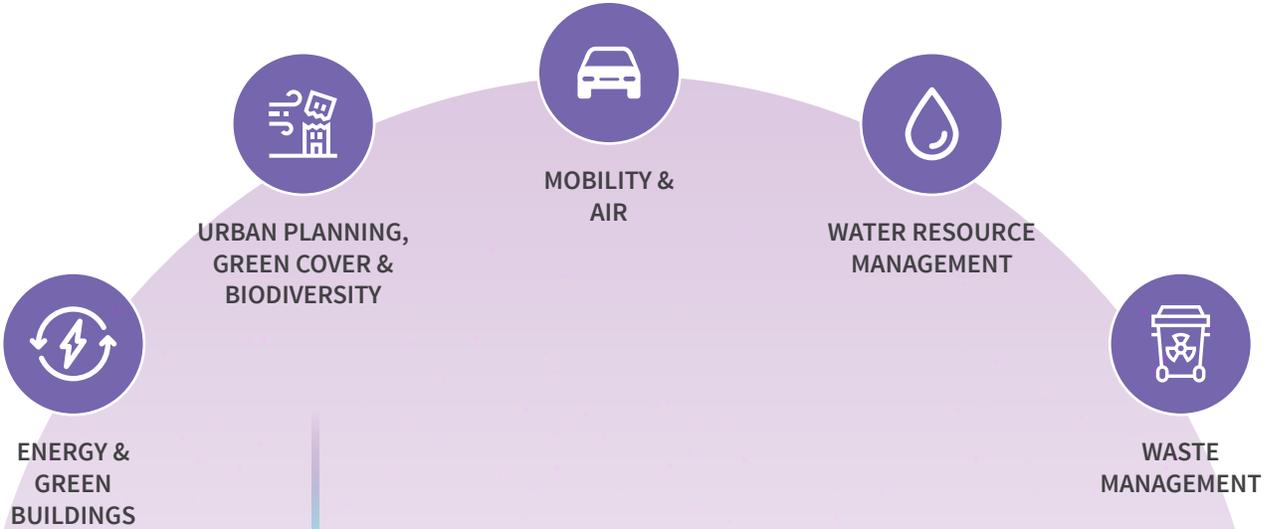


# Best Practices Compendium

## ClimateSmart CITIES





Implemented by  
**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH

On behalf of:  
  
Federal Ministry for the  
Environment, Nature Conservation  
and Nuclear Safety  
Of the Federal Republic of Germany

  
Ministry of Housing and Urban Affairs  
Government of India

  
Smart City  
Efficiency. Empowerment.

  
150  
YEARS OF  
CELEBRATING  
THE MAHATMA

# Best Practices Compendium

## ClimateSmart CITIES

**DAY-NULM**  
Deendayal Antyodaya Yojana-National  
Urban Livelihoods Mission

**HRIDAY**

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

  
अमृत  
Atal Mission for Rejuvenation  
and Urban Transformation

**Urban  
Transport**

  
स्वच्छ  
भारत  
एक स्वच्छ स्वच्छता ही जीव

# BEST PRACTICE COMPENDIUM CLIMATESMART CITIES ASSESSMENT FRAMEWORK

## Developed by

Ministry of Housing and Urban Affairs, Government of India

In collaboration with GIZ India



Climate Smart Cities Project

## Published by:

Ministry of Housing and Urban Affairs, Government of India

## Designed by:

Litmus ink

## Photo credits/sources:

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October 2019

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**Ministry of Housing and Urban Affairs**  
Government of India

## Hardeep Singh Puri

**Honourable Minister of State,  
Independent Charge**  
Ministry of Housing and Urban Affairs

Ministry of Housing and Urban Affairs has initiated several missions to further improve the urban areas in the country. These missions are focused on affordable housing, increasing coverage of basic services, urban transport, livelihood, improved sanitation infrastructure, heritage conservation in our cities. Though each mission has specific objectives to meet with, Smart Cities Mission focuses on the entire urban eco-system, namely, Liveability, Economic-ability and Sustainability.

Taking a step forward towards "Sustainability" aspects, especially climate resilience, my Ministry has initiated the "ClimateSmart Cities Assessment Framework" (CSC-AF) in January 2019, as a step towards holistic, climate responsive development. The results of the first phase of this assessment framework has demonstrated clear linkage between the implementation of various missions with city's

performance. A significant number of climate mitigation and adaptation interventions are undertaken in cities through various missions of this Ministry and these went unaccounted on the climate change perspective.

The calibration of these missions has resulted in many best practices across the country. To highlight these practices, Ministry is releasing a compendium titled "Best Practices Compendium on ClimateSmart Cities Assessment Framework". This compendium has documented some examples stories of inspiration from all over the country and few international policy measures to tackle climate change in urban context.

I hope this compendium will serve as a guiding document for all cities and our country to continue to see many more best practices.





**Ministry of Housing and Urban Affairs**  
Government of India

## Durga Shanker Mishra

**Secretary**

Ministry of Housing and Urban Affairs

Growing climate change awareness, livelihood and sustainability concern have brought about a second paradigm shift in urban management approach worldwide. For all development activities to be sustainable, climate change risk must be reduced. Sustainable Development Goals, 2030 Agenda (SDGs) and Paris Climate Agreement (2015) have made the global community realise and recognise that sustainable development and climate change are linked to each other. Cities are making continuous efforts to mitigate and adapt to climate change impacts but at the same time the economic and social cost of these climate change impacts are increasing year by year.

With ClimateSmart Cities Assessment Framework completing its first phase of assessment, it becomes imperative for us to expedite efforts for supporting our cities towards climate sensitive development. This is a first of its kind assessment framework for cities, creating a green mindset in cities while they plan and undertake various developmental projects.

There are some ULBs which have done in exemplary work in undertaking climate adaptation and mitigation measures. In our attempt to collate and put forward these successful stories in front of the citizens of India, the Ministry of Housing and Urban Affairs is releasing the compendium "Best Practices Compendium on ClimateSmart Cities Assessment Framework". This compendium its current edition will focus on the torch bearers of climate sensitive projects and policy interventions undertaken in urban India and abroad.

"Best Practices Compendium on ClimateSmart Cities Assessment Framework" will be a continuous series from the Ministry of Housing and Urban affairs focusing on best practices in several areas pertaining to climate sensitive Urban Development. I am hopeful that this compendium will be a guiding factor for all cities that will attempt to follow some models of effective climate mitigation and adaptation measures.





**Ministry of Housing and Urban Affairs**  
Government of India

## Kunal Kumar

**Joint Secretary &  
Mission Director (SCM)**

Ministry of Housing and Urban Affairs

Traditionally, agriculture and forestry are considered as climate change sensitive sectors but its impacts on cities and on the urban ecosystems as whole has become a global topic in the recent past. The severity of climate change is not just on the extent to which cities get affected and can adapt to climate change, but also on the extent to which cities can mitigate climate change by reducing their energy consumption and their greenhouse gas emissions. In other words, just as climate change affects cities, cities also affect climate change.

The “ClimateSmart Cities Assessment Framework” for the 100 Smart Cities is a first step from the Ministry of Housing and Urban Affairs under the aegis of Smart Cities Mission to enable cities to assess their preparedness to tackle the menace of climate change and degrading air quality as well as to provide them with a roadmap to do so.

In its quest to provide improved life quality, urban missions have implemented numerous projects which certainly mitigate or adapt towards changing climate but have

never been looked into through the climate lens. Use of clean technologies are promoted in Cities that harness renewable materials and energy sources, to reduce pollution and health hazards. Promotion of energy efficient green buildings, green transport, improved waste and water management.

I am happy to release this “Best Practices Compendium on ClimateSmart Cities Assessment Framework” wherein cities have demonstrated their interventions to take a step toward mitigating or adapting to climate change. This compendium provides a collection of good and promising examples which have been proven to be successful boosters in improving the climate action of cities. It presents projects, initiatives, schemes, and innovations initiated by city governments to contribute to the mitigation effects of climate change and to improve the climate adaptiveness of cities.

I am confident that this compendium will encourage other cities for moving towards “Sustainability and Climate Resilience.”

# Acknowledgement



## Mrs. Vaishali Nandan

Project Head, Climate Smart Cities  
GIZ India

The Best Practice Compendium has been developed for the Ministry of Housing and Urban Affairs under the aegis of the ClimateSmart Cities Assessment Framework in technical collaboration with the Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH, India. Through this, an attempt is made to highlight success stories in urban climate change sector. This compendium is a result of concentrated effort put in by my team with support of various stakeholders.

25 out of the 33 best practices included in this compendium have been shared by Smart Cities and other stakeholder organizations. I would like to express my gratitude for the support extended by the following officers:

- Mr. Kamal Kishor Yadav, IAS, Municipal Commissioner & CEO, Chandigarh Smart City Limited
- Ms. Aditi Garg, IAS, Additional Municipal Commissioner & CEO, Indore Smart City Limited
- Mr. Ashish Kumar Gupta, IAS, Commissioner Municipal Corporation Jabalpur
- Mr. Mohammed Nazeer, Managing Director, Mangaluru Smart City Limited
- Dr Ramnath Sonawane, CEO, Nagpur Smart City Limited
- Mr. Prakash Thavil, CEO, Nashik Smart City Limited
- Mr. P. Kalimuthu, CEO, Thanjavur Smart City Limited
- Mr. Pradeep Kumar Jain, CEO, Ujjain Smart City Limited

This compendium would not have been possible without sharing of learnings from various organizations. I would like to thank them for the contribution to the compendium.

- DFID (UK Government)
- ICLEI, South Asia
- Rocky Mountain Institute (RMI)
- Shakti Foundation and Development Alternatives
- The Energy and Resources Institute (TERI), Fondazione ACRA (ACRA), Stichting ENVIU Nederlands, Women Health and Development (WHAD)
- WRI, India

Additional practices and international examples were developed by the Climate Smart Cities project team of GIZ India.

We wish to extend special thanks to all the cities and the organizations for their generous contributions to the compendium.



# Introduction

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According to the Global Climate Risk Index 2016 by German watch, India is ranked sixth among the 10 most affected countries in the world. Further, it is projected that the per capita emissions in India will increase by about 130 percent until 2030 reaching 3.6 tCO<sub>2</sub>eq (without Landuse, Landuse Changes, Forestry (LULUCF)) (Climate Action Tracker, 2015). One of the main factors for the increasing Green House Gas (GHG) emissions is the substantial population growth in India. Indian cities are confronted with a comparably high population growth, with urban population doubling in the last 30 years to reach 31.16 percent (Census 2011) (377 million people). It is further projected that the urban population will increase to around 50 percent of total population by 2030<sup>1</sup>.

This will increase the requirement for additional housing, energy, mobility and infrastructure significantly. The social structure as well as the consumption and mobility patterns (increase of private vehicles and energy consumption, etc.) are changing fast. India's share of total global primary energy demand is set to roughly double from current 6 percent to 11 percent by 2040, due to strong population growth and economic development (BP Energy Outlook, 2019).

The implications of a changing climate is a matter of concern. In 2016, the country reported the highest number of deaths due to extreme weather (2,119 fatalities) and suffered losses of more than INR 1.4 trillion (USD 21 billion) in property damage. This is almost 1 percent of India's GDP of USD 2.5 trillion, and almost equivalent to the country's whole health budget (Jena, 2018)<sup>2</sup>. India accounts for about 7 percent of the global GHG<sup>3</sup>, so it plays a crucial role in combating climate change. Most importantly, urban India's approach towards growth will considerably impact the course of global climate change response.

Taking the climate change issues into consideration, the Ministry of Housing and Urban Affairs (MoHUA) initiated the "ClimateSmart Cities Assessment Framework" (CSCAF) for the 100 Smart Cities in January, 2019. This is a first-of-its-kind cities assessment framework on climate relevant parameters, including those of the recently launched National Clean Air Programme (NCAP). It also includes all the aspects from the National Mission on Sustainable Habitat (NMSH). The objective of this exercise is to provide a clear roadmap for the cities and in effect, urban India as a whole, towards combating climate change aspects of both mitigation and adaptation while planning and implementing their actions including investments. The Framework has 30 indicators across 5 sectors, namely, (i) Energy and Green Buildings; (ii) Urban Planning, Biodiversity and Green Cover; (iii) Mobility and Air; (iv) Water Resource Management and (v) Waste Management. These sectors and indicators are also limited to the areas that city authorities can assess and manage by themselves. Through this Framework, Ministry aims to provide a mechanism to identify gaps and facilitate improvements in order that cities can become more resilient and be prepared for future climate impacts.

The first phase of the assessment started in January 2019 with strategic support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, India and the National Institute of Urban Affairs (NIUA). During the process of handholding the 100 Smart cities to understand and unpack the indicators and data points, the cities suggested that it would be encouraging for them to see some of the best practice examples that are available nationally as well as internationally. Hence, the idea of putting together some of the cases that have been acknowledged nationally as well as internationally came forth and the compendium emerged. The various practices described in this compendium will serve as guiding lights along the path towards a resilient future, helping to show the way to cities toward effective approaches that resonate their own circumstances, available resources, and priorities.

### **About the compendium**

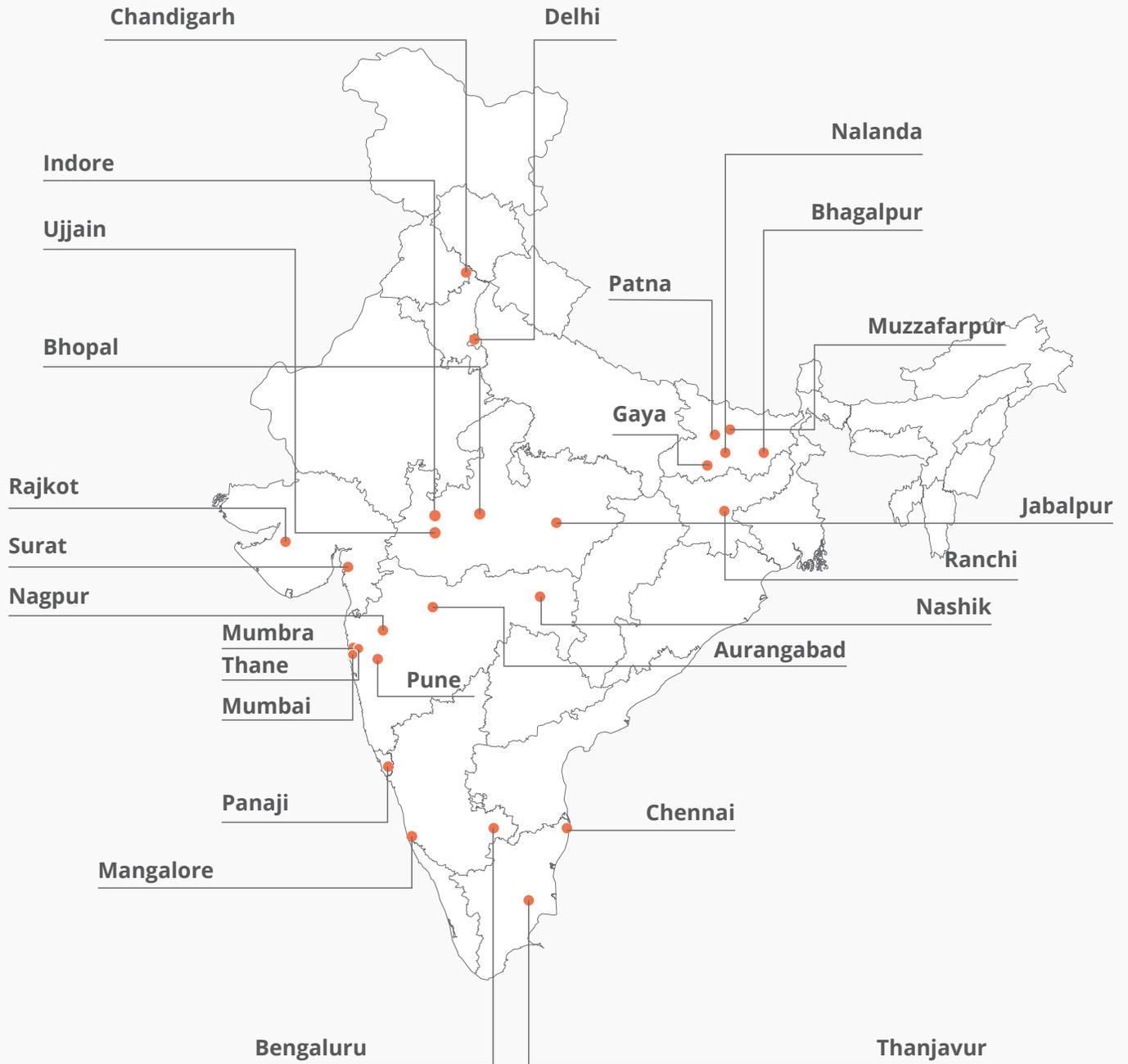
The Best Practice Compendium provides a collection of good and promising examples which have been proven to be successful boosters in improving the climate action of cities, both in India as well as globally. It presents projects, initiatives, schemes, and innovations initiated by city governments to mitigate effects of climate change and to improve the climate adaptiveness of cities. National support schemes, international cooperation programmes, public-private partnerships, and other project constellations were considered while selecting the best practice examples.

While climate action is a cross-cutting issue which must be addressed by all the sectors and sections of society, this compendium is specifically targeted to cities and to the five thematic areas of the Assessment Framework. The given examples can therefore inspire and guide city governments in taking the next steps as part of the assessment and prepare city specific climate relevant measures.

<sup>1</sup> <https://www.thehindubusinessline.com/economy/policy/half-of-indias-population-will-be-living-in-urban-areas-by-2030-says-puri/article9891352.ece>

<sup>2</sup> Jena, P. P. (2018). Climate Change and Forced Migration. IOSR Journal of Humanities and Social Science (IOSR-JHSS)

<sup>3</sup> <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>



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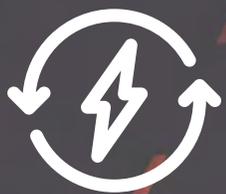


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1



# ENERGY & GREEN BUILDINGS

# 01

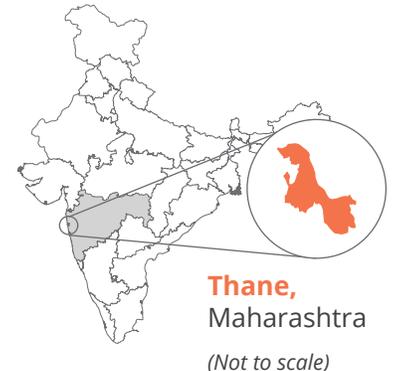
## LED STREET LIGHTING VIA ESCO MODE: THANE

### Project Highlights

- Replaced 8000 High Pressure Sodium Vapour street lamps with LED Lights across Thane
- Annual energy saving of 5.33 Million kWh
- Avoiding Greenhouse Gas (GHG) Emissions of 4385 tonnes of CO<sub>2</sub> eq.

### Background

Thane city, located near Mumbai, the financial capital of India in state of Maharashtra, is a rapidly growing city due to extensive immigration and urbanization. Thane Municipal Corporation is continuously undertaking environment-oriented projects to reduce GHG emissions from city and improve its municipal facilities. Considering the energy saving that LEDs can achieve, TMC was exploring options for assessing different financial models for scaling up the LED street lighting pilot initiatives across the city. TMC, with support from ICLEI South Asia, under the project Urban Low Emission Development Strategies, undertook feasibility assessment of its streetlight infrastructure to arrive at an ESCO mode of streetlight project implementation.



### Project Objectives

- I. Establishment of baseline of 8000 plus street-lights
- II. Performance Contracting with shared savings
- III. Involvement of third party for measurement and verification protocol
- IV. Development of remote management system, highest lumen per watt LEDs, adoptive control panels to optimize power consumption of LEDs as per the requirement of the time etc.

### Key Stakeholders

Thane Municipal Corporation, ICLEI South Asia

### Approach of LED Street Lighting Initiative

TMC followed a systematic approach for execution of LED installation under ESCO mode wherein, stakeholders were consulted at every stage. The approach is summarized as follows:

1. Stakeholder Consultations: Numerous stakeholders including energy experts, lighting experts, techno-commercial experts, political and administrative heads to local residents etc. were consulted for execution of LED street-lighting projects across city
2. Site Selection: Numerous sites were selected across the city based on various parameters like electrical infrastructure, road type, road width, geographical location, project visibility etc.
3. Investment Grade Audit and Baseline Assessment: An investment grade audit was carried out at different locations to establish the baseline and electrical infrastructure assessment of the site
4. Identification of Technology and Energy Saving Potential: Market assessment for best available technology with upgradability and compatibility
5. Payback and Public Private Partnership Financial Modelling:

- Carried out financial assessment to arrive at a feasible payback
  - Developed PPP structure around the capital and operation expenditure estimated
  - A suitable transaction procedure was established
6. Tendering and Procurement: Bids were invited through public competitive bidding
  7. Retrofitting: The streetlight replacement was carried out panel by panel. Once the entire replacement on a panel was carried out, the reduction in demand was recorded and new baseline established
  8. Third-Party Verification: TMC has implemented a third-party expert to verify the energy saving and ensure transparent transaction to technology provider

## Financial Structure of the initiative

The project was based on PPP arrangement with multiple stakeholders.

## Achievements



### Benefits and Co-Benefits

1. Energy Savings:
  - The LED ESCO project has achieved maximum energy savings in city, i.e., 5.33 Million kWh per year and energy consumption for street lighting reduced by more than 60%
  - Avoided GHG emissions of 4385 tonnes CO<sub>2</sub> eq. annually
  - On operational level, the share of GHG emissions from municipal services in Thane have reduced from 35% in 2012-13 to 11.7% 2017-18
  - Connected load of streetlight infrastructure reduced by 70%
2. Improved facilities for citizens:
  - The citizens have reported that white light provides better visibility and provides a sense of safety on roads
3. Enhanced Reliability:
  - Conventional technology was highly maintenance prone whereas higher life of lamp (50,000 hrs against 15,000 hrs) implies lesser downtime and higher reliability
  - Systems can be effectively controlled and monitored due to improved infrastructure and hence increasing the reliability
4. Better Light Quality:
  - The lighting optics as designed resulted in optimum lux levels with uniform spread across the roads and hence leading to improved visibility



Before (HPSV Settings)



After (LED Settings)

Are Thaneites happy with the new tech? We throw some light

- // I am elated to see that the Talaopali area has suddenly been illuminated. The area looks brighter and more clear.

**Vikas Mishra**

- // It's a very good initiative taken by Thane Municipal authorities. As these lights consume less power. They should be installed all across the city.

**Rohini Mandappwar**

- // The old yellow eyes used to prick the eyes, however this light has a soothing effect and everything looks crystal clear.

**Devappa Waze**

## Success Factors

- Determined Leadership
- Technical innovations for effective implementation of the LED street lighting project

## Limitations

1. Nascent Technology: LED was a nascent technology and was constantly evolving. Parameters like color rendering index, lens optics, drivers used to fail frequently
2. Higher cost of LED in comparison to conventional street lights
3. Absence of Indian standards for LED lighting
4. Shortage of testing facilities for Led lighting in India and limited expertise on LED technology
5. Retrofitting on existing infrastructure

## Future Prospects

TMC, plans to increase the LED installation to 100%. In addition to this, it plans to add individual addressability and Wi-Fi connectivity to the poles, in order to monitor individual lamp parameters and faults.

Source: As received from ICLEI, South Asia

For more Information

[https://carbonn.org/uploads/tx\\_carbonndata/Invitation%20for%20expression%20of%20interest%20and%20request%20for%20proposal%20for%20ESCO%20model%20at%20TMC.pdf](https://carbonn.org/uploads/tx_carbonndata/Invitation%20for%20expression%20of%20interest%20and%20request%20for%20proposal%20for%20ESCO%20model%20at%20TMC.pdf)

[http://www.districtenergyinitiative.org/sites/default/files/Thane%20Rapid%20Assessment%20Report\\_0.pdf](http://www.districtenergyinitiative.org/sites/default/files/Thane%20Rapid%20Assessment%20Report_0.pdf)

<https://egov.eletsonline.com/2018/02/thanes-transformation-into-a-smart-city/>

02

## PROJECT GREEN LIGHT: NAGPUR

### Project Highlights

- Largest environmental friendly LED (Light Emitting Diode) lights project ever undertaken by a city with an aim to replace 1,36,000 streetlights by 2020
- More than 1,20,300 specially designed programmed LED lights have been installed

### Background

Nagpur is located at the geographical center of India at 21°8'47.88" N and 79°5'19.90" E. It is an important urban area in Vidarbha region and is known as the winter capital of Maharashtra State. The city has been divided into 10 administrative zones and has population of 24, 05,665 as per census 2011. Nagpur city has around 1,36,000 street lights installed in all 10 zones, thus, presenting immense potential of switching to energy efficient lighting system. Under Smart City Proposal all the street lights are proposed to be replaced with energy efficient & programmed LEDs under 'Project Green Light' which is also a convergence project.



**Nagpur,**  
Maharashtra

2015-2018

(Not to scale)

### Project Objectives

- I. Retrofitting the existing conventional street lighting system with LED lights to ensure energy savings
- II. The project aims to save more than 40% of electricity annually
- III. Produce environmental benefits in terms of reducing the carbon footprints

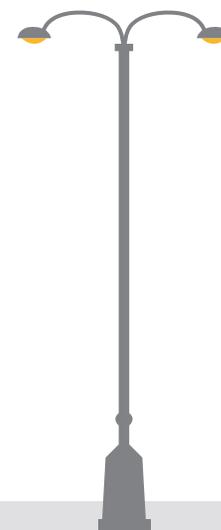
### Key Stakeholders

Nagpur Municipal Corporation (NMC), Maharashtra State Electricity Distribution Company Limited, Residents of the Nagpur City

### Approach of LED Street Lighting Initiative

The project has been initiated under the Smart Cities Mission and bidding has been undertaken in order to undertake the project. A Tender was floated to replace 1, 36,000 conventional lights (sodium lights) with specially designed energy efficient programmed LED lights.

- The work order has been issued to a private firm to procure to replace 1, 36,000 LED lights on PPP basis
- Till now 1, 20,300 programmed LED lights have been installed



## Financial Structure of the initiative

The project was based on PPP arrangement with multiple stakeholders.

### Achievements



#### Benefits and Co-Benefits

- Energy Savings: Energy bills arising from the street lights have been reduced by 40%
- Improved facilities for citizens
- Better Light Quality: The lighting optics as designed resulted in optimum lux levels with uniform spread across the roads and hence leading to improved visibility

### Success Factors

- Technical innovations for effective implementation of the LED street lighting project
- PPP type of arrangement for the implementation of the project

### Limitations

The project faced following challenges:

- Higher cost of LED in comparison to conventional street lights
- Retrofitting on existing infrastructure

### Future Prospects

The project Green Light has built-in savings that will provide energy and maintenance savings for future years and has high replication potential.

Source: Case received from the city

For more Information

<https://timesofindia.indiatimes.com/city/nagpur/nmc-reduces-power-bill-by-52-after-led-street-lights-project/articleshow/69832664.cms>

<https://timesofindia.indiatimes.com/city/nagpur/30k-street-lights-converted-to-led-96k-more-to-go-by-dec/articleshow/63965032.cms>

<https://numerical.co.in/numerons/collection/58304c4d86bd0f881f9fecac>



03

## GREEN BUILDINGS FOR COMPOSITE CLIMATIC ZONE-



### INDIRA PARYAVARAN BHAWAN: DELHI

## Project Highlights

- India's first energy-positive government building-integrates both energy efficiency and on-site renewable energy generation.
- Highest green- rated building: LEED platinum and GRIHA 5-Star
- 70% less energy use compared to conventional buildings with an Energy Performance Index of 44 kWh/m<sup>2</sup>/year

## Background

This is a project of Ministry of Environment and Forests for Construction of New office Building at Aliganj, Jor Bagh Road, New Delhi. The Building was planned to be a state-of-the-art landmark building, with emphasis on conservation of natural areas and trees to reduce adverse environmental impact. Being the highest green rated building in the country, the project serves as a shining example of high performing government buildings.



### New Delhi

**Building Use**  
Office Building  
**Climatic Zone**  
Composite  
*(Not to scale)*

## Project Objectives

- I. Managed to achieve the reduction in embodied energy of construction and further reduction in the operational energy through the choice of sustainable natural construction materials
- II. Managed to minimize the contribution towards Urban Heat Island effects through passive design features and sustainable site practices
- III. Successfully utilized the Adaptive Thermal Comfort model and demonstrated innovative passive cooling technologies like geo-thermal cooling of condenser water to minimize cooling load
- IV. Onsite rooftop solar power has been used for meeting the operational energy demands of the building

## Project Approach

- Building Integrated Photovoltaic (BIPV) system has been integrated for power generation from solar panels
- Building is north-south oriented, with separate blocks connected through corridors and a huge central courtyard
- More than 50% area outside the building is covered with vegetation
- 75% of building floor space is day lit, thus reducing dependence on artificial lighting
- Central courtyard helps in air movement as natural ventilation happens due to stack effect. Additionally, windows and jaalis add to cross ventilation
- Energy efficient lighting system (Lighting Power Density = 5 W/m<sup>2</sup>)
- High efficiency glass, high Visual Light Transmittance (VLT), low Solar Heat Gain Constant & Low U-value, optimized by appropriate shading
- 160 Tonnes of Refrigerant of AC load of the building is met through chilled beam system. Chilled beam are used from second to sixth floor. This reduces energy use by 50 % compared to a conventional system

- Variable Frequency Drives (VFDs) are provided in chilled water pumping system, cooling tower fans and AHUs
- Fresh supply air is pre-cooled from toilet exhaust air through sensible & latent heat energy recovery wheel
- Building Management System (BMS) has been integrated to monitor and control all building systems
- Solar PV system of 930 kW has been integrated to generate 300 kWh/day to meet the operational electricity demand of the building

## Achievements



- The project has received GRIHA 5 Star and LEED Platinum
- The building has already won awards such as GRIHA 5-star of MNRE for exemplary demonstration of Integration of Renewable Energy Technologies

Indira Paryavaran Bhawan

## Long term impacts

- The green building design strategies will help to maximize energy savings and minimize the operational cost of the buildings
- The green cover within the building premises will help to reduce the negative impacts of Urban Heat Island effects
- Water efficient design strategies will help not to impact the water resources of the locality in a negative manner

Source: As received from WRI

For more Information

[https://cpwd.gov.in/CPWDNationBuilding/InaugurationPM25.02.2014/architectural\\_design.pdf](https://cpwd.gov.in/CPWDNationBuilding/InaugurationPM25.02.2014/architectural_design.pdf)

<https://nzeb.in/case-studies/detailed-case-studies-2/jpb-case-study/>

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<http://terienvs.nic.in/index3.aspx?sslid=4177&subsublinkid=1362&langid=1&mid=1>

<https://mnre.gov.in/file-manager/akshay-urja/november-december-2014/EN/26-31.pdf>

04

## ENERGY RETROFIT OF EXISTING BUILDINGS -GODREJ BHAWAN: MUMBAI

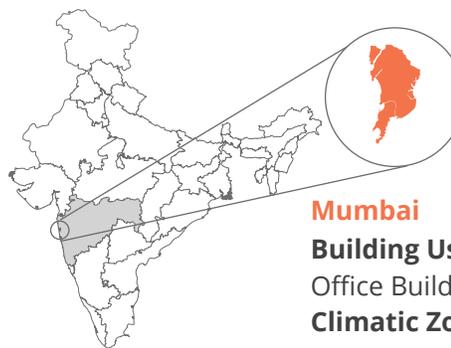


### Project Highlights

- This case study highlights Godrej Bhavan, an iconic office building in South Mumbai, focusing on the strong business case for energy-efficiency upgrades or retrofits
- The Godrej Bhavan retrofit shows that greener, energy-saving retrofits are practical and profitable in India's rapidly transforming building market and provides replicable practices for cost and energy savings
- Just two years after the upgrade, Godrej Bhavan is already reaping cost and energy savings (12.5%) and is on track to recover the costs of installing energy-efficiency measures through lower electricity bills

### Background

Godrej Bhavan, built by Godrej & Boyce in 1972, is a six-storey building that houses the company's chief management. After decades of high electricity consumption, Godrej & Boyce upgraded Godrej Bhavan in 2010 to include inclusive energy efficiency and sustainability features, such as efficient cooling and lighting systems. Because of the upgrade, Godrej Bhavan has now evolved to an energy efficient building that is achieving significant financial and indoor environmental quality benefits for its owner and occupants.



**Mumbai**  
**Building Use**  
 Office Building  
**Climatic Zone**  
 Hot and Humid  
*(Not to scale)*

### Project Objectives

- I. Demonstrated the low-hanging energy and cost-saving opportunities by upgrading HVAC, lighting, and building management systems through energy retrofits
- II. Managed to reduce electricity use, improves building systems, enhances occupant comfort, and increases environmental awareness through energy retrofits

### Project Approach

- Installed Building Energy Management System (BMS) dashboard display with digital energy meters that continuously monitor energy use, check and rectify energy-use discrepancies
- Upgraded the incoming and outgoing electrical systems for high-voltage electricity to a ring main unit system to provide an uninterrupted power supply
- Upgraded the chiller compressor-condenser unit from a 35-year-old HVAC system has been replaced with a new HVAC system with a screw chiller water-cooled condenser, electronic expansion valve, and a high coefficient of performance (COP) of 5.5 from a previous COP of 2.2.
- Installed dedicated Air Handling Units (AHUs) for each floor with VFDs and chiller water-modulating valves
- Installed double-glazed clear windows and shading devices to reduce heat gain through the windows while still providing light
- Conventional lighting fixtures are replaced with highly efficient lighting fixtures

- Developed the building's original green roof, which had a soil depth of nine inches, by removing the covering of the "tandoor" roof clay tiles. The Godrej team measured a reduction in the roof temperature by 10°C using thermal imaging.
- Planted trees around the building to maintain a cool microclimate and reduce the heat island effect.

## Achievements



- First building in Mumbai and the sixth building in India to receive the LEED Gold certification from the United States Green Building Council under the Existing Buildings Operations and Maintenance category
- Energy-Efficiency Leader Award by Ingersoll Rand in recognition of demonstrated initiatives for energy optimization in the air-conditioning system



Godrej Bhawan

## Long term impacts

- The energy retrofits will help to maximize energy savings and minimize the operational cost of the buildings

Highly efficient lighting fixtures and double-glazed windows



## Challenges

- The retrofit required implementing new energy-efficiency technologies in an aging office building with ongoing operations
- The building's architectural design, façade, glazing, lighting, and HVAC system were already in use, limiting the opportunity to redesign these components

## Solutions

- The retrofit focused on specific equipment and energy management upgrades instead of redesigning the building

05

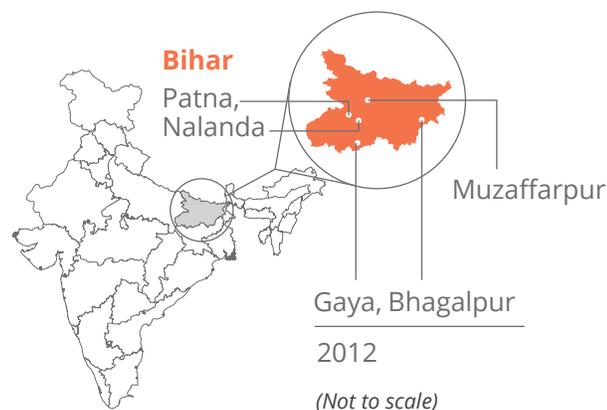
## CASE OF FLY ASH BRICK (FAB) SECTOR IN CITIES OF BIHAR

### Project Highlights

- Reduction of carbon emission through the utilization of cleaner bricks technology
- Utilization of waste material such as fly ash in fly ash brick technology
- Mass awareness and extensive stakeholders' engagement for the promotion of fly ash brick technology as a cleanest technology
- Technical support to fly ash brick enterprises

### Background

In Bihar, the brick sector is the third highest emitter of CO<sub>2</sub> after agriculture and energy. This high rate of emissions is due to the present technology of clay brick firing using coal as a fuel. In manufacturing of these clay bricks agricultural soil is used. The high use of agricultural soil puts an immense pressure on the agricultural activity which is the backbone of Bihar's economy. To decrease the dependences on clay brick technology, over the last six years, Development Alternatives (DA), with support from Shakti Sustainable Energy Foundation (SSEF), has been working to promote cleaner technologies and increase the market share of resource efficient building materials in Bihar with various private and government stakeholders. During the period of DA's intervention from 2012-2018, the market share of fly ash brick (FAB) industry has improved from 0 to 17% at present; of the total brick industry. With current market trends and continued systemic interventions, this market share has potential to reach up to 6% in next 2 years.



### Project Objectives

- I. To create and sustain a favourable policy environment in Bihar for the promotion of fly ash brick technology as a cleaner brick production technology
- II. Implementation of Fly Ash Brick Quality Rating System (to overcome the issues of quality of fly ash brick in the state)

### Key Stakeholders

Department of Environment, Forest and Climate Change, Govt. of Bihar, Bihar State Pollution Control Board, Building Construction Department, Fly Ash brick manufactures association and other govt departments

### Key government Initiatives



## Development Alternatives: Greening the Brick Sector in Bihar



### Technology Solutions Innovation & Research

- Technology know how Fly ash brick making
- Fly ash brick making machine



### Enterprise Support Services-

Business Sustainability Providing Technology support; market linkage; credit linkage and capacity building service to existing and potential fly ash brick entrepreneurs



### Policy Influence-

Favourable Policy Ecosystem

- Technical and advisory support to Govt of Bihar (GoB)
- Preferential procurement policy for green bricks
- Quality control through quality rating programme

## Communication & Outreach Mass Promotion; Demand Stimulation



GIS mapping of fly ash enterprises to validate supply



Mass promotion through workshops like green enterprise mela and awareness workshops



Mass promotion through communication products

## Achievements

- 31 enterprises were enrolled and service provided under FABQRS
- Improvement in the quality depicted after the technical training
- Rising public discourse towards FAB
- Building Construction Department, GoB reinstated procurement of 100% FAB in public sector projects



# Strategy for Intensification

To catalyse transformative change towards cleaner brick technology through technology solutions , enterprise service and policy influence in Bihar

## Focus Area



### Uptake of Fly ash bricks



Technology support and research



1 stop FAB enterprise solution



Partnerships with CSOs, academia, government

### Adoption of other cleaner technologies



Technical know how on cleaner technologies



Enterprise Support services to brick kilns units



Partnerships with CSOs, academia, government

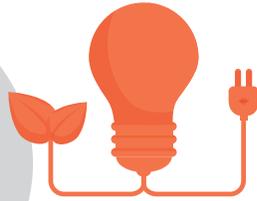
Source: As received from Shakti Foundation and Development Alternative

For more Information

[https://www.devalt.org/images/L2\\_ProjectPdfs/\(4\)FlyAshBrickIndustry.pdf?Tid=162](https://www.devalt.org/images/L2_ProjectPdfs/(4)FlyAshBrickIndustry.pdf?Tid=162)

<https://www.greeneconomycoalition.org/assets/reports/Cape-Town-Global-Meet-2019/India-Country-Posters-GM2019-FINAL-PRINT.pdf>

06



## ENERGY EFFICIENCY IN STREET LIGHTING SECTOR: RAJKOT

### Project Highlights

- Rajkot Municipal Corporation (RMC) was the first local body in the State of Gujarat to successfully retrofit all existing conventional street lights with energy efficient Light Emitting Diode (LED) lights within 3 months
- Energy Saving Company (ESCO) model has been applied to undertake this intervention
- Energy savings of 60% and GHG emission reduction of about 7,000 tCO<sub>2</sub> eq. from the street lighting sector was achieved
- Improvement in the illumination levels, aesthetic appearance, enhanced public safety and security, and providing better livelihood to citizens

### Background

In 2016, Rajkot had more than 60,000 streetlights within its city limits which were owned and maintained by the Rajkot Municipal Corporation (RMC). The city had prepared a GHG inventory under the urban LEDs project, where street-lighting sector was identified as the energy intensive municipal sector in the city. Therefore, street lighting service was prioritized to cut down the energy consumption and GHG emissions. After assessing the conditions on ground and identifying the gaps in street lighting, Rajkot city government with ICLEI South Asia's support identified that the replacement of existing HPSV street lights with LED lights was a solution to serve multiple objectives, such as - a) improved operation and maintenance management of the technology, b) energy saving benefits, c) reduced GHG emissions and d) improvements in illumination levels. The city thus, decided to undertake a pilot project on LED retrofits to demonstrate the technology and impacts in the local context.



**Rajkot,**  
Gujarat

October, 2016  
– April, 2017

*(Not to scale)*

### Project Objectives

- I. Retrofitting the existing conventional street lighting system with LED lights to ensure energy savings
- II. Reduction of 50% of energy consumption and related and related GHG emissions from street lighting sector without any upfront capital investment from Rajkot Municipal Corporation
- III. Achieve desired illumination levels in a uniform manner in order to reduce road accidents
- IV. Produce environmental benefits in terms of reducing the carbon footprints

### Key Stakeholders

Rajkot Municipal Corporation, ICLEI South Asia, European Commission

### Approach of LED Street Lighting Initiative

The project has been initiated under the Smart Cities Mission and bidding has been undertaken in order to undertake the project. The following steps were undertaken under the project:

- An on-ground survey was initiated by the city under the Urban-LEDS project to provide stakeholders with an enhanced understanding of the current conditions of the street lighting system in the city and the opportunities for improvements

- Through the development assistance available under the Urban-LEDS project, 291 existing HPSV lights were replaced with LED lights on a selected road stretch in the city
- Based on the successful implementation and positive results from this pilot intervention, the city government scaled up through a city-wide LED streetlight retrofit program
- Rajkot signed the agreement with EESL in December 2016 and within 3 months all poles of the city were retrofitted with LED lights

## Financial Structure of the initiative

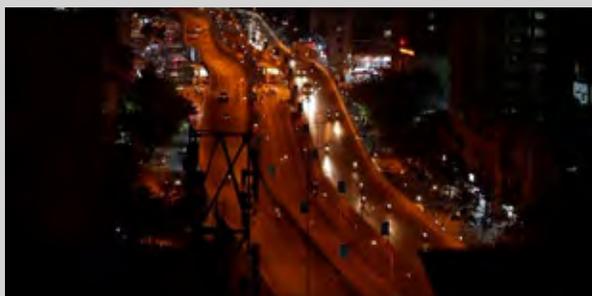
Financial grant from the European Commission through the Urban-LEDS program was provided for this project

## Achievements



### Benefits and Co-Benefits

- Improved illumination levels and uniformity has not only provided better aesthetic appearance but also reduced rate of accidents and improved quality of life of citizens
- Rajkot city government has saved more than **8.5 million kWh** conventional electricity (more than 60% of total electricity consumption from the sector before), which translates into savings of INR 50 million (\$ 0.75 million) and 7,000 tonnes CO<sub>2</sub> eq. GHG emission reduction through the project
- As Energy Efficiency Services Limited (EESL) is responsible for overall comprehensive operation and maintenance for 7 years, and all streetlights are managed automatically by Central Control Monitoring System (CCMS), not only enables maintenance without any delay but city government also saves INR 25 million (\$ 0.38 million) from the maintenance of old HPSV fixtures
- Online monitoring through CCMS and installation of smart panels enables city government to identify illegal theft from street lighting panels
- Project improved confidence level of city government and energy saving company with improved illumination level, uniformity ratio, benefit from energy savings and reduced maintenance costs
- Reduced rate of accidents, aesthetic appearance, improved working hours for road side vendors and enhanced public safety are added social impact through project



Before and After Project - Illumination levels with HPSV lights on 150ft Ring Road, Rajkot

## Success Factors

- Technical innovations for effective implementation of the LED street lighting project
- Strong and effective leadership
- Multi-level coordination and partnership

## Limitations

The project faced following challenges:

- Implementation challenges, such as removal of 10-15 years old corrosive fixture from poles as well as difficulties in fixing new LED fixtures on old lighting pole arms
- Approval of the technical innovations of the technology

## Future Prospects

- The project has built-in savings that will provide energy and maintenance savings for future years and has high replication potential.

Source: Case received from the city

For more Information

<https://timesofindia.indiatimes.com/city/rajkot/LED-bulbs-to-light-up-Rajkot-streets/articleshow/52426551.cms>

<http://archive.indianexpress.com/news/rs-2.3crore-led-street-light-project-of-ruda-lights-up/1102626/>

[https://mnre.gov.in/file-manager/UserFiles/Master-Plan-Solar-City/Rajkot\\_solar\\_city\\_master\\_plan.pdf](https://mnre.gov.in/file-manager/UserFiles/Master-Plan-Solar-City/Rajkot_solar_city_master_plan.pdf)

07

## RENEWABLE ENERGY DEPLOYMENT FOR COMMON UTILITIES OF SOCIAL HOUSING SCHEMES: RAJKOT



### Project Highlights

- 31.5 kWp grid connected solar PV system is installed under SDC funded CapaCITIES project at the Krantiveer Khudiram Bose social housing scheme for common utilities like pumps, lightings and elevators
- The solar PV system is generating ~3,780 units of electricity per month, which has the potential to reduce 37 tCO<sub>2</sub>e GHG emissions per year.
- INR 12,000 is paid by the DISCOM to the members of the township after adjusting with the grid consumption by the social housing common utilities

### Background

Rajkot is part of Swiss Agency for Development and Cooperation's (SDC's) Capacity Building for Low Carbon and Climate Resilient City Development project (CapaCITIES) project, which aims to enhance capacities of Indian partner cities (Rajkot, Coimbatore, Siliguri, and Udaipur) in planning and implementing climate mitigation and adaptation measures along with increasing awareness on low carbon and climate resilient city development. Rajkot Municipal Corporation decided to implement energy efficiency and renewable energy measures as pilot in one of their social housing scheme to see the results and replication potential. 31.5 kWp grid connected solar PV system for common utilities like common lighting, pumps and elevators is commissioned under CapaCITIES project funded by SDC.



### Project Objectives

- I. To increase Renewable Energy (RE) integration among the residential buildings sector by implementing grid-connected solar PV system deployment for all common utilities pilot project in one of the social housing schemes as per Gujarat Solar Policy 2015
- II. To power the common amenities such as elevators, common lighting and pumps in a social housing complex through a solar PV system and showcase to create awareness on the carbon and economic benefits and to encourage its integration in the private residential buildings

### Key Stakeholders

Rajkot Municipal Corporation (RMC); ICLEI South Asia; Residential Welfare Association

### Approach

Project was targeted to create model project of introducing EE and RE measures reducing conventional electricity from residential sector, RMC decided to implement one pilot project on one of the social housing schemes which then can be replicate at city level.

- Feasibility study was conducted by ICLEI South Asia to identify feasible social housing scheme for the pilot project implementation. Key steps were to identify:
  - Conventional electricity consumption for common utilities,
  - types of common appliances,
  - Available shadow free open roof area for deployment of Solar PV and electricity sanctioned load etc.

- “Krantiveer Khudiram Bose Township” was identified as potential project location.
- Project was designed by ICLEI South Asia based on actual electricity consumption from all common amenities of township and discussed with Residential Welfare Association (RWA).
- 31.5 kWp grid connected solar PV system installed on rooftop consisting 462 poly-crystalline Photo Voltaic panels of 315 Wp capacity each.
- Training provided to RWA for maintenance of solar panels by ICLEI South Asia. The solar PV system will be operated and maintained by the contractor who set up the plant for a period of 10 years from installation.

## Financial Structure of the initiative

Financial grant from the European Commission through the Urban-LEDS program was provided for this project

## Achievements



- The solar PV system will generate 3780 units of electricity per month (45,360 kWh per year), which has a potential to reduce 37 tCO<sub>2</sub>eq. GHG emissions per year.
- Since, the township is generating and utilizing solar energy from Solar PV system, approx. INR 12,000 is credited to their accounts by DISCOM every month.



## Success Factors

- Feasible to structure a PPP project to install Solar PV systems for catering to the common amenities load in all upcoming social housing complexes
- RMC has proposed a 100kWp grid connected solar PV system for common utilities at Smart Ghar III affordable housing scheme.
- The residential sector of Rajkot will have a significant proportion of their electricity demand met by grid-connected solar PV systems considering the proposed interventions implementation.

## Future Prospects

RMC plans to construct a total of 9,141 dwelling units by the year 2020. One of the main objectives of this solar PV project at the Krantiveer Khudiram Bose social housing complex is to encourage the adoption of solar PV in social housing.

Source: Case received from the city

For more Information

[http://capacitiesindia.org/wp-content/uploads/2018/08/Quickwin-Projects-Rajkot\\_Solar-PV-Social-Housing.pdf](http://capacitiesindia.org/wp-content/uploads/2018/08/Quickwin-Projects-Rajkot_Solar-PV-Social-Housing.pdf)

<https://capacitiesindia.org/projects-rajkot/>

# CLEAN ENERGY PROGRAM: NEW JERSEY



**New Jersey, USA**

Year of Initiation: 2003

## Project Highlights

- Incentive based approach to transform the energy consumption pattern of New Jersey
- People centric approach to ensure energy savings
- Fosters technology driven transformation of energy marketplace of New Jersey

## Background

Pressing challenges like congestion on the grid to energy efficiency and renewable source of power lead to the prioritization of energy issues for both consumers and businesses in New Jersey. NJCEP is one of the major initiatives undertaken by the city to ensure efficient utilization of energy and

existing resources. It is a statewide program offering financial incentives and services to various stakeholders of New Jersey to help them gain energy, economic as well as environmental benefits.

## Project Objectives

The NJCEP complements the New Jersey Energy Master Plan and abides to the goals of the master plan. The three specific goals of the New Jersey Energy Master Plan to be achieved till 2020 are:



**Reduce energy consumption by at least 20%**



**Reduce peak demand by 5,700 M**



**Generate 30% of the state's electricity needs from renewable resources**

## Key Stakeholders

NJCEP is an open stakeholder process and involves parties from various respects like energy efficiency & renewable energy businesses, public officials, electric & natural gas utilities, environmental groups, business organizations, state colleges and universities.

## Approach of NJCEP

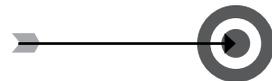
NJCEP targets the energy management sector of the city and aims to incentivize energy savings by providing financial gains to various stakeholders and consumers. The program has multiple avenues as indicated:

- The program undertook one innovative financing pilot program in 2007, Solar Renewable Energy Credits (SRECs)
- Transform the energy consumption patterns of the residents of New Jersey by providing tax credits, rebates and incentives on alternative sources of energy to consumers as well as business developers

## Financial Structure of NJCEP

- Receives funding from New Jersey's System's Benefit Charge
- Small surcharge, i.e., Societal Benefits Charge (SBC) on all customers' electricity bills is the main source of funding for the New Jersey Clean Energy Program
- A total of \$1.227 billion was collected to support NJCEP between 2001 and 2008
- A total of \$1.213 billion was collected to support the program between 2009 and 2012

## Achievements



### Benefits

- Energy savings of over 22.6 million MWh of electricity; 70 million dekatherms of natural gas; 7.5 million MWh of renewable generation; and 1.5 million MWh of distributed generation from combined heat and power systems was achieved through the program activities between 2001 and 2008
- NJCEP had supported the installation of 4,719 renewable energy projects across the state, providing 153.9 MW of sustainable energy, including solar, wind, biomass and fuel cell projects their carbon emissions till 2009
- Natural gas consumption in approximately 500,000 buildings was reduced by the activities of NJCEP

### Co-benefits

- Climate Change Mitigation
- Carbon-trading benefits to the low-income neighborhood cities

## Success Factors

- Strong and stable Institutional and legislative capacity
- Innovative and integrated strategy targeting a large spectrum of stakeholders
- Adoption of Incentive based mechanism for promoting energy savings and shift to clean energy
- Consistent and regular monitoring and evaluation mechanism



Source: <https://www.reeep.org/sites/default/files/Compendium%20of%20US%20Best%20Practices.pdf>

For more Information

<http://www.njcleanenergy.com/>

[https://www.energystar.gov/index.cfm?c=pt\\_univ.eeps\\_sites\\_njcep](https://www.energystar.gov/index.cfm?c=pt_univ.eeps_sites_njcep)

# CAPPING OF CLIMATE EMISSIONS FROM BUILDINGS CITY: NEW YORK



**New York, USA**

**Year of Initiation: 2019**

## Project Highlights

- First of its kind GHG emission cap for buildings of New York city
- Metropolis scaled version of a Green New Deal
- Innovative policy tool that provides targets as well as pathways to achieve the emission targets
- Most aggressive climate bill USA

## Background

The buildings of the New York City are a major source of GHG emissions and accounted for ~67% of the citywide GHG emissions released in the year 2015. The NYC is compliant with the Global

Covenant of Mayors for Climate and Energy and is strategically adopting aggressive initiatives like capping of climate emissions from buildings in order to meet its climate change goals.

## Project Objectives

To reduce the GHG emissions being released from the buildings of NY city by 40% till 2030 and by 80% by the year 2050

## Key Stakeholders

New York Council, Policy Makers, Real Estate Board of New York, Building Owners, Technology Developers, Architects

## Approach of “Climate Emission Capping for Buildings” law

The measure targets the building sector of the NYC and ensures adoption of retrofits to reduce the GHG emissions being released in the city.

The measure mandates:

- Buildings with area more than 2500 square feet (2,300 square meters) to cut the GHG emissions by 40% by 2030 relative to the 2005 levels
- Owners of buildings with area of 2500 square feet or more to make energy-efficient upgrades
- Establishment of an office of Building Energy Performance to ensure efficient adoption of the proposed law

## Financial Structure of “Climate Emission Capping for Buildings” law

- The total costs of upgrades is estimated to be around \$4 billion
- Heavy fines will be imposed on offenders. A penalty of \$268 per every assessed ton of carbon over the cap will be charged from building owners

## Achievements

### Benefits

- Minimize GHG emissions being released from the buildings of NYC
- Climate Change mitigation



- Development of a durable industry in energy retrofiting
- Development of replicable model for other cities across the world which aim to reduce their carbon emissions

### Co-benefits

- Minimize GHG emissions being released from the buildings of NYC
- Climate Change mitigation
- Development of a durable industry in energy retrofiting
- Development of replicable model for other cities across the world which aim to reduce their carbon emissions

## Success Factors

- Minimize GHG emissions being released from the buildings of NYC
- Climate Change mitigation
- Development of a durable industry in energy retrofiting
- Development of replicable model for other cities across the world which aim to reduce their carbon emissions

### Limitations

- Unprecedented costs associated with the new emission targets of buildings of NYC



Source:

1. <https://www.reuters.com/article/us-usa-climatechange-new-york/in-first-new-york-caps-climate-emissions-from-buildings-idUSKCN1RV149>
2. <http://www.omanobserver.com/in-first-new-york-caps-climate-emissions-from-buildings/>
3. <https://insideclimatenews.org/news/18042019/new-york-city-climate-solutions-buildings-energy-efficiency-jobs-low-income-greenhouse-gases>
4. <https://www.cbsnews.com/news/new-york-city-carbon-emissions-from-trump-tower-and-other-buildings-80-percent/>

# 2



## URBAN PLANNING, GREEN COVER & BIODIVERSITY



## A CASE STUDY OF PROTECTIVE MEASURES TAKEN BEFORE, DURING & AFTER THE FLOOD: NASHIK

### Project Highlights

- Revision of the Disaster Management Plan to update all the information related to flood preparedness
- Mass awareness and extensive community engagement
- Adoption of city-wide flood precautionary measures

### Background

Nashik, the Grape City of Maharashtra, situated on the North-west sides of Maharashtra not only the administrative center and industrial hub of the Maharashtra state but also a popular pilgrimage tourist destination. The district having a population of 61,09,052 makes it the 3rd most populated city of Maharashtra. Considering its geographical location, the city is vulnerable to various kind of hazard like flood, earthquake, fire hazard, drought etc. The affinity towards various natural disaster produce long lasting impacts on human lives, livelihoods and property of the city. In view of this, the District Administration felt the urgency of preparing an emergency response plan in order to minimize the negative impacts of a natural calamity. Thus, the city initiated an important measure of updating the District Disaster Management Plans.



**Nashik,**  
Maharashtra

Year of Start: 2019  
(Not to scale)

### Project Objectives

- I. To improve the preparedness measures during flood conditions in the city of Nashik
- II. To develop a comprehensive integrated long-term plan for Disaster Management for any climatic conditions
- III. To reduce disaster impact on health care facilities, schools, roads, infrastructure etc

### Key Stakeholders

Nashik Municipal Corporation & Municipal Disaster Management Cell, District Collector Office, District Disaster Management Cell, Municipal Smart City Development Ltd.

### Approach

An integrated approach was adopted to strategize the activities being undertaken to cover the various aspects of preparedness. The plan covered various aspects of preparedness measures before, during and after the flood disaster situation in both rural as well as urban areas of Nashik city. Considering the fact that the city had been experiencing very to very heavy rainfall over the year 2019, the municipal corporation along with its disaster management cell formulated a well-organized and integrated disaster management plan for the city. Disaster risk management component contains, multi-level plan preparation, capacity building at various levels through trainings, community awareness, create resources database with coordination at district administration and line departments, multi sector and multi-disciplinary actions for mitigate disasters with pre-during and post disaster activities, resource mobilization and technical assistance.



## Financial Structure of the initiative

- Funding's from State Disaster budget and regular disaster resource from Nashik Municipal Corporation, District Collectorate & Central Governments Smart City Mission Funding
- The Chief Minister of Maharashtra State demanded a special relief package of RS. 4,700 crores for Kolhapur, Satara & Sangli and amount of Rs. 2,105 crores for Kokan, Nashik and some rest of Maharashtra state
- There would be a compensation of Rs. 10,000/- for rural areas and Rs. 15,000/- for urban areas for affected families
- In addition to this, a compensatory amount of Rs. 75,000/- would be given for small businesses that have suffered the respective damages during the flood disaster

## Achievements



### Benefits

- The development of disaster management plan at an early stage led to increased preparedness for the disaster. All the information about damages, diversions, restoration was shared with the public through press conferences, Twitter, Facebook, etc. ensuring the effective implementation of precautionary measures
- Minimization of infrastructural and human health loss was observed due to extensive preparedness for the floods
- Reduced vulnerability and increased accessibility to food supply during the event of disaster

### Co-benefits

- Mass participation and awareness leading to high levels of preparedness to tackle the calamity
- Development of structural changes in buildings of low-lying areas
- Capacity building and skill development of various disaster management teams ensuring the development of efficient and skilled workforce

## Success Factors

- Effective unity among various citizens of various religions, places and ages.
- Mass awareness of management systems amongst the various levels of societies for every disaster and other critical conditions.

### Limitations

- Lack of communication systems for effective and speedy relief operations
- Alternate road infrastructures are to be constructed in quick time where there submerged roads and other infrastructures in high flood conditions

## Future Prospects

Nashik is a city where the normal and high flood situations arises frequently on each and every year. For this, the well organized and well-prepared Disaster management system is necessary. This year's disaster management plan and system has impacted effectively, which can be used a baseline for planning the disaster management initiatives in future.

Source: Case received from the city

<http://www.uniindia.com/flood-over-4-000-moved-to-safety-in-nashik/west/news/1692955.html>

<https://timesofindia.indiatimes.com/city/nashik/Flood-alert-for-low-lying-areas-for-second-day/articleshow/53501390.cms>

<https://www.irjet.net/archives/V6/i4/IRJET-V6I4916.pdf>

# 11



## TOWARDS A GREENER SOCIETY: REJUVENATION OF NEIGHBORHOOD PARK OF THANJAVUR

### Project Highlights

- Increased green cover and enhanced the aesthetics of the neighborhood park
- Improved the overall condition of the park which facilitated an increase in the footfall and its usability by local residents
- Improved the lighting facilities in the park region thus imbining the sense of security among the local residents

### Background

Neighborhood parks are considered as the lifeline of a locality as they yield numerous benefits and co-benefits. A park with an area of 1282 sq. km is situated in the west side of Thanjavur city in Tamil Nadu. The park is one of the prominent facilities of the area and is divided in three segments housing a children park with compound wall, which is in a dilapidated condition and cannot be used. The other segments are mainly used for informal parking of four wheelers, trucks and buses and thus, inhibit effective utilization of the facility by local residents. This triggered the local residents and municipal corporation to devise a project to rejuvenate the neighborhood park.



**Thanjavur,  
Tamil Nadu**

2019

*(Not to scale)*

### Project Objectives

- I. To improve the facilities in the park
- II. To develop the park in such a way that residents can spend their leisure

### Key Stakeholders

Thanjavur City Municipal Corporation; Near-by residents of the area

### Approach

The initiative aimed to redevelop and improve the overall aesthetic value of the neighborhood park in one of the localities of Thanjavur. An integrated approach involving pre-assessment as well as redevelopment was undertaken in order to improve the condition of the park. The key activities included:

- Assessment of the existing condition of the park in order to identify the requisites for improving the quality of the park
- Stakeholder consultations: Extensive involvement of the local residents in order to identify the facilities that need to be provided in the park
- Development of a comprehensive plan of action incorporating all the aspects identified through pre-assessment as well as residents consultations
- Development of financial plan and proposal for the project and implementation of the proposed plan through active participation of municipal corporation and local residents

## Financial Structure of the initiative

- Cost of the project is Rs.1.30 Crore
- This is service oriented and no revenue is expected

## Achievements



### Benefits

- Increased green cover leading to improvement in the overall aesthetics and quality of environment
- Increased the accessibility to various play equipment for the children of the locality, thus increasing the attractiveness of the parks
- Enhancement in the park infrastructure, i.e., park furniture, water fountains etc.
- Improvement in the lighting facilities in and around the park

### Co-benefits

- The practice of dumping garbage has been avoided, thus reducing the environmental and human health impacts
- The encroached portion of land has been reclaimed
- The enhancement of the quality of parks has increased the probability of indulging in physical activities and hence provide immense health benefits
- Improvement in the overall air quality of the locality

## Success Factors

- Active participation of local residents for improving the conditions of the park
- Increased usage of the park facilities by local residents and children
- Intensive mass awareness and involvement with municipal corporations and other local level government agencies

### Limitations

Size and location of the park, i.e., small surface area and vicinity to the road side hinder the expansion and optimum usage of the park to gain the intended benefits

## Future Prospects

Effective utilization of the improved green area facilities at local levels will meet the expectations of all the residents including senior citizens and children which will pave way for large scale transformations of these neighborhood parks in the city.

Source: Case received from the city



12



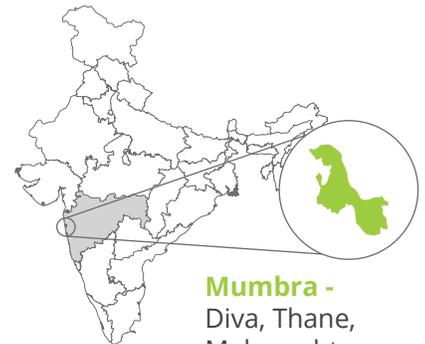
## GREEN THANE: TOWARDS A SMART GREEN CITY

### Project Highlights

- Increase in the green cover and regeneration of degraded forest land of Thane City
- Conservation of the fast depleting bio-diversity of Thane City
- Restricting further erosion of soil and hence reducing landslides in the hilly areas around Thane city
- Adoption of methods to restrict the loss of fresh water due to runoff during the rainy season in this degraded forest lands and in turn recharging the water table in the high-water scarcity areas of the City
- Generating employment to the tribal youths in these areas
- Involvement of Citizens, NGOs, students, etc. in the plantation program and creating awareness regarding the importance of environment conservation

### Background

Thane city located near Mumbai in the state of Maharashtra, is a rapidly growing city due to extensive immigration and urbanization. In view of this, there has been fast depletion of green spaces within the city as well as on its outskirts. Tree Census carried out in the year 2011 recorded 4, 55,070 of trees in the city, but in order to cope up with the fast growing concretization, Thane Municipal Corporation planned a drive of planting 5 Lakh trees in 3 years starting from 2015. Considering the scarce availability of land within the city, degraded forest land was identified within the city limits for the plantation drive in association with the Forest Department.



**Mumbra -  
Diva, Thane,  
Maharashtra**

2015-2018

*(Not to scale)*

### Project Objectives

- I. Regeneration of degraded forest land within the city limits
- II. Plantation of local forest tree species on all the areas identified for the plantation drive
- III. Restricting soil erosion in identified hilly areas
- IV. Minimization of fresh water wastage and adoption of techniques to ensure ground water recharge to minimize water scarcity problems in the city

### Key Stakeholders

Garden Department and Tree Authority, Thane Municipal Corporation

### Approach of Green Thane initiative

The project was planned with an initiative to resolve the issue of fast depleting green spaces due to the ever-increasing urbanization of Thane city as per the following criteria:

- Identification of big open spaces for plantation within the city limits due to scarcity of land in association with the forest department



- A large patch of degraded forest land located in the hilly regions in Mumbra and Diva city was taken on lease from the forest department for 7 years
- A tri-party agreement was made between the Forest Department, Thane Municipal Corporation and Forest Development Corporation of Maharashtra for the plantation project
- Distribution of free saplings to the Local leaders, NGOs, Citizens, schools and colleges within the city limits to ensure mass plantation initiatives across the city
- Extensive campaigns, media as well as community engagement drives to increase mass-awareness levels about the initiative: Local leaders and celebrities were also involved in the plantation drive
- Adoption of techniques like Nala bunding, mulching, etc. for the conservation of water in order to make it available for a longer time for the plants, as well as check dams for helping the water to percolate in the soil and recharge the water table in that area
- Geo tagging of the planted trees with the help of GIS/GPS technology
- Maintenance of the plants for 5 years by FDCM of the plantation carried out on Forest land which involves watering of plants, weeding, replacing dead plants with new, etc.
- Generation of employment opportunities for local tribal youth

## Financial Structure of the initiative

Project was funded through the annual budget of Thane Municipal Corporation

## Achievements



### Benefits



In 1st year 2015, total 49,638 no. of trees has been planted.

In 2nd year 2016, total 1,61,554 no. of trees has been planted. Out of which a record of 76,496 no. of trees were planted in a single day on 1st July 2016.

In 3rd year 2017, total 2,88,810 no. of trees has been planted. Out of which a record of 82,870 no. of trees were planted in a single day on 1st July 2017.

In the year 2018, total 1,19,000 trees has been planted, out of which 50,000 were mangroves.

More than 6 lakhs were planted within a period of four years in the Thane city limits involving local leaders, celebrities, NGOs, students, citizens, on degraded forest lands, roadsides, reservation plots, dividers, etc.



### Co-benefits

- Creation of employment for the local tribal people during the plantation process and maintenance period of the project

## Success Factors

- Strong and stable leadership of Forest Development Corporation of Maharashtra
- Intensive campaigning and mass involvement for the drive

### Limitations

- A total of 600 ha of land was made available on lease but due to intense degradation only 400 ha could be used for plantation
- Water availability a problem due to hilly areas

## Future Prospects

- Inclusion of local species of fruits, flower trees in the plantation drive will help to conserve and regenerate the depleting Bio diversity in Thane City area
- Plantation of fruit trees and flower trees can become permanent source of income for the tribal youths
- Increase in the green cover can help to reduce the pollution in Thane city

Source: As received from ICLEI, South Asia

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## URBAN DESIGN GUIDELINES FOR RANCHI



### Project Highlights

Developing the Urban Design Guidelines focusing on

- Creating a vibrant, safe, inclusive and sustainable city to live and work in for citizens
- Integrating city's ecological assets with the built environment thus ensuring sustainability
- Incorporating sustainable technologies and materials in building designs while leveraging natural elements
- Developing suitable strategies for climate resilience, and incentivizing the same

### Background

Ranchi is one of the 100 smart cities under the Smart City Mission and as part of the proposal, it has proposed a 656.30 acres of greenfield development. To enhance the quality of the built area and the open spaces, it is proposed that due focus will be given to urban design. Department of International Development (DFID)-UK, under the UK-India Strategic Partnership for Smart Urban Development in Indian States (SmUDI) initiated a project to prepare Ranchi Urban Design Guideline.



**Ranchi,**  
Jharkhand

2018

(Not to scale)

### Project Objectives

- To provide comfortable and high quality built environment, integrated with nature
- Enhance the sustainability and ecological viability of the city

### Key Stakeholders

Ranchi Smart City Corporation Limited,  
Urban Development & Housing Department,  
Government of Jharkhand

### Approach

The approach to develop the Urban Design Guidelines for Ranchi is threefold – 1) Study of the Master Plan for the Project Site, 2) Secondary Research to identify Global Practices, and 3) Stakeholder consultation. Based on an assessment, three broad design parameters have been identified; Streetscape, Building & Blocks and Open Space. The key features under these parameters are as follows:

- Streetscape design guidelines aim to create a unified and visually attractive environment that is safe, comfortable, convenient and sustainable. Establishment of discrete spaces encountered on the street - footpaths, cycle tracks, bus lanes, bus stops, carriageways and parking, - with street furniture, markings and designs
- Design of buildings and blocks aims at unique, cohesive and distinctive expression of physical forms.
- Adoption of sustainable techniques like rainwater harvesting, roof top solar, solar water heating, solar power for lighting and sustainable materials etc., for a green development.
- Designing open spaces to ensure integration with nature and creating a sustainable city.

### Financial Structure of the initiative

- Admissible incentive for Green Building and sustainability provisions (installing Solar heating, lighting & waste water recycling, city & site level greenery) to be given by the Competent Authority

- Additional FAR to be provided for buildings complying to GRIHA or similar green rating norms with a nominal fee
- Revenue sources from designed spaces for vendors along streets and other public open space, and parking space

## Achievements



### Benefits

- Streetscape Design
  - Street plantation and shaded resting space to maximize thermally comfortable street environment
  - Designing innovative multi utility and green zones along the streets to ensure intermediate and interactive break out spaces for the road users
  - Public spaces with cultural identity where people work, enjoy and congregate
- Building & Blocks Design
  - A cohesive and symmetric look across the city, through use of standard material options, colour palette and building massing
  - Building designs responsive to site conditions and do not disrupt the geology, hydrology and micro climatic conditions of the site
- Open Space Design
  - Preserving the natural waterbody and plantations within the site and developing recreational space along it

### Co-Benefits

- Active involvement of local Sohrai, Dhokhra, bamboo and wood, and other indigenous art form's artisans within Ranchi

## Success Factors

- Intensive consultation with RSCCL, experts and local artists for preparing a city specific guidelines incorporating the local character and ecology
- Strong and stable leadership guiding the development of the Guidelines
- Institutional and managerial models established within the RSCCL

### Limitations

Appropriate institutional strengthening across stakeholders shall be a key factor towards successful accomplishment of the project

## Future Prospects

The final guideline shall be made a part of all tender documents or auction documents or any other document related to any transaction or construction within the ABD

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## SURAT CLIMATE RESILIENCE STRATEGY

### Project Highlights

- Development of an early warning system for floods
- The system is an end-to-end early warning system which has been instrumental in reducing flood risks of the city
- Integrated strategy based on the expertise of multiple stakeholders from all walks of urban development
- Minimization of economic losses in the city attributable to floods

### Background

Surat, one of India's most economically successful city is extensively prone to floods leading to the constant threat for the city. The geographical location of the city, i.e., on the Tapi river makes it flood prone not only from heavy precipitation in and around the city but also from heavy precipitation upstream and from high tides downstream. In order to minimize the risks of disaster and make the city resilient to the shocks of disasters, the city took an initiative of developing early warning systems and bring together expertise from all walks of urban sector to demonstrate how this strategy can help in not impeding growth of the city.



### Project Objectives

- I. Development of an integrated climate resilience strategy for Surat to make the city resilient to the impacts of natural calamities, especially floods

### Key Stakeholders

Surat Municipal Corporation with technical support from TARU Leading Edge, a research and consultancy company working on disaster management and climate change

### Approach of Climate Resilience Strategy

The strategy was planned with an aim to minimize the impacts of floods on the city and make the city resilient to the disaster. The strategy was developed under the Phase II of the Asian Cities Climate Change Resilience Network (ACCCRN) initiative. A city advisory committee including stakeholders from all sections of urban life- including academia, industry, local government and civil society etc. was established to study the impacts of climate change on the city. The thorough understanding gained by the committee was used to create a Surat Climate Change Trust. This trust is a unique instrument designed to develop a resilience strategy for the city.

- An "End-to-End Early Warning System" was setup to reduce the intensity of flood damage
- Extensive public awareness campaigns and sensitization was done to increase the level of understanding the impacts of flood warning systems
- A large number of risk resilient workshops were conducted with the key stakeholders to develop the strategy for the city

## Financial Structure of the initiative

The strategy was funded by the Rockefeller foundation under Phase II of the Asian Cities Climate Change Resilience Network (ACCCRN) initiative

### Achievements



- Surat has been able to ensure sustainable economic growth in the city in the face of the ecological challenges
- Since its inception the system has saved the city from any intensive impact of floods due to its timely warning system
- Sensitization of the local public about the importance of these warning systems
- Creation of the “Urban Health and Climate Resilience Centre” in the city which primarily works on urban health and building climate change resilience
- One of the major achievements of the initiative was the inclusion of a budget line specifically for climate change in the Surat Municipality budget for the year 2013-2014

### Success Factors

- Strong and stable leadership the Surat Municipal Corporation
- Technological Innovations to establish an “End-to-End alarming system”
- Commitment and support of the local bodies
- Intensive campaigning and mass involvement for the drive

### Limitations

Presence of large number, i.e. ~60% of migrant population in the city making it difficult to spread awareness about the key challenges associated with floods

Source: <https://smarnet.niua.org/sites/default/files/resources/Urban%20Green%20Growth%20Strategies%20For%20Indian%20Cities%20Vol.3.pdf>

For more Information

2. [http://www.asiapacificadapt.net/sites/default/files/resource/attach/Surat\\_City%20Resilience%20Strategy\\_TARU-SMC.pdf](http://www.asiapacificadapt.net/sites/default/files/resource/attach/Surat_City%20Resilience%20Strategy_TARU-SMC.pdf)
3. <http://www.100resilientcities.org/strategies/surat/>



# MASTERPLAN 100% CLIMATE PROTECTION, 100% RENEWABLE ENERGY SUPPLY: FRANKFURT



**Frankfurt, Germany**

Year of Initiation: 2013

## Project Highlights

- 100% shift to regenerative sources of energy by 2050
- People centric approach to ensure energy savings

## Background

Frankfurt am Main is among the most built-up cities in Germany; the population rose to around 690,000 in 2013. In 2010, approximately 22,600 gigawatt hours (GWh) of final energy were consumed—just under 1% of German’s final energy consumption. 95% of this energy was imported, i.e. generated outside of Frankfurt and, as a rule, outside of the region. Ever since the founding of

the Energy Agency and the co-founding of the Climate Alliance in 1990, Frankfurt has put a great deal of effort into climate protection. In 2012, the City Council decided to convert the city’s entire energy supply to renewable energies by 2050 and to develop the “Master plan 100% Climate protection” for its implementation.

## Project Objectives

The master plan aims to change the energy landscape of the city and ensure the adoption of regenerative forms of energy. The specific objectives of the master plan are:

1. Conversion of entire energy supply to renewable energies by 2050
2. Halving energy consumption and reducing CO<sub>2</sub> emissions by 95% by 2050

## Key Stakeholders

Frankfurt Energy Agency; Climate Alliance; Frankfurt city council; Federal Ministry for the Environment

## Approach

The master plan focuses on three areas heat, electricity and local traffic. The plan aims at not only drastically cutting the consumption but also aligning and optimizing demand and supply. The current Master Plan envisions that approximately 25% will be supplied from energy generated within the City, 25% from outside the City, and total energy consumption will be decreased by 50%. The plan included:

- Converting to an exclusively regenerative energy supply; energy production largely from renewable sources in Frankfurt and the Rhein-Main Region; promoting sustainable regional material cycles
- Participation of residents, companies, energy providers, housing industry, universities and science; involvement in brainstorming and concept development; motivation to implement own measures
- The program also supports initiatives like:
  - “Saving with a bonus – Frankfurt is saving electricity”. The initiative encourages participants to save electricity by providing them with incentives, for instance, participants have saved an average of 65 euros and also protected the climate
  - Linking up for more efficiency – Mainova AG is expanding its district heating network
  - Climate-friendly nutrition – climate gourmet: This initiative specifically targets the nutrition sector of the city
  - Reduction in operational costs of various organizations

## Financial Structure

Receives funding from Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

## Achievements



- Climate Change Mitigation
- Carbon-emissions mitigation and adoption of renewable energy alternatives
- Behavioral changes and mass awareness among the residents of the city about the issues of climate change

## Success Factors

- Strong and stable Institutional and legislative capacity
- Innovative and integrated strategy targeting a large spectrum of stakeholders
- Adoption of Incentive based mechanism for promoting energy savings and shift to clean energy
- Consistent and regular monitoring and evaluation mechanism
- Highly educated work force
- Citizenry that supports climate action



Source:

1. <https://www.frankfurt-greencity.de/en/status-and-trends/climate-and-open-spaces/renewing-frankfurts-energy/>
2. Masterplan 100 % Climate Protection – Frankfurt am Main, City of Frankfurt am Main, Municipal Energy Agency

For more Information

1. <https://www.100-percent.org/frankfurt-am-main-germany/>
2. <https://www.futurepolicy.org/renewable-energies/100-renewable-energy-urban-areas-frankfurt-germany-2012/>
3. <https://www.renewables-networking.eu/documents/Case-Study-Frankfurt-DE.pdf>

3



**MOBILITY  
& AIR QUALITY**

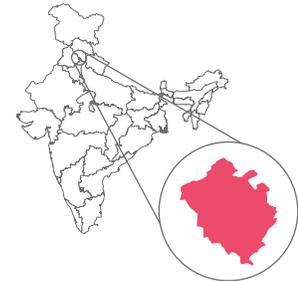
## STRATEGY FOR PEDESTRIANISATION & NON-MOTORISED TRANSPORT (NMT), CHANDIGARH

### Project Highlights

- Establishment of a NMT Cell for inter agency coordination on NMT action
- Information, Education and Communication (IEC) initiatives to encourage behavioural change and promote shift to active transport
- Provision of NMT infrastructure and supporting policy that ensures safety and security, connectivity and directness, comfort and attractiveness and universal accessibility

### Background

Chandigarh, 'the City Beautiful' has the unique administrative character of being a Union Territory (UT) and joint capital of Punjab and Haryana. Spread over an area of 114 sq. km, it is home to 1.05 million people as per Census of India, 2011. Due to extensive urbanisation around Chandigarh and rapid increase in motorised traffic, city is facing challenges of increased pollution, road congestion and safety concerns for pedestrians and cyclists. To address these challenges, Department of International Development (DFID)-UK, under the UK-India Strategic Partnership for Smart Urban Development in Indian States (SmUDI) has initiated the preparation of a Strategy for Pedestrianisation and Non-Motorised Transport (NMT).



**Chandigarh**

2018

(Not to scale)

### Project Objectives

- I. To formulate strategies to increase NMT share
- II. To recommend policy and infrastructure measures for enhanced Non-Motorised Transport (NMT) usage and shift from motorised modes
- III. To recommend institutional framework for inter agency coordination on NMT action

### Key Stakeholders

Municipal Corporation Chandigarh, Chandigarh Administration, Chandigarh Smart City Limited, Transport Department, Chandigarh Traffic Police, Engineering Department and Urban Planning Department among others

### Approach

- A consultative and need based approach adopted covering (i) as-is assessment of traffic characteristics, supporting policy and institutional structure (ii) identification of improvement areas based on national & international good practices/standards (iii) formulation of strategies and implementation roadmap for policy, institutional structure, and provision of NMT infrastructure
- A Steering Committee was constituted with members from relevant departments/agencies to facilitate inter-departmental coordination
- Delineation of ABD Area under Smart City Plan for recommendations on infrastructure provision as it represented a good mix of land uses
- Strategy developed based on following Guiding Principles: Safety and Security, Directness and Connectivity, Comfort and Attractiveness and Universal Accessibility

## Achievements



- **Establishment of a NMT Cell**
  - Formation of an independent cell to ensure institutionalisation of NMT inclusive planning and policy action
  - NMT Cell to facilitate inter-departmental coordination to enhance commitment and progress towards adopting and shift to NMT
- **NMT database creation**
  - Origin-Destination data on existing travel pattern of NMT users and Road Inventory Survey on existing NMT infrastructure. RfP floated for traffic surveys
  - Accident Recording and Reporting System (ARS) to be standardised and adopted for uniform recording of accidents, as undertaken by MoRTH
- **Revision of Road Safety Policy and Draft Parking Policy**
  - Mandate Road Safety Audits (RSA) at different stages of existing/proposed projects to enhance safety of NMT users
  - Parking Policy to prioritise NMT movement, and access to Public Transport. Projects generating significant movement to provide Traffic Impact Assessment
- **Information, Education and Awareness initiatives**
  - Awareness events at frequent intervals - Car Free Day, Cycle Rally and Raahgiri
  - Actively engage with work related commuters by preparing Travel Plans
- **Provision of infrastructure facilities**
  - Provision in compliance with IRC/national guidelines/standards including ITCN and Complete Streets and gaps identified in Inventory Survey.
  - Installation of CCTVs, street lighting, solid fill painted NMT tracks, traffic calming measures at intersections, retrofitting of road cross section giving equal right of road space to all modes of transport

## Long Term Impacts

- Increase NMT share to reduced carbon emissions, improved air quality and health of the citizens
- Shift from private vehicles to NMT and PT to reduce traffic congestion and improvement safety of vulnerable road users

### Limitations

- Inter departmental coordination across key stakeholders is the most important success towards creating enabling ecosystem for NMT users
- Behavioural change among existing motorized transport users key to enable shift to and adoption of NMT

## Future Prospects

- Strategy can be scaled up across the city
- Focused interventions to increase modal share of Public Transport to reduce ATL for NMT will enhance NMT usage
- Pilot Projects to be taken up to showcase best practices

Source: As received from DFID

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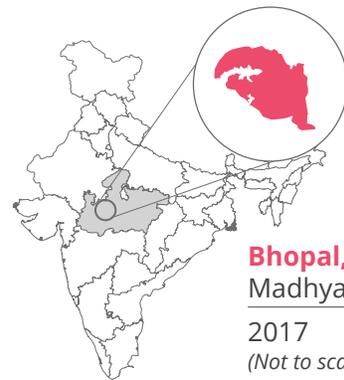
## PUBLIC BICYCLE SHARING SYSTEM AND CYCLING INFRASTRUCTURE IN BHOPAL

### Project Highlights

- Aimed at improving the usage of cycling and increasing the catchment area of BRTS and public transport in Bhopal through provision of first and last mile connectivity
- Public bicycle Sharing System comprising of 500 cycles spread across 50 stations, focused on important trip generating and attracting points including connectivity to bus/BRTS stops
- Cycling Infrastructure: 5 meter wide and 12 km long dedicated and segregated cycle track
- Another 55 km cycle track under construction along with expansion of PBS stations

### Background

Bhopal, is the capital of Madhya Pradesh. Like any other city Bhopal was facing issues due to rapid urbanisation, For a city like Bhopal which is the youngest (65 years) and the fastest sprawling city (850 Sq Km) Public bike sharing fully integrated with the BRTS was seen as a apt solution to encourage a shift in mode share and reduce the issues of pollution.



**Bhopal,**  
**Madhya Pradesh**

2017  
(Not to scale)

### Project Objectives

- I. To improve mode share of cycling in the city and reduce dependence on motorized private vehicles
- II. To reduce pollution, improve environment and well being by promoting healthy commuting options

### Key Stakeholders

Bhopal Smart City Development Corporation Limited (BSCDCL), Urban Administration and Development Department (UADD), Bhopal Municipal Corporation (BMC), CharteredBike (Operator) and Citizens

### Approach

The project adopted an integrated approach to improve the mode share of cycling and reduce the negative impacts of increased motorization in the city. City authorities carefully strategized activities being undertaken under the initiative as indicated below:

- Creating awareness around importance of cycling and its usage through Raahgiri Day and using the platform for citizen inputs and feedback on the project
- Planning and designing of public bicycle sharing system to improve cycling mode share as well as increase the catchment of existing public transport system
- Integration of PBS with existing public transport in terms of station placement and payment integration
- Provision of cycling infrastructure in conjunction with PBS system through dedicated and segregated cycle tracks

## Financial Structure of the initiative

- Capital cost for PBS jointly funded by government and private operator
- 40% subsidy on operating cost provided to PBS operator by government based on performance against pre defined service level benchmarks
- Major sources of revenue for operator are user and membership charges, advertisement and sponsorship revenue
- The infrastructure cost is completely borne by city government

## Achievements



### Benefits

- The stations are unmanned and linked to the Central control system and this data is used to make decisions on redistribution of cycles around stations during the hours of operations
- The PBS acts as a feeder service to the BRTS and this has improved the catchment area of the public transport in the city
- The system now has 2.35 rides per cycle per day
- The Infrastructure for Bhopal PBS now has 500 cycles and 50 stations
- More than 5000 kgs of CO<sub>2</sub> emissions saved from being released, equivalent to planting almost 1200 trees

### Co-Benefits

- Improved public transport usage through provision of first and last mile connectivity
- Improved awareness around benefits of NMT usage

## Success Factors

- More than 50 thousand registered members and around 2.35 rides per bicycle per day
- Achieved 12 km of 5m wide Cycle tracks integrating BRTS to Public Bike sharing

### Limitations

Funding to sustain and expand the PBS as well as infrastructure

## Future Prospects

The city is planning to extend the cycle network to spread across the city connecting through green links, simultaneously expanding the coverage of PBS stations and number of cycles

Source: As received from WRI

For more Information

<https://www.citylab.com/transportation/2017/07/can-bike-sharing-survive-in-india/533610/>

<https://smartbhopal.city/public-bike-sharing-system>

[https://smarnet.niua.org/sites/default/files/webform/PBS%20Bhopal%20DPR\\_23%20JUNE%20\(2%20files%20merged\).pdf](https://smarnet.niua.org/sites/default/files/webform/PBS%20Bhopal%20DPR_23%20JUNE%20(2%20files%20merged).pdf)

# 18



## **BIG BUS NETWORK, BANGALORE (ROUTE & SERVICE OPTIMIZATION FOR CITY BUS SERVICE)**

### **Project Highlights**

- Route and service rationalization refers to a large-scale periodic review of the entire bus network to meet the changing public transport needs in a changing city.
- Route and service rationalization at the network level ensure that services are of high quality and meet the changing needs of a growing city.
- Route and service rationalization was implemented in Bengaluru by Bangalore Metropolitan Transport Corporation on 4 major corridors (arterial roads) in the city – Hosur Road, Kanakpura Road, Old Madras Road and Ola Airport Road.

### **Background**

Bangalore Metropolitan Transport Corporation (BMTC) was operating buses on 2400 routes with an average of 2.7 buses per route. The buses were operated using a complex destination-based bus network resulting in low bus frequencies on individual routes. Hence, BMTC decided to adopt a direction-oriented bus network as it would help service the city better. Accordingly, it conceptualized Bangalore's 'BIG Bus Network'- a city wide connective grid of high frequency services on 12 major roads in the city.



### **Project Objectives**

- I. To transition to a direction-oriented model for bus services to provide a higher quality public transport for Bengaluru residents with a simplified route structure and reduced waiting times

### **Key Stakeholders**

Bangalore Metropolitan Transport Corporation (BMTC), Bruhat Bengaluru Mahanagara Palike (BBMP)

### **Approach**

The Project Approach involved 4 stages:

- Qualitative Assessment of Existing Services: Service providers conduct a qualitative and comprehensive evaluation of the existing services
- Network Model Evaluation and Alternative Development: In this step, agencies explore the underlying network model of the service
- Data Collection and Modelling: In this step, relevant data was collected to develop an in-depth analysis of existing services

- Finally Route and Service Planning: The magnitude of planning in this stage will be based on the decision from Step 2 and 3. If the decision entails a system overhaul and change in network model, this step will require the development of an entirely new slate of routes and services. If the data supports the existing model, a marginal yet meaningful effort will be required

## Financial Structure of the initiative

- The Project primarily required redistribution of existing bus fleet
- Project was funded by BMTC

## Achievements



### Benefits

- Big Trunk routes, providing high-frequency services on Bangalore’s 4 major arterial roads;
- Big Circle routes, providing high-frequency services along Bangalore’s circular Outer Ring Road (ORR);
- Big City routes, providing high-frequency services along high-density and high-demand corridors in the city center; and
- Big Connect routes, providing high-frequency services between arterial roads beyond the ORR

### Co-Benefits

- Improved public transport usage through provision of improved Services
- Improved Bus network Efficiency.

## Success Factors

A combined 42 buses, namely the BigTrunk buses and the Samparka Sarige feeders, were launched on Kanakpura Road and a combined 51 buses on Old Madras Road. This brings the total BIG Bus Network to three corridors, of the 12 planned, and a total of 185 buses as part of this network.

### Limitations

- Fare structure and transfer penalties deterred acceptance of the system
- Lack of interagency co-ordination to create comfortable waiting infrastructure at bus interchange points

## Future Prospects

Feeder routes will also be introduced to link villages and suburban destinations to their nearest arterial roads.

Source: As received from WRI

For more Information

<https://wricitieshub.org/infographics/big-bus-network-bmtc-bangalore>  
<https://wriroscities.org/media/photo-essay/big-bus-network-bangalore-india>  
<https://wriroscities.org/our-work/project-city/bangalores-big-bus-network>  
<https://wri-india.org/news/launch-new-resource-improving-bus-transport-india>  
<https://www.smartcitiesdive.com/ex/sustainablecitiescollective/bangalore-exclusive-metro-india-having-profit-making-public-transport-system/244831/>



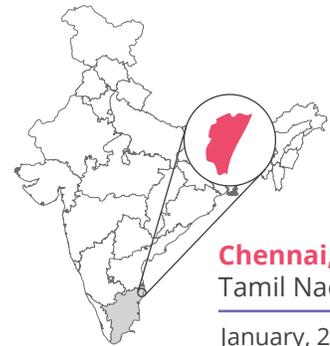
## SWITCHING TO SUSTAINABLE AUTO-RICKSHAW SYSTEM-CASE STUDY OF ELECTRIC AUTO FEEDER FOR CHENNAI METRO RAIL LIMITED

### Project Highlights

- First of its kind electric auto-based feeder system for City Metro Rail Limited
- First set of Electric Autos to be registered in the city of Chennai
- Research on estimating carbon emissions from existing auto-rickshaw fleet completed
- Roundtables organized to carve possible sustainable IPT solutions including detailed research identifying behavioral patterns of metro-users related to last-mile connectivity
- Collaborative Initiative- Auto-drivers, Metro Rail, Local Transport Departments

### Background

Auto rickshaws play an indispensable role in the mobility needs of most Indian cities. They act as an intermediate public transport mode and provide first and last-mile connectivity. However, they are still an inefficient sector that neither answers appropriately to the changing dynamics of urban mobility in India nor embeds a sustainable pattern of transportation. A multitude of challenges plagues the auto-rickshaw ecosystem some of which includes lack of technological up-gradation contributing to poor air quality, inefficiencies in operations as auto-drivers are less organized and competition from other modes of transport such as Cab Aggregators. On the other hand, cities, despite having good public transport, are falling short of reliable last-mile connectivity. It is therefore pertinent that the Auto-rickshaw sector needs to move towards Sustainable Businesses, where less polluting technologies are promoted among service providers, auto-rickshaws act as reliable and viable options for last-mile connectivity to public transport, at the same time, customers are educated and aware of the need to shift to sustainable modes of transport. Chennai is a standard example of a growing city that is attempting to meet the mobility needs of its citizens. With over 75,000 registered autos, a considerable portion of its mobility needs is catered by auto-rickshaws. In view of this, the city undertook this project of transforming the existing fleet of auto-rickshaws in the city.



**Chennai,**  
Tamil Nadu

January, 2019-  
February, 2020  
*(Not to scale)*

### Project Objectives

- I. Scaling up of a replicable and integrated model of sustainable auto-rickshaw transport, based on clean technologies
- II. To create a synthesis document based on the pilot, that can inform the up-scale /replication potential of the pilot project
- III. Increase demand for electric autos as a feeder system (first and last-mile connectivity) to metros
- IV. Support the use of sustainable autos as a feeder system to metro stations in Chennai, to effectively integrate auto-rickshaws in the multi-modal urban transport system

### Key Stakeholders

Consortium consisting of Fondazione ACRA (Italy), Stichting ENVIU (Netherland), Women Health and Development (India) and The Energy and Resources Institute (India).

## Approach

The following steps were undertaken under the project:

- Setting up of the pilot operations of electric auto-rickshaw as a feeder network to Chennai Metro Rail Limited in two heavy footfall stations
- Awareness generation and behavioral change intervention for promoting the use of this service among metro rail users
- Analysis of the regulatory framework for promoting electric mobility in the auto-rickshaw sector through stakeholder discussion and develop a paper on the same
- Contribution towards developing an ecosystem for promoting electric auto-rickshaw system (Loans, information about technology, training for drivers etc.)

## Achievements



### Benefits and Co-Benefits

- First set of Electric Auto-rickshaws to be registered in the city of Chennai
- For the first time, electric autos were used as a feeder to the city metro rail with nominal service rates to the passengers
- Drivers who are trained under the project and adhering to the code of conduct were chosen to be the face of the service
- Extensive support by the City Metro Rail for implementation of the feeder service on the ground by providing charging and parking facility
- Appreciated by European Union ambassador, during his latest visit to Chennai
- Total of 8910 riders used the service till date from Aulander Station
- Reduction in carbon footprint of the city, and thus environmental benefits



## Long Term Impacts

- The project has a long-term impact at the given levels:
- This project will reduce passenger carbon footprint and thereby the air quality in the city. As per TERI's analysis, the average annual carbon dioxide emission from an LPG auto is 3.72 tonne
- Switching to electric autos, in the long run, helps the driver who will benefit from low operational cost (reduced by approximately 40%) leading to an increase in income
- The learnings from the pilot can be used to build sustainable models of last-mile connectivity in cities where Metro Rail Networks are active

## Limitations

One of the major barriers in the implementation of this pilot in the initial months was the absence of Electric Vehicle Policy in Chennai which posed the following challenges:

- No permit available specifically for electric auto
- New Electric autos were not allowed to register in the city

## Future Prospects

- The pilot is currently limited to one metro station with three electric autos on a pre-fixed route plan. It is ready to start operations in the second station soon
- Tamil Nadu derives a significant source of its electricity requirement from renewable sources. By going electric, the carbon footprint from transport can be drastically reduced by up scaling such pilots appropriately
- Pilots give significant visibility, awareness and information to different stakeholders about this new category of the electric auto. This will contribute to the adoption of this technology in the city

Source: As received from The Energy and Resources Institute (TERI), Fondazione ACRA (ACRA), Stichting ENVIU Nederlands, Women Health and Development (WHAD)

For more Information

<https://thecityfix.com/blog/auto-rickshaw-fare-reform-chennai-sustainable-transport-regulation-competition-drivers-roshan-toshniwal/>

[https://www.switch-asia.eu/fileadmin/user\\_upload/Publications/2017/Sustainable\\_Auto-Rickshaw/NammaAuto\\_brochure\\_Final.pdf](https://www.switch-asia.eu/fileadmin/user_upload/Publications/2017/Sustainable_Auto-Rickshaw/NammaAuto_brochure_Final.pdf)

<https://wricitiesindia.org/Chennai-Autos>

<http://bwsmartcities.businessworld.in/article/Rethinking-Urban-Mobility-With-Alternative-Experiments/07-01-2019-165882/>

20



## THE URBAN MOBILITY LAB: ENABLING A SHIFT TO SHARED, CLEAN, & PEOPLE-CENTRIC MOBILITY IN DELHI & PUNE

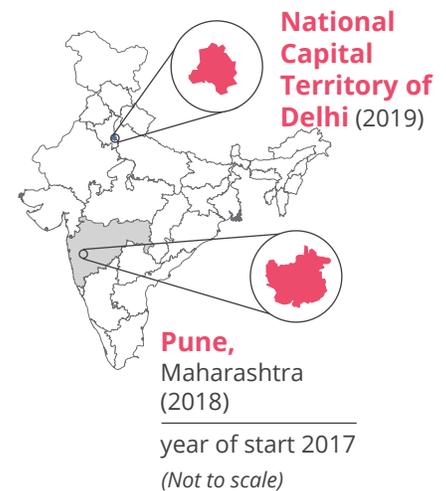
### Project Highlights

- Partnered with the cities of Delhi and Pune to support their transition to a shared, clean, and people-centric mobility paradigm
- Facilitated the successful implementation of 25 electric buses, 35 shared electric vehicles (EVs), 250 shared cycles, and more in Pune
- Created commitment for 35,000 electric and accessible vehicles, at least 1,000 EVs for last-mile deliveries, and several hundred public charging and swapping stations by 2020 in Delhi

### Background

The Urban Mobility Lab is a platform that partners with Indian cities to identify, integrate, and implement mobility solutions that transform how people and goods move. Rocky Mountain Institute (RMI) and NITI Aayog jointly developed the concept of Lighthouse Cities—early leading geographies for testing new mobility solutions—in India Leaps Ahead. The Urban Mobility Lab was created in November 2017 to support the development of Lighthouse Cities. It offers support for policymaking and pilot projects related to transformative mobility solutions. RMI leads the Urban Mobility Lab and works with central, state, and city government partners to implement the program.

Delhi and Pune are the first two host cities for the Urban Mobility Lab. The Dialogue and Development Commission of Delhi (DDC-D) and the Pune Municipal Corporation (PMC) are RMI's partners in each city.



### Project Objectives

To accelerate India's shift to shared, clean, and people-centric mobility by helping cities to:

- Identify, integrate, and implement mobility solutions
- Adapt projects to local needs and conditions
- Increase collaboration across public and private sectors
- Problem-solve on key regulatory and system-level barriers

### Key Partners and Stakeholders

#### Advisors and partners

- Central government: NITI Aayog, Ministry of Housing and Urban Affairs
- Local government: Government of

#### Key stakeholders

- Government: Central, state, and urban local bodies
- Industry: mobility solution providers

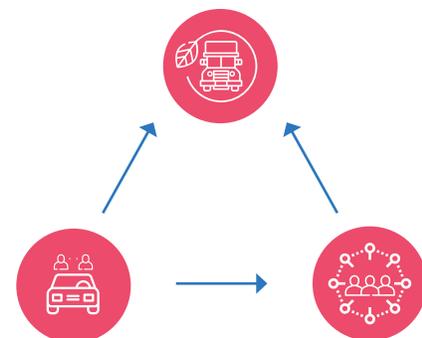


Figure: Shared, clean, and people-centric are foundational elements of India's new mobility paradigm

Maharashtra, Pune Municipal Corporation; Government of NCT of Delhi, Dialogue and Development Commission of Delhi

- Academia: universities
- Civil society: local non-governmental organizations and citizens

## Approach

For each city, RMI and its partner conduct a process to support the identification, integration, and implementation of mobility solutions. This process includes four phases:

- Phase 1: Conduct a needs assessment: Assess the city's mobility needs and opportunities through literature review and stakeholder interviews
- Phase 2: Solution identification: Identify and shortlist solution providers to offer mobility solutions that align with the needs that were identified during the needs assessment
- Phase 3: Solutions Workshop: Convene a workshop to provide an open forum for the government, private sector, and civil society to codevelop solutions and implementation plans for mobility pilot projects
- Phase 4: Implementation Support: Support the public and private sectors in implementing solutions from the workshop and track and share progress and lessons learned

The Solutions Workshop is a core part of the Urban Mobility Lab process. It supports the aforementioned objectives through four key components:

- Solution development: Solution providers advance their solutions from ideas to implementable projects through a facilitated process
- Coaching and feedback: City- and state-level public agencies and industry experts provide coaching and feedback to the solution providers on how to customize their solutions to meet the city's needs and address implementation barriers
- Integration and networking: Solution providers engage with each other to identify system-level barriers that can benefit from collaborative action
- Vision setting: Policymakers provide a vision and call for action for transformative mobility solutions

## Financial Structure

- RMI is an independent, nonprofit that currently offers the Urban Mobility Lab platform at no cost to partner cities thanks to philanthropic support.
- The Urban Mobility Lab seeks to connect cities and solution providers with public and private funding sources, such as fiscal incentives from the Central government (e.g., FAME II).

## Achievements



### Benefits

- Advanced progress on Delhi and Pune's mobility planning, policymaking, and goals.
- Identified opportunities to address system-level barriers and developed potential solutions.
- Shared lessons learned across levels of government to inform policymaking.
- Supported the implementation of several innovative mobility projects and created commitment for future project deployment.

### Examples of implemented mobility projects in Delhi and Pune

Public transport	Electric vehicles	Accessible transport
		
<p>Pune’s public transit agency, PMPML, closed a tender for 25 electric buses and charging infrastructure. RMI offered technical guidance on the charging infrastructure planning.</p>	<p>Lithium Urban Technologies launched 35 EVs at a Pune IT park.</p>	<p>Ezy Mov Solutions developed several partnerships at the Delhi Urban Mobility Lab to bring its wheelchair accessible transport services to Delhi.</p>
Charging infrastructure	Non-motorized transit	Final-mile parcel delivery
		
<p>Magenta Power Solutions installed 9 AC community chargers across Pune.</p>	<p>YULU deployed 250 shared bikes at a Pune IT park.</p>	<p>RMI is supporting a multi-stakeholder pilot project to launch 1,000 electric goods carrier vehicles in Delhi. 270 vehicles are currently operating under the pilot.</p>

#### Co-Benefits

- Building relationships and creating a collaborative environment for the public and private sector.
- Generating awareness of innovative mobility solutions and establishing proof points for new business models and operational practices.
- Conducting planning with a whole-systems approach.
- Contributing to improved local air quality and greater access. If Delhi achieves its 25 percent battery electric vehicle registration target by 2024, approximately 2,085 tonnes of PM2.5 tailpipe emissions can be avoided over the lifetime of the EVs deployed by 2024 (relative to an equal-sized internal combustion engine fleet; RMI internal analysis).

## Success Factors

- Strong government leadership
- Shared commitment to a shared, clean, and people-centric mobility future
- Openness to collaboration from the public and private sectors
- Participation and coaching by urban local bodies

## Long Term Impacts

- In urban road-based passenger mobility, shifting to a shared, clean, and people-centric mobility paradigm could save India 1 gigatonne of carbon dioxide emissions and US \$330 billion in fuel imports by 2030, according to NITI Aayog and RMI's May 2017 report, India Leaps Ahead. This shift can also lead to improved local air quality (e.g., through avoided PM2.5 emissions) in cities and greater access to mobility options.
- Collaboration and coordination across levels of government can lead to more informed decision making and consistent application of policy.
- The Urban Mobility Lab is a replicable process that can be adapted to and performed by any city to support its specific mobility goals.

## Limitations

- Although the Urban Mobility Lab aims to create an environment that supports implementation, the implementation responsibility resides with the public and private sector actors.

## Future Prospects

- The Urban Mobility Lab will continue to work with Delhi and Pune to support the implementation of shared, clean, and people-centric mobility projects and policies.
- RMI is looking forward to partner with more cities in 2019 and beyond to cohost the Urban Mobility Lab.
- To scale the Urban Mobility Lab to more cities, RMI is developing thematic cohorts to create customized learning opportunities for multiple cities to advance their understanding of a specific topic and work towards developing and deploying sustainable mobility solutions in their respective cities.

Source: As received from RMI

For more Information

<https://rmi.org/insight/urban-mobility-lab-pune/>

<https://economictimes.indiatimes.com/industry/transportation/shipping/-/transport/pune-selected-as-indias-first-lighthouse-city-for-urban-mobility-lab/articleshow/66226268.cms?from=mdr>

<https://www.financialexpress.com/industry/urban-mobility-lab-think-do-tank-plans-major-makeover-for-punes-transportation/1378884/>

# PEDESTRIAN PRIORITY PROGRAM (PPP) : BUENOS AIRES



**Buenos Aires,  
Argentina**

Year of Initiation: 2003

## Project Highlights

- Urban renewal project to prioritize non-motorized modes of transportation
- Development of a Pedestrian-Scale Downtown promoting democracy on the roads
- Integrated and Sustainable Transportation system

## Background

The increased reliance on private modes of transportation and deterioration of the existing transport system of Buenos Aires led to the adoption of the Pedestrian Priority Program (PPP). The PPP was launched as a part of the “Healthy Mobility initiative” under the purview of

its government in order to improve transform the modal share of the city and prioritize pedestrian and sustainable modes of transportation. The program presented tremendous scope of transforming face of the urban centers of the city and improve the aesthetic value of the landscape.

## Project Objectives

The primary objective of the initiative was to improve access to daily needs, prioritize NMT and public transport, bring order to general traffic, decrease congestion, and reduce traffic accidents and casualties

## Key Stakeholders

Ministry of Urban Development, Buenos Aires Government, Urban Residents, Architects, City Planners, Environmentalists

## Approach of Pedestrian Priority Program

The PPP was implemented to prioritize the needs of the pedestrians and transform the existing built environment of the city to suit their requirements. The key measures taken in this regard included redesigning of narrow streets and public spaces and restrictions on the movement of car traffic flows in designated areas. The components undertaken to implement these measures included:

- Renewal of streets: 20-lane 9 de Julio avenue was restructured into public transit corridor having a 300 km bicycle network, public bike system
- Waste Collection System was replaced by centralized waste receptacles in order to provide clean and hygienic environment to pedestrians
- Increase in the green/tree cover
- Improvements in the signage, traffic signals, street furniture, lighting system to facilitate smooth pedestrian circulation

## Financial Structure of Pedestrian Priority Program

- The PPP program was sponsored by the City of Buenos Aires Ministry of Urban Development
- The PPP project was expected to cost ~195 million Argentina pesos (\$25 million U.S.)

## Limitations

- Opposition from various stakeholders like city planners and architects
- Unprecedented costs of the proposed interventions



## Achievements



### Benefits

Reduction in noise and air pollution levels in the restricted areas

- 97% reduction in the levels of air pollutants was observed leading to improved air quality
- The noise pollution levels and impact were reduced by 50%
- Promotion of social cohesiveness and social sustainability due to increased avenues for social activities and meeting points

### Co-benefits

- Climate Change mitigation
- Increase in awareness levels towards environmental sustainability
- Economic benefits due to improvements in land values and rents
- Behavioral shift from car travel to non-motorized modes of transport

## Success Factors

- Strong Institutional and legislative Support and capacity
- Urban renewal innovations to encourage pedestrian movements and car-free environments
- Regular and timely monitoring and evaluation of the program

Source: [https://pearl.niua.org/sites/default/files/books/GP-GL4\\_MOBILITY.pdf](https://pearl.niua.org/sites/default/files/books/GP-GL4_MOBILITY.pdf)

For more Information

<https://www.liberallandscape.org/2019/04/15/pedestrian-priority-in-buenos-aires/>

<https://www.thebubble.com/pedestrian-area-buenos-aires-retiro>

<https://www.unenvironment.org/es/node/20148>

<http://www.mile.org.za/June%202015/Metropolis%20Conference.pdf>

4



# WATER RESOURCE MANAGEMENT

## UTILIZATION OF MANGALURU CITY SEWAGE WASTEWATER FOR INDUSTRIAL PURPOSE

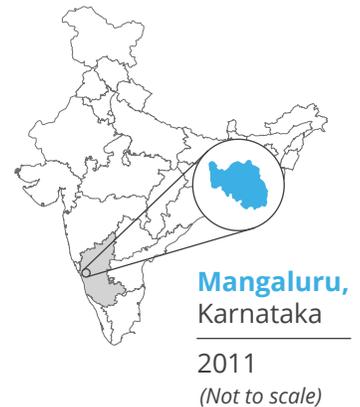
### Project Highlights

- Reuse of wastewater for the Industrial purpose
- Reduction in the cost of Operation and Maintenance from the side of ULB for the Sewage Treatment Plant and the connected wet wells
- Adoption of separate Special Purpose Vehicle (SPV) for Monitoring and Supervising the activities Wastewater Utilization

### Background

Mangalore is the chief port city of the Karnataka state located about 352 kilometers (220 mi) west of the state capital, Bengaluru between the Arabian Sea and the Western Ghat mountain ranges. It is the administrative headquarters of the Dakshina Kannada District and accessible via all forms of transport - Air, Road, Rail and Sea, thus, making it a unique location for commercial investments & activities. Mangalore's economy is dominated by the Industrial, Commercial, Agricultural processing and port-related activities. One of the largest SEZs in India, the MSEZ is in Mangalore. In view of this, Mangaluru City is receiving water from the 'River Netravati'. Since MSEZ has been established the demand for the supply of water was increased for the Industrial purposes, under the strong political will and administrative leadership of the Commissioner discussion was carried out with the MSEZ officials to take over the sewage wastewater produced within Mangaluru City Limits after secondary treatment of the wastewater.

Hence, a Special Purpose Vehicle (SPV) has been formed for operation and maintenance of the sewerage treatment plants and connected wet wells.



### Project Objectives

- I. To utilize the wastewater, which was discharged to the sea after secondary treatment
- II. To reduce the stress on the existing water resources by Recycling and reuse of wastewater
- III. To reuse in diverse avenues such as non-potable domestic use; horticulture, agricultural, power plants, industries and others

### Key Stakeholders

Mangaluru City Corporation

### Approach

- Formation of Special Purpose Vehicle (SPV) for the implementation of the project
- Agreement between MCC & MSEZ Ltd.
- Approval from Government of Karnataka
- Operation and Maintenance of STPs and Connected Wet wells
- Cost Sharing of O&M by Mangalore SEZ Ltd (MSEZL) and Mangaluru City Corporation (MCC)
- Establishment of Sewage Treatment Plants and Wets within MCC Limits
- 4 STPs: Kavoora (43.5 MLD/9.5 MGD), Bajal (20 MLD/4.40 MGD), Surathkal (16.5 MLD/3.63 MGD) & Pachanady (8.75 MLD/1.92 MGD)
- 22 No's of wet wells connected to their respective STPs

# Financial Structure

The initiative is funded under the Smart Cities Mission

## Achievements

### Benefits and Co-benefits:

- Operation and Maintenance of three Sewage Treatment Plants (Kavoor, Surathkal and B. and connected wet wells/ Pumping station from Wet wells to STP) in Mangaluru.
- Reduction in dependency on natural water resources.
- Reduction of Financial burden on Mangaluru City Corporation for O&M of STP.
- Avoiding disposal of Secondary treated sewage in natural river body thereby Minimization of pollution loads on Fresh water sources & improving Environmental quality.
- Employment Generation



## Success Factors

- Technical innovations for effective implementation of the project
- PPP type of arrangement for the implementation of the project

## Limitations and Future Prospects

The project faced following challenges:

- Only 3 STPs have been tied up with MSEZ and the secondary treated wastewater is further treated to tertiary level and being reused for industrial purpose
- The 4th STP having a capacity of 8.75 MLD treatment facility, the wastewater after secondary treatment is being let to the river. Hence, the wastewater needs to be utilized such as non-potable domestic use; horticulture, agricultural, power plants, industries and others. Tertiary treatment plant needs to be setup for future to reuse the wastewater
- The uncovered area within the MCC limits needs to be covered using underground drainage system facility hence the wastewater is completely collected, recycled and reused. Thereby completely minimizing the pollution load on fresh water sources & improving Environmental quality

Source: Case received from the city

For more Information

- <https://blogs.adb.org/blog/mangalore-shows-way-wastewater-management-india>
- <https://www.genexutility.com/mangalore-model-wastewater-management-karnataka>
- <https://development.asia/insight/one-way-dispose-wastewater-turn-it-profit>



## SUSTAINABLE WATER MANAGEMENT THROUGH NON-REVENUE WATER CELL IN SURAT

### Project Highlights

- Development of a dedicated cell, i.e., NRW cell to manage issue of non-revenue water
- Significant decline in the leakage per km length of pipeline as well as the complaints associated with water supply leakages

### Background

Surat is the second largest city in Gujarat and is known as the commercial capital of the state. Surat Municipal Corporation (SMC) manages the water supply and sewerage system of the city. River Tapi is the major source of water supply and the city has piped water supply network since 1898. The growing population of the city has led the authorities to invest in the water supply system and it has implemented a new WATER SUPPLY Master Plan in 2015, which expects to cover the entire city and meet water demands up to the year 2041. The NRW has been reported to be at 20.4% under the SLB framework, hence is a serious cause of concern. Considering this, in order to enhance the water supply services of Surat, SMC constituted an NRW cell in 2007 with the mandate to plan, develop, implement and monitor an action plan for reduction of NRW.



Surat,  
Gujarat

2007

(Not to scale)

### Project Objectives

The NRW cell was formed with the objective of undertaking a thorough estimate of NRW levels and then progressively improving and maintaining overall NRW level at 20%. The NRW cell had six major objectives:

- I. Efficiency enhancement in transmission and distribution network
- II. Achieving equity in distribution
- III. Achieving financial recovery
- IV. Creating awareness for water conservation
- V. Conducting periodic water audit
- VI. Implementation of efficiency and equity measures as per requirement

### Key Stakeholders

Surat Municipal Corporation (SMC)

### Approach

The NRW cell was mandated with taking an integrated perspective in evaluating the efficacy of the initiatives and to ensure streamlined implementation. The following steps were taken by the cell:

- Identified leakage mapping as a priority initiative and involved identification of leakages based on current and historical complaints from citizens/areas and ground level assessment by SMC's Hydraulic department

- Thorough discussions with leakage team and fitters in various areas to identify the frequent leakage points
  - Leakage repairs were done at three levels based on the size of the pipes, i.e.,
  - Leakages in pipe sizes > 750mm: by outsourcing by AMC to private operators
  - Leakage in pipe sizes 550-750mm: by AMC
  - Leakages in pipe sizes < 550 mm: by zonal offices
- Leakage repairs

## Financial Structure

The initiative has been majorly funded by SMC

## Achievements



### Benefits and Co-Benefits

The initiative yielded numerous impactful results:

- Reduction in leakage per km length of the pipeline: Ratio of the number of leakages per km length of the pipeline has drastically declined over the years
- Reduction in number of complaints: The number of leakages were reduced by 30% annually in all zones
- Effective and better tracking of complaints: Daily reporting of the leakage repairs is done by all the zones to the head office of SMC
- Leak Repairs and water savings: Identification and repair of over 185 frequent leakage points and over 110 contamination points post creation of the NRW cell. It also estimated saving to the extent of 708 ML of potable water translating to a net savings in water costs and road reinstatement cost of Rs. 212 Lakh annually

### Limitations and Challenges

Presence of large number, i.e. ~60% of migrant population in the city making it difficult to spread awareness about the key challenges associated with floods

## Future Prospects

SMC aims to extend this initiative at a full swing covering all the regions of the city.

Source:

1. [https://pearl.niua.org/sites/default/files/books/GP-IN2\\_WATSAN.pdf](https://pearl.niua.org/sites/default/files/books/GP-IN2_WATSAN.pdf)
2. [https://niti.gov.in/writereaddata/files/document\\_publication/BestPractices-in-Water-Management.pdf](https://niti.gov.in/writereaddata/files/document_publication/BestPractices-in-Water-Management.pdf)



## RENEWABLE ENERGY DEPLOYMENT AT AJI WATER TREATMENT PLANT IN RAJKOT

### Project Highlights

- Installation of 145kWp grid connected solar PV system at Aji water treatment plant
- Compensation of 18% of the electricity demands of the water treatment plant by renewable source

### Background

Rajkot is part of Swiss Agency for Development and Cooperation's (SDC) Capacity Building for Low Carbon and Climate Resilient City Development project (CapaCITIES) project, which aims to enhance capacities of Indian partner cities (Rajkot, Coimbatore, Siliguri, and Udaipur) in planning and implementing climate mitigation and adaptation measures along with increasing awareness on low carbon and climate resilient city development. Water supply accounting for 61% of the total municipal electricity consumption (2015-2016) is the most energy intensive municipal service of the city. This depicts immense potential of reducing energy consumption of the water supply sector through renewable energy alternatives. In view of this, RMC implemented a pilot project with energy efficiency and renewable energy measures in one of the water treatment plants, i.e., Aji water Treatment Plant.



**Rajkot,  
Gujarat**

2015-2016

(Not to scale)

### Project Objectives

- I. To reduce conventional electricity consumption by introducing Energy Efficiency (EE) in pumping and maximize use of Renewable Energy (RE) through grid-connected solar PV system deployment as per Gujarat Solar Policy 2015
- II. To reduce the conventional electricity consumption and related GHG emission from Aji WTP by approx 15 to 18%
- III. To understand the potential of scaling up EE and RE integration in the water supply sector of Rajkot based on learnings from the solar PV system deployment at Aji water treatment plant

### Key Stakeholders

Rajkot Municipal Corporation (RMC) and ICLEI India

### Approach

The following initiatives were undertaken to transform the electricity consumption patterns of the Aji water treatment plant:

- Feasibility study was conducted by ICLEI South Asia to identify feasible location for the project
- Technical specifications were identified for project and contractor was finalized for implementation through technical terms of reference
- The solar PV system was installed based on a co-financing model and the performance of the system is monitored in real time through an online software
- The solar PV system will be operated and maintained by the contractor who set up the plant for a period of 10 years from installation

## Financial Structure of the initiative

The total cost of the project was estimated to be around INR 8.3 million. The breakup of the funding scheme is: INR 4 million was financed by SDC under the CapaCITIES project (for 70kWp solar PV) and the remaining INR 4.3 million was financed by RMC through the 'SJMMSVY' scheme (for 75kWp solar PV).

## Achievements



### Benefits and Co-Benefits

- Energy Savings: Plant has generated a total of 224,150 kWh electricity
- Improved facilities for citizens
- Environmental Benefits: reduced 184 tons of CO<sub>2</sub> equivalent GHG emissions since its installation over a period of 12 months



Glimpse of the Solar Rooftop setup at the Aji water treatment plant

## Success Factors

- Technical innovations for effective implementation of Solar panels at the water treatment plant

## Future Prospects

RMC has already proposed a 250kWp grid connected solar PV at Raiyadhar wastewater treatment plant after the successful implementation of this project and is commissioning a feasibility study to install solar PV systems on other water and drainage pumping stations/ treatment plants. A bankable project based on the RESCO model is also being developed with an aim to install solar PV systems on Ribda and Raiyadhar water treatment plants; and Gavridhar and Madhapar sewage treatment plants. These projects when realized will supplement a significant proportion of the electricity consumed by the municipal services provided by the RMC. Thus, RMC will lead by example in achieving CO<sub>2</sub> abatement through RE integration into their services.

Source: Case received from the city

For more Information

<https://capacitiesindia.org/projects-rajkot/>

<https://timesofindia.indiatimes.com/city/rajkot/rmc-to-set-up-80-ml-d-plant-at-madhapar/articleshow/57708719.cms>

[https://www.unescap.org/sites/default/files/IDM\\_Water\\_Demand\\_and\\_Waste\\_Water\\_Management\\_Rajkot.pdf](https://www.unescap.org/sites/default/files/IDM_Water_Demand_and_Waste_Water_Management_Rajkot.pdf)

[https://urban-leds.org/wp-content/uploads/2019/resources/case\\_studies/ICLEI\\_UrbanLEDS\\_case\\_story\\_Rajkot\\_2016.pdf](https://urban-leds.org/wp-content/uploads/2019/resources/case_studies/ICLEI_UrbanLEDS_case_story_Rajkot_2016.pdf)

# 25



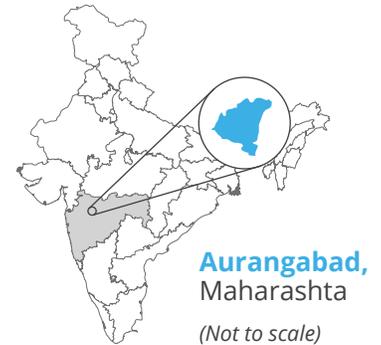
## ECO RESTORATION OF KHAM RIVER: AURANGABAD

### Project Highlights

- Multifold increase in the biodiversity of the regions along the riverfront
- Improvement in the aesthetic value of the river due to increased levels of green cover
- Disruption of the dumping of MSW in the river leading to decrease in the levels of air, water and soil pollution

### Background

Historically Aurangabad city efficiently managed its water supply despite the low rainfall in the region due to the visionary water management practices instituted by its rulers. However, the unmanaged development of the city has taken toll on these traditional water management practices causing serious water crisis in current years. Kham River receives domestic and industrial wastewater from the city and adjoining industrial areas. The polluted water is being used for farming downstream of the city following which the river confluences with the Godavari River; impacting water quality of the Godavari River as well. The non-monsoon flow of Kham river is 40-50 MLD (dry weather) and the reported pollutant levels are well above the permissible limits.



### Project Objectives

- I. To develop a plan for sustainable restoration of the Kham river
- II. To undertake the eco-restoration of the river in such a manner that it can be considered as the pride of the city

### Key Stakeholders

Confederation of Indian Industry (CII); Aurangabad Cantonment Board (ACB) and Aurangabad Municipal Corporation (AMC); Green Water Revolution Pvt. Ltd.; Shrishti Eco Research Institute

### Approach

The approach taken in eco-restoration of the river was mainly in-situ bioremediation. The design philosophy of the project was to keep it chemical free and maintain zero electricity consumption in the remediation methods.

Some of the solutions adopted were:

- Removal of all unwanted weeds, municipal solid waste like plastic, dead animals carcasses
- Installation of three metal screens with anti-corrosive paints
- Stream – training and bank stabilization along the selected stretch
- Installation of Green Bridges to degrade pollutants. Green Bridge is a horizontal filtration system comprising physical and biological filtration by providing space for growth of floating, submersed and benthic biota. These useful microorganisms form a self-sustaining ecosystem, starting from detritivores, thus improving the self-purification capacity of the stream naturally
- Plantation of species useful in reducing the pollution on both sides of the bank
- Benthic system development in the selected stretch

## Achievements



### Benefits

- Control of odor and improvement in the aesthetics of the riverfront
- Obstruction of the dumping of Municipal Solid Waste (MSW) in the river is and adoption of filtering of suspended solids and contaminants before discharging in the river
- Facilitation of natural aeration and bio-control of pollutants
- Multifold Increment in biodiversity
- Uninterrupted flow of river with meandering and bank stabilization
- Overall improvement in all the parameters such as DO etc. of the river, thus, enhancing the water quality of the river



(a) Before and (b) After Glimpse of the Kham river after the Restoration Activity

## Success Factors

- Discussion with all the stakeholders, IMA and public participation
- Intensive mass awareness and involvement with municipal corporations and other local level government agencies

### Limitations and Challenges

- Huge quantity of Municipal Solid Waste, medical waste of hospitals, food waste of hotels etc. was being dumped in the riverbed daily
- Designing the project to take care of the varying inflow was critical
- There were number of broken sewerage chambers discharging wastewater in the river
- Theft of material by localities

## Future Prospects

The local authority is making provisions for operation and maintenance of such ecological restoration projects

Source: As received from WRI

For more Information

<https://timesofindia.indiatimes.com/city/aurangabad/Green-bridge-technology-to-give-fresh-lease-of-life-to-Kham/articleshow/50295234.cms>

# 26



## JAKKUR LAKE REJUVENATION: BENGALURU

### Project Highlights

- Improvement in the biodiversity in the surrounding area of the lake, increasing the aesthetic value of the locality
- Increase in employment opportunities and livelihood opportunities to the fishermen
- Increase in the usage of the lake by the local residents for recreational purposes

### Background

Jakkur Lake is approximately 160 acres in size and is located in the northern part of Bengaluru near Yelahanka. It receives storm water through three (3) inlet drains starting from Yelahanka, Agrahara and Shivanahalli. Due to urbanization and increase in population, the quantity of the storm water reaching the lake decreased significantly over time and led the drains dry. Instead, the lake started receiving sewage from nearby 12,500 households surrounding the lake.



### Project Duration

Initial Restoration by the government was carried out between 2009 and 2011, while the further restoration was conducted by Jal Poshan 2015 onwards

### Key Stakeholders

Jal Poshan, Satya Foundation, Biome Environmental Solutions, Ananas, ATREE, BBMP, KSPCB, Fisheries Department, BWSS, Horticulture Department of Bengaluru

### Project Objectives

- I. To use natural and self-sustainable methods of treating domestic wastewater to rejuvenate Jakkur lake

### Approach

In the Jakkur model, the restoration work has integrated conventional grey with green infrastructure. Following step wise approach was adopted:

- The Lake was fenced to remove encroachments and de-silted
- The original 10 MLD secondary STP was upgraded to 15 MLD tertiary treatment STP. The local governing body maintained the legal standards for the STP as the water was fed into the constructed wetland for treatment and later into the lake
- Islands were created and trees were planted along the sides of the lake for creating bird habitation and to maintain natural flora and fauna
- The constructed wetland of 7 acres was created with wetland species such as vetiver, water hyacinth, typhaceae, and alligator weed. They helped in phytoremediation of the lake water
- Separate tank (kalyani) was built for idol immersion during religious/ cultural festivities thereby preventing the pollution the lake water
- Since 2015, through a collaborative and multi-stakeholder engagement model, Jal Poshan brought in various organizations to rejuvenate the lake ecosystem. Some of the key activities included:
  - Sustainable landscaping such as permaculture, community gardens etc.
  - Developing a permanent space for fishing community.
  - Up gradation of existing sedimentation tank

## Achievements



### Benefits and Co-Benefits

- Jakkur lake restoration project has provided livelihood opportunity to fishermen. On a normal day, they are able to collect at least 100 kilograms of various kinds of fish
- 100,000 liters per day of water is drawn from a step well near the lake for agricultural purposes
- Improved biodiversity in the surrounding area with increased presence of local and migratory birds
- Increased land value of nearby properties



(a) Before and (b) After Glimpse of the Jakkur Lake after the Restoration Activity

## Success Factors

- Active participation of local residents for improving the conditions of the lake
- A consensus was reached between the villagers and BBMP that they would draw the water and use it beyond the lake boundary for their activities
- Jal Poshan fulfilled the role of coordinating between all agencies to maintain the lake

### Limitations

- Rural-urban conflict due to restrictions placed on activities such as cattle grazing and bathing during the implementation period.
- Lack of awareness about the lake as some urban commons among all beneficiaries
- Continued fund raising to meet the O&M expenses

## Future Prospects

This is a successful model of collaborative approach for lake restoration. Institutional mechanisms could be provided to facilitate an easier dialogue between various administrative agencies involved in keeping the lake clean and healthy.

Source: As received from WRI

For more Information

<https://www.cseindia.org/jakkur-lake-urban-lake-management-6402>

<https://swachhindia.ndtv.com/bengaluru-jakkur-lake-tree-plantation-drive-by-citizens-28264/>

<http://bengaluru.urbanwaters.in/case-study-lake-rejuvenated-for-people-nature-319>

<https://www.thehindu.com/news/cities/bangalore/348-crore-promised-in-budget-for-developing-59-lakes-over-three-years/article26227094.ece>

<https://sustainabilitynext.in/case-study/jakkur-lake-rejuvenation-lessons-in-impact-of-strong-community-leadership/>

# DEEP TUNNEL SEWERAGE SYSTEM - SUSTAINABLE WATER MANAGEMENT: SINGAPORE



**Singapore,  
Southeast Asia**

Year of Initiation: 2000

## Project Highlights

- **Innovative and Integrated Water Management Approach**
- **Centralized waste water treatment system**
- **DTSS is a superhighway for Singapore's used water management**
- **Massive public education and awareness is a key factor for the success of DTSS**

## Background

Deep Tunnel Sewerage System (DTSS) is a massive integrated water management project that caters to the country's long term clean water needs through the collection, treatment, reclamation and disposal of used water from industries,

homes and businesses. It is a perfect example that incorporates the concept of integrated land and water management for achieving sustainable environment.

## Project Objectives

The DTSS project aims to improve Singapore's water conveyance and treatment system while reducing the land occupied by the used-water infrastructure on the island by 50%

## Key Stakeholders

Singapore's National Water Agency, Ministry of Environment and Water Resources, National Environment Agency of Singapore

## Project Approach

DTSS project is being developed in two phases and is proposed to be completed by 2022. The key aspects of the project include:

- Construction of two large tunnels, 6.5 m in diameter and 80 km long, located ~ 50 m below the surface to carry the used water to the three centralized water reclamation plants (WRPs)
- WRPs will treat and purify sewage into clean, high-grade reclaimed water, while the effluent will be discharged through deep sea



## Financial Structure of “Climate Emission Capping for Buildings” law

- The first phase of the DTSS project was completed with an investment of \$2.7 billion and the project is self-financing through retained earnings
- In 2005 Public Utilities Board (PUB) issued the bond for \$400 million, while in 2010 PUB received an operating grant of \$185 million

## Achievements



### Benefits

- Reduction in water consumption from 165 liters per person per day in 2003 to 155 liters per person per day in 2009
- Reduction in water losses, i.e., non-revenue water



Source: [https://pearl.niua.org/sites/default/files/books/GP-GL2\\_SANITATION.pdf](https://pearl.niua.org/sites/default/files/books/GP-GL2_SANITATION.pdf)

For more Information

<https://www.aecom.com/sg/projects/deep-tunnel-sewerage-system-phase-2/>

<https://www.arcadis.com/en/global/what-we-do/our-projects/asia/singapore/deep-tunnel-sewerage-system/>

- Centralized water management system ensuring minimum land utilization
- Development of replicable model for other cities across the world

### Co-benefits

- Behavioral changes among residents mediated through tariff structure
- Economic benefits and cost-effective model

## Success Factors

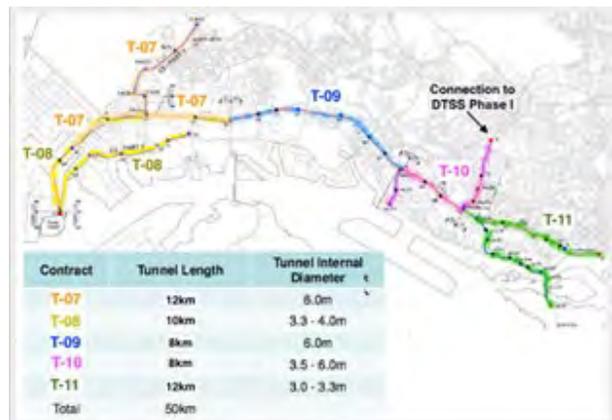
- Effective policy implementation and law enforcements
- Effective Institutional and legislative management
- Effective engineered and technological solutions

## Limitations

- Unprecedented costs associated with the centralized water management system

## Future Prospects

Phase II of the DTSS project commenced in 2016 and is envisaged to be completed by 2022





5



# WASTE MANAGEMENT



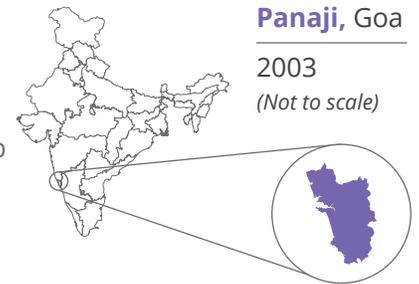
## A CASE OF DECENTRALIZED SOLID WASTE MANAGEMENT SYSTEM TOWARDS A BIN FREE & LANDFILL LESS CITY: PANAJI

### Project Highlights

- Reduction in waste generation through behavioral change among the residents of the cities towards waste management and segregation
- 100 percent bin free city with 100 percent success in door-to-door waste collection and waste segregation at source
- Mass awareness and extensive community engagement
- Adoption of city wide waste reduction measures

### Background

Panaji, the capital of Goa is not only the administrative center and commercial hub of the state but also a popular tourist destination. In view of this, under the strong political will and administrative leadership of the Municipal Commissioner, a comprehensive city revitalization campaign called “Bin Free in 2003” was launched to improve sanitary conditions and solid waste management (SWM) system of the city.



### Project Objectives

- I. To improve sanitation conditions in the city of Panaji
- II. To develop a comprehensive integrated plan for SWM in Panaji city in compliance with the SWM Rules, 2016

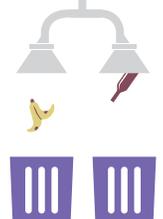
### Key Stakeholders

Corporation of the City of Panaji (CCP), school and college staff and students, resident welfare associations (RWAs), local leaders and celebrities

### Approach of “Bin Free” campaign

The campaign covered various aspects of SWM in Panaji and adopted an integrated approach to strategize the activities being undertaken under the initiative as indicated below:

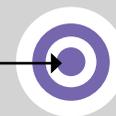
- Segregation of waste at source into eight waste streams
- Modifications and innovations in the waste collection instruments to ensure effective door-to-door waste collection services throughout the city
- Establishment of material recycling stations and decentralized composting units for effective management of dry and wet waste
- Adoption of extended producer responsibility (EPR) initiatives through innovative strategies and fostering tie-ups with recycling units for efficient management of recyclable, hazardous as well as e-waste being generated in the city
- Extensive campaigns and community engagement drives to increase mass-awareness levels about the initiative and the issue of SWM



## Financial Structure of “Bin Free” campaign

- User Charge, i.e., monthly costs for waste management services were imposed on the residents of Panaji by CCP was a major source of revenue for this model
- Other revenue sources include: sale of compost and segregated waste
- EPR initiatives with Tetra Pak
- Co-processing costs for bailing and transportation to cement plants were incurred by CCP

## Achievements



### Benefits

- **Minimized waste to landfill through effective management**
  - The city composts over 70 percent of the wet waste generated, reducing the waste reaching landfills
  - 120 residential colonies are effectively running the wet waste composting system
- **Improved recycling efficiency through market creation and tie-ups**
  - Dry segregated waste undergoes material recovery for ensuring maximum recycling rate which yields both environmental and financial benefits
  - 2,464 tonnes of non-recyclable waste has been sent to the cement kilns since the commencement of the initiative
  - 926 tonnes of recyclable material was sold between a time span of February, 2014 and October, 2015

### Co-benefits

- Active involvement of rag pickers, women volunteers/ SHGs, thus, generating employment opportunities and immense awareness about the problem of SWM

## Success Factors

- Strong and stable leadership
- Institutional and managerial models established within the CCP
- Technical innovations for effective management of solid waste
- Intensive campaigning and meetings with RWAs for increasing the mass awareness levels about waste segregation and management

### Limitations

Unmanaged composting sites leading to reduction in communities willingness to participate in waste management practices.

## Future Prospects

The city is working on the ideals of the bin less campaign and taking initiatives to manage the solid waste being generated across Panaji.

Source: <http://www.npcindia.gov.in/wp-content/uploads/2017/08/7.1-Annex-for-NPC-Panaji.pdf>

For more Information

<https://www.downtoearth.org.in/news/waste/back-to-bins-58380>

<https://swachhindia.ndtv.com/getting-right-can-learn-cities-managing-waste-4226/>

<https://india.smartcitiescouncil.com/article/panaji-boots-out-waste-landfills-other-cities-can-learn-too>





## CONSTRUCTION & DEMOLITION (C&D) WASTE MANAGEMENT AND UTILIZATION OF RECYCLED PRODUCTS: CHANDIGARH

### Project Highlights

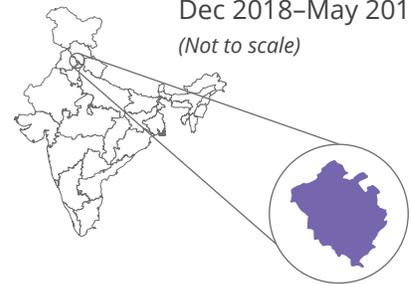
- Revision of the Disaster Management Plan to update all the information related to flood preparedness
- Mass awareness and extensive community engagement
- Adoption of city-wide flood precautionary measures

### Background

Govt. of India has notified CONSTRUCTION DEMOLITION WASTE MANAGEMENT RULE 2016 in which construction building material cement debris, stones etc. is to be reused after recycling. C&D waste should not be dumped in open spaces/landfills grounds without processing. To implement the same it should be made mandatory for the residence of the city that should send their plans for constructions/reconstruction before approval. They should be bounded by terms and conditions to reuse the recycle material. All the local Govt. Institutions should be bounded by terms and conditions to reuse the recycle material. They have directed to install C&D waste processing plant to recycle and reuse the material. Accordingly MC, Chandigarh has installed the C&D waste processing plant & as well as cement concrete products factory to use recycled aggregates by-products made by C&D waste should be made mandatory to be used in road Construction/building Construction etc. They also to be bound to dump their C&D waste at designed site/plant and dumping in unauthorized area result into punishable offense.

#### Industrial Area Phase I, Chandigarh

Dec 2018–May 2019  
(Not to scale)



### Project Objectives

- I. To develop a C&D waste processing unit in the industrial area of Chandigarh
- II. To comply to the waste policy of the local area of the city

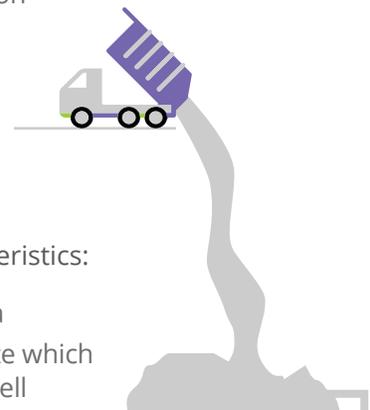
### Key Stakeholders

Municipal Corporation Chandigarh and Engineering Department, UT Administration

### Approach

Municipal Corporation Chandigarh has set up the construction and demolition waste processing plant in its industrial area for stacking, crushing, processing and manufacturing of various C&D products. The C&D plant has the following characteristics:

- It has been set up at a very low budget in comparison to other cities across India
- The plant has a capacity of about 150 MT per day for crushing construction waste which can further increase up to 180 MT/day and meet the demand of the Tri-city as well



- It produces material which can be utilized for cement concrete works such as washed sand, crushed aggregates of 10 mm, 20 mm and 40 mm
- The plant also manufactures road material i.e., PCC kerbs, PCC Channel, PCC Tiles, Paver Block etc. at a relatively low cost
- The plant reduces the in-house cost of construction by approximately up to 10% and has the tipping charges and processing cost at relatively lower costs than other cities in India
- It provides facility for the residents of Chandigarh to dump their construction waste in authorized manner

## Achievements



### Benefits

- Till date 5000 MT C&D waste has been processed into recycled products from the date of commissioning of plant i.e. 15th May 2019
- Natural Resource Savings due to development of recycled products
- Reduction in the quantum of waste reaching landfills
- Reduction in carbon footprints and hence yielding numerous environmental benefits

### Co-benefits

- Economic benefits, for instance in reduction of transportation costs of the construction materials
- Job creation

## Limitations

- Minimum land required for setting up C&D waste plant in Chandigarh is 3-4 acre
- In future stacking of recycled material need extra land
- General Awareness among residents of the city on C&D Waste Management

## Future Prospects

- Production of plant increases from 150 MT/day to 180 MT/day by increasing the working hours which will meet the demand of tricity (Chandigarh – Mohali- Panchkula)
- In long term manufacturing of public health related items like PCC Road Gully covers, PCC Manholes covers etc. is also planned
- For Horticulture works, manufacturing of PCC benches will also be taken up
- Preparation of ISO-9001 is in progress

Source: Case received from the city

For more Information

<https://www.tribuneindia.com/news/chandigarh/dumping-debris-to-cost-you-dear-in-chandigarh/738521.html>

<https://timesofindia.indiatimes.com/city/chandigarh/chandigarh-starts-to-gather-debris/articleshow/65650726.cms>

<https://www.tribuneindia.com/news/chandigarh/ut-civic-body-in-dock-over-c-d-waste-plant/793080.html>



30



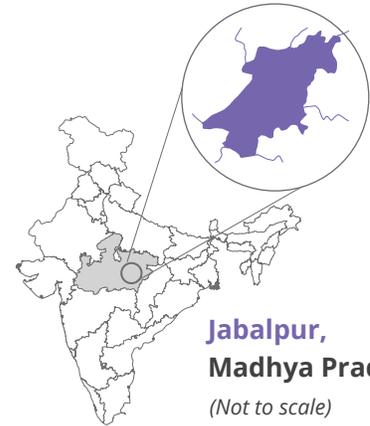
## ZERO LANDFILL & BIN FREE CITY: JABALPUR

### Project Highlights

- Establishment of a 10 Acre Waste to Energy plant at Kathonda area on PPP model providing all round solution to the waste problems of the city
- The plant consume 600 tons of waste per day and generates 11.5 Mega Watt electricity
- Installation of an ICT based 100% door to door garbage collection monitoring system with 276000 RFID tags installed across city to eliminate bin and make it a Bin free City

### Background

Waste management is a basic requirement of ecologically sustainable development. It is a comprehensive program optimizing waste collection, transport, and disposal along with activities to prevent, recycle, and draw energy from waste. Jabalpur Municipal Corporation (JMC) is responsible for providing municipal and civic services, which includes but not limited to the collection, segregation, transportation, treatment and disposal of Municipal Solid Waste (MSW) generated in the Jabalpur city of Madhya Pradesh. The city authorities in view of the mounting issues of waste management refined the solid waste management services by building a waste to energy plant at Kathonda for scientific disposal of all kinds of municipal waste, thus providing all-round solution to the waste related problems of the city.



**Jabalpur,  
Madhya Pradesh**  
*(Not to scale)*

### Project Objectives

- I. To develop a waste to energy plant at Kathonda which can yield the following benefits:
  - A robust solid waste management solution to make Jabalpur a Zero Landfill City
  - A royalty amount of collected waste provided by ESSEL Infra increases the revenue of JMC
  - Prevention of ground water pollution due to the application of mass burning technology
  - Integration of the Waste-to-Energy plant with the centralized monitoring system

### Key Stakeholders

Jabalpur Smart City Limited, Jabalpur Municipal Corporation, Implementation Agency- ESSEL Infra, Vendor on boarded for Garbage Collection- ESSEL Infra

### Approach

The campaign covered various aspects of SWM in Jabalpur and adopted an integrated approach to strategize the activities being undertaken under the initiative as indicated below:

- Modifications and innovations in the waste collection instruments to ensure effective door-to-door waste collection services throughout the city
- Establishment of waste to energy plant to process all kind of solid waste
- Extensive campaigns and community engagement drives to increase mass-awareness levels about the initiative and the issue of SWM



## Achievements



The development and inception of the waste to energy plant has resulted in the following benefits and co-benefits:

- Efficient collection of waste, reduction of littering, foul odor and unaesthetic appearance of bins
- Sense of good hygiene and awareness towards environment are visible among citizens of Jabalpur.
- Better governance on collection of daily garbage & monitoring of garbage collection, Transportation system by the command Control center.
- While ensuring Cost reduction and resource optimization, system has contributed in improved environmental excellence
- City Wide apps (Mobile/Web based) enabled citizens & ward committees to upload concerns and report any violation such as missed collection points, Illegal dumping etc. to help the concerned authorities to take action within 24 hours and maintain cleanliness in the city
- Citizen centric system & MSW monitoring cell with the help of Integrated Command and Control Center having 24\*7 operations monitoring with data integration platform.
- Citizen reporting to provide complete situational awareness about real time information regarding Collection, transportation, treatment & disposal which is available at the ICC

## Success Factors

- Strong and stable leadership
- Technical innovations for effective management of solid waste including IT based innovations
- Intensive campaigning for increasing the mass awareness levels about waste segregation and management

## Limitations

- The key challenge faced for the successful implementation of the WTE plant was reducing the usage of one time usable plastic (Disposals) due to lack of awareness

## Future Prospects

The electricity generated by waste to energy plant is sent back to the grid for utilization. The environment is pollution free in the aspect of ground water and air pollution. The waste to energy plant also helps to avoid the consumption of useful land required for garbage dumping.

The system can easily be replicable and must be adopted by all major cities and towns of India to make a new India. The project helped significantly to achieve the targets set under Swachh Bharat Mission for Jabalpur City.

Source: Case received from the city

For more Information

<https://india.smartcitiescouncil.com/article/how-manage-solid-waste-learn-these-cities>

[http://www.ijater.com/Files/6e2b4d67-f7f0-4e7e-975d-4c9a52271844\\_IJATER\\_35\\_03.pdf](http://www.ijater.com/Files/6e2b4d67-f7f0-4e7e-975d-4c9a52271844_IJATER_35_03.pdf)

[https://smartinvestor.business-standard.com/market/ipoNews-560069-Jabalpur\\_shows\\_the\\_way\\_with\\_its\\_smart\\_system\\_of\\_solid\\_waste\\_management.htm](https://smartinvestor.business-standard.com/market/ipoNews-560069-Jabalpur_shows_the_way_with_its_smart_system_of_solid_waste_management.htm)





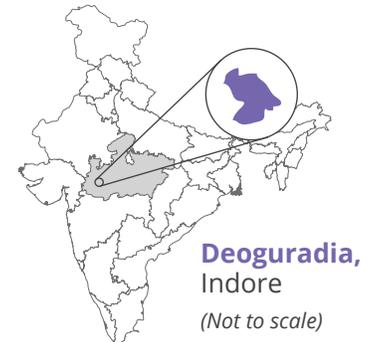
## BIOREMEDIATION/ BIO MINING OF LEGACY WASTE: DEOGURADIA

### Project Highlights

- 100 % legacy waste Bio-remediated
- 100 acres land worth Rs.300 cr. Reclaimed
- Green Belt developed on Bio-remediated Land

### Background

India has been battling the war against waste, be it through sound recycling practices or efficient disposal of garbage. Indore had taken considerable steps to tackle waste management in new and innovative ways. Indore's Devguradiya, a 100-acre dumpsite proved to be an eyesore. Despite the city being dubbed the cleanest in India in 2017 in Swachh Survekshan survey, the dumping yard, saddled by heaps and heaps of smelly garbage for decades together, remained a concern for officials and citizens alike.



### Project Objectives

- I. Compliance of The Solid Waste Management Rules of 2016 directed urban local bodies
  - To clear legacy waste dumps as well as existing operational dumpsite
  - To Reclaim 100 Acre land of worth Rs.300 Cr.

### Approach

The project adopted an integrated approach to strategize the activities being undertaken under the initiative as indicated below:

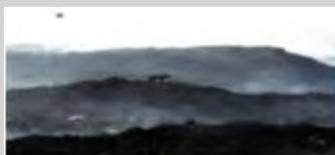
- Quantity of the waste to be Bio-remedied was determined on the basis of contouring of area to be treated
- Bioremediation treatment was done by dividing the site into suitable blocks
- Raking of garbage layer through long spike harrow operating in cross directions was done regularly to pull out rags, plastic, rubber, textiles etc.
- Coarse material and garbage was screened through rotary/ horizontal screens. The recovered earth was spread in the dedicated area. No extra charge was paid to the contractor for load or lift of the material
- The stone, bricks, ceramics which were removed while screening and raking was sent for land filing or for filling up of low-lying area, while the recyclables like plastic, glass, metal, rugs cloth recovered from the waste was bundled and sold
- The soil recovered was used for refilling the ground on the same site where greenery is developed
- The recovered construction and demolition waste was recovered and sent to C&D processing facility to produce building materials and the left-over of the waste was sent to a secured landfill
- Valuable land has been recovered by bio-remediation process of legacy waste
- The project deployed 10 Trommels, 15 Horizontal Screens, more than 50 excavators, back hoe loaders with 200 plus workers to execute the work
- Daily monitoring of the progress of work was done by a team headed by ED-Indore Smart city

## Achievements



The development and inception of the waste to energy plant has resulted in the following benefits and co-benefits:

- Foul odor had disappeared completely to benefit the citizen living nearby
- Considerable decline in diseases arising out of the trenching ground
- 100 acres of land had been reclaimed
- Due to adoption of scientific bio remediation process the area inside the processing and disposal site is transformed into beautiful Green-Belt and has uplifted the environment of the whole site
- Elimination of dump fires and leachate generation
- Reduction in Green House Gas Emissions, soil pollution and Ground water contamination
- Increase in nearby Real state value
- At present, IMC is collecting, transporting and processing 100 % of the waste generated on daily basis by various means
- Plantation of 60000 saplings with their geo-tagging making it a popular destination within the city



## Success Factors

- Technical innovations for effective management of solid waste including IT based innovations

### Limitations

The key challenge faced for the successful implementation of the WTE plant was outsourcing of the manpower on a contract basis leading to slowing down of the pace of the project

## Long Term Impacts

- Bio-Mining/Bio-remediation Project of Indore Smart City is a unique project to deal with huge quantities of legacy waste and can be replicated in other cities of India
- Presently more than 20 ULBs have started Bio-Mining/Bio-remediation Projects
- Based on Quantity of Legacy Waste dumped in the city, the scalability of project is possible so as to complete the project in short span of time

Source: Case received from the city

For more Information

<https://www.thebetterindia.com/169584/ias-hero-indore-garbage-management-recycling/>

<https://swachhindia.ndtv.com/indore-does-away-with-waste-15-lakh-mt-on-landfill-this-is-how-empty-space-used-30367/>

# 32

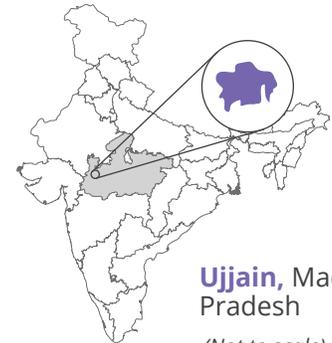
## BIO-METHANATION PROJECT: UJJAIN

### Project Highlights

- Decentralized waste treatment plant directly connected to the electricity grid
- Sustainable collection mechanism
- Revenue Generation
- By-product utilization

### Background

Ujjain, the ancient city, situated on the banks of River Kshipra in Madhya Pradesh is known for its holy and sacred identity due to presence of the age old deity Lord Mahakaleshwar. Ujjain city, as a municipal entity, spans an area of 92.68 sq. Km. The city is divided into 6 zones covering 54 wards. There are 4 daily markets and 3 weekly markets in the city which produce 25 – 30 MT of vegetable waste weekly. The implementation of the Bio-methanation plant has emerged a head turner as it has become self-sustainable by using the existing resources and then later converting it into electricity which in return is used for the working in the plant and also to the nearby street lights. Also, the materials implemented in the project such as smellers, powders acts as an upper edge towards treating and prohibiting health issues for the laborer. The implementation has focused on Waste to Energy utilization. The plant is processing the bio-degradable waste of the city to generate electricity and compost and is currently processing 5 tonnes per day of waste and is planned to be scaled up in the near future. This plant is helping in the solid waste management of the city and is also a step towards reducing the burden on non-renewable resources by producing electricity.



### Project Objectives

- I. To create decentralized facility apart from the existing centralized facility that is located outside the city
- II. Selection of apt technology with respect to size, waste quantity, waste characteristics, generation and use of gas
- III. Installation of a 5TPD capacity Bio-methanation plant for the treatment of organic market waste to generate green energy
- IV. To decrease carbon footprints
- V. To Promote awareness of clean and green technologies to combat global warming

### Key Stakeholders

Ujjain Smart City, Nagar Nigam, Aryan Associates

### Approach

The project adopted an integrated approach to strategize the activities being undertaken under the initiative as indicated below:

- Treatment of the total Market waste generated daily in Ujjain.
- To collect vegetable waste from all the mentioned markets via E-Vehicle
- To install Bio-methanation plant with M-KVIC Floating Dome Technology
- By product utilization(Methane gas, Compost)

## Achievements



The development and inception of the waste to energy plant has resulted in the following benefits and co-benefits:

- Provided electricity to light the Street Lights in Ujjain using clean energy and reusing resource (organic waste),
- Reduction in the amount of waste reaching land fills
- Reduction in the cost of tipping fee and C&T cost was also reduced on the ULB
- The slurry generated from Bio-methanation was utilized for landscaping, gardening and farming purposes
- The project promoted the awareness of clean and green technologies and reduced greenhouse emissions onto the environment by 12,176 Kg/month



## Success Factors

- Technical innovations for effective management of solid waste

### Limitations

Preliminary phase of the Project had many issues which included:

- The Land issue, as the area where project was supposed to be installed was not a free land
- The land was a low lying area, prone to inundation, therefore had to be maintained prior the development of the project
- Vegetable vendors had a fear of Land Encroachment as the Bio-methanation plant was supposed to be installed near to the Mandi area.
- Collection of vegetable waste was also one of the main issues, as municipal corporation already had door to door collection but this project had a target of reduced tipping fee
- Post the implementation of the Bio-methanation plant few technical issues were observed as there was no Net Metering Policy for the Bio-methanation

# PLASTIC TO LIQUID FUEL CONVERSION: PHITSANULOK



Phitsanulok, Thailand

Year of Initiation: 2008

## Project Highlights

- Integrated waste management scheme aimed at zero landfills in the city
- The waste management scheme is one of the best example of 3R's, i.e., integration of polluter-pays principle, public participation and pre-treatment prior to landfill and pyrolysis
- Conversion of plastic into a valuable resource

## Background

Phitsanulok municipality located in northern Thailand covering an area of 18.26 sq. km houses a population of ~9 million. The city had been experiencing a rapid increase in the amount of waste being generated, which forced the municipality to shift the dumping sites in the outskirts of the city leading to urban sprawl and increase in land prices. In order to address these

issues, a municipal solid waste management scheme aiming zero waste landfill in the year 2007 was adopted by the municipality of the city. The scheme was a comprehensive waste management scheme based on the ideals of 3R's, i.e., reduce, reuse and recycle. The scheme targeted all the key aspects of waste management with special focus on plastic waste.

## Project Objectives

The primary objective of the initiative was to address the growing problem of plastic waste by initiating a refuse derived fuel (RDF) generation process for conversion of waste plastics to oil

## Key Stakeholders

Phitsanulok Municipality; Ministry of Energy – Energy Policy and Planning Office (Eppo)

## Approach

The waste management scheme was adopted to provide complete solution to the waste related issues in the city. The following specific steps were undertaken:

- Construction of a waste plastic to liquid fuel facility in the city which will be fed by the plastics being discarded as waste material
- o The plant has 2 reactors operating alternatively and in batches
- o 4-8 tons of plastic are fed per batch, which leads to the production of 2000 liters of fuel per day

## Achievements



### Benefits

- Conversion of plastic waste into a valuable resource
- Resource conservation leading to enormous economic benefits
- Reduction in the amount of GHG emissions being released in the atmosphere. This reduction has been done through two major pathways:
  - Fuel from plastic waste can obviate an equivalent amount of fossil fuel

- Avoidance of anaerobic decomposition of organic waste in landfills due to the co-disposal of plastic waste

### Co-benefits

- Climate Change mitigation
- Increase in awareness levels towards plastic waste and overall waste management issues of the city
- Economic benefits

## Success Factors

- Strong Institutional and legislative Support and capacity
- Technological Innovations for effective management of plastic waste
- Integrated approach of the waste management scheme relying on 3R's, i.e, polluter-pays principle, public participation and pre-treatment prior to landfill and pyrolysis
- Extensive awareness initiatives across the city to sensitize the issue and scheme among local residents

## Future Prospects

This scheme has high replication potential, specifically in developing countries like India, where the reliance on plastics is quite high.





**Ministry of Housing and Urban Affairs**  
**Government of India**