion has led to a decrease in groundwater levels and an increase in the area that becomes waterlogged. This adversely impacts water supply. More of the city suffers from flooding issues now than in 1986; again the trend continues.
6. Kolkata's heritage including buildings and their settings are in decline. Although many are privately owned, there is no clear policy for their enhancement and integration.
7. Peri-urban areas along the city's periphery are 'urbanising' through development of numerous new housing projects; there is, however, no strategic oversight. Recently three new wards were added to KMC's area of control. These were agricultural fringe areas, but are now peri-urban settlements, devoid of basic infrastuctural facilities and with poor connectivity among other problems.

Recommendations

There is a clear need to reverse some of the current trends pertaining to landuse of the city. The focus of this module is to address the effects of the heat island effect which is on the increase within Kolkata. The recommendations below will, therefore, put forward options to tackle this. In addition, some alternative planning concepts have been highlighted that would be able to contribute to the mitigation of the plethora of climate changes issues that currently face the city.
The key strategies are therefore:
1. Preparation of a landscape/ urban design strategy for the promotion of a greener Kolkata; and
2. The promotion of alternative planning strategies, for example:
- Policies that promote Transit Orient Development (TOD); and
- Pre-planning of peripheral areas to ensure infrastructure provision prior to incorporation into the KMC area.

The key features of these are discussed briefly below.

Preparation of Landscape Strategy for 'Urban Green Space'

The proposed strategy focuses primarily on two key measures, namely:
1. The need to reduce the urban heat island effect; and
2. The need to improve the appearance of the city to make it greener, reduce areas of blight and to contribute to a more aesthetic environment.

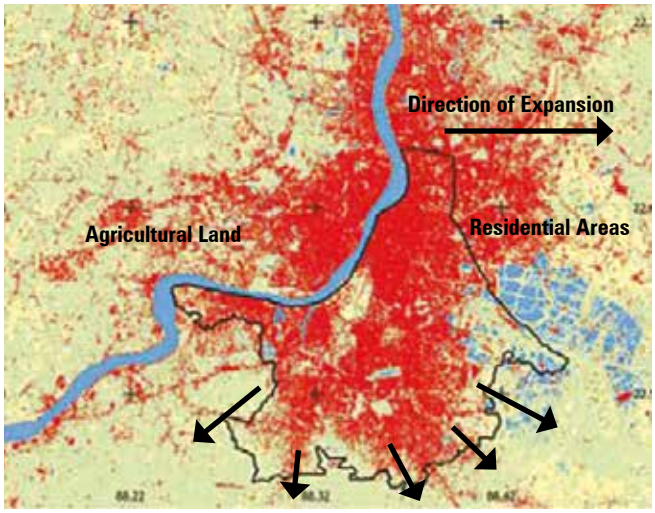
When discussing their recommendations for a reduction in the heat island effect, the US Environmental Protection Agency (EPA) proposes five key strategy areas. This includes increasing tree and vegetative cover; installing green roofs; installing cool, mainly reflective, roofs; using cool pavements (either reflective or permeable); and utilising smart growth practices.

Elements of these five strategy areas should be included within a proposed landscape strategy. They should be supported by other proposals, such as the development of an urban design strategy, which will contribute significantly to a more climate-smart city and help to promote social activity and the economic vitality necessary to foster a rich, self-sustaining environment.
The key principles of climate resilient landscape design include:
- design for water conservation and restoration techniques, including the introduction of new technology such as bio-swales and sustainable drainage systems (SUDS) to ensure a long-term drainage system ;

"It would be nice to have a playground where our children could play" – *Debjani, local resident*

One of the many heritage buildings in the city

Figure 47: The Expanding City



Recent attempts by the State towards decongestion of the city are evident in the latest amendment to the West Bengal Land Reforms Act which allows township developers to develop large projects of area more than 24 acres – this is expected to encourage development of small satellite townships on the outskirts of the city. The State also plans to develop smart cities (GOI funding) and theme cities

- design of the open space networks to provide opportunities to improve legibility, way-finding, social interaction and respite for residents and visitors;
- facilitate a 'walkable' city of local character with robust, climate-smart design features;
- recognising and enhancing significant site/ development features such as gateways, district and local centres, existing vegetation and view corridors; and
- establishing a strong unit within KMC, that will have design control and enforcement powers.

Components of Landscape Strategy for Urban Green Space

With an already low green cover in many Wards and decreasing water bodies throughout the city, the recommended 'greening' strategy promotes the components indicated below.

Alternative Planning Strategies to Improve the City's Green Credentials

1. Transit-Oriented Development

Transit-Oriented Development (TOD), is a planning tool that has recently gained popularity globally as a potential solution to urban growth challenges faced by cities today, as it encourages the co-location of different land uses, linked to public transport

Recommendation	Description
Developing a hierarchy of open/ green spaces	Establish a hierarchy of open spaces, containing areas for both active and passive recreation. Spaces to be accessible to all residents, fully integrated with the pedestrian and bicycle circulation networks to create safe, shaded and convenient connections to neighbourhood centres, metro stops and schools.
Additional Landscape Components	The strategy recommends additional types of green space, including: • **Rooftop gardens** – reduce temperatures; provide shade; reduce air pollution and GHG emissions; enhance storm water management and water quality; and provide aesthetic value. • **Vertical gardens** – including wall greening, balcony greening and windowsill greening; they increase green space within high-rise developments. • **Residential Complexes** – planting along all street-facing boundaries. More tree-lined pedestrian walkways, cycle tracks, small parks, should be developed. • **Green streets** – traffic islands/ areas beneath flyovers can be transformed into gardens, capturing storm water run-off. • **Urban agriculture/Organic farming** – promoting urban agriculture through 'sack' gardening in backyards of low-income houses/ housing areas, waste water farming and bio-composting, integrated pest management, etc.
Hierarchy of Streets and Streetscapes/ Rail and Inland Waterway Corridors	Transport corridors provide connectivity between land uses/ service centres. The landscape strategy should promote the landscape design of these based on a hierarchy of the streetscapes with special emphasis on increasing the 'greens' along these corridors through tree-lining along the sides of streets and medians, 'bio-swales' along the medians and side-walks, shaded pedestrian side-walks with permeable grass pavers and cool-pavements that would help increase infiltration of surface water and reduce run-off. Other corridors, including the River Hooghly and the sides/upper levels of all canals, should be developed as landscape corridors, including pedestrian routes/cycleways with appropriate green cover.
Conservation of water bodies, ponds, canals	Actions required to stop the decline and restore the water bodies include: • Canal restoration. • Water body restoration; bio-engineering techniques including floating gardens. • Use of sustainable drainage systems to protect groundwater/ watercourses. • Introduction of natural materials in the lakes to pollutants. • Hard and soft landscape designs for the water bodies and their surroundings. • Restoring and linking the inland waterways with other modes of transport. • Stricter regulation for disposal of waste into the water bodies. • Proper maintenance/ management of the port area and adjacent river. • Identification of Heritage Ponds and specific protection zones around them.

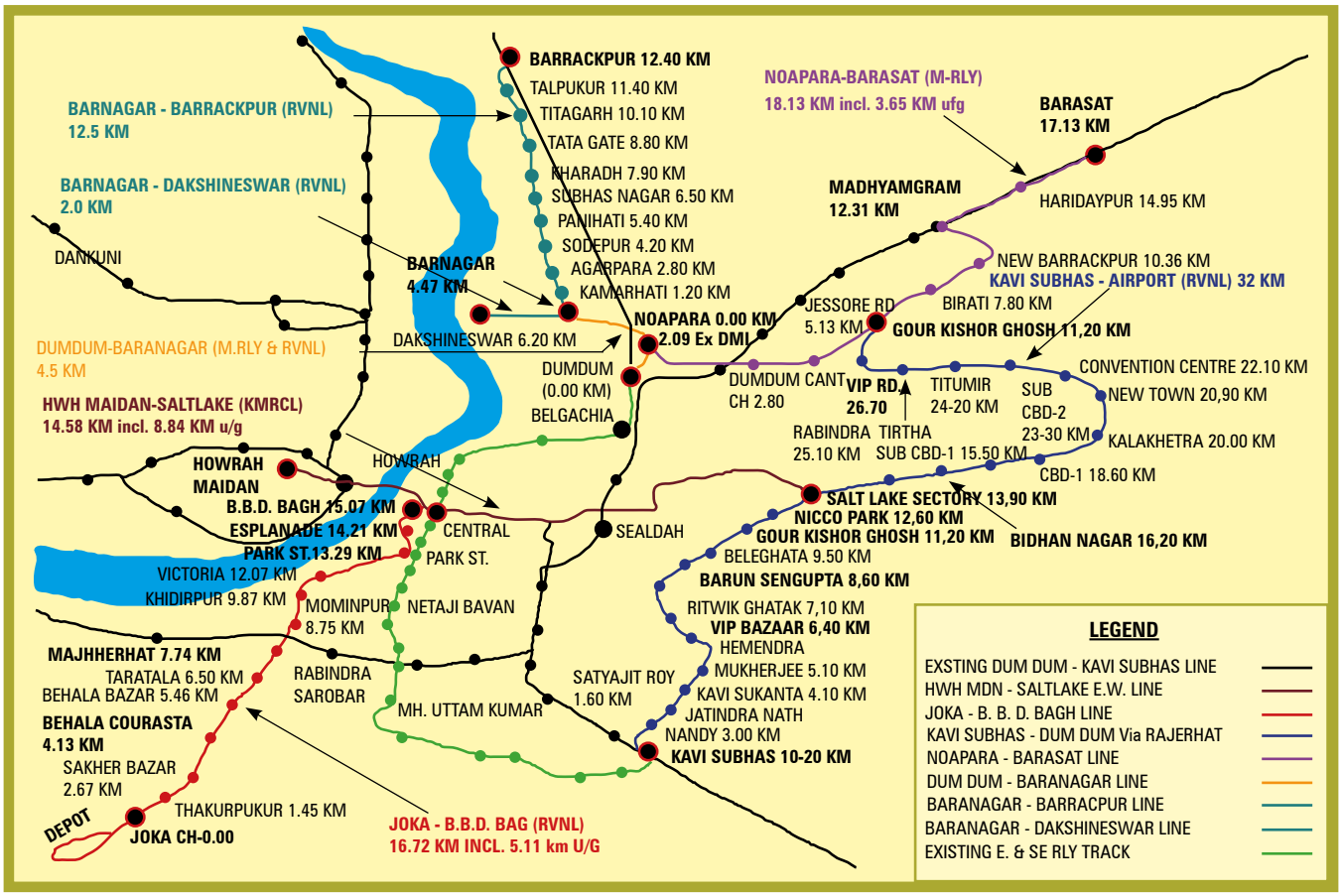
Recommendation	Description
Aesthetic Redevelopment/ Beautification of Blighted Areas – need for an Urban Design Strategy	To improve blighted areas, KMC may take a holistic approach and prepare an urban design strategy for the city to form the basis for future decision-making. The strategy should give direction to guide future development. Including identification of key projects. Two examples are: **1. Redevelopment of the Hooghly Riverfront** – An opportunity to create a truly internationally recognised landmark project that: • contributes to the creative/ sensitive upgrading of the River Ganges network; • can become a tourist attraction in its own right; • can play a leading role in the city's open space network; • can be integrated into the proposed pedestrian and cycling networks; • can contribute to wider climate change actions through integrated river bank works to better protect urban areas from river surges. **2. Heritage Areas** – Preparation of a pilot plan promoting design and conservation measures that are climate change compliant, whilst also saving the heritage asset and their wider setting for future generations. Plan should focus on an area, where there is a collection of buildings and urban spaces, including open spaces as well as a traditional water bodies.
Way-finding and Signage Strategy	Development of a bespoke way-finding/ signage strategy to improve movement through the city. Signs need to be developed with basic identity components, such as a Kolkata 'branded mark' and/ or area-wide signature.
Creation of a Design Unit within KMC	A specialist design unit may be established within KMC, to develop appropriate urban design/ landscape policies and projects for the city. It should be staffed with design specialists and allocated enforcement powers to protect city assets.

networks that effectively reduce usage of private vehicles.

Given the density of development in the city, it would seem an ideal concept within the KMC area, as well as wider use throughout the KMDA. Possible public transport routes that could benefit from tailored TOD projects at key locations include:

- the proposed East-West Metro Corridor (See Figure 49);
- the Eastern Metropolitan (EM) Bypass;
- the existing Metro Corridor (See Figure 49);
- the Suburban Railway Network; and
- the Circular Railway.

Figure 48: Existing and Proposed Metro Corridors in Kolkata



CONSIDERING THE HIGH LEVELS OF PER CAPITA GENERATION OF WASTE IN KOLKATA AND THE LACK OF TARGETED ACTIONS TO COMBAT SOLID WASTE MANAGEMENT (SWM) RELATED ISSUES, IT IS ESSENTIAL TO DEVELOP AN INTEGRATED SWM STRATEGY AND AN APPROPRIATE ENABLING ENVIRONMENT. TO ACHIEVE THIS, DIFFERENT ENABLING POLICY MEASURES ARE RECOMMENDED THAT WILL ADDRESS THE CITY'S SWM ISSUES.

TOD Benefits – Social
- Increased mobility choices for all;
- Increased disposable household income;
- Increased health benefits;
- Increased public safety; and
- Increased housing choices for all.

TOD Benefits – Economic and Fiscal
- Increased land values and property tax revenues;
- Increased transit ridership; and
- Reduced road and infrastructure costs.

TOD Benefits – Environmental
- Reduced rates of vehicle kilometres travelled;
- Space efficiency;
- Energy efficiency;
- Better air quality; and
- Conservation of resources / reduced urban sprawl.

To implement this strategy, a number of actions will be required to be undertaken by KMDA and KMC. These include:
- identify locations on transport networks that could be considered for a TOD project;
- develop a priority list of TOD development opportunities across the city;
- include a high-level real estate and investment analysis;
- develop model urban planning and design guidelines; and
- provide an overall Implementation Strategy for TOD's for Kolkata.

Once this Strategy has been prepared, it will need to be integrated into the City Development/ Master Plans prepared by the KMDA, when these are next updated and adopted by the city authorities. Where necessary, KMC byelaws may need to be modified to enable TOD projects to proceed.

2. Forward Planning of Peri-urban Areas

The separation between urban and rural areas grows less. Around many mega-cities, traditional rural villages are slowly being enveloped by their larger neighbours.

Developers often construct large-scale residential complexes beyond the limits of existing urban areas, because comparatively inexpensive land is available. However, supporting utility and social infrastructure generally fails to keep up with these new developments. With the growing urban economy, peri-urban areas can be expected to 'change' to urban areas at accelerated rates. This calls for modified and innovative planning, regulations, technology, design, financing options and delivery that are incremental, maintainable and sustainable.

There should be an overall strategy for the pre-planned development of the peri-urban areas in order to integrate them successfully into the KMC area. The authorities should encourage the implementation of concepts such as the abovementioned TOD, which could work to better manage Kolkata's spill-over problems.

Short-term Action Plan (actions to be completed in 0-2 years)	
LU	**Short-term Actions (Land Use)**
1	Establish a Design Cell within KMC, staffed with professional urban designers and landscape architects.
2	Develop a Landscape Strategy for Kolkata.
3	Develop an Urban Design Strategy for Kolkata.
4	Initiate a Master Plan for the Riverfront in tandem with other sectoral plans being prepared/conceived by other concerned agencies such as KMDA.
5	Initiate an Action Plan for a pilot Heritage Redevelopment Area.
6	Prepare a TOD Strategy for Kolkata including identification of locations on existing transport corridors that could be considered for development of the concept.
7	Identify peripheral areas around Kolkata that are likely to be taken over in the near future and initiate discussions with the relevant municipality on steps towards merger.

Prime Implementing Agency: KMC, the proposed KMC Design Cell, KMDA, the proposed UMTA, selected peripheral municipalities

Medium (2-5 years) & Long-term (more than 5 years) Action Plan	
LU	**Medium/ Long-term Actions (Land Use)**
1	Expand the KMC Design Cell to meet operational needs.
2	Implement the Riverfront Redevelopment Master Plan.
3	Implement the recommendations of the Heritage Action Plan.
4	Prepare and implement a Way-finding and Signage Strategy throughout Kolkata.
5	Implementation of an initial TOD project.
6	Prepare plans for future infrastructure requirements of the next rural areas that are likely to be incorporated into Kolkata and its need for additional land for growth.

Prime Implementing Agency: KMC, the proposed KMC Design Cell, KMDA, the proposed UMTA, selected peripheral municipalities

Key Messages

- The city needs a comprehensive landscape/ urban design strategy that is capable of restoring Kolkata's former grandeur, whilst simultaneously re-establishing a walkable and liveable city for its residents. The strategy should focus on the reduction of urban heat islands; the adaptive re-use of areas of urban blight; and the restoration of the city's water bodies.
- The issue of urban blight needs to be addressed comprehensively. A detailed urban design strategy needs to be developed that seeks to improve blighted areas through adaptive re-use of heritage buildings and upgrading general surroundings.
- Urban heat islands can be addressed through the introduction of more greenery into the city; on buildings (rooftop/ vertical gardens including urban agriculture options such as 'sack' gardening in backyards of low-income houses/ housing areas, waste water farming and bio-composting, integrated pest management, etc.); improved greening of streets (avenue plantations, tree-lining and bio-swales along the median and side-walks as well as permeable grass-pavers.) and other transit corridors (rail/ waterways); the introduction of a hierarchy of spaces for use by residents; and the introduction of 'cool' surfaces to reduce radiated heat. Other new technologies should be introduced whenever appropriate.
- The city's traditional water bodies need to be regenerated for aesthetic and to re-establish their historic role of dealing with excess floodwater. Regeneration could be through a variety of means including water body/ canal embankment protection using non-organic/ plastic paving tiles, geo-textiles and sustainable plants; bio-remediation; tourism usage; NMT corridors; integration of canals into city transportation networks.
- Consideration should be given to the introduction of a sustainable drainage system for the city to protect groundwater and drainage channels from pollution
- Strategic urban development needs to consider alternative practices that will engender a more people-friendly, as well as climate-friendly urban environment. New planning concepts such as transit-oriented development (TOD) would encourage mixed-use development at transport hubs, as well as supporting improved pedestrian/ cycling facilities to encourage journeys by these modes especially for short trips.

Key Projects

In addition to the messages, two multi-purpose projects that will contribute to both the objectives of urban enhancement as well as tackling climate change issues are recommended:

- A design-led Riverfront Redevelopment Project, which can aim to create a significant international destination capable of increasing local and international tourism; incorporate measures to protect the city from tidal surges; improve the city's relationship with the river; adaptively reuse heritage buildings/ areas; provide pedestrian/ cycling linkages from the centre to both north and south along riverfront; and which can integrate the Circular Railway as a part of the scheme.
- The city has beautiful heritage buildings and 'human-scale' areas, with streets designed for walking/cycling. A heritage-focused project should seek to reverse urban blight by restoring traditional neighbourhoods, so as to provide a significant asset for the city's tourism sector, as well as implementing the proposed green building guidelines for heritage buildings; and improving NMT mobility and connectivity through these areas using traditional pathways/ narrow streets.

Implementation of the Roadmap
Conclusion and Key Messages

Kolkata has been losing open space and the traditional water bodies for many years under pressure from developers to satisfy the city's insatiable housing need. This pressure will not decrease and it can be envisaged that more areas will disappear as older areas of the city fall into decline and are replaced with speculative high-rise development.

The city should therefore look towards policies and strategies that:
a) seek to actively conserve Kolkata's historical legacy, in terms of its former green openness; the water bodies that are an intrinsic element of its past; and work on strategies of adaptive re-use for its heritage asset and the neighbourhoods within which they are located;
b) seek to re-humanise the city through replacing green areas and making the urban area one which residents can again enjoy, including the ability to walk or use other forms of non-motorised transport between different areas;
c) seek to implement new concepts that favour integrated developments and keep the need for motorised transport to a minimum; and
d) seek to forward plan so that past mistakes or 'hidden messes' are not continually repeated.

"Our local pond needs cleaning so that we can put it to better use. It will also solve our drinking water problems" – *Ruby Sashmal, local resident*

PART C
CREATING A GREEN ECONOMY

Section C1: City Business Plan

The rapid decline in the earth's ecological environment has emphasised the need for sustainable development to be at the forefront of future thinking and that policies and actions taken by a city's leadership will, in future, be required to balance economic and physical growth with the decreasing natural environmental resources required to achieve that growth. Global environmental concerns, such as global warming as a result of the greenhouse effect, ozone layer depletion and biodiversity destruction have become important issues not only for environmentalists, but also for decision makers at all levels of the government.

This is especially significant in the context of Kolkata – a city that has grown faster than the city authorities can safely and appropriately develop it.

The concentration of many slums, coupled with large-scale migration of labour from other rural areas adjoining Kolkata into the city, have created numerous physical and economic problems that bodies like the KMC are finding difficult to mitigate; increasing congestion and the growing volume of polluting vehicles; haphazard industrial development capable of polluting the neighbourhoods where they have been established; growth of the informal economic sector rather than the formal sector; and inadequate waste management practices, have resulted in a precarious situation for the city.

However, these challenges also present the authorities with an opportunity, in particular an economic opportunity to generate new livelihoods. If managed successfully, these can contribute to the creation of a 'green economy' in Kolkata, with this in turn helping to mitigate some of the other environmental problems prevalent in the city.

The Task

To structure the potential for a green economy, the UK-KMC Programme has included a module to prepare a City Business Plan (CBP) for Kolkata. This will be an operational document that identifies the various sectors with potential to generate environmentally-friendly, carbon neutral and better paying "green jobs" in Kolkata as well as indicating the upgrade in the skills of local residents that will be required to fill them. Key work items are shown in Figure 50.

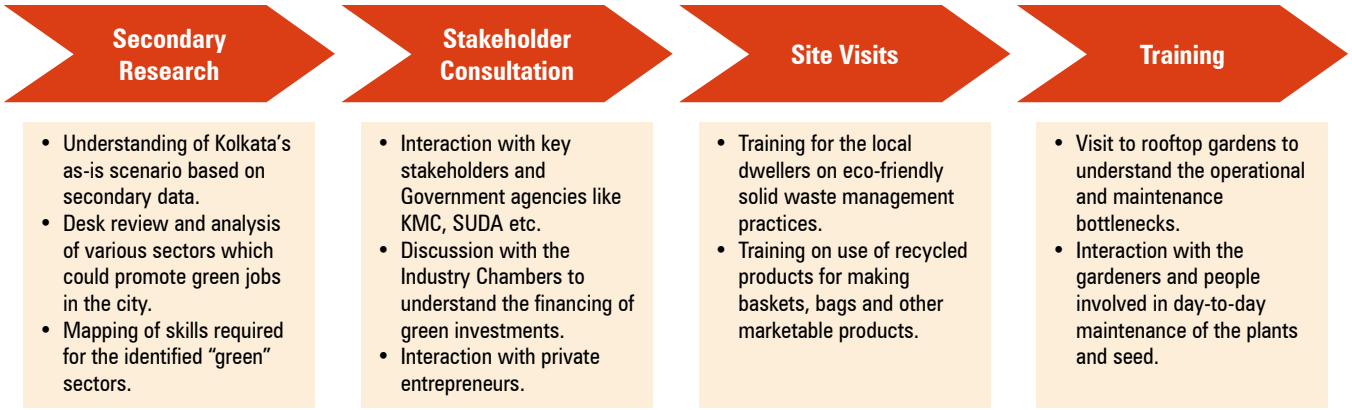
Figure 49: Components of the City Business Plan

It is recognised that there are limitations with the analysis currently being undertaken for this module, mainly due to there being no clear segregation of "green" and "non-green" areas in the various economic sectors within Kolkata, as well as there being an absence of credible secondary data on investments in the "green" economy, which have posed challenges for the estimation of potential scale of job creation over the next 10 years. Similarly, there was limited data on self-help groups available, posing challenges in recommending targeted measures to increase profitability and revive their operational mechanisms.

The key objectives of the CBP are as follows:

- to identify skills needed for opportunities created as a result of green investments with respect to structural shifts and new, emerging and changing occupational profiles;
- to prepare a Roadmap for bridging the demand-supply gap of vocational skills for green jobs in the city; and
- to map green economic development opportunities within the city, enabling effective interface between government agencies and business communities for attracting investment into these green sectors.

Figure 50: Components of the City Business Plan



The approach adopted and the broad methodology followed is indicated in Figure 51.

Current Situation In Kolkata

There is immense opportunity for Kolkata to embrace a path towards a greener economy by tapping into those green investment sectors that have substantial livelihood generating potential.

Kolkata's comparative advantage, like most other cities of India, lies in the service sector. ***According to the National Skills Development Corporation (NSDC) estimates for the city, close to 530,000 jobs would be created between 2017-22 out of which 450,000 are expected to be absorbed in the service sector. The figures suggest that only 16% of jobs will be created in the primary and secondary sectors.*** This data relates to conventional jobs; the concept of "green" jobs is not covered by these forecasts.

Neighbourhood groups and committees, community development societies under the Swarna Jayanti Sahri Rojgar Yojana (SJSRY) have been formed in several boroughs within KMC's area. These self-help groups have, from time to time, developed several initiatives to promote the livelihood interests and efforts of the urban poor. The Department of Self-help Groups and Self-employment, Government of West Bengal was created to look after policy formulation and coordination of all works pertaining to Self-help Groups (SHG) and self-employment schemes operated by the different departments in the State as well as to monitor all matters in connection with the formulation and functioning of the Bangla Swanirvar Karmasansthan Prakalpa (BSKP).

Kolkata has 9 polytechnic institutes and 15 ITIs/ ITCs; it also has the highest number of private ITIs present in the State. The density of these industrial training institutes was found to be 0.65 by calculating seats per thousand population. The students that have graduated from the Trade Courses are awarded National Trade Certificates by the National Council for Vocational Training. The line departments associated with the Government of West Bengal for skill training and up-gradation are the Technical Education and Training Department, the Labour Department, the Micro and Small Scale Enterprises and Textile Department, the Panchayat and Rural Development Department, the Food Processing and Horticulture Department and the Information and Technology Department. All these bodies could have a role to play in the development of training courses for jobs in Kolkata's green economy.

Key Findings

Among the categories of economic activity frequently cited in discussions on green jobs are renewable energy, energy efficiency, pollution prevention/ clean-up and the conservation of natural resources. However, translation from these high level categories into more specific industries or occupational categories varies across studies.

The potential sectors as identified in the City Business Plan for Kolkata include green construction, sustainable tourism, sustainable transportation, solar rooftops, solid waste management, waste water management and community based initiatives.

Sectors	Findings
Green construction	Close to 1.4 million jobs to be created according to IGBC estimates in 10 years
Solar rooftops	Has the potential of creating 1,200 jobs for a single 100 MW plant over 10 years
Solid waste management	A group of 30 can be deployed for 1 year for making 50 bags per day. If 10,000 of these are sold per year, annually it can generate 150,000 in a year. Along with compost and ready plants, these might fetch around ₹4,500 per planter. 400 decentralised composting units of 5 MT each could employ about 10,000 people.
Waste water management	A 2 acre water body, would generate employment of 500 man days, over a duration of 6 months
Rooftop farming	A 1,000 ft^2 area of rooftop farm would generate employment of 557 man days, over a duration of 1 year

Certain areas or sub-activities across the sectors where green jobs could be created are as follows:

- ***Green construction*** has the potential to create jobs related to architectural design, manufacturing, research and development activities, design and consultancy, construction and maintenance.
- ***Sustainable tourism*** is a niche area where a lot of ancillary firms can become involved in activities such as development, operation, maintenance and promotion.
- ***Sustainable transportation*** caters mostly to design and engineering, plus operation and maintenance activities along with boosting the tourism sector within the city.
- ***Solar rooftops*** have immense potential in an energy deficient situation in the areas of research and development, engineering and manufacturing, operations, and installation and maintenance activities.
- ***Solid waste management*** in a slum area could be a major source of livelihood through collection and processing activities, recycling, composting and marketing the finished recycled products to earn better revenues.
- ***Wastewater management*** using tools such as the bio-engineering of wastewater and the eco-restoration of canals, this could be a major area which could be tapped not only for wastewater treatment but also to encourage tourism growth through rehabilitation of canals and waterways.

Apart from these sectors, community based initiatives such as food and agro-processing and solid waste recycling and urban farming could be initiated with the assistance of self-help groups. Other innovative solutions for green jobs in Kolkata include roof-

Key Green Sectors for Job Creation
- Green construction
- Sustainable tourism
- Sustainable transportation
- Solar rooftops
- Solid waste management
- Wastewater management

Innovative Green Sectors
- Rooftop farming
- Vending zones
- Newspaper recycling
- Green cobblers

top farming, vending zones, skill development through sale of newspapers and recycling used tyres for better living conditions of the cobblers.

Recommendations and Implementation of the Roadmap

In the recent years, although some headway has been made towards improving the environmental management and industrial development regimes in the country, Kolkata continues to face formidable challenges in fostering the greening of existing industries and promotion of green jobs. The barriers faced can broadly be attributed to a combination of market and policy failures, lack of capacity and necessary skills and lack of financial support for green business ventures.

Green Community Initiatives
- Food/ agro-processing
- Solid waste recycling
- Embroidery work

Some short, medium and long-term interventions can be considered by the government to show commitment and resolve towards promotion and development of the green economy within the city, which in turn will have a spill-over effect through the creation of new avenues for employment generation, are indicated below.

Short-term Action Plan (actions to be completed in 0-2 years)

CBP	Short-term Actions (City Business Plan)
1	It is recommended that a detailed survey be conducted that can demarcate various jobs into green and non-green sectors. This can then provide a basis for reliable projections of employment opportunities created by these 'green' sectors.
2	A Training Needs Assessment (TNA) for helping to improve the skills of the unskilled workforce based on results of the above survey should be devised and implemented.
3	Educating trade unions on the importance of green jobs.
4	Registering all local/ household workers, maids, servants, cooks, cobblers and drivers on a ward by ward basis, following completion of a survey on their living/ working standards.

Primary Implementing Agency: KMC with support from industry and training institutions

Medium-term Action Plan (2-5 years)

CBP	Medium-term Actions (City Business Plan)
1	Providing incentives to 'green' entrepreneurs, through the provision of tax breaks, easy availability of capital, creation of favourable demand conditions and innovative financing schemes.
2	Based on the TNA, invest in capacity building and training though skill enhancement programmes to prepare the workforce for a transition to a green economy.
3	Maintenance of online records, accounts, correspondence and training activities of SHGs.
4	Demarcation of zones for vending activities by identifying and providing appropriate land for this purpose and ensure adequacy of civic amenities, including water, sanitation, waste management and electricity in the designated vending zones.
5	Improve policy coordination and encourage social dialogue through community participation activities.
6	Promote training of SHGs for maintenance of urban green spaces, public canteens and cafeterias, conservancy in school and college premises, centralised kitchens for supplying mid-day meals and van rickshaws to facilitate transport.
7	Work with identified institutions/ agencies to impart technical training, carry out revisions in curriculum of the training modules to suit the needs of the green economy and ensure proper 'training of trainers'.

Primary Implementing Agency: KMC with support from industry and training institutions

Long-term (more than 5 years) Action Plan

CBP	Long-term Actions (City Business Plan)
1	Develop a rating agency involving government representatives, municipal authorities and private bodies for waste management across the city.
2	Removal of barriers/ easy access to clean technology for different industries, many of which are proprietary and protected by strong patent regimes.
3	Incentives for supporting local technologies and subsidizing compost and social incentives for people who segregate waste at source.

CBP	Long-term Actions (City Business Plan)
4	Offer loans at reduced interest rates to developers that agree to build to the specified green standards through a specified loan fund.
5	Budget allocation for market development in order to provide an effective platform for marketing of SHG products.
6	Setting up of Facilitation Centres with a database of skilled, semi-skilled and unskilled labour along with skill-mapping.

Primary Implementing Agency: KMC with support from industry and training institutions

Key Messages

- There is scope to nurture the existing skills of the workforce in Kolkata, as well as promote community based self-entrepreneurial activities.
- Many SHGs, vocational institutes and NGOs are actively participating in streamlining home-based economic activities in green jobs sectors.
- Niche sectors such as rooftop gardening/ farming, green buildings, sustainable tourism, waste recycling and others are seen as having immense potential to harness employable skills, whilst also building the platform for entrepreneurs.
- Green enterprise development needs to be promoted through tax incentives and ease of business regulations.
- The proposed training for various skills required in green sectors could be included within the existing schemes. The curriculum of the vocational training programmes currently provided could be modified to suit the needs of these "green" sectors. The existing vocational training institutes and some of the technical skill enhancement institutes could also be involved in this process of skill building and up-grading.
- Integration with existing livelihood promotion schemes such as National Urban Livelihood Mission (NULM) is recommended.
- An improved picture of opportunities available is required and it is recommended that a primary survey is conducted across Kolkata to assess and facilitate better projections of the future scale of the green economy. The growth of the green economy could be instrumental in creating more opportunities in a highly environmentally sensitive and job scarce city like Kolkata. Potential employment opportunities resulting from modules in this Programme are significant (see table below).

Estimated sector wise green job potential		
Sector	**Unit**	**Total Green Jobs Created**
Solar rooftops	500 MW	9,000 jobs in 10 years
Green buildings	70 million square feet	1.4 million jobs in 10 years
Rooftop farming	1,000 square feet	0.45 million jobs in 10 years
Waste management through neighbourhood model	Group of 30	50,000 jobs in 10 years
Waste management – decentralised composting	400 units, 5 MT each	10,000 jobs
Bio-toilets	4 in each ward and 2 near each primary school	2,212 jobs
Bike and bicycle sharing shelters	2 each near 27 metro stations	108 jobs
Green vending zones	1 in each ward	290 jobs
Canal restoration	2 acres	7,260 jobs in a year
Source: PwC calculations/ Stakeholder discussions		
N.B. Most of the full time jobs created in sectors such as bio-toilets, bike and bicycle sharing, green vending zones and canal restoration relate to maintenance activities and hence the number of jobs created would remain the same over a 10 year period. Thus the jobs created in the first four sectors are projected for 10 years and the rest for a year		

Section C1A: Livelihood Training

As part of the process to prepare the City Business Plan, the Programme required the delivery of a training programme in one of the low-income neighbourhoods within Kolkata. In part, this training exercise was undertaken at the request of the local Councillor who was keen to see climate change progress in his Ward and in part the training was to identify the potential for 'green jobs' within one of the city's poorer communities.

The work undertaken is reported here, with further discussion also appearing in Section D1 where the Ward Action Plans are discussed. The graphics have, in part, been produced by members of the community.

The Task – Community Capacity Building for Alternative Livelihood and Climate Adaptation

The UK-KMC Programme for a Low Carbon and Climate Resilient Kolkata has been designed as a two-pronged approach that will make a difference in the city.

First, there has been a 'top-down' macro-planning approach that has identified broad-level policy changes and strategies to be adopted for climate resilience in a number of key sectors such as the Built Environment, Mobility, Public Health and Disaster Management. Secondly, a 'bottom-up' micro-planning approach was adopted. This has involved community planning, together with interventions at a ward level, working directly with the end-users.

As part of this 'bottom-up' approach five pilot wards were selected based on a variety of vulnerability parameters for which Ward Action Plans would be created – plans to guide small-scale participatory interventions/ innovations led by the local Councillors.

Further, a pilot settlement was identified in one of the five selected wards, where participatory planning could be initiated. The neighbourhood, identified by the KMC, is located at Christopher Road in Ward 58. It is hoped that it would act as a demonstration project for KMC to replicate in other areas in the city. The following interventions were undertaken.

Training on Green Livelihood Options

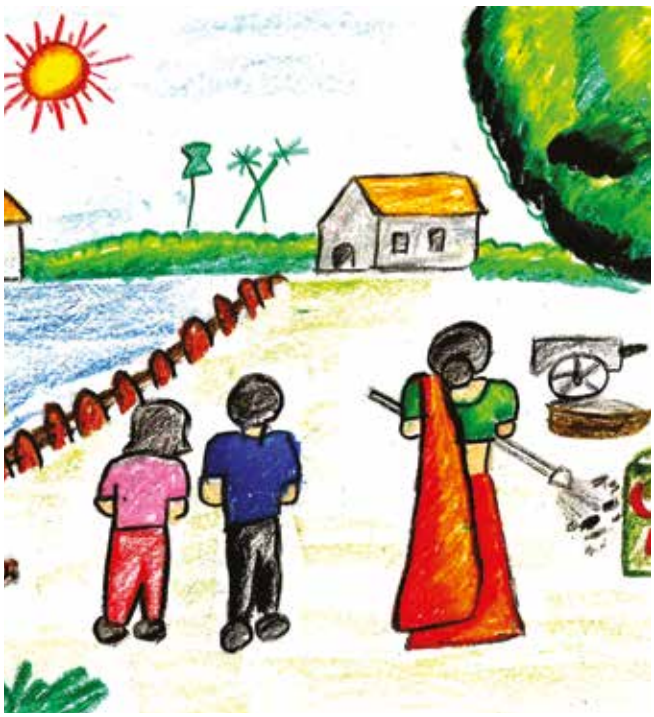
Livelihood training sessions were held with modules focusing on eco-restoration and the creation of livelihood opportunities, especially for women residents.

As part of the training, community members from the low-income groups were provided hands-on training covering:

- Composting from household organic waste;
- Recycling of waste plastics to create handicraft items and planters; and
- Organic urban farming

Planning for an eco-responsive neighbourhood

Identification of community-beneficial projects that could help transform the area into a model climate-smart neighbourhood. The area was surveyed and development options discussed with the local community, leading to a number of low-carbon projects being proposed for this area, with these then integrated into the proposed Ward Action Plan covering the entire ward.



Quick Wins

Increased awareness and behavioural change – People have started segregating their waste at source in order to create compost for their homes. Women have shown enthusiasm in eco-friendly livelihood training.

Increasing interest among the wider community with successive training sessions – The nature of the interventions has been carefully customised to suit the needs and limitations of the target beneficiaries. There has been a growing awareness and growing popularity of the programme, with an increased number of people voluntarily registering for successive training sessions.

Increased ownership by locals – The Ward Councillor has taken immense interest in the interventions proposed and intends to expedite their implementation through existing government schemes and grants. He plans to propose replication of the same model in other wards across the city.

Visible changes in the area – In order to enable the low carbon interventions, KMC has expedited solid waste collection/ removal and pond dredging operations in the pilot settlement. Post training, the local community has started recycling their household waste to create compost; preparing planters using recycled plastics; and instigated organic farming procedures using the seeds and saplings that were disseminated. They intend to expand usage and create a green space in the pilot area.

Ensuring Sustainability – These interventions have generated interest among numerous government departments and community-based organisations. This will strengthen the case for replicability of the interventions in other areas and promote sustainability so that work by the community continues beyond the end of the programme, increasing the viability of the green livelihood model through creation of market linkages and future scale-up in livelihood options such as:

- *floating gardens;*
- *pavement blocks from recycled plastic;*
- *ornamental fish farming; and*
- *horticulture.*

Key Messages

- The project has demonstrated on a pilot scale how local communities can be successfully motivated and empowered to undertake localised interventions and create visible change in their city landscape.
- The project has proposed and initiated the first ever integrated model for a climate resilient neighbourhood, which marries the concepts of micro-planning, access to finance, livelihood promotion, women empowerment and sustainability.
- The local Councillor needs to play an active role in the mentoring members of the community as well as seeking to identify available city funds to implement small projects.
- The model plan can be replicated across low-income settlements in Kolkata and other cities.

Section C2: City Investment Plan

Existing cities need to change as they grow. The challenge is to provide the green infrastructure needed to maintain growth while cleaning up the environment. To foster investments in green infrastructure, two things are needed. The first is to give cities the capacity and incentive to plan, finance, and implement needed infrastructure that provides the basis for innovation appropriate to the competitive advantages of the city and its rural hinterland. The second is to enable the private sector to participate effectively in this process, leveraging government resources. With the right support, incentives, and freedoms, Indian cities may be able to solve their problems and even contribute in a major way to solving global problems such as greenhouse gas emissions and climate change.

The Task

The City Investment Plan seeks to provide a clear plan for implementing projects that have been identified under the different modules of the UK-KMC Programme, along with possible options for financing the various interventions recommended.

It is not the intention to prepare an Investment Plan that covers all anticipated expenditure by KMC. Instead this plan is targeted at proposals that can be linked directly to climate change and interventions that will be of value to the reduction of climate change issues within the city.

Interventions Proposed for Achieving Low Carbon and Climate Resilient Development in Kolkata

The different modules under the multi-disciplinary programme of works have identified a number of interventions for achieving low carbon and climate resilient development in Kolkata. The interventions proposed are classified into three categories, based on the nature of investment and funding requirements:

1. Technical Assistance – Training and Capacity Building;
2. Technical Assistance – Consultancy Services; and
3. Financial Assistance – Capital Investment.

Indicative cost estimates have been presented against each of the interventions proposed. Further, the proposed interventions have been prioritised as short, medium and long-term plans based on their implementation and operational periods as follows:

- High Priority – short-term interventions planned over a period of 0-2 years;
- Medium Priority – medium-term interventions planned over a period of 2-5 years; and
- Low Priority – long-term interventions planned over a period of 5-10 years.

Financing a Green Economy in Kolkata

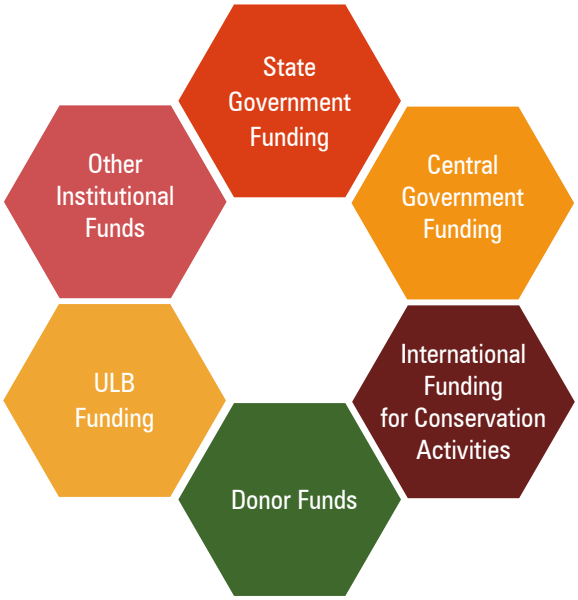
The landscape for infrastructure funding and finance has been dramatically altered in recent times and could remain in a state of flux for at least the near term owing to the following three trends that are emerging in this context:

- First, governments are attempting to use increased infrastructure spending as a tactic for economic stimulus.
- Second, tightened credit markets are posing an obstacle to raising debt finance for infrastructure delivery models – pub-

lic or private – that depend on high levels of up-front capital repaid over the long term through user fees or general taxation.

- Thirdly, government balance sheets are constrained, making it more difficult to fund infrastructure projects.
- In light of the above trends, a number of on-going schemes and programmes under different Ministries of the Government of India (GoI), the Government of West Bengal, KMC, funding from Donor Agencies, international funding for conservation activities and other institutional funds that are accessible for funding feasible interventions towards the promotion of a Green Economy in Kolkata have been identified. The nature of this funding is outlined below.

Figure 51: Funding Options for Promotion of Green Economy in Kolkata



1. Ministry of Skill Development and Entrepreneurship, GoI – This ministry has initiated collaborations with relevant central ministries, state governments, international organisations, industry and NGOs for multi-level engagement and greater implementation of skill development efforts.

2. Ministry of Labour and Employment, GoI – The Ministry of Labour and Employment can be approached for introducing new courses that are directly and indirectly linked to the creation of green jobs and the promotion of a 'Green Economy' and the updating of relevant syllabi for these courses. The courses can be offered through the existing network of ITIs in the country.

3. Ministry of Urban Development, GoI – The Ministry of Urban Development is the apex authority within the Government of India that formulates policies, sponsors and supports programmes, coordinates the activities of various central ministries, state governments and other nodal authorities and monitors the programmes that relate to urban development in the country. MoUD promotes projects in urban infrastructure and governance through numerous initiatives such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Capacity Building of Urban Local Bodies Scheme and the Pooled Finance Development Fund (PFDF) Scheme.

The PFDF scheme launched in 2006 aimed at facilitating the development of bankable urban infrastructure projects and the Municipal Bond Market, among other objectives. After initial success of Tamil Nadu and Karnataka, however, the scheme did not yield the expected results owing to the various pending issues related to pooled financing, such as, legislative sanctions, streamlining approval process, addressing data gaps and establishment of Urban Infrastructure Funds to expand the use of pooled bond issues. Addressing these issues and making optimal use of pooled financing could be a promising option for municipal finance in the coming years.

4. Ministry of New and Renewable Energy, GoI – This ministry has sanctioned a modified scheme on "Energy Efficient Solar/ Green Buildings" for implementation during 2013-14 and rest of the 12th Five Year plan period. The main objective of the scheme is to promote the widespread construction of energy efficient solar/ green buildings in the country, through a combination of financial and promotional incentives and other support measures so as to save a substantial amount of electricity and other fossil fuels, apart from having peak load shavings in cities and towns.

5. MPLAD Scheme – Under the scheme, each Member of Parliament (MP) has the choice to suggest to the District Collector/ District Magistrate/ Deputy Commissioner works up to Rs 5 crores/ annum to be taken up in their constituency. The Rajya Sabha MPs can recommend works in one or more districts in the State from where they have been elected. The Nominated Members of the Lok Sabha and Rajya Sabha may select any Districts from any State in the Country for implementation of their choice of work under the scheme.

6. Bidhayak Elaka Unnayan Prakalpa Scheme (MLALAD Scheme) – Under this scheme, each MLA is entitled to recommend schemes for Rs 50 lakhs for each financial year for their Constituency during the tenure of membership of the Legislative Assembly. The work under this Prakalpa shall be developmental in nature based on locally identified needs. The emphasis should be on creation of durable assets. The funds may also be used for provision of service support facilities and community benefits for the socio-economic benefit of the constituency.

7. Directorate of Industrial Training, Govt. of West Bengal

THE CURRICULUM OF THE VOCATIONAL TRAINING PROGRAMMES CURRENTLY PROVIDED COULD BE MODIFIED TO SUIT THE NEEDS OF THESE "GREEN" SECTORS. NICHE SECTORS SUCH AS ROOFTOP GARDENING/ FARMING, GREEN BUILDINGS, SUSTAINABLE TOURISM, WASTE RECYCLING AND OTHERS ARE SEEN AS HAVING IMMENSE POTENTIAL TO HARNESS EMPLOYABLE SKILLS, WHILST ALSO BUILDING THE PLATFORM FOR ENTREPRENEURS.

– Vocational Training in the State of West Bengal predominantly is based upon two flagship schemes, namely the Craftsmen Training Scheme (CTS) and the National Apprenticeship Training Scheme (NAT). The CTS provides institutional training, whereas NAT is a combination of institutional as well as on the job training in which trainees are exposed to real life industrial environments. Modular Employable Skill (MES) under the Skill Development Initiative Scheme (SDIS), GoI has also been introduced by this Directorate.

8. Donor Funds – The GoI is deeply involved with international agencies, both governmental and non-governmental. Agencies of many countries are actively participating in the government's efforts for infrastructure development and the promotion of a 'Green Economy'. Similar donor agencies are active in India, particularly towards the promotion of green economies within the country.

9. International Funding for Conservation Activities – There are also several international institutions funding conservation activities across the globe which can be utilised in Kolkata.

10. Other Institutional Funds – In addition to the ongoing schemes and programmes of Central and State Governments, international funding for conservational activities and funding from donor agencies, there are a number of other institutional funds that can be tapped for the promotion of a 'Green Economy' in India.

Investment in Training and Capacity Building

Improving governance at the level of the Urban Local Body (ULB) by way of training and capacity building activities, it is important to ensure effective planning and delivery of these training programmes over a period of time. Given that, by 2030, many of India's cities and metropolitan areas will become larger than most countries in terms of both GDP and population, it is vital that the state of governance in Indian cities is improved. Building effective governance is about ensuring a suitable mandate, designing effective structures, delegating power, embedding accountability and making sure the ULBs have appropriate and sufficient capabilities at their disposal.

KMC has undertaken quite a few initiatives to improve service delivery to its residents. However, additional capacity building is still required at various levels within KMC to strengthen it as an institution so that it can deliver quality services to its residents on a regular basis in a sustained manner. This is especially true of its ability to deliver activities that are linked to climate change and the city's ability to respond to natural disasters.

Investment in Consultancy Services

On a global basis, while adaptation to climate change is still seen as more of a public sector focus than mitigation, some increased focus on private sector participation has been evident. The private sector should also be seen as a "supplier of innovative goods and services". There is a clear need to meet the adaptation priorities of developing countries with expertise in technology and service delivery.

Capital Investment

Infrastructure funding is characterised by non-recourse or limited recourse funding, large scale investment, long gestation periods, high initial capital, low operating cost and repayments from the revenues generated from the project. Typically government has been the sole financier for these projects and has been responsible for implementation, operations and maintenance of these projects. However government solely may not be able to meet the rising funding requirements in the future.

Banks and financial institutions can play a major and decisive role in these global efforts to respond to the potential impacts associated with climate change. As providers of finance, banks can ensure that businesses adopt environment-friendly practices. Incentives by way of offering cheaper funds for adopting green technologies will have a long term beneficial impact on the environment.

Proposed Interventions and Cost Estimates

Urban Local Bodies (ULBs) have critical roles in adaptation to climate change in the country, as well as in mitigation by way of reducing greenhouse gas emissions. It can be argued that they have the central role in adaptation within their jurisdictions – although it is obvious that they need a supportive institutional, regulatory and financial framework from higher levels of government and also from international agencies, wherever there is a possibility for external support/ assistance.

KMC plays an important role in responding to the impacts of climate change, by way of timely investment on green initiatives at the city level. The following are the interventions proposed across multiple sectors for achieving low carbon and climate resilient development in Kolkata with a continued investment of ₹ 4,199.54 million and much more over the period of 10 years.

The proposed interventions are spread across various sectors/ modules and a broad classification of the proposed interventions based on the same is provided in the following sections.

Further, the proposed interventions are prioritised as Short-term, Medium-term and Long-term plans based on their implementation and operational periods. Short term interventions are planned over a period of 0-2 years, medium term interventions are planned over a period of 2-5 years and long term interventions are planned over a period of 5-10 years.

The chart below gives a break-up of the cost estimates based on priority:

Out of the total cost estimated for implementation/ execution of the proposed interventions of ₹ 4,199.54 million, ₹ 1,634.54

Cost estimated for implementation/ execution of interventions proposed in Solid Waste Management sector is ₹ 2,515 million. Five interventions are proposed for creation of suitable infrastructure facilities to handle both Bio-degradable and Non-biodegradable waste in the city

million (38.92%) is prioritised for implementation/ execution over the short-term, INR50 million (1.19%) is prioritised for implementation/ execution over the medium term and ₹ 2,515 million (59.89%) is prioritised for implementation/ execution over the long term, towards the achievement of low carbon and climate resilient development in Kolkata.

Summary of Proposed Interventions and Cost Estimates – Module-wise

S.No.	Proposed Interventions	Downstream Assignment	Estimated Cost (₹ Million)
I. Climate Smart Built Environment in Kolkata			
1.	Setting up of a Green Building Cell (GBC) at KMC	Commissioning of a Green Building Cell	4.92
2.	Training & Capacity Building of KMC Officials – Green Building Cell	Organising Training Sessions	0.40
3.	Developing suitable Infrastructure facilities at KMC for GBC	Procurement and Installation of Infrastructure Facilities	0.98
Sub – Total			**6.30**
II. Climate Smart City Mobility in Kolkata			
4.	Enforcement of Auto Fuel Quality Norms and Emission Standards	Organising Training Sessions	1.20
5.	Drafting of a Parking Policy for KMC	DPR[1] Preparation	15.00
6.	Introduction of Public Bicycle Sharing System in Kolkata	DPR Preparation	6.00
7.	Introduction of Organised Taxi Services by UMTA/ KMC	Feasibility Study	6.00
II. Climate Smart City Mobility in Kolkata			
8.	Organising Auto-rickshaw Services within KMC	Feasibility Study	10.00
9.	Improving Conditions of Pedestrians and Cyclists	NMT Master Plan Preparation	30.00
10.	Introduction of Congestion Tax	Feasibility Study	5.00
11.	Promotion of Integrated Public Transit System	DPR Preparation	100.00
Sub – Total			**173.20**
III. Strategy and Action Plan for Climate Induced Public Health Hazards			
12	Development and Roll-out of an IT enabled Grievance Redressal Mechanism at KMC	Commissioning and Operating Grievance Redressal Cell	10.00
13	Development and Roll-out of a Health Management Information System (HMIS) at KMC	Commissioning and Operating Health Management Information System (HMIS)	70.00
Sub – Total			**80.00**
IV. Climate Induced Multi-Disaster Management Plan			
14	Setting-up of a City Level Disaster Management Coalition and Emergency Operation Centre	Commissioning and Operation of City Level Disaster Management Coalition and Emergency Operation Centre	10.00
15	Information and Communication System for Local Floods, Water Logging and Heat Waves	Commissioning and Operating the Information and Communication System for Local Floods, Water Logging and Heat Waves	50.00
16	Tidal Back Flow Prevention System	DPR Preparation	6.00
Sub – Total			**66.00**
V. City Business Plan for Promotion of Green Economy in Kolkata			
17	Training for Promotion of Green Economy in Kolkata	Organising Training Sessions	9.60
18	Primary Survey for Promotion of Green Economy in Kolkata	Commissioning Primary Survey	5.00
19	Facilitation Centres for Promotion of Green Economy in Kolkata	Commissioning and Operating the Facilitation Centres	5.44
Sub – Total			**20.04**

[1] Detailed Project Report

VI. Sensitisation Programme[2] for Councillors and Members of the Mayor-in-Council at KMC			
20	Training Programme for KMC Councillors and Executive Staff	Organising Training Sessions	0.30
21	Study Tours for Bureaucrats and Executive Officers	Organising Study Tours	0.35
22	Promotional Activities – Green Ward Award Scheme	Organising Green Ward Award Scheme/ Competition	0.75
Sub – Total			**1.40**
VII. Policy Guidelines for Grid-connected Rooftop Solar Panels[3]			
23	Installation of Carbon-neutral Solar PV street Lights in Public Parks of Kolkata	Selection and Appointment of Private Agencies/ Contractors for execution of underlying works	37.60
Sub – Total			**37.60**
VIII. Energy Efficiency – Preparation of an Energy Policy and Action Plan for KMC[4]			
24	Introduction of Rainwater Harvesting and Rooftop Solar PV in KMC Buildings	DPR/ TEFR[5] Preparation	2.00
25	Introduction of Block Metering in KMC Markets	DPR/ TEFR Preparation	5.00
26	Introduction of Energy Efficient Air-conditioning System in KMC Offices	DPR/ TEFR Preparation	2.00
27	Preparation of City-wide Energy Efficient Lighting Plan for Street Lighting	Preparation of EE Lighting Plan & Technology Demonstration	50.00
28	Introduction of Performance based O&M Contracts for Water Supply and Sewerage Services in KMC Area	DPR/ TEFR Preparation	2.00
29	Introduction of Energy Efficient Lighting System for Office Buildings	DPR/ TEFR Preparation	2.00
30	Short Term Action Plan for Water Pumping stations Owned and Operated by KMC	Selection and Appointment of Private Agencies/ Contractors for execution of underlying works	87.00
31	Long-term upgrading of technology including future capacity enhancement in KMC Water Supply and Sewerage and Drainage systems	DPR/ TEFR Preparation	---
Sub – Total			**150.00**
IX. Climate Smart Solid Waste Management Strategy for KMC[6]			
32	Primary Collection of Non-biodegradable Waste	Selection and Appointment of Private Agencies/ Contractors for project execution	10.00
33	Segregation of Non-biodegradable Waste	Selection and Appointment of Private Agencies/ Contractors for project execution	320.00
34	Transportation of Non-biodegradable Waste to Recycling Units/ Plants	Selection and Appointment of Private Agencies/ Contractors for project execution	383.00
35	Non-biodegradable Waste Recycling Units/ Plants	Selection and Appointment of Private Agencies/ Developers for project execution	682.00
36	Compost Plant for Treatment of Bio-degradable Waste	Selection and Appointment of Private Agencies/ Developers for project execution	1,120.00
Sub – Total			**2,515.00**

[2] The assumptions and cost estimates presented in this section are as provided by International Council for Local Environmental Initiatives (ICLEI) South Asia. PwC disclaims all liability to any party who may place reliance on such assumptions and cost estimates, and therefore does not assume responsibility for any loss or damage suffered by any such party in reliance thereon.

[3] The assumptions and cost estimates presented in this section are as provided by Ashden India Renewable Energy Collective and Meghraj Capital Advisors (India) Pvt. Ltd. PwC disclaims all liability to any party who may place reliance on such assumptions and cost estimates, therefore does not assume responsibility for any loss or damage suffered by any such party in reliance thereon.

[4] The assumptions and cost estimates presented in this section are as provided by Ernst & Young LLP. PwC disclaims all liability to any party who may place reliance on such assumptions and cost estimates, and therefore does not assume responsibility for any loss or damage suffered by any such party in reliance thereon.

[5] Techno Economic Feasibility Report

[6] The assumptions and cost estimates presented in this section are as provided by Ernst & Young LLP. PwC disclaims all liability to any party who may place reliance on such assumptions and cost estimates, and therefore does not assume responsibility for any loss or damage suffered by any such party in reliance thereon.

Table 1 Summary of Proposed Interventions and Cost Estimates – Module-wise

S.No.	Proposed Interventions	Downstream Assignment	Estimated Cost (₹ Million)
X. Land Use Control and Development Guidelines			
37	Hooghly Riverfront Master Plan	Master Planning and DPR/ TEFR Preparation	500.00
38	Heritage Master Plan and Area Action Plan for Kolkata	Preparation of Heritage Master Plan and Area Action Plan	400.00
39	Preparation of a Transit Oriented Development (TOD) Strategy for Kolkata	Preparation of TOD Strategy and DPR/ TEFR Preparation	100.00
40	Preparation of a Landscape and Urban Design Strategy for Kolkata	Preparation of Landscape and Urban Design Strategy, Commissioning and Operating Design Cell	150.00
41	Sustainable Stormwater Management – Water Sensitive Urban Design (WSUD)	---	---
Sub – Total			**1,150.00**
Grand Total			**4,199.54**

The estimated capital cost across interventions proposed for creation of suitable infrastructure facilities is ₹ 2,776.02 million and forms 66.10% of the total cost estimate

Table 2 Break-up of Cost Estimates based on Priority

S.No.	Priority	Estimated Cost (₹ Million)
1.	High (0 – 2 years)	1,634.54
2.	Medium (2 – 5 years)	50.00
3.	Low (5 – 10 years)	2,515.00
Total		**4,199.54**

Figure 52: Proposed Interventions and Cost Estimates – Module-wise

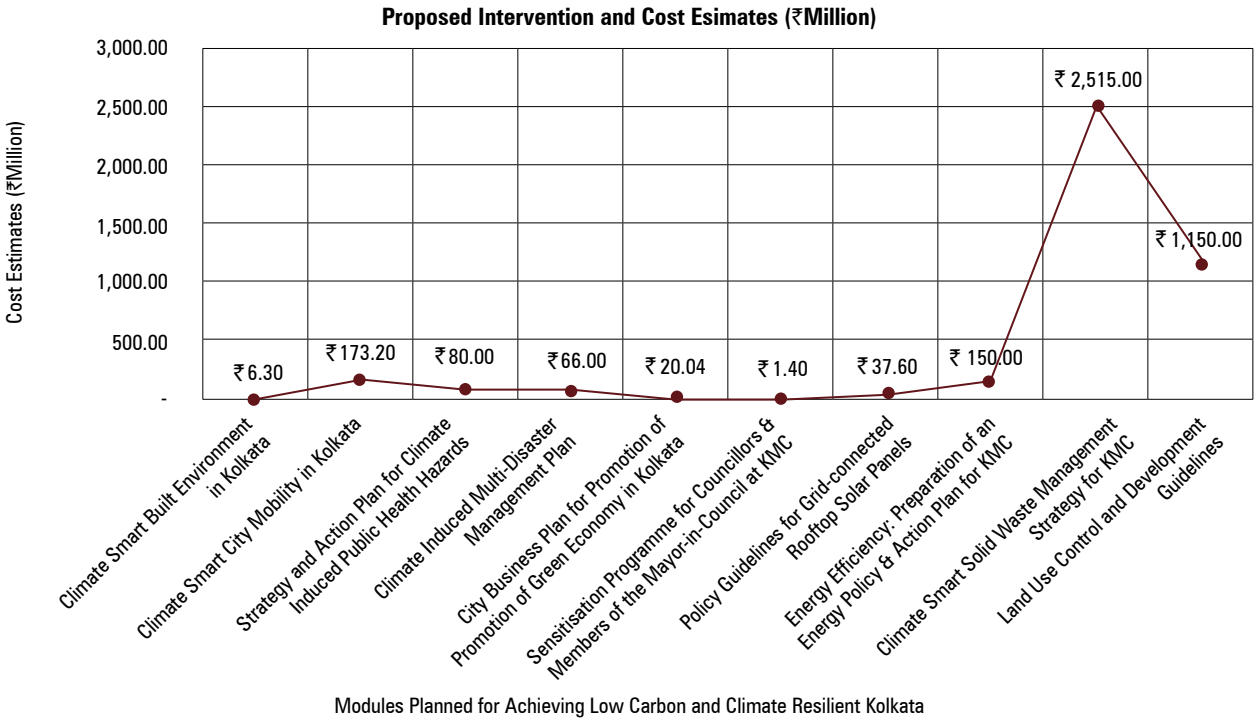
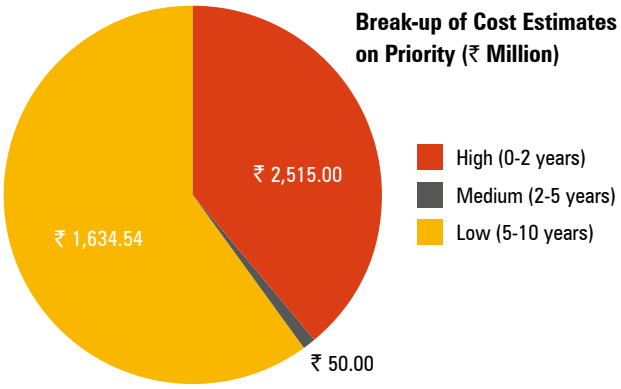


Figure 53: Break-up of Cost Estimates based on Priority



Break-up of Cost Estimates based on Type of Investment		
Type of Investment	**Investment Requirements (INR million)**	**Proportion**
Technical Assistance (Training & Capacity Building)	27.52	0.66%
Technical Assistance (Consultancy Services)	1,396.00	33.24%
Financial Assistance (Capital Investment)	2,776.02	66.10%
Total	4,199.54	100.00%

On a pilot basis, installation of 301 number of carbon-neutral solar PV street lights across 28 public parks maintained by KMC is proposed. A rough estimate of the quantum of reduction in carbon emission and the quantum of energy savings puts the figures at 211 tons of CO_2 equivalent per annum and 30,204 KWH per annum respectively

Key Messages

- KMC needs to put in place a dedicated team that would be responsible for preparatory activities associated with the implementation of the proposed interventions. A PMU approach could be considered in view of existing manpower constraints within the KMC and the need for extensive multi-departmental coordination. The proposed institutional framework could be led by a High Powered Steering Committee at KMC.
- KMC may segregate interventions for which further detailing can be undertaken in-house and those for which procurement of suitable services from external agencies is required.
- KMC may need to determine a suitable implementation framework for each of the proposed projects including item-rate contracts, engineering procurement and construction, public private partnerships so as to facilitate successful project implementation. As part of this process, KMC will need to determine in consultation with relevant State authorities an appropriate means of financing the projects.

THE GOVERNMENT SHOULD SUPPORT THE CONSTITUTION OF A 'STANDARD SETTER' OR 'RATING AGENCY' TO APPROVE, CERTIFY OR RATE GREEN PROJECTS (OR INVESTMENT VEHICLES SUCH AS GREEN BONDS OR GREEN FUNDS) TO ENSURE THAT FUNDS ARE USED JUSTIFIABLY FOR GREEN INVESTMENTS.

PART D
SPREADING THE MESSAGE

Section D1: Ward Action Plans

There are now 144 Wards in 16 Boroughs within KMC's area; three of these are new wards that have been added relatively recently. Each ward has an elected Councillor, who is responsible for the wellbeing of the ward residents and for helping to ensure that municipal services within the ward are run efficiently and effectively.

The Ward Councillors will need to play an important role, if measures to mitigate climate change are to be successful, at the 'grass roots' level. Therefore, in addition to the 'top-down' approach that has been adopted for a number of modules under this UK-KMC Programme, which have recommended the strategic policies presented earlier in this document, the Programme also recognises that without 'buy-in' from local residents and elected local Councillors, achieving the end goal of a low carbon and climate resilient Kolkata will be difficult.

The Programme envisages a larger role for the local Councillors and seeks to place the responsibility of spearheading implementation of localised climate-smart interventions with them.

The Task

To help the Councillors with this approach, Ward Action Plans are proposed for each ward. These promote a 'bottom-up' approach with active involvement from the residents, through their elected representative, with actions that are targeted at the actual end-user. Together, these plans aim to help make the city climate-smart by developing an understanding of the different issues faced by the residents of each and every ward.

Scope of Work

- Preparation of 1 year Action Plan for 5 KMC Pilot Wards
- Creation of an evidence-based baseline for benefit monitoring
- Preparation of a Community Mobilisation Strategy to engage and involve local people

Objectives

- Suggest climate friendly interventions to enable climate resilience in Kolkata
- Encourage use of innovative and low cost solutions to tackle climate change
- Create jobs and generate livelihood opportunities for the local community

Potential Interventions

- restoration of the city's landscape;
- conservation/ improved use of water bodies and green pockets;
- creation of green verges;
- blighted area redevelopment;
- bio-diversity conservation;
- waste management;
- energy savings;
- promotion of green livelihood;
- energy-smart mobility;
- community awareness building.

The Ward Action Plans are prepared by means of a process-oriented approach to address climate issues with innovative and simple interventions that actively involve the citizens and where appropriate Non-Governmental Organisations (NGOs) and Civil Society Organisations (CSOs). It is hoped that these can yield faster and more visible results to make the city resilient and to make a difference for many of its citizens.

As part of the Programme, it is not possible to prepare Ward Action Plans for all 144 Wards. Instead a 'Pilot Project' approach as had to be adopted, whereby the Programme can illustrate the steps required in a small number of wards with these then being replicated elsewhere in the city. Therefore, Ward Action Plans are being prepared for five wards within the city. These will be reported upon separately once they are complete. Here it is only possible to outline the steps required to complete the process, starting with ward selection.

Selection of Wards

In keeping with the agreed Programme, five pilot wards were to be selected and a Ward Action Plan would be prepared for each of these with the assistance of the Ward Councillor.

The selection methodology followed was to identify wards that faced a number of different urban challenges due to the ward's physical location or due to a range of other community-detrimental criteria. These included:

- high vulnerability to floods and other natural calamities;
- unplanned and rapidly changing land use;
- high population growth;
- inadequate civic infrastructure; and
- presence of environmentally sensitive zones/ hot spots that needed to be conserved.

To identify such wards, the following parameters were used.

Selection Criteria	
1	***Vulnerable Wards identified by the World Bank report*** – The report "Vulnerability of Kolkata Metropolitan Area to Increased Precipitation in a Changing Climate" listed what it considered to be the most vulnerable wards, assessed on the basis of topography, land use, infrastructure, social parameters and predictions on natural calamities.
2	***Vulnerable Wards identified by the WWF report*** – This identified the KMC Wards, located alongside the Ganga, as being vulnerable to natural disasters. Vulnerability was decided on the basis of the presence of a large slum population and the number of industries that would be adversely affected by floods.
3	***Waterlogged areas*** – Wards that include areas that are known to be "major water logging pockets" in the KMC Action Plan to mitigate flood, cyclone and water logging.
4	***Decadal growth in population*** – Wards with a high population growth over the last decade.
5	***Rapidly changing land use pattern/ growth corridors*** – Wards that fall along/ within the spatial growth corridors and are suffering from high degrees of urban sprawl.

Selection Criteria	
6	***Wards which lack parks/ open space*** – Based on the Centre for Contemporary Communication report on open space, which identified a number of Wards that lacked open/ green spaces.
7	***Added areas under KEIIP interventions*** – The Kolkata Environmental Improvement Investment Program (KEIIP) aims to provide organized sewerage and drainage facilities to areas that lack these basic necessities. Wards with no/ minimal facilities became eligible.
8	***Wards with high green cover, water bodies or interface with environmentally sensitive zones/ hot spots that need to be conserved*** – KMC has classified Wards into different categories based on green coverage. The 'Ward-wise Open Area Index' gives the percentage of tree coverage in a given area. Wards with high green coverage have been included as they require protection before this asset is destroyed/ lost.

Using the above criteria, several wards were shortlisted. Out of the total of 144 wards, some 16 were initially selected, effectively representing one ward for each city borough.

This long list was submitted to KMC for refinement and ultimate selection of the five wards, with the selection process being based upon the ward's location in the city and other criteria including demographic and socio-economic profiles.

Based on the above process, the following 5 wards were selected:

Ward 33 – Beliaghata, in the north east of the KMC area, on the border with the neighbouring municipality of Bidhannagar. (Population of approx. 46,000)

Ward 58 – Topsia/ Dhapa, covering both urban and rural areas in the eastern part of KMC. (Population of approx. 88,500)

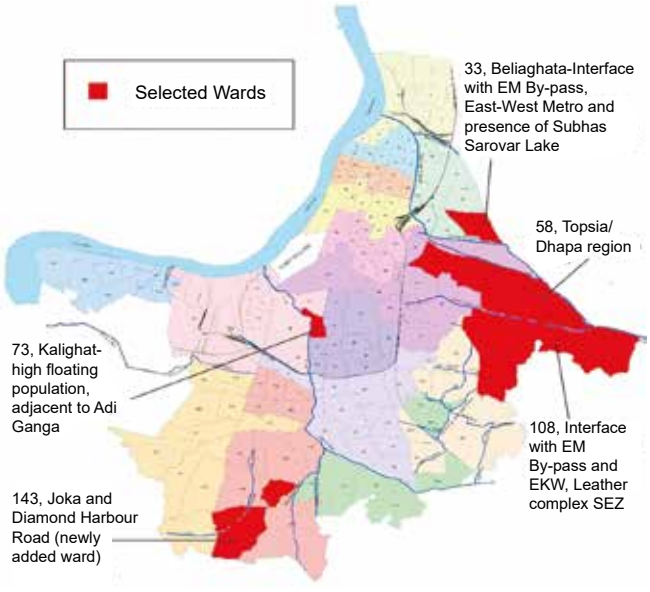
Ward 73 – Kalighat, an established residential area, located to the south of Kolkata's central area. (Population of approx. 24,000)

Ward 108 – Unnamed Ward on the eastern fringe on the KMC area. Predominantly rural. (Population of 65,000)

Ward 143 – Joka/ Diamond Harbour Road. One of the three new wards and a mix of urban and rural traits. (Population unspecified)

Based on the lessons learnt whilst implementing interventions in these five pilot wards, KMC will be able to prepare similar Ward Action Plans for other wards in the city.

Figure 54: The Selected Pilot Wards



Community Mobilisation Strategy

As indicated above, the intent was to use a participatory and community-based approach to implement the recommendations of the Ward Action Plan, which had a one-year implementation time horizon. The basis for this short timeframe was that it would help the communities in taking immediate action towards solving their most pressing problems and to do this as a collective effort. It was hoped that by being involved in the process and having to continually review local practices and services, the community members themselves would become active 'experts', able to solve existing, as well as new problems that arose within the community. The level of commitment from the participating members also ensures ownership over the monitoring activities and accountability from those involved to provide quality services. Thus, it was considered appropriate to involve community members actively in all stages of the process.

In addition to the community members, there are a number of other stakeholders who will be able to participate in the process in one capacity or another, as indicated below.

- The Ward Councillors will act as the project lead, coordinating the activities of the community groups, mentoring, where required and facilitating KMC funds, when possible;
- KMDA can help with advice on planning issues and the legal

Figure 55: Plan of Work required in the Ward

implementation of the Ward Action Plans;

- The Municipal Affairs Department, Government of West Bengal can contribute through provision of advice and, where necessary, facilitate actions with regard to healthcare improvement programmes and provision of basic municipal services.

Ward Action Plan activities could take the form of small interventions and projects that can help in improving basic living conditions; it is not envisaged that long-term, large-scale municipal projects will form part of the Action Plans. Ward Action Committees may be formed to undertake these community-led interventions through active involvement of the local community members.

Their participation is envisaged on two levels, namely:

1. Involvement in Planning
2. Involvement in Implementation, Execution and Monitoring

Implementation of the Ward Action Plans

Ward 58: Model Climate Resilient Neighbourhood Development

As has been discussed earlier, a pilot settlement was identified within one of the five selected Wards, to understand how the proposed community-led approach would work in practice. The neighbourhood, identified by the KMC, is located at Christopher Road in Ward 58 and is understood to be one of the larger areas of low-income groups within the city.

Figure 57: Ward Action Plan - the Process

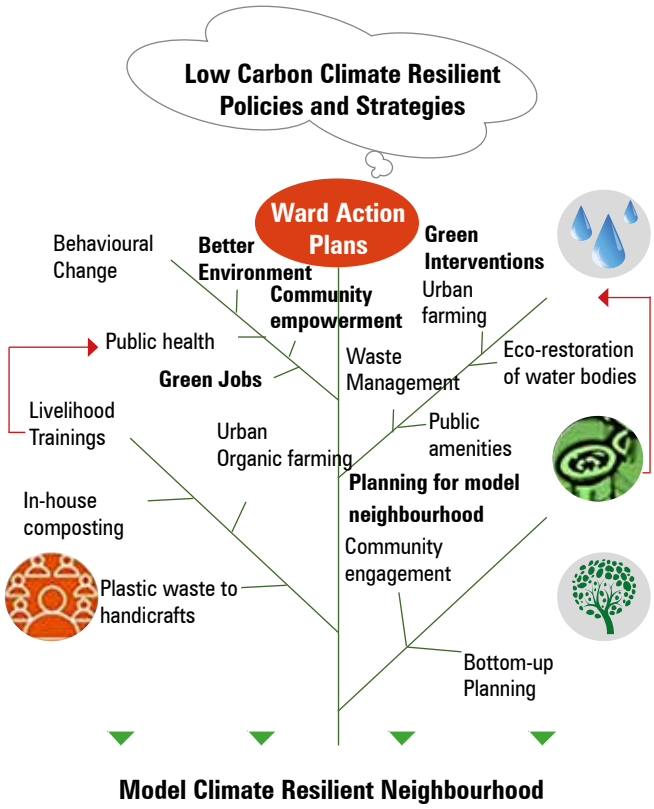
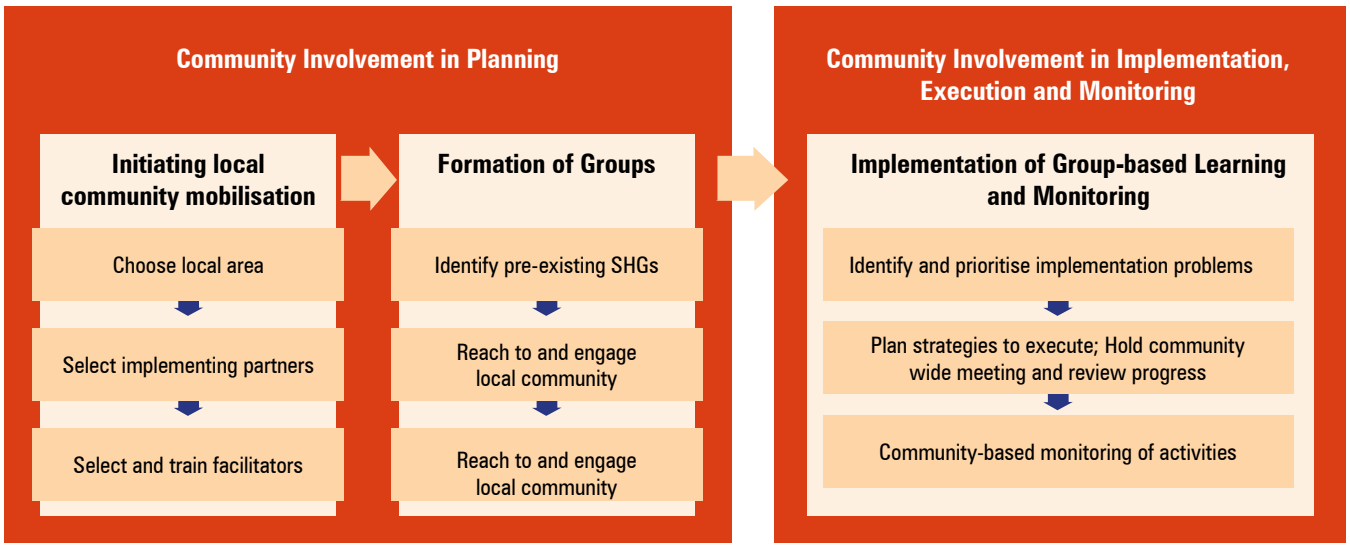


Figure 56: Community Involvement in the Planning Process



Ward No.	Key issues & Vulnerabilities	Recommendations
Ward 33	• Increased eutrophication of Subhash Sarovar. • Lack of footpaths, encroachment of footpaths, lack of last mile connectivity and poor infrastructure at existing bus stops and pedestrian crossings. • High fire risk due to the presence of inflammable storage. • Depletion of the ground water due to indiscriminate extraction. • Water logging along the low-lying drain outlets during heavy rainfall due to drainage overflow/ clogging of drains. • Low family incomes, less access to remunerative jobs and productive resources.	• Eco-restoration of Subhash Sarovar Lake through Bio-engineering techniques; • Decentralized Organic Composting System. • State-of-the-Art Bus-stops, Cycle-lanes and footpaths; Public Cycle Sharing System. • Ward-wise contour maps highlighting low lying areas inundated by flooding for preparedness plan. • Developing welfare benefits for people within 4 km radius of the area affected by flooding and waterlogging. • User-need assessment, Training Need Assessment, awareness generation, training and capacity building measures. • Upgrading the two canal embankments along the two boundaries of the wards through landscaping and phyto-remediation technique.
Ward 58	• High density informal settlements coupled with rapid real estate development; 60% of the families living in low income settlements. • Degraded quality agricultural produce due to overuse of the Dhapa Landfill site. • Dearth of sanitation facilities • Lack of proper drainage and wastewater outlets. • Water logging in majority areas due to unavailability of drainage outlets/ silting of the open drains. • Lack of footpaths, encroachment of footpaths, lack of connectivity of the real estate to the public transport corridor and poor infrastructure at existing bus stops and pedestrian crossings.	• Organic material recovery facility/ Compost system, bio-toilets and Bio-Phyto-ponic system for water treatment. • Urban Farming at household level and marketing and outreach facilities through the KCCC Cell of KMC. • Eco-restoration of the water bodies through bio-remediation, phyto-remediation and floating garden. • Green-capping of the Landfill Site and Leachate Treatment. • State-of-the-Art Bus-stops, Cycle-lanes and footpaths; Public Cycle Sharing System. • Developing welfare benefits for people within 4 km radius of the area affected by flooding and waterlogging.
Ward 73	• Waterlogging during monsoons and high tides in the Adi Ganga as well as tidal backflow in the canal. • Decreasing ground water level. • Improper design of the road junction and pedestrian crossing. • Lack of infrastructure for auto rickshaws and buses. • Heavy vehicular movement in inner streets.	• Green Sky Market and Green Technology interventions to create Smart Vending Zones. • Decentralized material recovery facility for composting organic waste from the temple, shops and residents. • Adi-Ganga restoration using Bio-remediation and Bio-engineering techniques; installation of Bio-Toilet beside it; restricting disposal of waste flowers to the river and organized collection of them by the vendors association. • State-of-the-Art Bus-stops, Cycle-lanes and footpaths; Public Cycle Sharing System.
Ward 108	• Highly vulnerable to flooding and waterlogging during annual monsoon rains. • Predominantly resided by low-income group residents, based on agro-economy in informal settlements; 14 slum pockets with 2770 families. • Lack of treated drinking water, proper drainage facilities across residents • Lack of footpaths, last-mile connectivity, integration between bus and feeder services and high traffic volume in inner/ narrow lanes.	• Canal restoration and upgradation of Chowbaga canal through Bio-Engineering techniques; promotion of water sports and angling in large ponds and wetlands. • Mobilization and streamlining of rag-pickers. • State-of-the-Art Bus-stops, Cycle-lanes and footpaths; Public Cycle Sharing System • Preparation of the 'Preparedness Plan' based on the ward-wise contour mapping of the topography. • Developing welfare benefits for people within 4 km radius of the area affected by flooding and waterlogging. • High flood levels and water logging levels to be marked on major public infrastructure and awareness program for preventing clogging of drains.
Ward 143	• Less developed since it was erstwhile a peri-urban municipality and recently got added to KMC, primarily depended on agriculture. • Lack of basic municipal services with narrow roads without footpaths. • Vulnerable to waterlogging and flooding due to low topography, overflowing of the canals and lack of drainage facilities with certain pockets remaining inundated throughout the year resulting in loss of income for a large proportion of residents. • Not all households connected to piped water supply. • Prevalence of open drainage channels and dumping of wastes results in unhygienic living conditions.	• Public Health Awareness creation and Installation of Bio-toilets. • Eco-restoration of Open Water Bodies and Ponds. • State-of-the-Art Bus-stops, Cycle-lanes and footpaths; Public Cycle Sharing System. • Preparation of the 'Preparedness Plan' based on the ward-wise contour mapping of the topography and low-lying areas inundated by flooding. • High flood levels and water logging levels should be marked on the major public infrastructures and the newly constructed buildings for generating awareness.

It is hoped that it would act as a demonstration project for KMC to replicate in other similar areas. The general process followed is shown opposite in Figure 57, whilst the following interventions were undertaken with the local community.

Livelihood Training - Green Options

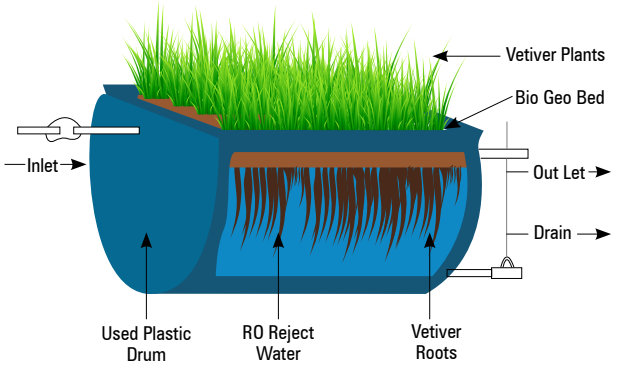
Training sessions were held with modules based on discussions with the residents. The sessions focused on eco-restoration and the creation of livelihood opportunities, especially for the women residents.

Training modules, therefore, covered:

- Composting from household organic waste
- Recycling of waste plastics to create handicraft items and planters
- Organic urban farming

From the discussions held during the training sessions, the following projects of relevance to climate change were identified as being the ones that should be included within the one year Ward 58 Action Plan and which can be implemented by the local community:

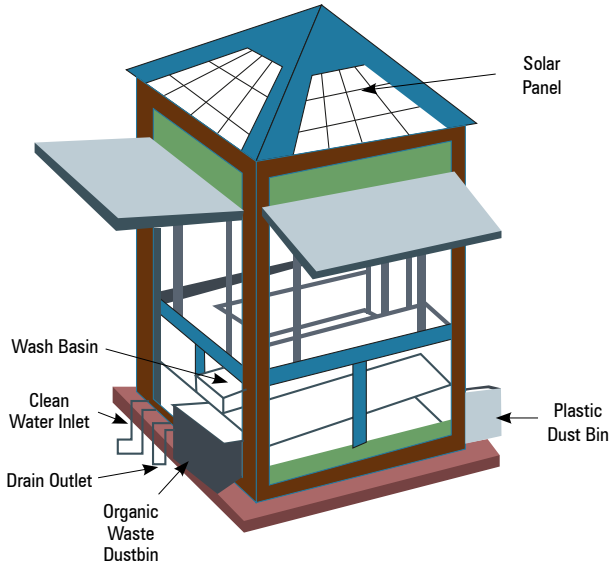
Figure 58: Bio-phytoponic water treatment system proposed



1. Organic waste compost system;
2. Inorganic waste such as waste plastics, disposable pet bottles etc to useful products such as planter bags and artefacts;
3. Urban farming – seedling nursery and organic vegetable cultivation;
4. Eco-restoration with Bio-remediation and Photo-remediation, together with the introduction of floating gardens and floating agriculture beds (with KMC support in dredging and debris removal);
5. Bio-toilet installation; and
6. Installation of solar powered RO drinking water with reject water recovery system (250 lph)

The success of the Ward Action Plans will depend on the implementation of the actions suggested by the community and incorporated into the plan with agreement of the Ward Councillor. The Councillor along with other stakeholders, such as KMC, will need to take a proactive role and act as the facilitator for obtaining the small funds required to implement the projects. In part, success will need to be measured by the pace of investment mobilisation for the suggested projects, which will be important to maintain momentum.

Figure 59: Eco-friendly street vending kiosk proposed



However, involving the local communities and self-help groups in all stages and activities will increase the support for the projects.

It is hoped that through preparation of these initial five Ward Action Plans, a similar exercise can be undertaken in the city's other Wards, phased as necessary, so that measures of relevance to the mitigation of problems that relate to various climate and livelihood related issues can be addressed. It is believed that such a 'bottom-up' approach, used in tandem with the strategic policies recommended for adoption under other modules, will go some way to solving problems faced by the end-users.

Key Messages

- Much of the work under this Programme has focussed upon the actions required by the State or by KMC, the body that provides urban leadership in Kolkata. These essentially are considered to be a 'top-down' approach to urban development. However, there are significant advantages for developing a bottom-up approach in communities throughout the KMC area. These should be championed by the local ward councillor, who can bridge the gap between the needs of his 'community' and the KMC.
- The proposed implementation model of the Ward Action Plans needs to incorporate a larger proportion of community-led decentralised mini-projects, instead of continued heavy reliance on government/ city-led large-scale projects.
- In the pilot scheme, implementation of these community projects have shown results and seem to be a positive way to gain short-term visible results as well as ensuring sustainability of such projects.
- Several innovative pilot projects have been proposed in the Ward Action Plans, with many having potential for replicability in other KMC wards and for scope enlargement if the circumstances permit. Apart from the integrated model for climate resilient neighbourhood, interventions such as use of biotechnology (floating gardens for water body restoration), green sky malls and skywalks, green vending zones and eco-friendly street kitchen kiosks have been proposed.

Section D2: Sensitisation Programme for Councillors and Members of the Mayor-in-Council

Cities in India can no longer ignore the challenges posed by rapid urbanisation and vulnerability to the impacts of climate change, which together are stretching the limits of urban infrastructure and other urban systems, thus impacting the city's basic services.

Kolkata has its particular problems and is currently considered to be one of the most vulnerable urban areas due to its exposure to flooding and other potential natural disasters. While the City's Vision 2020 Strategy aims at achieving economic growth in a "resource efficient" and "eco-friendly" manner and to "provide social amenities, community facilities and securities to all", there is limited understanding of issues relating to climate change adaptation and relevant mitigation needs among the city's key decision makers. Capacity building of local municipal officials and locally elected representatives is therefore a critical first step towards building city resilience, as these are the individuals who can influence key decisions, as well as direct public behaviour towards mainstream low carbon and climate resilient interventions.

The Task

In this context, ICLEI – Local Governments for Sustainability, South Asia (ICLEI South Asia), in collaboration with the Bengal Chamber of Commerce and Industry (BCCI), conducted a sensitisation programme for councillors and Members of the Mayor-in-Council from within KMC, which focused on the low carbon and climate resilient development of Kolkata.

This involved a series of 16 borough-level training workshops targeting local Councillors and ULB officials to enhance the overall understanding of the participants on aspects, including:

- the basic rationale for pursuing climate change initiatives;
- the opportunities and challenges arising out of climate change;
- the response to climate change;
- how to encourage communities to take action on climate; and
- dos and dont's for ensuring success of mainstreaming climate change initiatives.

Figure 60: Key Components of the Sensitisation Programme

As part of the sensitisation process, ICLEI South Asia developed a toolkit for use during the training workshops. The toolkit consisted of the following items:

1. ***A Graphic Booklet*** explaining the science of climate change, its impacts on urban systems and the role of locally elected representatives in meeting the challenge of climate change.
2. ***A Compendium of Case Studies*** depicting good practices/ success stories from other areas where local governments have adopted measures to tackle climate change.
3. ***A Motivational Poster*** on Low Carbon Climate Resilient Kolkata depicting small and vital actions that could be implemented locally – by the community or individual households to address climate change.

A launch workshop was organised on 17 February 2015, during the visit of the Speaker of House of Lords and UK Parliamentarians, where the Rt Hon. Baroness D'Souza CMG, the Lord Speaker of the House of Lords, and Hon'ble Mayor of Kolkata, Mr Sovan Chatterjee, launched the sensitisation toolkit on climate change for KMC Councillors.

4. ***A Manifesto*** signed by the Mayor pledging to support climate resilience initiatives in Kolkata.
5. ***Guidelines*** for a proposed Green Ward Scheme – a mechanism to encourage and incentivise better performing wards that showcase good practices towards climate change mitigation or adaptation.

Key Findings

Key findings of the training programmes are:

- Although the basic idea of environmental change is well understood, climate change concepts are generally unclear; most of the participants need more information on the basics of climate change.
- Simple technological solutions are favoured and these should be the focus of future strategies. There is need for planning to be at a decentralised level, such as at ward or community level, so that they will have more chance of success.
- There is need for municipal officials and local NGOs/ organisations to work together on climate change and citizen behavioural changes.

During a special event on 25 August 2015, during the visit of Right Honourable Mr. Desmond Swayne, UK Government's Minister at the Department for International Development (DFID) to Kolkata, the hon'ble Mayor, in the presence of Dr Sudarshan Ghosh Dastidar, Hon'ble Minister-in-Charge, Department of Environment, Government of West Bengal and Mr Scott Furssedonn-Wood, British Deputy High Commissioner, Kolkata and other senior officials of KMC launched the Hindi and Bengali graphic booklet for councillors and the poster for KMC councillors developed as part of the toolkit.

- There is need to build linkages between local government and state government, so that complementary steps can be taken up on climate change.

Recommendations

The main recommendations that have emanated from the discussions held in the various training workshops include:

1. ***Climate change science*** – The participants were interested to know more about the science of climate change and requested more discussion on these issues at different levels, especially at the community level.
2. ***Technological support*** – The participants requested technical support in designing different technological solutions for their wards, such as rainwater harvesting systems, decentralised waste management systems, roof top solar power plant installation, vertical gardening, etc.
3. ***Community involvement*** – The participants requested assistance n involving local communities through suitable Information, Education and Communication (IEC) materials and to provide technical training to local grass root NGOs who work at the ward level, but who may not have sufficient awareness regarding climate change, its causes and impacts.
4. ***Environmental issues*** – The participants raised various environmental issues that they face and that may get worse as a result of climate change. The most common issues were regarding solid waste management, especially plastic waste management and hazardous waste management; encroachment of green and blue areas; ground water depletion and recharge.
5. ***Legislative support*** – The participants stressed the need for developing linkages with the state government to promote supportive legislations that can encourage low carbon and resilient actions to be taken up at the ward level or borough level.

Implementation of the Roadmap

The following will be required to assist in the implementation of the Roadmap proposals:

SP	Proposed Actions (Sensitisation Programme)
1	Development of annual climate change Ward Action Plan (Year 1, with annual revisions). A Ward Action Plan (WAP) will help identify issues, prioritise them and help focus activities and resources to address them. Should be revised annually. *Proposed Indicator – WAPs to be developed for all wards; monitoring system in place.*
2	IEC programmes at ward level to discuss climate change and resilience (Regular – 3/ annum). IEC activities should be arranged with the local community/ organisations, including street plays, local competitions, meetings, workshops, as well as use of print and electronic media. *Proposed Indicator – At least 3 IEC programmes/ year*
3	Identification and prioritisation of sectoral studies for each ward (Annually). WAP to identify and prioritize necessary sectoral studies so as to obtain detailed information on specific sectors and suitable plans made. *Proposed Indicator – At least one study/ year, with recommendations implemented. Recommendations costed in KMC annual budget.*

SP	Proposed Actions (Sensitisation Programme)
4	Training programmes for KMC Staff (Annually). KMC to develop a cell to organize training programmes on climate change. Technical training for KMC executive and political staff. *Proposed Indicator – At least 2 training programmes/ year.*
5	Site visits for KMC political and executive staff (Biennially). Exchange visits to learn about good climate change practices. Visits can help introduce new ideas to KMC staff. *Proposed Indicator – At least one site visit every 2 years.*

Primary Implementing Agency: KMC with support from industry and training institutions

Key Messages

- There is a clear need for capacity building among the Ward Councillors who are responsible for developing policy and guiding the planning and development of their individual wards. An institutional mechanism of regular training and capacity building would be helpful to systematically increase awareness and provide information to the political and executive staff of KMC. Site visits to other locations where innovation is being displayed should form part of this capacity building exercise.
- There is also a need to liaise with the state government to develop suitable policies that can support climate resilient actions in the city
- Development of annual climate change Ward Action Plans along lines identified in the previous section of this Roadmap should be prepared for all KMC wards. These short-term plans will help identify issues, prioritise them and help focus activities and resources to address them. They should be revised regularly and encourage contributions from the local communities.

Section D3: Knowledge Exchange Programme for KMC Officials

In the context of the UK-KMC Programme for a Low Carbon and Climate Resilient Kolkata, a Knowledge Exchange Programme was arranged for key government officials and elected representatives from KMC. The objective is to enable these representatives to expand their knowledge about best practice interventions that are available and their capacity to address climate change issues at the municipal level.

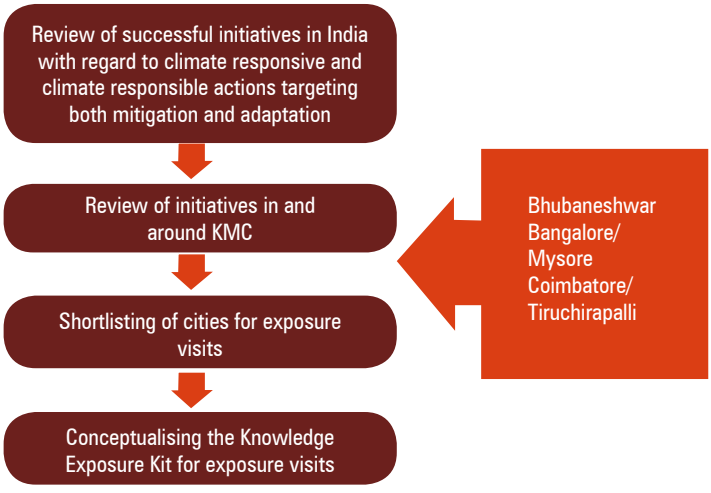
The Task

Under this task, site visits were organised for these officials to three selected cities within India which have demonstrated successful interventions for making the cities climate smart. These involve institutionalising and implementing climate responsive and climate responsible actions, targeting both mitigation and adaptation. The tour's focus was to gain increased information and knowledge on different aspects of environmental sustainability, including water management, waste management and energy security in the context of climate change impacts on urban areas and to showcase efforts undertaken by city governments to mitigate climate change impacts of climate change.

Knowledge Exchange Visits

Knowledge exchange/exposure visits were undertaken during November 2015 and included knowledge exchange events and site visits, linked to municipal activities geared towards climate change interventions.

Figure 61: Methodology and Approach



Exposure Kit Contents

Deliverable 1:

- Introduction to the issues concerning sustainable development, climate change and policy response and actions by States within India
- Impact of climate change on Kolkata and relevant case studies in the international context

Deliverable 2:

Compilation of best practices from UK on:

- Integrated planning (with a climate change focus)
- River-front development
- Heritage buildings
- Water conservation
- Wastewater management
- Solid waste management
- Energy conservation and renewable energy
- Online building/ planning applications

As part of the knowledge exchange programme, KMC officials and elected representatives visited various cities, interacted with officials from counterpart organisations and visited project sites to gain first hand exposure of best practices being followed in these cities. Here are some of the best practices found in the cities:

City	Initiative
Bhubaneswar	• City-level disaster management plan • 'Go Green' drive • Slum free city
Bengaluru	• Slum development improvements towards a Slum-free city objective • Solid waste management • Solar power • Rainwater harvesting projects
Mysuru	• Plastic-free city • GPS fleet management for waste transportation • Solid waste management • Promotion of Non-motorised transport
Coimbatore	• Energy efficiency • Solid waste management • Mobile app for toilet maintenance and SMS compliance system

Establishment of a Kolkata Centre for Climate Change (KCCC) within KMC

The **Kolkata Centre for Climate Change (KCCC)** has been set up in KMC's main offices in central Kolkata. Details of this new climate change unit are provided below.

KOLKATA CLIMATE CHANGE CELL	**Kolkata Centre for Climate Change (KCCC)**
What	The KCCC is a web-enabled and help-desk resource cell that connects managers, decision-makers, private providers, civil society and citizens with usable techniques that address climate change in the planning stages of projects and in their application. This is a virtual vis-à-vis real time resource centre. The portal along with a mobile app provides information on various building-based climate friendly initiatives such as rooftop solar, rainwater harvesting, rooftop organic farming, etc., and link the citizens with the empanelled private providers and provide them with the required information to implement climate-smart projects. This web portal, developed by IPE Global also provides information about KMC's climate-responsive interventions, UK-KMC MoU programme, local, national and international good practices, disaster management and citizen's queries. It also helps citizens to calculate their carbon footprint and rooftop solar feasibility. Visit: www.kmcclimate.org An Android Mobile App (KMCCLIMATE) was also developed by IPE Global, keeping the citizen in mind. Simple things like "what I can do to reduce carbon emission, knowledge about buying electrical appliances, etc, has been provided, along with, alerts about disaster and information about climate change Download from https://play.google.com/store/apps/details?id=com.kmcclimate
Why	With increased urbanisation and growing importance of cities in terms of their contribution to the national economy and to general development, there has been an increasing demand for avenues for participation in urban governance, to increase transparency in civic management, for modernizing administrative procedures and for improved service delivery. The KCCC provides a platform for that interface by bringing academia, private providers, civic managers and citizens together, with each working towards creating a more climate resilient Kolkata. This enables KMC to progress climate-responsive initiatives and encourage its citizens to take climate responsible actions.
Who	The facility is managed by KMC. Initial setup support was provided by the UK Government.
Where	**Location**: KMC has provided space in the existing Kolkata Municipal Digital Archive.
When	The cell was refurbished and formally inaugurated by Debashis Kumar, Mayor-In-Council and Mr. Scott Furssedonn-Wood, British Deputy High Commissioner on February 10, 2016.
How	Activities include: • Web portal (citizen – private providers) • Mobile App (information dissemination) • Knowledge dialogues (sharing and learning) • Digital resource (capacity building and wider interaction) • Library (knowledge building) • Citizen interface actions (IEC, info-tainment) • Help desk (queries, interaction, participation) • Communication list (empanelled private providers, NGOs, universities, resource personnel) • Self-explanatory models of some interventions (what, why, how to do, etc)
Technical Assistance	The UK-KMC Programme has provided the technical assistance for the setting up of the facility, including: • Design and development of a web portal for citizens and private providers interface • Design and development of a mobile app for citizens to know more about climate-responsive initiatives • Procure books, journals, etc. for the resource library • Procure e-journals for the library • Assist the facility in organising quarterly interactive sessions • Link the facility with universities/ climate-change projects • Support in creating a database of global agencies and projects

Figure 62: The KCCC Portal and Mobile App developed under the Programme

Key Messages

- A new unit established within KMC to handle all climate change related issues. This is a web-enabled and help-desk resource unit that will connect managers, decision-makers, private providers, civil society and citizens with usable techniques to address climate change in the planning stages of projects and in their application.
- The unit will be able to provide services for other modules developed under the UK-KMC Programme.
- Knowledge exchange/ exposure visits should continue for selected officials within KMC both nationally and internationally. These will ensure that councillors and other members within KMC keep up-to-date with climate change innovation occurring in other metropolitan areas.

Section D4: The Interface Plan

The purpose of the Interface Plan is to guide preparation and development of the communications strategy to ensure that all relevant stakeholders are informed of the central theme and supporting key messages that have emanated from the different components of the UK-KMC Programme.

The Interface Plan will help:
a) in the dissemination of key outcomes of the Programme;
b) in communicating the key messages that emanate from the Programme's central theme; and
c) in ensuring widespread outreach to all its stakeholders including the general public, government bodies, the media, donor agencies and others who will need to participate in some capacity.
In particular, it would facilitate:
a) dissemination of the various policy changes and strategic measures that have been recommended as part of the Programme;
b) community outreach to influence behavioural changes necessary for building support for successful climate resilience within the city, including awareness of the significant role the community will need to play in future and their contribution to the implementation of the overall programme objectives;
c) communication to all stakeholders by means of awareness campaigns and the use of various modes of print and visual media for sensitisation of the beneficiaries to the benefits and implications of programme initiatives; and
d) helping to connect and unite the community and the ULBs to undertake their respective behavioural change communication

Figure 63: Stakeholder Map

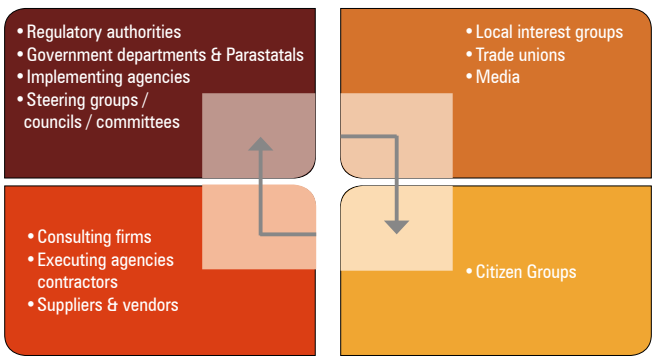


Figure 64: An Example of Urban Street Art in Kolkata

Source: HM Amby Tribute Art by [Reaper96] & [ET Crew] and E32 by [Red Crew]

(BCC) actions, etc.

The Interface Plan will also contribute significantly to ensurencreased visibility for the Programme's objectives and proposed activities in the wider national and international arenas.

The Task

The task was to develop an Interface Plan that is able to convey the key messages to the identified stakeholders, mapped in terms of their functional roles involved in contributing to the success of the overall programme objectives. Some of the key stakeholders involved are indicated in Figure 64 (*previous page*).

The Interface Plan discusses in detail the key modes of interface proposed; messages to be delivered as part of the outreach plan; content for dissemination of the final project outcomes; and an implementation plan for it.

Programme Messages and Interface Modes

The Programme can leverage existing government efforts where these are applicable and relevant to stakeholders. KMC, for example, has already been actively using social media platforms such as WhatsApp and Facebook for disseminating KMC initiatives. The use of these platforms can be strategically increased alongside traditional modes of outreach such as television and print news network to ensure greater public interface.

Relevant government initiatives such as the Swachh Bharat Mission (SBM) and the National Environmental Awareness Campaign (NEAC) can also be used to promote programme objectives. The SBM promotes public participation by assisting ULBs with appropriate Information, Education, Communication (IEC) materials. These IEC materials target the general public, including school children and the materials include quizzes, crosswords, pictorial games on waste segregation and similar subjects.

Figure 65: Street Play for mass awareness on climate change performed at one of the events under the programme

The NEAC involves educational institutions, community organisations, training institutions, professional institutes, NGOs and action research groups to organise various programmes at different community levels – local, regional and national – to create environmental awareness. Every year NEAC develops an annual theme to promote environmental awareness in a specific direction; topics have included subjects like biodiversity conservation, combating desertification, land degradation and the

effects of drought.

The West Bengal Pollution Control Board as part of its Environmental Campaign, has been conducting various theme-based programmes – skill development training, topic workshops, field surveys, etc. – to spread awareness of climate change and environmental sustainability. State run events and fairs such as the Rajya Paribesh Mela; Run for a Cleaner Environment; the Eco-Tourism Fair; and the Industrial India Trade Fair can also be utilised to achieve greater community outreach.

Participatory Outreach – Apart from print and visual media, there also exist more participatory forms of mass outreach such as street plays, urban street art, walking festivals, fund-raiser events to promote cycling and celebrating regular car free days.

Branding through Events – UK donors and the British Council regularly hold seminars and conferences around climate change issues, such as the promotion of low carbon technologies; urban resilience and adaptation, etc. to facilitate outreach and the engagement of stakeholders that include participation at the events by members of both the public and private sectors, including ministerial delegations, government officials and eminent business personalities.

Co-branding, sponsorships, knowledge partnerships, speaking or presentation platforms, displays at expositions, side-events, press conferences are some of the usual ways project implementers adopt for branding.

Branding through popular international and national forums can also be considered, including:

- Climate themed film screening at international film festivals;
- "Climate-smart pavilions" at international climate change/ environment seminars;
- Climate themed painting and photography exhibitions;
- Promotion of "Climate-smart Kolkata" at side events of national and international events, such as the Conference of Parties and the Carbon Expo, etc.; and
- Climate-smart innovations from the city could also be promoted as entries for innovation contests in publications such as the 'Honeybee' magazine produced by the National Innovation Foundation (NIF).

Dissemination Strategy

Key project outcomes can be publicised through the KMC portal. Sector-specific content can be designed and publicised through relevant state government websites or other similar modes of dissemination. Ward Councillors could use dissemination material created by the project in their offices and in public facilities within their respective constituencies.

The present practice of KMC to use social media such as a Facebook page and WhatsApp for gathering feedback on the quality of municipal service delivery can be utilised for propagating key promotional messages. Press releases of any events, for example the "Green Ward Event" can be accompanied by some IEC materials, such as a snapshot of the winning Ward, including a description and photographs of the area depicting the positive changes that have resulted from the actions taken and of the people who have taken a leading role in bringing about the changes. These would all be helpful to garner media attention on the subject.

Figure 66: Green Kolkata hoarding at a busy street crossing in Kolkata

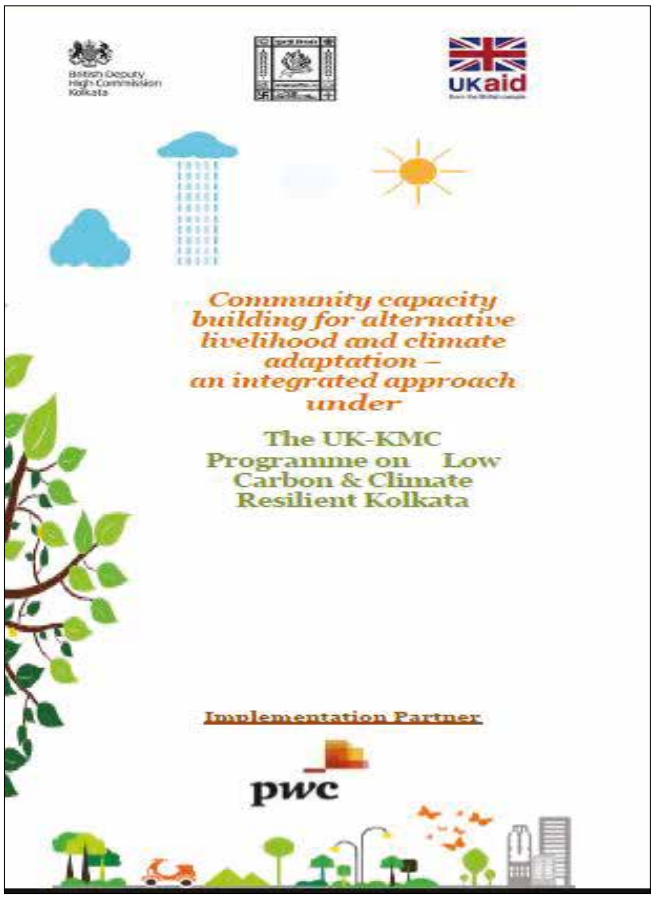
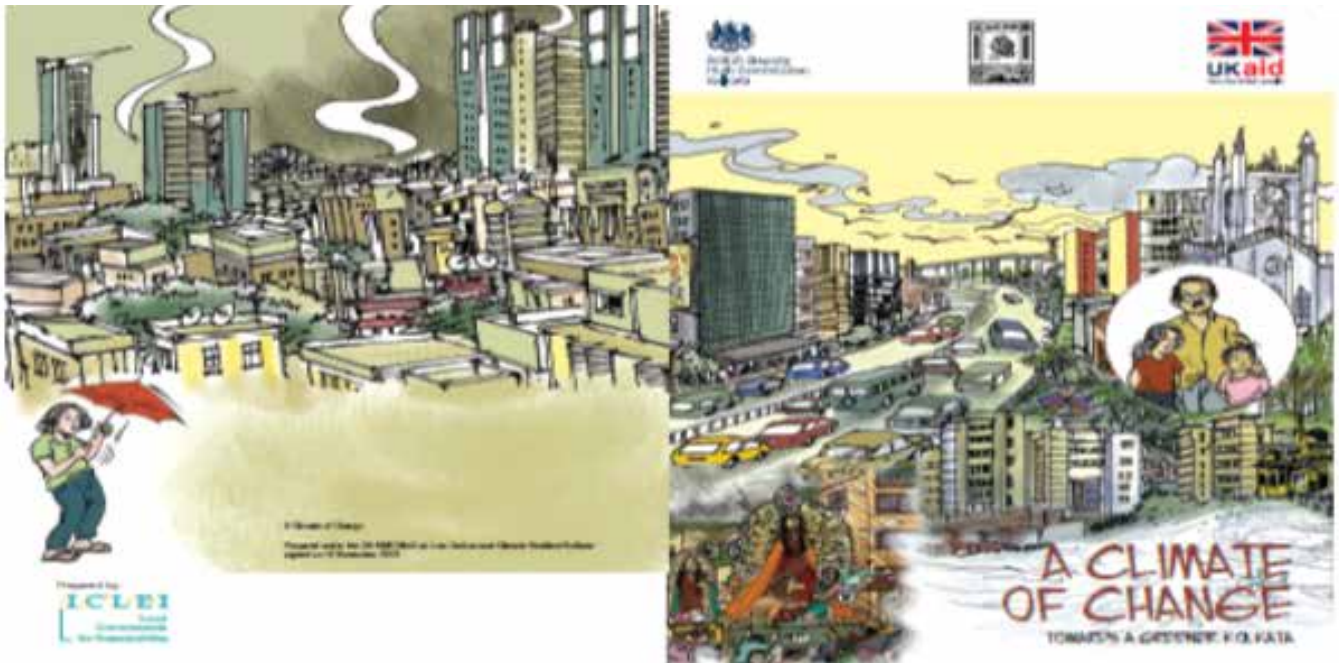


Figure 67: Graphic Booklet to Promote Climate Change Awareness



Under this UK-KMC Programme, content for dissemination includes the following:

Roadmap Document – This Roadmap Document for Low Carbon and Climate Resilient Kolkata is available for dissemination to interested stakeholders through the Kolkata Climate Change Centre established within KMC under this programme.

Presentations and Video(s) – Presentations and video-clips prepared as part of this Programme capturing messages from a range of stakeholders including community voices from the beneficiaries can be popularised through events and online channels such as 'youtube'.

Advocacy Paper – An Advocacy Paper for the Government of India, capturing the key lessons learnt on climate resilience from this Programme, will be submitted to the relevant Central Government Ministries with the objective of further dissemination to other States and ULBs in India, so that they could consider replication of the initiatives.

Figure 68: Examples of Relevant Communication Messages under the UK-KMC Programme

Solid Waste Management
- SWM source segregation
- Recycling at home
- Composting at home
- Prevent Littering

Built Environment
- Planting trees (to combat heat island effect)
- Creating green spaces

Ecological Preservation
- Conserving water bodies
- Preserving nature

Resource Conservation
- Rainwater harvesting
- Solar water heating
- Solar Lighting

Sustainable Mobility

Pedestrianism
Use of walkways
Promotion of cycling
Use of mass transit systems

Public Health

Malaria prevention
Vector borne disease - factsheets, posters

Adaptation to Climatic Disasters

Do's/don'ts during flood, cyclones, Beat the heat campaign for elderly, homeless, ect. to combat heat island effect

Green Jobs

Dissemination of Livelihood development schemes

Figure 69: Implementation Process for the Interface Plan

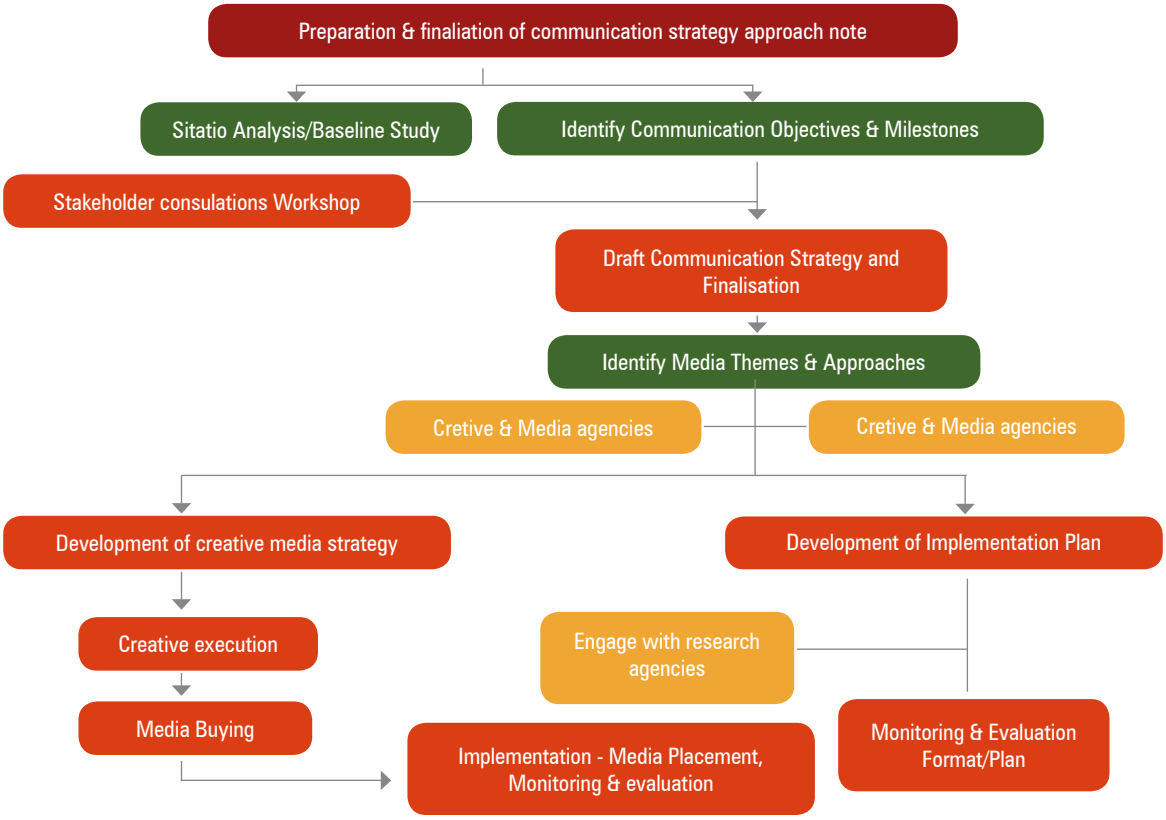


Figure 70: Outreach Actions – a Snapshot

Posters and Graphic Booklet – A graphic booklet, together with numerous posters and flyers, targeted at awareness generation amongst ordinary citizens as well as elected representatives, has been prepared. These can be disseminated through the KMC and other state government channels for maximising outreach.

Exposure Visits and Knowledge Exchange Toolkit – A toolkit has been prepared to assist ULBs organise knowledge exchange programmes and exposure visits to increase capacities of their officials and elected representatives. This toolkit is also available at the KMC and could be disseminated to other ULBs through the State government (Department of Municipal Affairs).

Communication Strategy for Behavioural Change – Fundraising events to promote a move towards a better environment; celebration of a special day, for example, Environment Day; using visual arts, performing arts; could all be possible communication strategies. Using collaborative learning methods, for example Peer Outreach; the Hub and Spoke Model; peer support models; etc. would also be beneficial in this case.

Well-tested communication methods include:
- awareness workshops or community group meetings;
- updating the community at regular intervals through provision of Information and Fact Sheets and then receiving feedback from the community stakeholders;
- media releases, use of social media and broadcast media (TV, Radio, FM) and internet;
- using posters, signs and flyers, preferably in the local language; and
- distributing information booklets, leaflets etc.

Keeping up-to-date details of local community contacts, drop-in session for face-to-face discussion on the concerns and impacts with local community people will also assist in effecting a proper interface.

Conclusion and Key Messages

The communications strategy adopted to promote the Programme objectives will need to be robust and dynamic to ensure that the central theme and the accompanying key messages are properly developed and broadcast to the relevant stakeholders. Use of the techniques identified above will assist in this process.

Monitoring and Evaluation

Monitoring and evaluation will need to be an integral component in all processes during the development and execution of the communications strategy, with these two activities aimed at ensuring the positive progress of "the messages", thereby reaping the expected benefits from the Programme.

This work could be done either by an internal team with KMC; or through the employment of an existing project management team; or by hiring an external agency that specialises in communication strategies/ programmes.

Evaluation of communication activities must be undertaken on a periodic basis to measure the impact of the interventions. Indicators for M&E of outreach interventions have been discussed in the community interface plan under this project.

Key Messages

- The Programme can leverage existing government efforts, where these are applicable and relevant to stakeholders. KMC, for example, has already been actively using social media platforms such as WhatsApp and Facebook for disseminating KMC initiatives. The use of these platforms can be strategically increased to ensure greater public interface, in conjunction with traditional media such as newsprint and television.
- Localised climate resilience campaigns need to be designed customised to vulnerable populations in heat island zones, infrastructure deficient areas, flood prone zones, etc.
- Relevant government initiatives such as the Swachh Bharat Mission (promoting public participation by assisting ULBs with appropriate IEC materials) and the National Environmental Awareness Campaign (involves educational institutions, community organisations, training institutions, professional institutes, NGOs and action research groups to create environmental awareness) can also be used to promote programme objectives.
- A communications strategy needs to be developed to take the climate change programme forward. It will need to be robust and dynamic to ensure that the central theme and the accompanying key messages are properly developed and broadcast to the relevant stakeholders.
- Participatory Outreach programs may be promoted through engaging the youths in street plays, urban street art, walking festivals and fund-raiser events to promote cycling and celebrating regular car free days.

PARTICIPATORY FORMS OF MASS OUTREACH SUCH AS STREET PLAYS, URBAN STREET ART, WALKING FESTIVALS, FUNDRAISER EVENTS TO PROMOTE CYCLING AND CELEBRATING REGULAR CAR-FREE DAYS NEED TO BE LOOKED AT, BEYOND TRADITIONAL OUTREACH METHODS

PART E
ACTION SUMMARY

Section E1: Actions Identified by the Individual Modules

The preceding sections of this Roadmap document have looked at the different issues involved in making Kolkata a low carbon and climate resilient city. Each module has looked at a specific issue and has put forward a number of recommendations on the actions required for that topic. These have been made according to a general timeframe of short-term (0 to 2 years), medium-term (2 to 5 years) and long-term (more than 5 years).

In this section, these actions have been allocated into a number of important categories, so that the KMC is aware of the different actions required of it and others to initiate the resilience process. The time-frames have been kept constant.

The categories are as follows:

1.***Urban Governance*** – Urban governance is defined by UN-Habitat as "the many ways that institutions and individuals organise the day-to-day management of a city, and the processes used for effectively realising the short term and long-term agenda of a city's development"[34]. To enable KMC to move the city towards a low carbon/ climate resilient future, changes may be required to the way in which the city is managed on a daily basis, including potentially a change to laws or byelaws that currently operate within the city.

2. ***Capacity Building (New Cells)*** – Capacity building essentially seeks to improve the performance of local administrations through use of new toolkits devised for a specific purpose or by improving the skill sets of the employees. Here, two areas of recommendation are made, with the first being recommendations on new units that should be created within KMC to undertake a specific task that will strengthen KMC's effectiveness to respond to the challenges it will face as a result of climate change.

3. ***Capacity Building (General)*** – A number of recommendations are also made for the strengthening of KMC's human resources and their individual and collective capability to respond to the challenges presented.

4. ***Technical Assistance/ Studies*** – Recommendations are made on a number of different projects/ studies that may require external assistance of some description. Similar to the current UK-KMC project, these can be for a particular technical assistance of benefit to KMC or they could be the precursor for future capital intensive works.

5. ***Operational Efficiencies*** – Some recommendations have been made that relate to improvements that need to be made to the way that KMC currently operates a system/ procedure so that greater efficiencies can be made and the current impact on the environment/ climate change processes reduced.

6. ***Development Projects/Capital Investment*** – To move towards climate resilience, it is likely that significant construction projects will be required within the KMC area to improve the existing situation. This could be for improved river defences or for the introduction of new facilities. A number of projects have been identified, although it is considered that more will emanate from the technical assistance projects mentioned above.

7. ***Community/ Business Initiatives*** – There will also be other costs associated with the overall programme that are not for capital works. Funds, sometimes as financial incentives to private sector entrepreneurs, will be required to encourage, for example, the creation of the green economy, whilst other funds might be needed for community compensation purposes.

The key actions that have been proposed under the individual modules are presented in the following pages in the aforementioned categories. Further details can be found in the appropriate modules earlier in this document.

Actions proposed

Urban Governance

Short-term Actions – Urban Governance

Module		Project Description
1	DM	Coordinated and integrated Emergency Support Functions (ESFs) and Standard Operating Procedures (SOPs) are to be formulated and made operational in all relevant KMC departments.
2	DM/ PH	KMC may develop inter-departmental and intra-utility coordination guidelines and ensure that utility infrastructure departments consider disaster prevention/ resilience when designing infrastructure networks.
3	DM	The State Emergency Operations Centre (EOC), KMC, the Fire Department and Kolkata Police's DMC need to improve coordination; a rigorous training regime with 'mock' exercises needs to be established.
4	DM	KMC may enforce all existing building byelaws for all new development. Byelaws may be applied retrospectively to all old buildings/ developments where feasible.
5	PH	KMC may develop an engagement framework for civil society and private sector to enable greater coordination between the different sectors.
6	CM	KMC, together with relevant State departments, may establish and enforce auto fuel quality guidelines and emission standards, as well as vehicle age, to lower pollution levels.
7	SWM	Trade licences may not be issued by KMC to companies if Consent to Operate from the West Bengal Pollution Control Board (WBPCB) is not produced.
8	SWM	KMC could consider the possibility of levying SWM user charges through coupons; through trade license renewal charges; or addition to property taxes through unit area assessment and creation of IT based database management system.
9	LU	Peripheral areas around Kolkata that are likely to be 'taken over' in the near future may be identified and discussions initiated with the relevant municipality on steps required towards an integrated/ successful merger.

[34] UN-Habitat

URBAN GOVERNANCE IS DEFINED BY UN-HABITAT AS "THE MANY WAYS THAT INSTITUTIONS AND INDIVIDUALS ORGANISE THE DAY-TO-DAY MANAGEMENT OF A CITY, AND THE PROCESSES USED FOR EFFECTIVELY REALISING THE SHORT TERM AND LONG-TERM AGENDA OF A CITY'S DEVELOPMENT"

Short-term Actions – Urban Governance		
Module		**Project Description**
10	CBP	All local/ household workers (maids, servants, cooks, cobblers, drivers, etc.) may be registered on a ward-by-ward basis, following completion of a survey on their living/ working standards.

Medium-term Actions – Urban Governance		
Module		**Project Description**
1	DM	KMC may ensure that rainwater harvesting is be made compulsory for all multi-storied buildings/ developments.
2	DM	KMC may review planning byelaws and restrict construction in low-lying areas. Throughout Kolkata, plinth Levels of all new buildings should be above the highest expected flood level.
3	PH	KMC may prepare a Heat and Health Action Plan and fund financial and operational improvement plans for the urban public health sector to ensure its ability to respond to disease outbreaks in Kolkata.
4	SWM	KMC building byelaws may be amended to include mandatory inclusion of mini composting plants in larger commercial and residential establishments.
5	SWM	KMC may enforce existing regulations and punitive measures with regards to use of plastic polybags.

Long-term Actions – Urban Governance		
Module		**Project Description**
1	DM	KMC may upgrade all its systems to ensure it has state-of-the-art computerised technology for its emergency response activities.
2	CM	KMC may introduce a Congestion Tax for vehicles entering central Kolkata to reduce pollution and city congestion. KMC needs to demarcate an appropriate inner zone and procure the new technology that will be required.
3	CBP	A rating agency involving government representatives, municipal authorities and private bodies may be developed for long-term waste management across the city.

KMC Capacity Building – New Cells		
New Cells within KMC/ Kolkata		
Module		**Project Description**
1	DM	A Disaster Management Cell may be established within KMC to ensure that procedures, systems and dedicated human resources are capable of handling all potential disasters.
2	EM	An Energy Management Cell may be established to monitor energy efficiency within KMC operations and identify alternative renewable technologies that can further improve efficiency.
3	CM	A Unified Metropolitan Transport Authority, with close linkages to KMC may be set up to coordinate the city's transport and formulate policies for schedules, transfers, routing, and fares for all forms of public transport.

New Cells within KMC/ Kolkata		
Module		**Project Description**
4	BE	A Green Buildings Cell may be established to support the implementation and monitoring of the proposed Green Building guidelines.
5	LU	A Design Cell may be established within KMC that is able to lead landscape and urban design initiatives within the city and to lead activities to reduce the urban heat island effect.
6	SP	KMC may develop an internal Training Cell to organize training programmes on climate change. Technical training to be provided for KMC executive and political staff.

KMC Capacity Building – General		
Short-term Actions – Capacity Building		
Module		**Project Description**
1	DM	KMC staff may be properly trained in disaster management activities at regular intervals so that they can adequately respond to disasters as they occur.
2	DM	The undertaking of User Need Assessments, Training Need Assessments together with Awareness Training and Capacity Building all require strengthening with KMC.
3	PH	KMC may develop internal financial and operational efficiency improvement plans for the public health sector so that it can respond effectively to disease outbreaks in the city.
4	PH	Manpower training needs assessments may be prepared for departments that operate with public health hazards.
5	BE	Capacity building/training of KMC officials may be undertaken with the training programmes focussing on implementation and monitoring mechanisms for Green Buildings.
6	BE	Suitable infrastructure/systems may be developed within KMC to support implementation of the Green Building guidelines, including developing portals for reporting and relevant monitoring tools, data bases, etc.
7	CBP	KMC, with the city's business chambers, may undertake a comprehensive survey to identify jobs that fall into green/ non-green sectors and provide a basis for reliable employment opportunities projections available in the 'green' sector.
8	CBP	Based on the above survey, a Training Needs Assessment (TNA) for helping to improve the skills of the unskilled workforce may be devised.
9	CBP	Trade unions may be provided with training on the importance of 'green' jobs and the benefits that these could bring to their members.
10	SP	KMC may initiate IEC programmes at ward level to discuss climate change and resilience and make the local community/ organisations more aware of climate change issues.
11	SP	A programme of exchange visits may be developed to educate KMC staff on climate change best practice.

Medium-term Actions – Capacity Building

Module		Project Description
1	PH	KMC may identify/pursue options for improved community engagement including civil society and the private sector, appointing additional appropriately trained staff as required.
2	PH	KMC may respond to issues identified by the manpower needs assessments, appointing new staff in relevant departments.
3	CBP	Based on the TNA, invest in capacity building and training though skill enhancement programmes to prepare the workforce for a transition to a green economy.
4	CBP	KMC may maintain online records, accounts, correspondence and training activities of Self-Help Groups (SHGs).
5	CBP	KMC may also promote the training of SHGs so that they can become more involved with climate-smart activities within Wards – i.e. for maintenance of urban green spaces, public canteens and cafeterias, conservancy in school and college premises, etc.
6	CBP	KMC may work with identified institutions/ agencies to impart technical training, carry out revisions in curriculum of the training modules to suit the needs of the green jobs and to ensure proper 'training the trainers'.

Long-term Actions – Capacity Building

Module		Project Description
1	DM	KMC may implement a programme of ward-level storm water management measures that should encourage preventative action, including a behavioural change amongst residents so as to encourage the safe disposal of waste.
2	CBP	KMC may establish Facilitation Centres that contain a database of skilled, semi-skilled and unskilled labour along with skill-mapping.

Technical Assistance/ Studies

Short-term Actions – Technical Assistance/ Studies

Module		Project Description
1	DM	Ward contour maps may be prepared to indicate the low-lying areas that are susceptible to flooding. Detailed Preparedness Plans should also be prepared for each ward, based on these contour maps.
2	PH	KMC's health department may lead the preparation of area-specific micro-plans within wards; elaboration of these into Ward plans; and then elaboration of these into Borough level macro-plans.
3	PH	A central disease risk reduction master plan may be prepared for monitoring the various area interventions.
4	CM	A study may be undertaken looking at the introduction of a public Bike Sharing System in Kolkata. Development of a pilot scheme should follow based on the report's recommendations.

Short-term Actions – Technical Assistance/ Studies

Module		Project Description
5	CM	A comprehensive Non-motorised Transport (NMT) Master Plan may be prepared for the city, with recommendations being implemented by the proposed UMTA.
6	LU	A Landscape Strategy for Kolkata may be prepared to develop a hierarchy of 'green' spaces and options for reducing urban heat island effects.
7	LU	An Urban Design Strategy for Kolkata may be prepared, with this looking at design improvements within the urban area, including the protection of heritage assets..
8	LU	KMC, in conjunction with KMDA, may initiate a Master Plan for Kolkata's Riverfront to turn this into an internationally recognisable landmark.
9	LU	KMC may initiate the preparation of an Action Plan for a pilot 'Heritage Redevelopment Area. This should be area-based and include the adaptive reuse of buildings and spaces and the promotion of climate-smart technologies.
10	LU	A Transit-Oriented Development (TOD) Strategy may be prepared for Kolkata including identification of locations on existing transport corridors that could be considered for implementation. This should adopt 'Compact City' principles, encouraging mixed-use development and the integration of multiple forms of public and NMT transport.
11	SP	Development of annual climate change Ward Action Plans to identify issues, prioritise them and help focus activities and resources to address them, with work being undertaken with input from local residents.
12	SP	Identification and prioritisation of sectoral studies for each ward to identify and prioritize necessary sectoral studies of relevance to the local community.

Medium-term Actions – Technical Assistance/ Studies

Module		Project Description
1	DM	KMC may ensure effective city drainage planning, with coordination being required between different departments for the proper drainage of urban/ peri-urban areas.
2	PH	KMC may need to plan for periodic monitoring to ensure that the vector control activities are being carried out in accordance with the micro-plan.
3	PH	KMC may develop a centralised database of key disease prevalence across the city by encouraging all private hospitals and doctors to contribute relevant information.
4	PH	KMC's health department may procure services for the introduction of predictive models for water borne and vector borne diseases.
5	CM	Based on the output of the NMT Master Plan, KMC, in collaboration with the UMTA, may create 'safe' routes and supporting infrastructure for pedestrians and cyclists, with KMC designating footpath and cycleway networks and with the Traffic Police ensuring these remain free from encroachment.

Module		Project Description
	SWM	KMC may initiate detailed studies for the improvement of city-wide solid waste management services, including: • decentralised services at Borough level; • identification of land for decentralised systems, including landfill sites; and • decentralised mini-composting on a ward basis or beside markets.
	SWM	KMC may prepare a Rag-pickers' Livelihood Development Plan.
6	LU	KMC may prepare/ implement a Way-finding/Signage Strategy for the city.
7	LU	KMC with neighbouring municipalities may prepare advance plans for future infrastructure requirements of the next rural areas that are likely to be incorporated into Kolkata to feed its need for additional land for growth.

Long-term Actions – Technical Assistance/ Studies

Module		Project Description
1	DM	KMC, in collaboration with KMDA, may identify major arterial roads throughout its area that can be used as emergency corridors in the event of a major disaster.
2	All	Additional studies/ technical assistance needs will emanate from the work already recommended. These may need to be implemented by KMC. Feasibility assessment to explore options for introducing energy efficient fleet of double decker/articulated buses and trams (replacing old and polluting fleets), in selected suitable road/transit corridors in the city, for increasing use of public transport and lowering per capita emissions

Operational Efficiencies

Short-term Actions – Operational Efficiencies

Module		Project Description
1	DM	To enable improved operational efficiency and coordination, KMC data may be accessible to other departments to reduce the risk from disasters.
2	DM	To improve its operational capacity, KMC should have access to the State Disaster Response Fund (SDRF) for the procurement of essential search, rescue and evacuation equipment.
3	PH	KMC may develop an IT-enabled Health Management Information System (HMIS) to increase operational readiness in the event of a disease outbreak.
4	EE	To increase energy efficiency at all KMC operated facilities, improved maintenance procedures and the replacement of old equipment with new is required. Improvements required in KMC's: • Water supply and sewerage networks; • Street-lighting; • Buildings/ offices and Crematoria.

Short-term Actions – Operational Efficiencies

Module		Project Description
5	CM	KMC may prepare an integrated parking policy (on/ off street) that demarcates parking supply and introduces dynamic parking charges, which when raised can be allocated to a new Urban Transport Fund (UTF) to improve city transport infrastructure.

Medium-term Actions – Operational Efficiencies

Module		Project Description
1	DM	KMC early warning systems/ emergency operation centres need to be fully functional.
2	DM	KMC may improve its sewage treatment operations to prevent the flow of untreated sewage into open drains.
3	PH	KMC may ensure optimal utilisation of the proposed Grievance Redressal Mechanism (GRM) to improve efficiency in its public health operations.
4	EE	KMC may improve energy/operational efficiency in its water and sewerage networks through a PPP O&M contract. KMC should also prepare/ implement a strategy for upgrading its technology, including future capacity enhancement.
5	EE	KMC may increase energy/ operational efficiency for street-lighting through adoption of city-wide Lighting Plan and improved O&M mechanisms.
6	EE	KMC may introduce improved energy/ operational efficiency for all buildings through use of renewable technologies/ other operational improvements.
7	CM	The re-organisation of Kolkata's taxi services may be initiated by KMC to improve operational efficiency. The proposed UMTA (with KMC/ Traffic Police) to set regulations/ standards for the city services, including the design of supporting infrastructure.
8	CM	The re-organisation of the city's auto rickshaw services may be initiated by KMC to improve operational efficiency. The proposed UMTA (with KMC/ Traffic Police) to set regulations/ standards for the city services, including the design of supporting infrastructure and the integration of auto routes with major public transit hubs.

Long-term Actions – Operational Efficiencies

Module		Project Description
1	SWM	KMC may improve solid waste management services, through promotion/ provision of both dry waste recycling units and a PPP arrangement for dry waste collection/ operations as recommended by an earlier technical assistance study.

Development Projects/ Capital Investment

Short-term Actions – Development Projects/ Capital Investment

Module		Project Description
1	DM	KMC may increase the number of automated weather monitoring stations and river gauge stations across the city.

A TRANSIT-ORIENTED DEVELOPMENT (TOD) STRATEGY NEEDS TO BE PREPARED FOR KOLKATA INCLUDING IDENTIFICATION OF LOCATIONS ON EXISTING TRANSPORT CORRIDORS THAT COULD BE CONSIDERED FOR IMPLEMENTATION. IT SHOULD ADOPT THE 'COMPACT CITY' PRINCIPLES, ENCOURAGING MIXED-USE DEVELOPMENT AND THE INTEGRATION OF MULTIPLE FORMS OF PUBLIC AND NON-MOTORISED TRANSPORT (NMT)

Short-term Actions – Development Projects/ Capital Investment		
Module		**Project Description**
2	DM	Automated tidal flow prevention valves may be installed where the storm water drains/ sewage channels connect with the canals/ river.

Medium-term Actions – Development Projects/ Capital Investment		
Module		**Project Description**
1	CM	Further to the proposal indicated earlier on the introduction of a public Bike Sharing System, investment may be required to implement a pilot project in Kolkata.
2	LU	Based on proposals made in the earlier technical assistance project, investment may be required to implement the Riverfront Redevelopment Master Plan covering engineering works and the proposed hard/ soft landscape design.
3	LU	Investment may be required to the recommendations made in an earlier technical assistance project to implement the recommendations of the Pilot Heritage Action Plan.
4	All	Increased budgets may be required for all new cells proposed within KMC so that measures recommended can be implemented.

Long-term Actions – Development Projects/ Capital Investment		
Module		**Project Description**
1	DM	KMC may need to consider the widening of specific roads in the city to provide access for emergency vehicles. Parking and use of road corridor for other commercial activities to be avoided on the roads identified.
2	DM	Structural storm water management strategies may need strengthening. This should include physical interventions and investment in engineering infrastructure for improved drainage.
3	LU	Based on an earlier study, investment may be required for the implementation of an initial TOD project. This investment, however, will not come only from the public sector, as works will need to be undertaken in conjunction with the private sector.

Community/ Business Initiatives

Short-term Actions – Community Investment		
Module		**Project Description**
1	DM	Population living within a 4-kilometre radius of a specific environmental hazard may be moved or compensated.
2	PH	KMC may assess operational needs to enable improved community engagement, including increased staffing if appropriate.
3	PH	KMC may identify potential financing agencies to deliver its investment needs, together with the preparation of high calibre proposals/ applications.

Medium-term Actions – Community Investment		
Module		**Project Description**
1	DM	KMC may consider provision of welfare benefits/ subsistence allowances in compensation for low-income groups who suffer from water-logging and loss of income/ increased stress due to flooding events remaining unresolved.
2	CBP	Incentives may be provided to 'green' entrepreneurs, through the provision of tax breaks, easy availability of capital, creation of favourable demand conditions and innovative financing schemes.
3	CBP	KMC may identify preferred vending zones and appropriate land allocated with this being provided with full civic amenities including water, sanitation, waste management and electricity.

Long-term Actions – Community Investment		
Module		**Project Description**
1	SWM	KMC may promote the introduction and development of solid waste management initiatives through Corporate Social Responsibility (CSR) activities.
2	CBP	KMC may work towards the removal of barriers and the easy access to clean technology for different industries, many of which are proprietary and protected by strong patent regimes.
3	CBP	There may be incentives for supporting local technologies and subsidizing compost and social incentives for people who segregate waste at source.
4	CBP	Loans may be offered at reduced interest rates to developers that agree to build to the specified green standards through a specified loan fund.
5	CBP	KMC may plan a budget allocation for 'market development' in order to provide an effective platform for marketing of SHG products.
6	SWM	KMC may consider the provision of incentives/ subsidies to make the price of compost competitive with chemical fertilisers so as to encourage community involvement in its production. Similar financial incentive packages should be considered for Self Help Groups (SHGs)/ plastic recyclers.

British Deputy
High Commission
Kolkata

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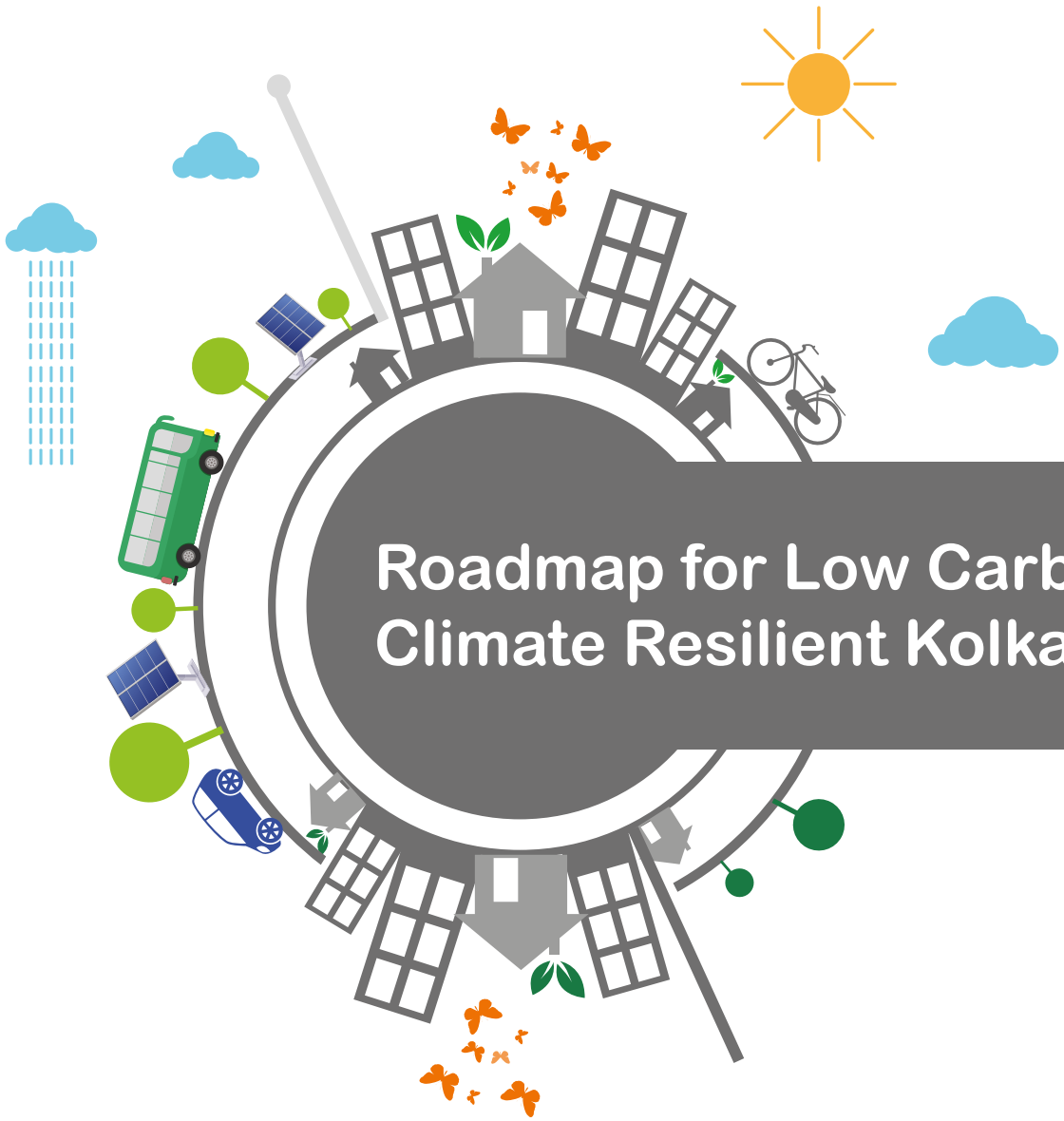

Roadmap for Low Carbon and Climate Resilient Kolkata

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