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# WASTE MANAGEMENT



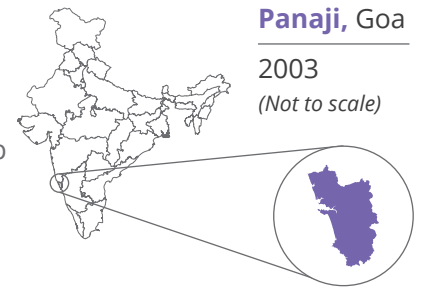
## A CASE OF DECENTRALIZED SOLID WASTE MANAGEMENT SYSTEM TOWARDS A BIN FREE & LANDFILL LESS CITY: PANAJI

### 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

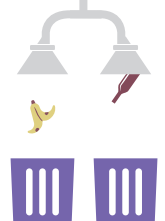
### Key Stakeholders

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

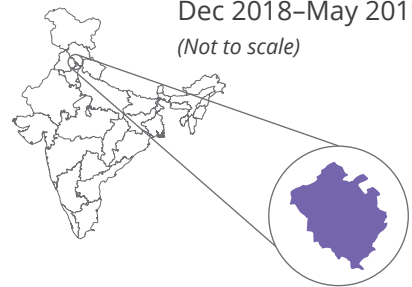
- Revision of the Disaster Management Plan to update all the information related to flood preparedness
- Mass awareness and extensive community engagement
- Adoption of city-wide flood precautionary measures

### 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

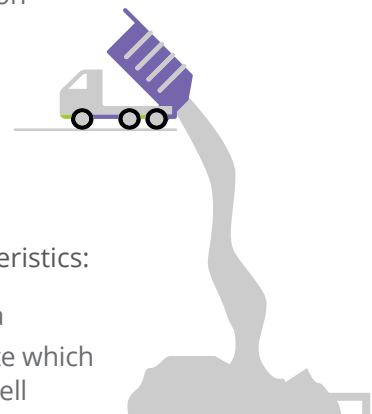
### Key Stakeholders

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 an 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>



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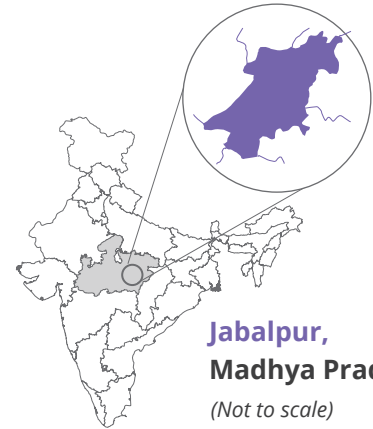
## ZERO LANDFILL & BIN FREE CITY: JABALPUR

### 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)





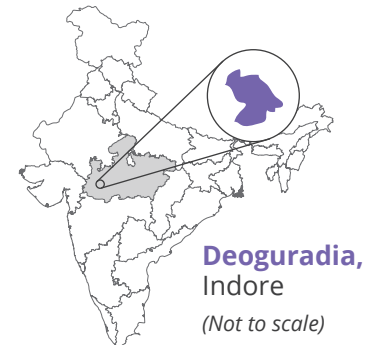
## BIOREMEDIATION/ BIO MINING OF LEGACY WASTE: DEOGURADIA

### 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 filling 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

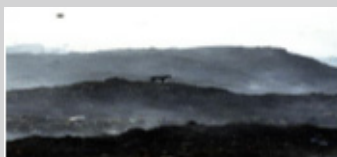


## Achievements



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/>

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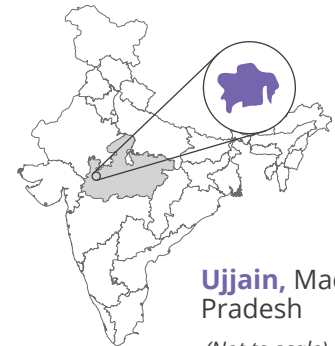
## BIO-METHANATION PROJECT: UJJAIN

### 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:

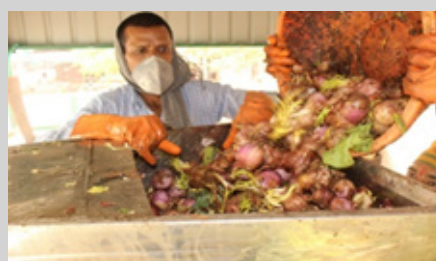
- Treatment of the total Market waste generated daily in Ujjain.
- To collect vegetable waste from all the mentioned markets via E-Vehicle
- To install Bio-methanation plant with M-KVIC Floating Dome Technology
- By product utilization(Methane gas, Compost)

## 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.

