

# **Solid Waste Management: Issues, Challenges, Strategies and Opportunities**

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# Waste Issues - nowhere to go



# Inappropriate Waste Management

**Dumping**



**GHG gases emanating from  
landfills**



# Impact of Dumping

**Non-compostable contraries**



**Leachate with high BOD and COD**



# Challenges: Wastage and Littering

**One Third of The World's Food Supply  
IS WASTED EVERY YEAR**



Children die needlessly of hunger every year, not because we don't have enough food in the world, but because money, greed and corruption stops food from getting to the people that need IT THE MOST.

<http://preventdisease.com/food-waste.shtml>

PreventDisease.com

## DIGEST THIS

A first-of-its-kind analysis says that 15–20 per cent of the food served at social gatherings is wasted. The maximum wastage takes place in marriages, followed by seminars and conferences

### SERVING NONE

How much goes waste

Delhi Gurgaon Ghaziabad  
Faridabad Total

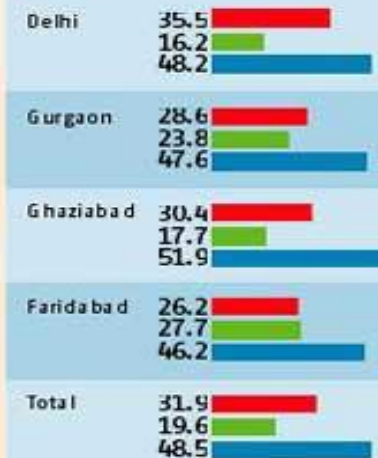
### Wastage City-wise response



### AFTER-PARTY

Unused at functions

Leftovers in plates  
Unserviced food  
Both



All figures in percentage; including percentage of respondents interviewed as part of the survey. The analysis was done on the basis of a five-city survey. Source: Field survey, Centre for Consumer Studies, IIPA

# Water Stress

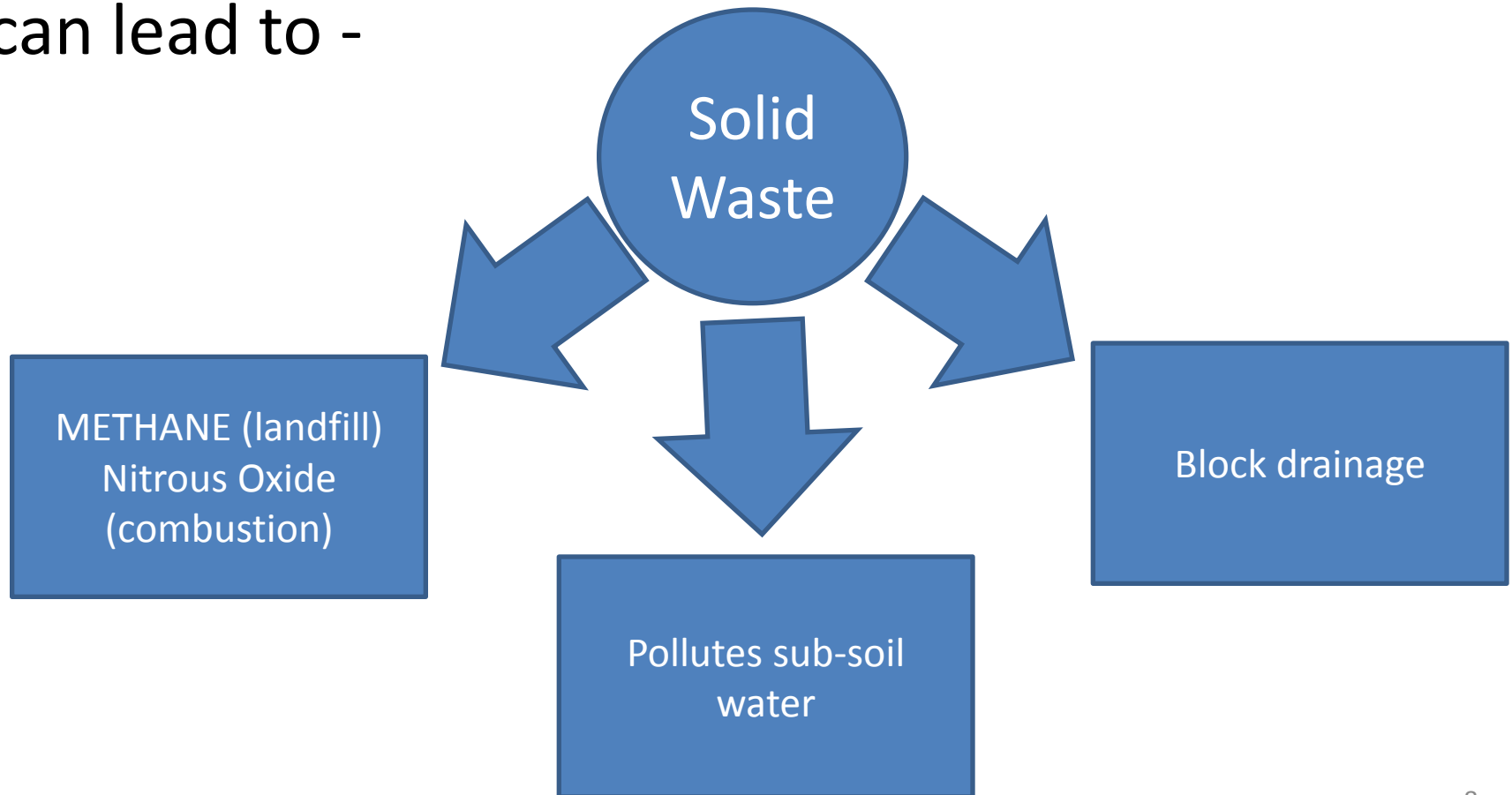


# Powerless Stress



# Impact of Solid Waste – dumped on roadside or in an open dumpsite

Municipal solid waste if not disposed properly can lead to -

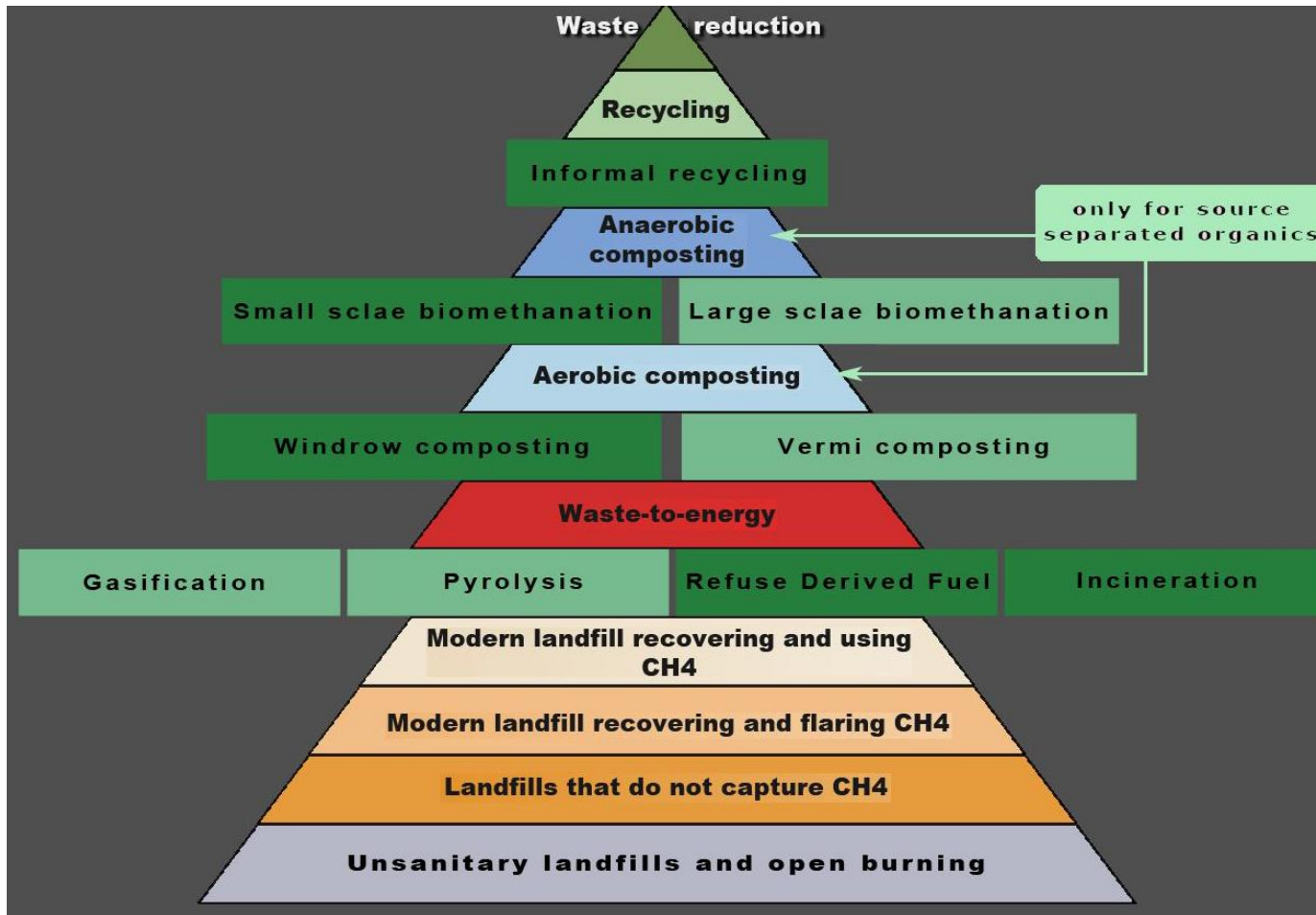




# Current Scenario of Municipal Solid Waste Management in India

- Waste generation** 1,43,449 TPD during 2014-15 (as per CPCB report)  
1,70,000 TPD (62 million tons annually)  
(as per Task Force on Waste to Energy, Planning Commission, 2014, New Delhi)
- Average waste generation** 0.11 kg/capita/day (GIZ, 2015)
- Per capita waste generation** 200-300 gms/capita for small towns  
300-400 gms/capita for medium cities  
400-600 gms/capita for larger cities  
(as per Planning Commission, 2014, New Delhi)
- Waste collection** 68 percent of the waste generation (MoUD, 2011)  
70-90 percent in larger cities  
less than 50 percent in smaller cities.
- Waste disposal** More than 80 percent of MSW is disposed at open dump sites without any treatment (Planning Commission, 2014, New Delhi)

# Current Waste Management



# Recycling Offset Potential

- It is estimated that **increasing the national recycling rate from to just 5% percent would reduce greenhouse gas emissions by another 10 MMTCE, compared to landfilling the same material.**

**Together, these levels of waste prevention and recycling would be comparable to annual emissions from the electricity consumption of nearly 4.9 million households**

# Offset Potential of avoiding transportation of MSWM to Landfill

- Savings on avoiding the **transportation of one Ton of MSW to landfill = Rs.638,75,00000 /year** per 10,000 tons of MSW transportation to landfills
- **CO2 Emissions avoided by avoiding the transport of 1 ton of MSW = 721.4 kg/year** per ton of MSW transportation

# Urban Agglomerations/Towns by Class/Category : Census of India 2011

As per 2011 census, number of towns 7935, with 468 Class I cities of which 53 are 1,000,000 plus cities

Class	Population Size	No. of UAs/Towns
Class I	1,00,000 and above	393
Class II	50,000 – 99,999	401
Class III	20,000 – 49,999	1,151
Class IV	10,000 – 19,999	1,344
Class V	5,000 – 9,999	888
Class VI	Less than 5,000	191
Unclassified		10*
All classes		4378

# NIUA 2000 report on services

A study of 300 class I cities and all State and UT capitals

- Average expenditure on Solid Waste Management as part of Total Revenue Expenditure of a Municipality/ Municipal Corporation was 15-20%
- About 75% of this expenditure was on Establishment and Salaries and about 20% on Transportation, rest being on other O&M costs
- All ULBs experienced financial crunch and hence the quality of services suffered

# Cost of SWM in 2014-15

- Establishment and Salaries/ Wages 65%
- Operation and Maintenance 35%
  - Transportation 20%
  - Other O&M including consumables 10%
  - Contingency 5%

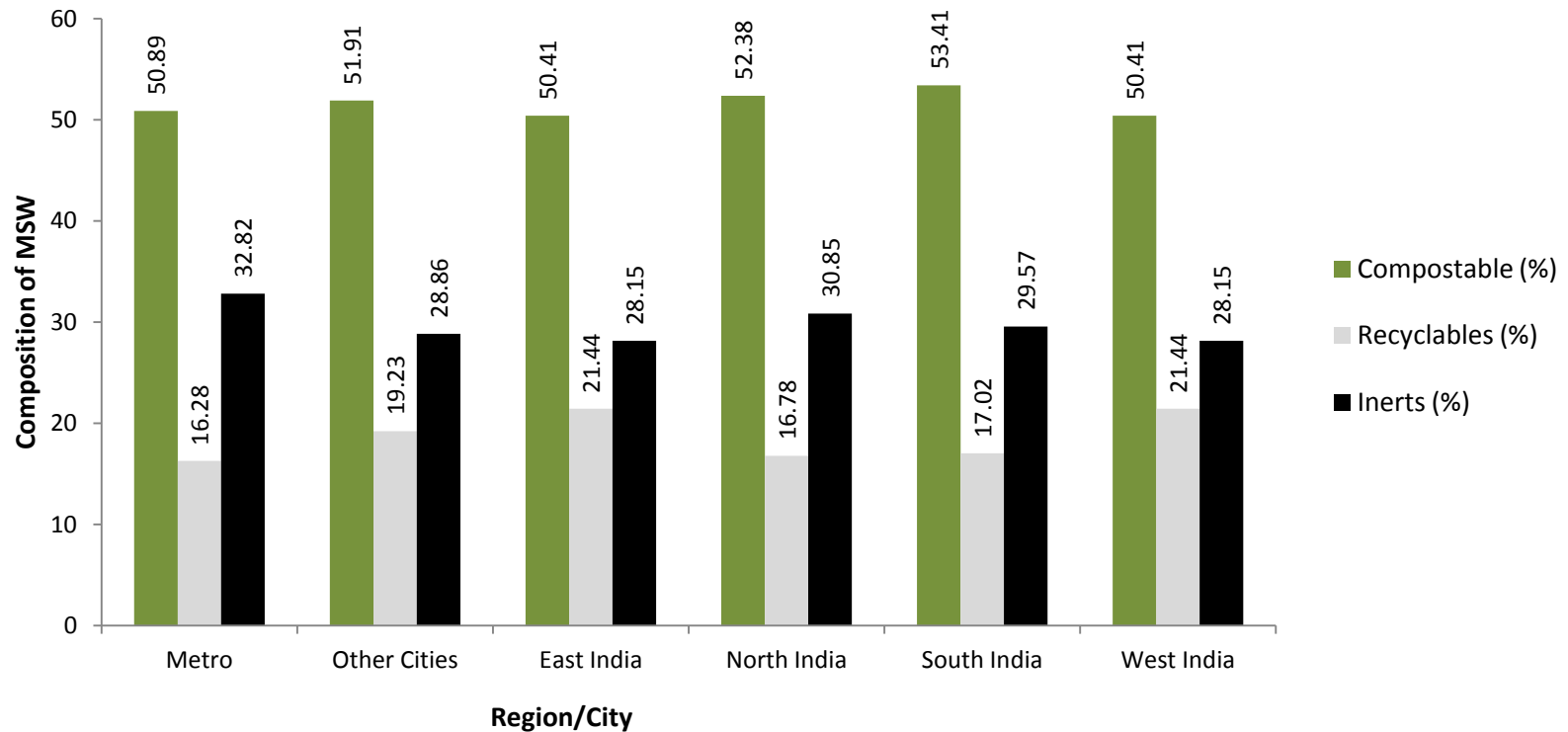
# Expenditure on Solid Waste Management

City	Year	Population	Actual SWM expenditure	Total Revenue Expenditure	Percentage
Pune (Class I A)	2014-15	31.24 lakhs (Census 2011)	Rs.203.125 Cr	Rs. 3125 Cr	6.5%
Hospet (Class I C)	2014-15	2.06 lakhs (Census 2011)	Rs. 2.3 Cr	Rs. 20 Cr	11.5%
Bangalore	1997-98	50.1 lakhs	Rs.42.24 Cr	Rs.528 Cr	8%
Rajkot	2008-09				23%
GVMC (Vizag)	2008-09				25%



# Composition of Municipal Solid Waste (MSW)

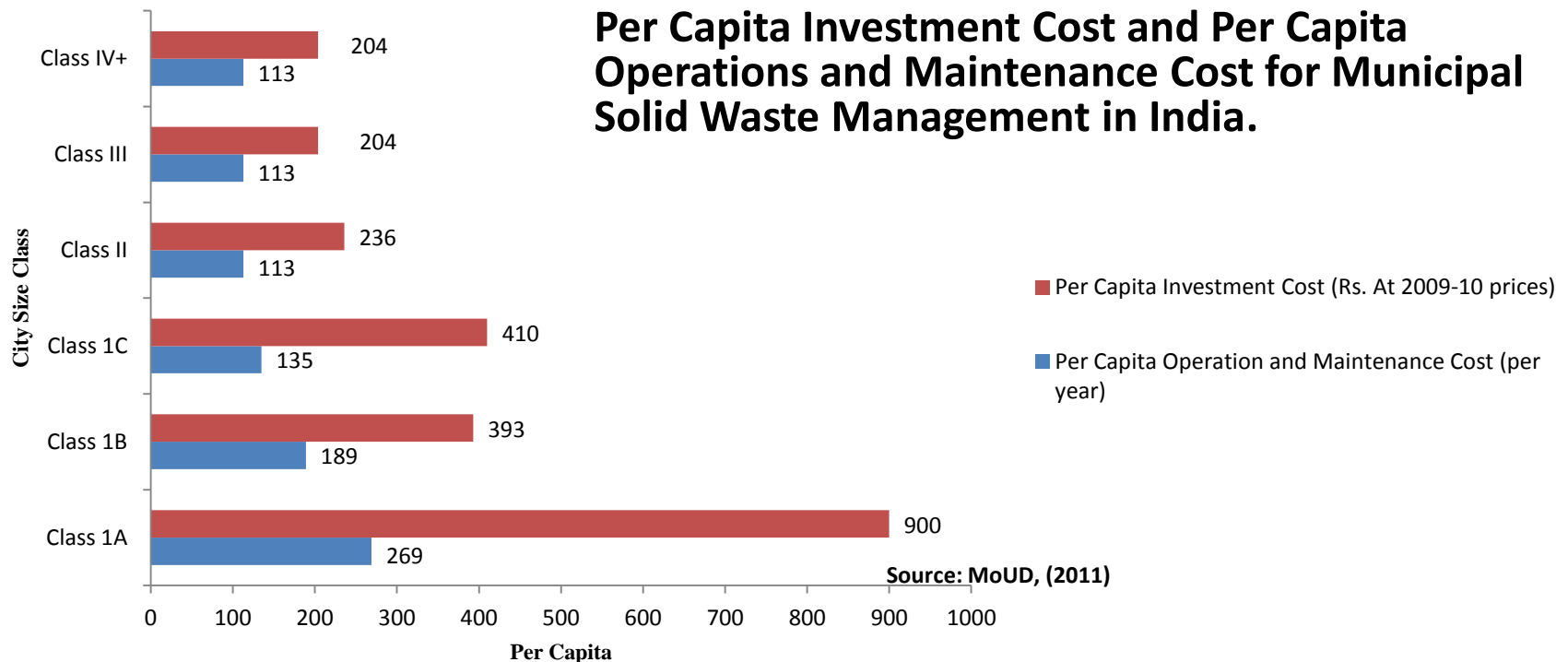
Composition of MSW in India & Regional Variation



□ Source: Earth Engineering Centre, 2012

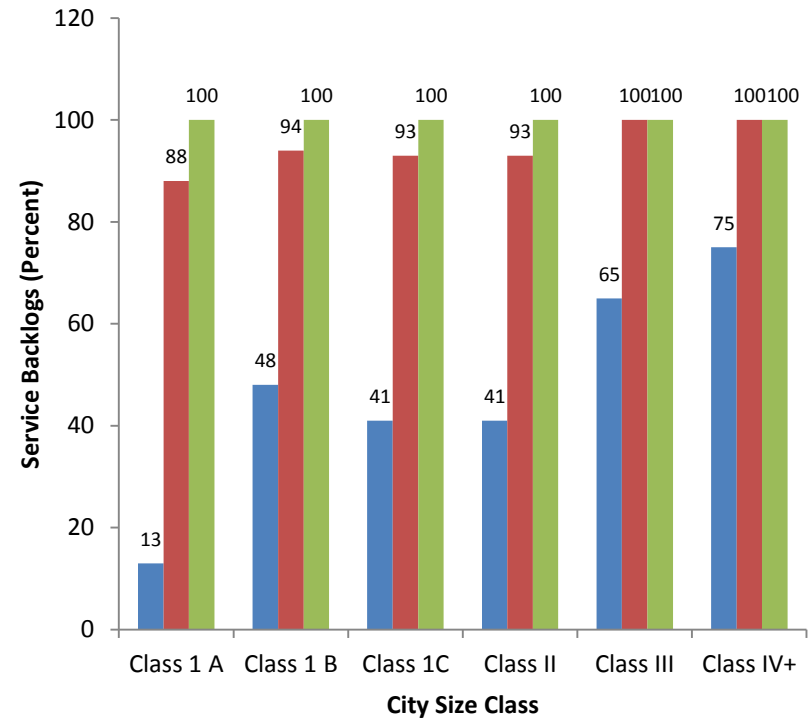
# Devolution of 12<sup>th</sup> Finance Commission Grants for SWM

Sl. No.	Particular	Amount (₹ in Crore)
1.	Collection & Transportation equipment & Machinery	386.44
2.	Compost Plants	1001.23
3.	Sanitary Landfill Development	1056.88
	Total	2444.55



# Backlogs of Service Level Benchmarks

Sl.No	Performance Indicator	Service Level Benchmark (in percent)	Current Average Performance ( in percent)
1.	Complaint Redressal	80	89.1
2.	Collection Efficiency	100	75.3
3.	Household Coverage	100	47.7
4.	MSW Recovery	100	31.7
5.	User Charges Collection Efficiency	90	31.4
6.	MSW Segregation	100	19.5
7.	Scientific Disposal	100	8.0
8.	Cost Recovery	100	17.3



■ Collection and Transportation ■ Processing ■ Scientific Disposal

Source: MoUD, (2011)

# Challenges

- **Mixing of wet and dry waste** along with household e-waste, **toxic waste and bio-medical waste**.
- **Vehicle break-down, foul smell and spillage** due to improper collection/ transportation.
- **Inefficient monitoring of routes** and operators are other issues that need to be addressed.
- **More than 80 percent waste is disposed indiscriminately** at dump yards in an unhygienic manner by municipal authorities.
- **Finding new landfill sites** is a major constraint especially because of the 'not in my backyard' (**NIMBY**) phenomenon.

# Costs –Treatment& Technologies

# WTE-Waste to Energy

- The capital cost of building a WTE plant is INR 2,300,000 per ton of waste processed or Rs.20 crores per mega watt installed.
- OPEX is Rs.13/kwh
- Subsidy offered by Power Ministry is Rs.7.9/kwh



# Sanitary Landfill Site

- Capacity 11.50 Lacs Metric Tones (i.e. 1.15 million tones) -total construction cost of the site is **Rs 13 Crores** and area used is **12.88 Hectares** (32.8271 acres)



Windrow composting costs Rs. 2,00,000 per ton of organic waste processed





# Impacts of Mixed Solid Waste Plants

**Unsaleable products**



**Unscalable mountains**



# A Small Scale Biogas Unit Developed by Biotech, Kerala; Capacity: 2 kg/day of Organic Waste



- Kerala as a case study for small scale biogas. A company has installed twenty thousand (20,000) units of small scale biogas in Thiruvananthapuram and Kochi, combined.
- Units installed divert **about 40 tons of waste from landfills, which is 7% of the organic waste generated in both cities together.**
- It also implies avoidance of about 5% of collection and transportation costs and resulting GHG emissions
- Cost is Rs.20/day

# Approach to SWM Rules 2016

An altered paradigm

# WET WASTE



# DRY WASTE



# HAZARDOUS WASTE



# Insanitary / Home healthcare waste

## Infectious waste



## Infected sharps



# Quality and quantity of waste per One lakh population

▣ WASTE FROM HOUSEHOLDS:	44.25 TONS
▣ WASTE FROM MARKETS	: 4.0 TONS
▣ SLAUGHTER HOUSE	: 0.5 TONS
▣ RAILWAY QUARTERS & STATION	:0.3 TONS
▣ BUS STAND	:0.2 TONS
▣ RESTAURANTS	:1.5 TONS
▣ HOSPITALS	:0.5 TONS
▣ OPEN DRAINAGE	:0.3 TONS
▣ COMMERCIAL & ROAD	:0.45 TONS



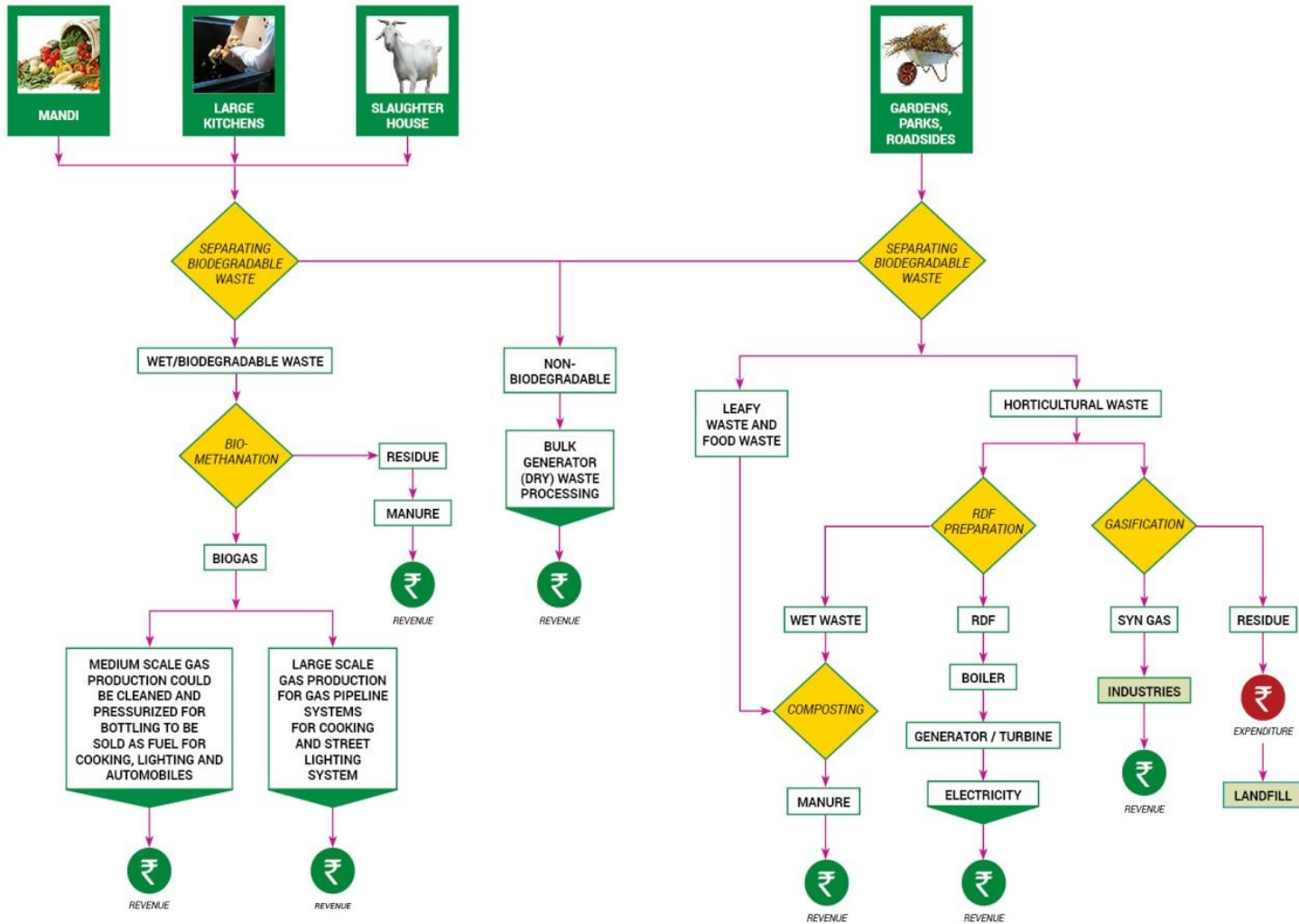
# Waste or Resource?

- Of this waste, 50 per cent is wet waste and therefore 25 tons of wet waste per day is generated which can be composted and almost 150 tons of compost is obtained every month.
- Furthermore, about 7 to 10 tons of dry waste can be sold or converted into useful products every day. Both these together can earn upto Rs.25,00,000 per month for the ULB, i.e. Rs.3,00,00,000 annually!

# Recommendation I

Use Biomethanation for market, restaurants, fish wholesale, hotels, hostels and slaughter house waste

# BULK GENERATOR (WET) – SEGREGATE AT SOURCE



# Market waste - plenty

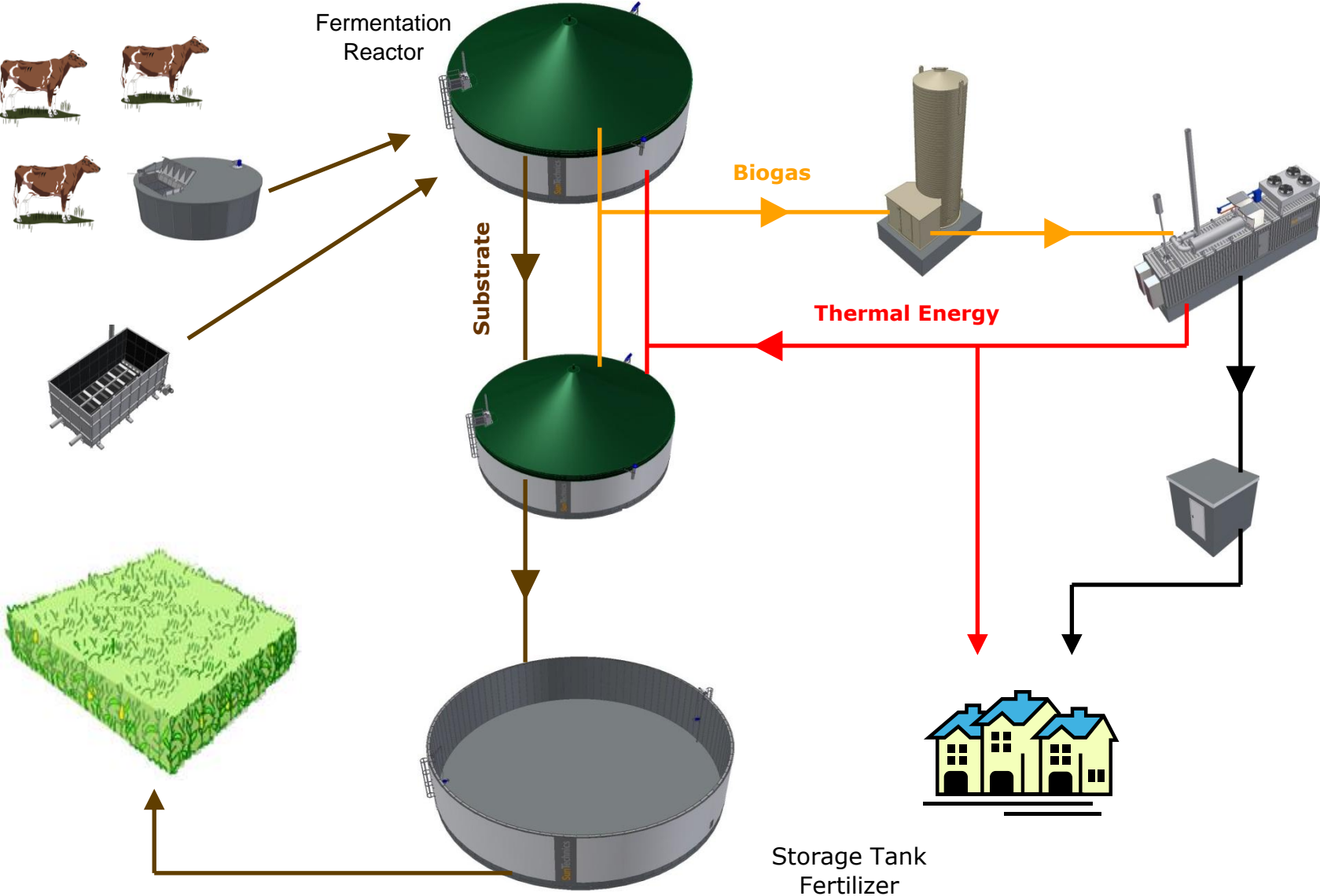


# Bio-Methanation - Salient features

- No storage of waste is required as it is to be directly loaded into the plant every day
- No foul smell since the digesters are gas tight
- No insects/rodent menace since there is no storage of waste
- The biogas generated from these digesters is substantial.
- Organic digested sludge removed periodically is an excellent manure.
- Manpower requirement is less – Unskilled manpower can be utilized



# Material Flow Chart



# De-centralised Biomethanation Nisargruna & Containerised Plants



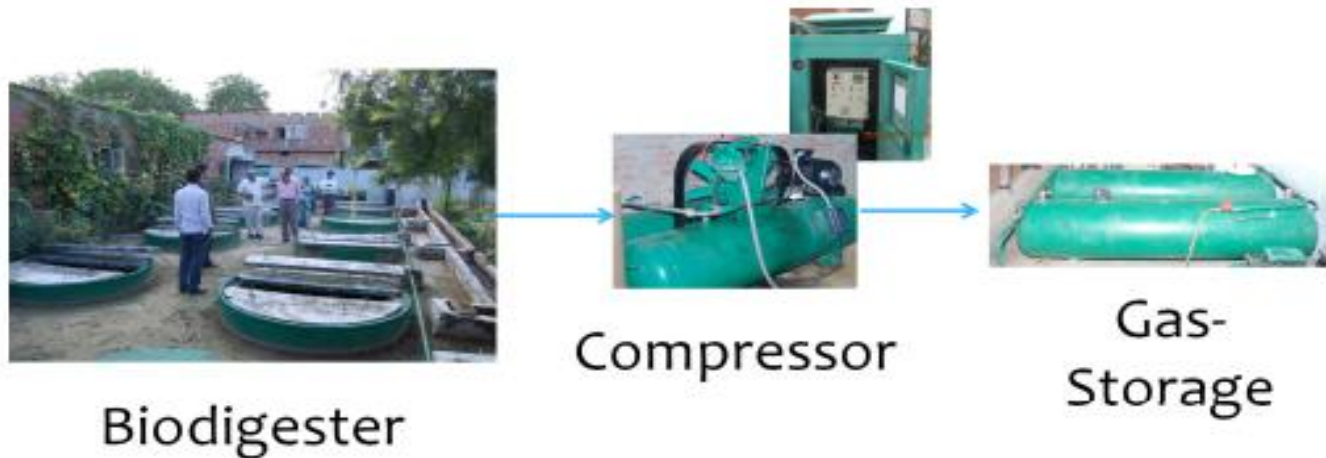
# Bio-methanation for market waste





# Community level Biomethanation

Organic Waste to Energy



## Salient Features

- Community level
- Converts biomass to methane for combustion
- Accepts dry and wet biomass (need 20% cow dung)
- Already implemented in field

# Biomethanation for hotels and canteens

**TEAM technology at Sona**



**TEAM technology at Faridabad**



# Bngalore 2015 contd...

**Restaurant and Bulk generator  
Wet waste sorting shed**

**Biomethanation Plant for converting wet  
waste to Biogas used for streetlighting**



# Bangalore 2015

Biogas stored for conversion to electricity



Biogas for cooking and Electricity for Streetlighting



# 1. Mahindra & Mahindra, Chennai



## Plant details:

**Capacity:** 100 N.Cu.m/hr

**Substrate :** Kitchen Waste

**Application:** Bio-CNG

**Stage:** Installed, Commissioned & Running.



Recently Inaugurated By Hon'ble Ministry Of  
Power Piyush Goyal



होटल  
ली-मैरीडियन  
HOTEL  
LE-MERIDIEN







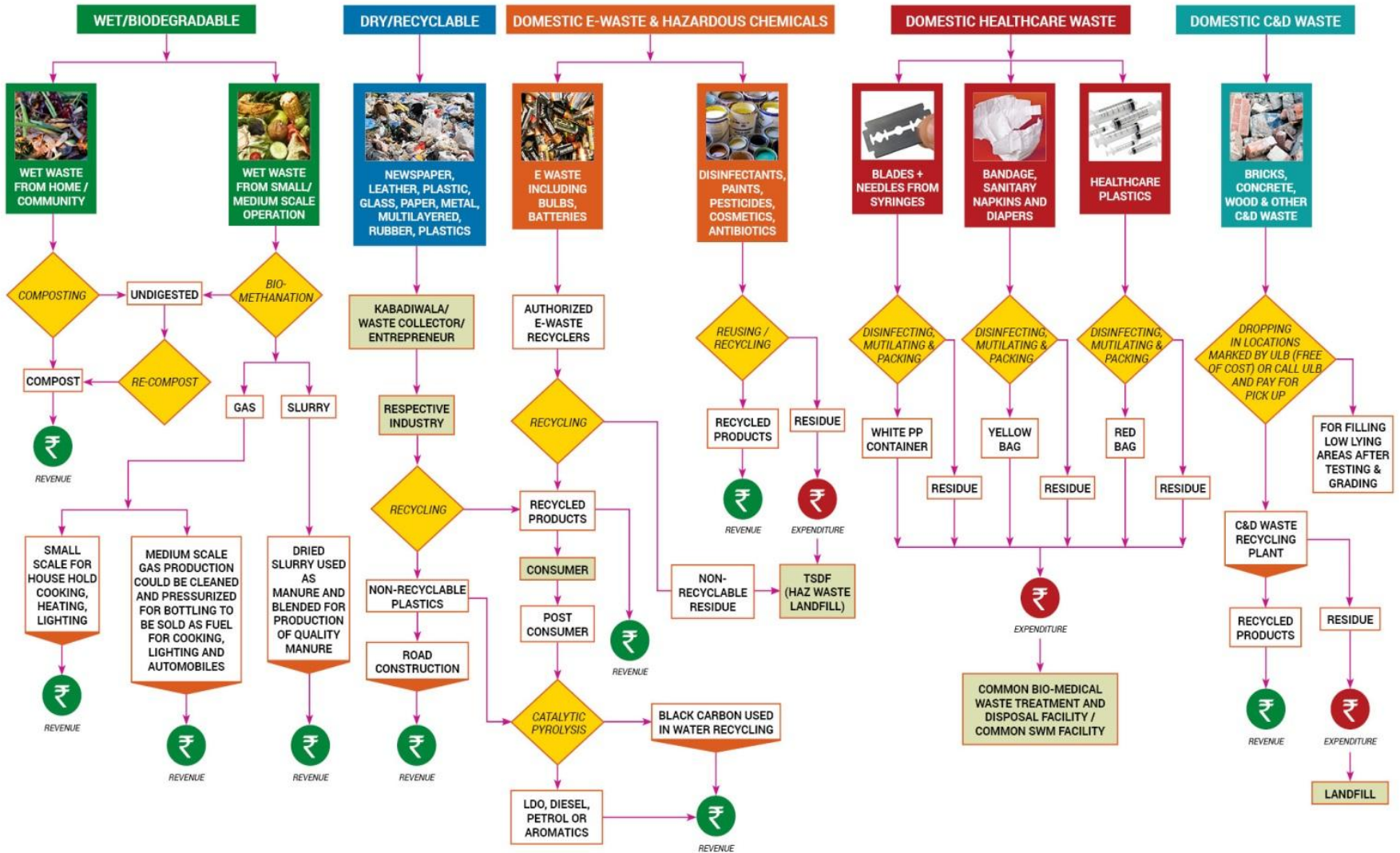




# Recommendation II

Zero waste homes and Door to door collection of source separated waste and decentralized composting of wet waste for newly developing areas

# HOUSEHOLD WASTE (SEGREGATE AT SOURCE)



# Separation of wet waste at source & Home Composting



# Waste Utilisation and Reduction at source

Use terracota to compost wet waste, do gardening!



# Dry waste separation at source

**A bag hung in a convenient place**



**Source separated dry waste**



# Dry waste collection and conversion

**Dry waste conversion**



**Dry waste cleaned and converted**







# 100 percent separation at source and in-house composting at Regency Park II, Gurugram



# Composting of canteen and garden waste in green campuses by Green Bandhu

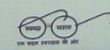




Recycle your  
plastic bottles here  
and make Regency Park II  
a **Swachh Complex**



For more Detail  
☎ 9599484067



f GREENEARTHMOVEMENT  
www.gemrecycling.com | www.beingresponsibleindia.com



The bin is primarily yellow with a blue base. On the left side, there is a coin slot and a small rectangular door. The right side features a grid of icons: three rows of a plastic bottle icon followed by icons for paper, clothing, and shoes. To the right of this grid is a full-body image of a person in a yellow uniform. Below the icons is a circular logo with a checkmark and the text "Be Responsible". The bottom section is blue and contains the GEM logo (GEM Green Environment Movement) and the PET logo. Social media icons for Facebook, Twitter, and YouTube are also present.

# Segregated collection in e-rickshaws and in-vessel composting at Sector 21A, Faridabad

E-rickshaw with Blue and Green bins for collecting segregated waste from Households



In-vessel composter for colonies with 300-500 households



# Bangalore 2015

**Dry waste Collection and storage  
at Housing Complexes**

**Composting at Housing  
Complexes**



## Wet Waste

(Daily Collection)



- Veg & Fruit Peels
- Tea Leaves
- Egg Shells
- Leftover Food (Veg & Non Veg)
- Coffee Powder
- Dry Flowers, Seeds
- Small Quantity of dry leaves

**Disposal: In closed marked bins, to be kept at DOORSTEP ONLY**

**Pickup: Daily**

## Rejects (Red Bucket)

(BBMP)

### **SANITARY WASTE**

**(To be suitably wrapped in paper and marked "X")**

- Sanitary pads,
- Disposable diapers
- Menstrual cloths
- Bandages
- Ear buds, Hair
- Used Cotton
- Any material contaminated with blood and the like.

- Household dust, sweepings
- Coconut shells
- Tender coconut
- Old Brooms
- Sponge & Dusters
- Crayons
- Wood, Furniture
- Rubber, Cloth
- Rexin
- Discarded Footwear
- Leather, Thermocol

**Disposal: In closed marked bins, to be kept at DOORSTEP ONLY**

**Pickup: Daily**

## Recyclable Dry Waste

(ITC/RECYCLER)



- Pizza and Food Boxes
- Junk Mail, Tickets
- Pamphlets, Bills
- Rinsed Paper Cups and Plates
- Empty Cartons
- Cardboards, Bubble wrap
- Computer Printouts
- Empty Paper Packets
- Paper Gift Wrapping
- Broken Plastic Toys
- Empty Plastic Medicine Bottles
- Cartons ( used for Packaging )
- Metal



- Washed Milk Covers
- Plastic Bags, Gift Wraps
- Chips and Toffee Wrappers
- Plastic Bottles (Shampoo, Floor Cleaners, Toothpaste etc.)
- Rinsed Plastic Plates & Cups
- Empty Tetra pack Containers
- Aluminum Foil
- Empty Metal Spray Cans
- Shaving Brushes
- Metal Bottle Caps
- Broken Household Metal

## Recyclable Dry Waste

(ITC/RECYCLER)

**(Glass Bottles & Tin Cans)**

- Unbroken Emptied Bottles (Beer, sauce & jam bottles, medicine bottles, glass jars etc.)
- Emptied Tin Cans (coke, beer etc.)
- Emptied Tinned food cans

**Pickup: Weekly Once  
On Saturday by 12 noon**

## Electronic Waste

(Saahas)



- **Batteries & Wires, button cells**
- **CFL bulbs, Expired cards with chips**
- **CD/ DVD/ Floppy & Tapes**
- **Broken Electronic Toys**
- **Bulbs & Tube lights**
- **Chargers & Adapters**
- **Printer Cartridges**
- **Computer and mobile parts**
- **Other household electronic items**

## Household Hazardous Waste (HHW)

(TRD)

- **Cleaning agents, Mosquito Repellants mats, spray cans**
- **Paints**
- **Oils (other than cooking oil)**
- **Solvents & their containers**
- **Discarded Medicines/ Syringes/Thermometers**
- **Chemical Cosmetics**
- **Razors**
- **Insecticides & their containers**
- **Unused/ Expired Metal Spray Cans**
- **Air Fresheners**

**Disposal: Individuals to dispose in designated bins**



# THROW

Plastic covers, wrappers, packaging of any kind (chips, biscuits, chocolate, sugar, grains, pulses etc)

- ✓ Milk, curd, batter packets – rinsed and dried
- ✓ Netted vegetable bags
- ✓ Cleaned plastic/glass bottles
- ✓ any kind of paper, books, newspapers, magazines, flyers
- ✓ sweet boxes, pizza cartons
- ✓ tetrapaks, soap boxes, cereal cartons
- ✓ cardboard packaging of appliances
- ✓ paper party plates and cups
- ✓ inner cardboard roll of toilet paper and kitchen towels
- ✓ hardware: nuts/bolts/nails/scre

# DO NOT THROW

Plastics soiled with liquids

Expired or unused medicines, strips or bottles

Pizza boxes with pizza stuck

Tetrapacks with liquid inside (drain in the sink before throwing)

Heavily soiled party plates or cups (rinse before throwing)

Soiled bathroom tissue (RED BUCKET) or wet kitchen towels (GREEN BUCKET, if paper)

Containers with unused cleaning agents, cosmetics (HAZARDOUS)

Heavily soiled food containers from restaurants (rinse before throwing)

any kind of thermocol (packaging, party plates, etc.)



# Recyclables (ITC)



# Plastic/Metal/Glass/Paper



# Water Usage

- ✓ Put 20ml water in milk packet and add to milk
- ✓ Cut open and leave soiled plastic in the sink – it will get rinsed while dishes are being washed
- ✓ Wipe milk packets with a wet cloth rather than rinsing
- ✓ Use waste water from washing vegetables, to rinse soiled plastic
- ✓ Keep aside a separate large plastic bag to collect lightly rinsed plastic waste through the week. Dump the whole bag on ITC collection day
- ✓ *Other suggestions/ideas?*

# Wet waste (green bucket)

- ✓ Vegetable/fruit peels/residue
- ✓ Tea/coffee powder residue
- ✓ Tea bags (remove the thread and tag)
- ✓ Leftover/spoilt food
- ✓ Flowers
- ✓ Wet paper
- ✓ Egg shells, non-veg waste

# No Plastic Lining



Smell ?





# Housing Complex at Koramangla, Bangalore 2015

**Composter for 40 households  
within housing complex**



**Beautification of walls after  
assuring Cleanliness**



# Bangalore 2015 contd...

**Biomethanation Plant in the Decentralised Ward level DWCC/ MRF**



**Composting facility for wet waste conversion at DWCC/ MRF**



# Insanitary waste (red bucket)



- ✓ House sweepings, hair
- ✓ Pet droppings, wrapped in newspaper
- ✓ Sanitary pads, diapers, etc \* – wrapped in newspaper and marked with a red X
- ✓ Home healthcare waste including syringes, needles, soiled cotton and bandages
- ✓ Bin lined with newspaper only
- ✓ Collected daily (if needed)

Sanitary waste includes any tissues/cloth soiled with body fluids

# Bangalore 2015 contd...

**Container for Sanitary+Home  
BMW at DWCC**

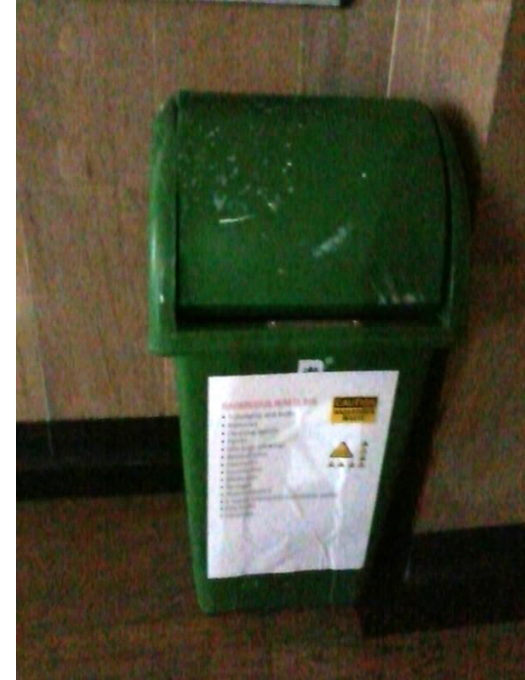


**Decentralised DWCC/ MRF in  
every ward**



# Hazardous + E-waste

- ✓ Tubelights and bulbs
- ✓ Batteries
- ✓ Cleaning agents
- ✓ Paints
- ✓ Oils (non-cooking)
- ✓ Aerosol cans
- ✓ Cosmetics
- ✓ Insecticides
- ✓ Medicines
- ✓ Syringes
- ✓ Thermometers
- ✓ CDs/DVDs
- ✓ Cassettes
- ✓ E-waste (computer and mobile parts)



- ✓ Common bin placed in each block lobby
- ✓ Collection/Disposal - TBD

# **RECOMMENDATION III**

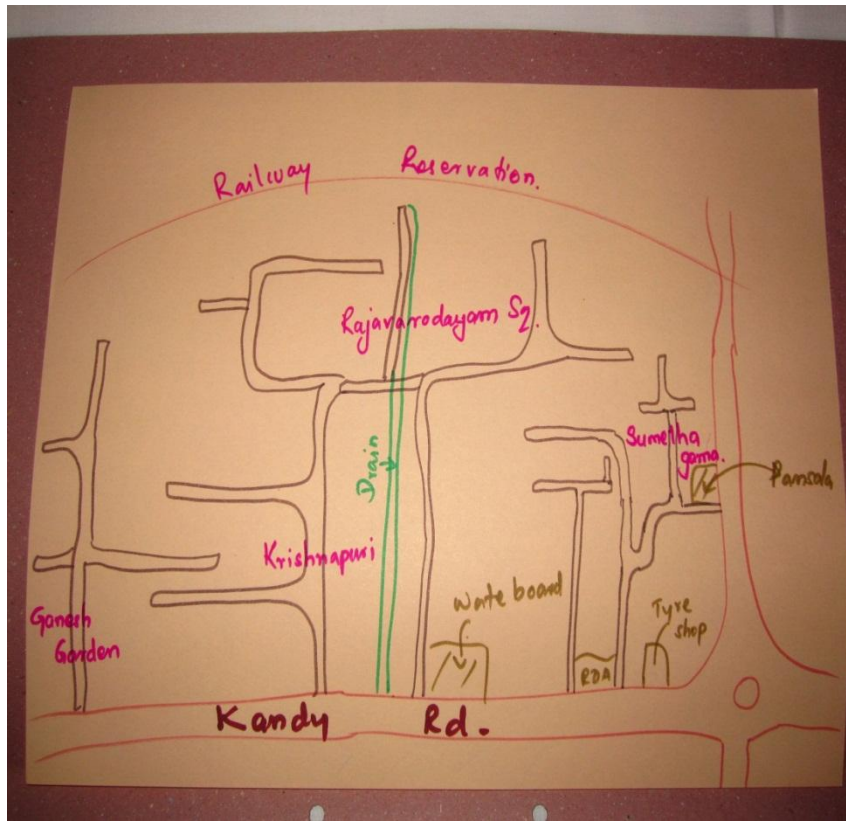
Make provision for separate collection of dry, wet, sanitary and Hazardous waste at source

# For an expanding town

## Composting for source separated household wet waste in new localities

- About 500 households and a population of 2500, the recommended method is to set up a door to door collection and a decentralized composting managed by the Residents Committee
- Therefore it is recommended that in the civic amenities site, close to the area, a decentralized secondary separation cum composting facility be set up.
- The residents committee be asked to monitor & take care of this facility.

# Example of a locality planning exercise

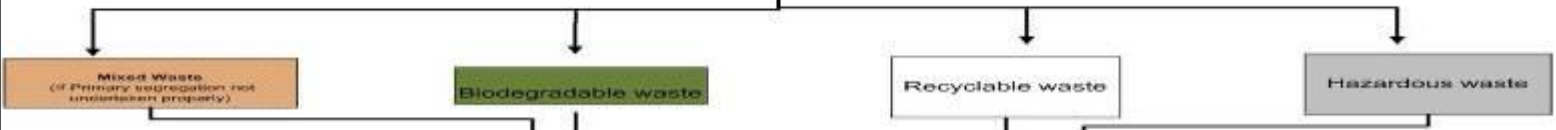






Generation Point (Households, Resorts, Commercial establishments and vendors)

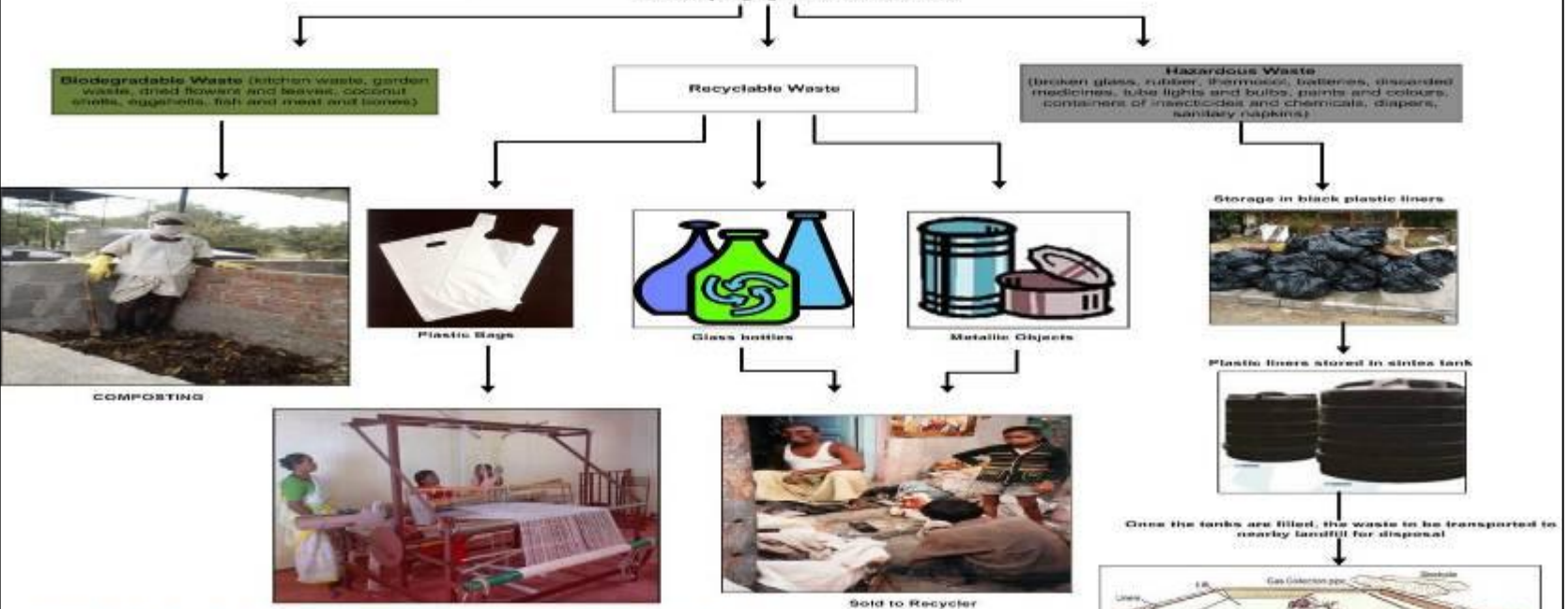
Primary Segregation of waste at point of generation



Waste Collection  
Transportation of collected waste



Segregation cum Composting Site  
Secondary Segregation of collected waste





Training of the identified personnel for the door to door collection of household waste

- Door to door Motivation of the Households using Educational materials



# SWM IN THE PROJECT AREA



- ▣ Meetings with the Residents Association and formation of Waste Management Committee (WMC)
- ▣ Identifying Ragpickers and Unemployed persons for the programme.

# Equipment and Management



# Door to door collection of segregated waste



## Waste Management Committees (WMC)

- ▣ WMCs are formed by the residents in all the zones and can help in sharing the responsibility of running the SWM programmes in the various divisions and the town.
- ▣ WMCs can successfully handle all the financial and maintenance cost of the SWM programme as well.
- ▣ Some of the WMCs can be instrumental in building their own office premises and maintaining a healthy bank account to help the implementing agencies.

# WASTE MANAGEMENT COMMITTEE AT WORK

- **DISTRIBUTION OF SALARIES TO THE WASTE RETRIEVERS BY THE WMC**



# Suggested structure for Field office-cum-shed





# Solid Waste Management Demonstration site

- ULB area is earmarked as a SWM Demonstration site



# Well managed Compost Pits Clean is Green!



# Wasted waste



The collected wet waste is put into the pits for composting



Compost harvested at the end of the cycle and sieved to get fine and coarse compost. Both Aerobic and Vermi composting methods are followed

# Open Space Management (OSM)

- ☐ Development of parks, medians, road sides and other open spaces in the project area.
- ☐ Development of plantations along median and lands beneath high tension line as green gardens-Boulevards.
- ☐ Propagation of alternative methodology for water harvesting and other water conservation measures.

# Components under OSM

- Development of Parks and Mini forests, Development of Medians
- Development of Boulevard
- Water Harvesting
- Rejuvenation of Mini - forests



# Delhi can do it too!

SUNDAY TIMES OF INDIA, NEW DELHI  
SEPTEMBER 6, 2015

TIMES CITY

## Nothing goes waste here, Vasant Vihar takes care

Suraksha.P  
@timesgroup.com

In what could be seen as a unique community initiative, residents of Vasant Vihar have taken it upon themselves to manage the waste generated by the colony. Instead of banking on the civic body to clear the garbage, the RWA has created a composting facility in its three-acre Shaheed Rajguru Park to turn the wet waste into manure.

South Corporation standing committee chairman and area councillor Radhey Shyam Sharma recently inaugurated the "Community Composting Station". He was so impressed by it that he has decided to replicate the model in 6,400 parks under the corporation's jurisdiction.

A South Corporation spokesperson said, "We do have composting pits at various locations but now we are going to take this up on a pilot basis—around 10 parks in each zone." The park in Vasant Vihar is a zero-waste park that even composts dry leaves and twigs into leaf mould. The manure produced from the composting station is used for nurturing the plants in the park.

There are three rainwater harvesting units in the park and a fourth one is going to be set up soon. Plants like wood apple, aloe vera, shyam tulsi, giloy amrita,

papaya and lemon grass are available in a small nursery within the park. RWA members are allowed to take five saplings free of cost. Most of these have medicinal value with antibacterial qualities.

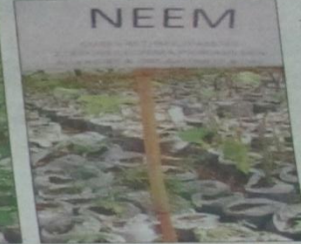
Promila Vohra (85), who has been residing in Vasant Vihar since 1989, recalls how the space was being used as a dump yard till a few years ago. She claims to have pursued the cause and made the residents take stock of the mess they were living in. "People would defecate in the open. The place used to stink. It took so many years to get the residents together," Vohra said.

Rajinder Maggu, vice-president of the RWA, said Vohra would sit in the park and catch hold of people. "She got us to contribute for the welfare of this park," he said.

The park has five sheds demarcated for composting and each shed has five rows of wet waste. "At a given point, we can process around a tonne of segregated wet waste. We cover it with grass and leaves after segregation, turn it around for aeration every 15 days and the manure is ready in 45 days," Maggu explained. The leaf mould takes six



**GREEN CAUSE:** Promila Vohra (above) convinced her neighbours to create a composting facility in the colony park; (right) saplings available in the nursery



months and produces very fine manure, he added.

There are around 300 members in the RWA who contribute Rs 200 per month. Six workers are involved in the collection and segregation of garbage from each household. "The landfill sites in Delhi are overburdened and have beyond capacity. If every RWA comes up with such facilities, we can reduce the burden on landfill sites greatly," said Sharma.





A Mini Ratna  
Schedule 'A' PSE

# SOLID WASTE MANAGEMENT PLANT, NEW MOTI BAGH (WASTE PROCESSING UNIT)





# SOLID WASTE MANAGEMENT PLANT (COMPOST MACHINE OWC FOR HOUSEHOLD WASTE)





A Mini Ratna  
Schedule 'A' PSE

# SOLID WASTE MANAGEMENT PLANT (FOR HORTICULTURAL WASTE)





A Mini Ratna  
Schedule 'A' PSE

# SOLID WASTE MANAGEMENT PLANT (STORAGE/PROCESSING RACK FOR PELLETS & COMPOST)





# **NATIONAL BUILDINGS CONSTRUCTION CORPORATION LTD.**

(A Government of India enterprises)

Inauguration of

## **Plastic Waste to Fuel Plant**

at

### **GPRA Complex, New Moti Bagh, New Delhi**

by

### **Dr. Sudhir Krishna, IAS**

Secretary, Ministry of Urban Development, Govt. of India

on

**17th May, 2014 (Saturday) at 11.00AM**

(Plant by ICPE & Managed by M/s. Green Planet Waste Management Pvt. Ltd.)

STEPS  
POLYCRACK



PLASTIC WASTE  
TO  
FUEL PLANT





# Door to door collection of source separated waste

கழிவுகளைப் பிரித்தெடுப்பதன் மூலம் நமது இயற்கை ஓதாரங்களையும், சுற்றுச்சூழலையும் பாதுகாக்கலாம்.

குப்பைகளை எறியும் முன் அவற்றைப் பிரித்திடுவோம், நமது நலன் காத்திடுவோம், நாட்டின் நலனைப் பேணிடுவோம்.

உலர்ந்த வகை



பிளாஸ்டிக், காகிதம், கண்ணாடி, உலோகம், கோண்பைகள், ரப்பர் ;

மறு சுழற்சிக்கானவை



மிதமான உணவுப் பொருட்கள், சமையலறை கழிவுகள், அழுகிப் பொருட்கள், மானிசம், தெரு மற்றும் வீட்டுப்பழுதி, கறைபடிந்த காகிதம் ;

உரமாக்க தகுந்தவை

நமது திருப்பூர் நகரையும் சிங்கப்பூர் போல் தாய்மையாக்க முடியும், நீங்கள் உதவினால் :-

- ☛ தயவு செய்து குப்பைகளைப் பிரித்து இடவும்.
- ☛ குப்பைகளை சாக்கடைகளிலும், தெருக்களிலும் போடுவதை தவிர்க்கவும்.
- ☛ நிலம் மற்றும் கட்டிடக் குப்பைகளை, நிலத்தை சமப்படுத்த உபயோகிக்கவும்.

திருப்பூர் நகராட்சி மற்றும் சுற்றுப்புறச் சூழல் கல்வி மையம், திருப்பூர் களப்பணி அலுவலகம், வாலிபாணையம், திருப்பூர்.

Supported By NIUA, New Delhi



# Bioconversion Process

## Aerobic Composting



The segregated wet wastes from zones 1, 2 & 3 is brought to the composting site. It is composted in the heap method through a process called Aerobic Composting.

- The heap of waste is turned for aeration once in four days. This helps to regulate the moisture and temperature and hastens the process of organic composting.



# Collection of source separated waste and composting of household waste



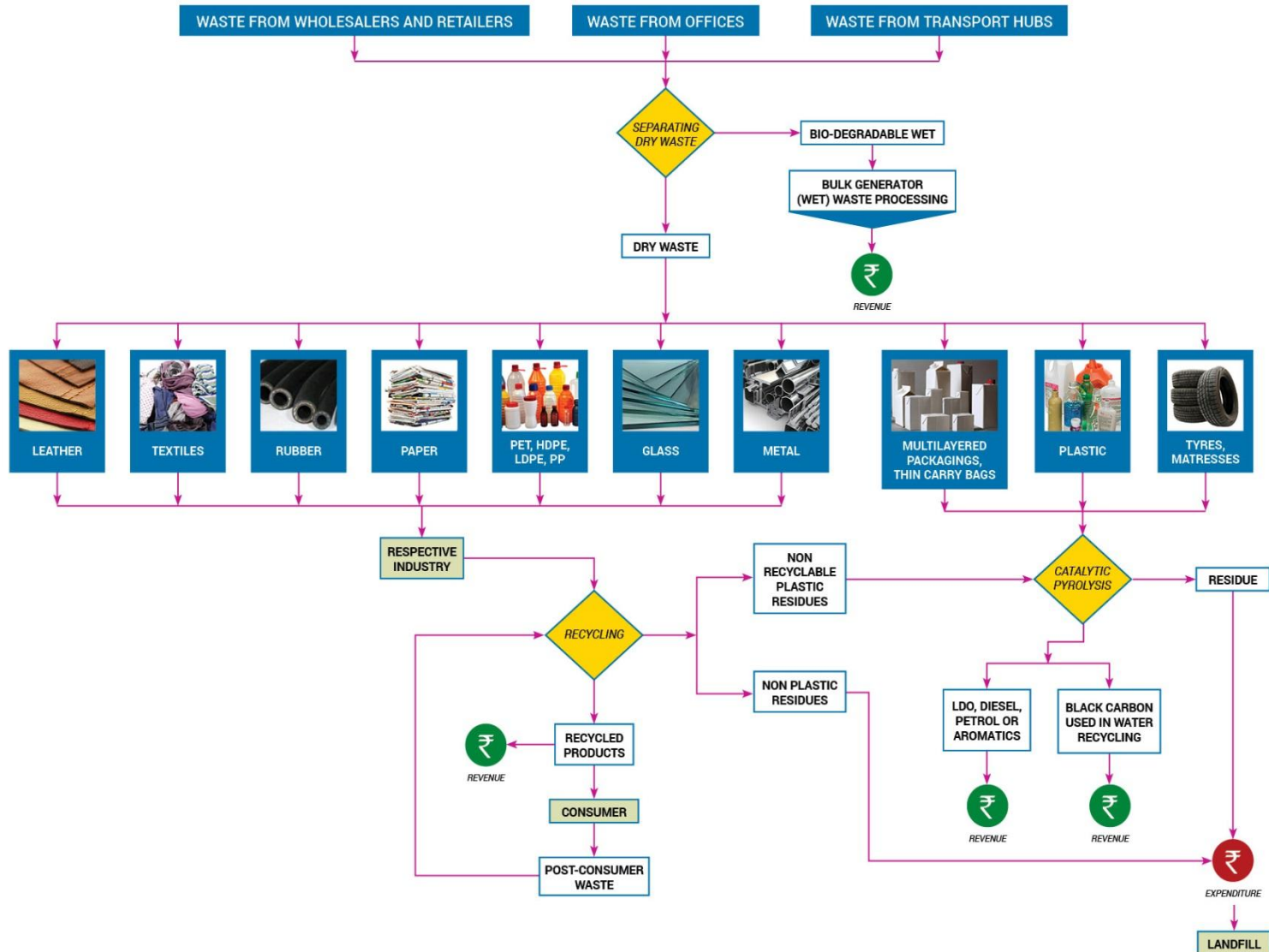
# Rich harvest!



# Peri-urban farming



# BULK GENERATOR (DRY) – SEGREGATE AT SOURCE



# Bangalore 2015

**Waste segregation at source and separate storage**

**BBMP Dry Waste collection Centre (DWCC) /  
Materials Recovery Facility (MRF)**



# Raheja Dry Waste (May '12)

<b>Blocks</b>	<b>Paper</b>	<b>Plastic</b>	<b>Plastic Bottles</b>	<b>Glass Bottles</b>	<b>Cartons</b>	<b>Books/ Craft</b>	<b>Newsp aper</b>	<b>Milk Packets</b>	<b>Metal</b>	<b>Total in Kgs</b>	<b>Total Amount</b>
<b>A</b>	38	42	0	0	0	0	0	0	0	80	202
<b>B</b>											
<b>C</b>	59	56	15	0	42	9	0	0	0	181	634
<b>D</b>	25	0	4	0	21	0	0	0	0	50	280
<b>E</b>	0	18	6	0	73.5	43	12	2	9	163.5	986
<b>F</b>	0	29.5	3	13	31	0	0	9	0	85.5	310
<b>G</b>	5	10	9	5	4					33	100
<b>H</b>	46							7			194
<b>Total</b>	<b>173</b>	<b>155.5</b>	<b>37</b>	<b>18</b>	<b>171.5</b>	<b>52</b>	<b>12</b>	<b>18</b>	<b>9</b>	<b>593</b>	<b>2706</b>

# Bangalore 2015 contd...

Transportation of Dry and Sanitary waste from Bulk generators



Dry waste donation collection from Individual Bunglows



# Bangalore 2015 contd...

**Dry waste sorting at DWCC/ MRF**

**Separated and Stored for sale at DWCC/ MRF**





# Bangalore 2015 contd...

Dry waste sorting shed with storage



Recyclables Rate List displayed at DWCC

Sl	Grade	Rate / KG
1	Dry Mixed Waste (Paper, Plastic, LVP, Tissue Paper) - MW ಶ್ರೀ ಮೂಲಕ ಶುಭ್ರತೆಗೆ ಹರಿಸಿ, ಶುಭ್ರತೆಗೆ LVP, ಶುಭ್ರತೆಗೆ	01
2	Sorted Dry Mixed Waste (Paper & Board) - SB ಒಂದೇ ರೀತಿಯ ಲೆಕ್ಕ, ಶುಭ್ರತೆಗೆ, ಶುಭ್ರತೆಗೆ	02
3	Pet Bottles ಶುಭ್ರತೆಗೆ	10
4	Milk Pouches ಶುಭ್ರತೆಗೆ	11
5	Hard Plastic ಶುಭ್ರತೆಗೆ	03
6	Tetra Pack ಶುಭ್ರತೆಗೆ	05
7	Kraft / Carton boxes ಶುಭ್ರತೆಗೆ, ಶುಭ್ರತೆಗೆ, ಶುಭ್ರತೆಗೆ	09
8	Old News Papers (ONP) ಶುಭ್ರತೆಗೆ, ಶುಭ್ರತೆಗೆ	07
9	Old Magazines ಶುಭ್ರತೆಗೆ	07
10	Old Note Books / Text Books ಶುಭ್ರತೆಗೆ, ಶುಭ್ರತೆಗೆ, ಶುಭ್ರತೆಗೆ	07
11	Waste Record (WR) ಶುಭ್ರತೆಗೆ	15
12	Metal Iron ಶುಭ್ರತೆಗೆ	60
13	Metal (Aluminum) ಶುಭ್ರತೆಗೆ	15
14	TIN (Metal - Magnet Check) ಶುಭ್ರತೆಗೆ, ಶುಭ್ರತೆಗೆ	60
15	TIN (Aluminum) ಶುಭ್ರತೆಗೆ	01
16	Beer bottles ಶುಭ್ರತೆಗೆ	03



SUNDAY TIMES OF INDIA, PUNE  
MARCH 13, 2011

## Now, waste-pickers get portable work space

Mandar Deshpande

**TIMES NEWS NETWORK**

**Pune:** In a bid to make Pune a healthy city, and to reduce visual discomfort caused to citizens due to waste-pickers sorting waste on roadsides, the Swachh cooperative has introduced portable recycling centres and sheds in some parts of the city. These areas will be used by waste-pickers to sort dry-waste.

While only four such centres have been started so far, the aim is to have one each in every neighbourhood.

Laxmi Narayan of Swachh said the four centres have been started by raising donations and the Swachh is now planning to reach out to the corporate sector for help.

"Ideally, the state should invest in setting up sorting centres, so that the waste-

any designated space to carry out their work," Narayan said.

Narayan explained that these sheds will also be a way to recycle scrap material. "Flex-boards that we see across the city are the biggest concerns these days as they cannot be recycled and are seen lying around. We plan to use these boards as screens for the sheds. Eventually, these areas will be used for recycling garbage, or sale of scrap material," she said.

The Swachh cooperative, established by Ragad Kach Patra Kashinkari Panchayat, is an autonomous enterprise of waste-pickers that is authorised to provide door-to-door waste collection and waste management services by the Pune Municipal Corporation.

pickers have a proper space to do their job. The aim is to shield the waste-pickers, as people often complain about women sorting waste on roadsides or outside housing societies. This is because, waste-pickers do not have

A sorting centre at Bhosalenagar

- There are 25 sorting shed Including 6 Portable & Other
- Sonia Gram Udyog Prkalp
- 1) Aundh 2) Katraj
- 200 – 250 Waste Picker Directly Attached Processor
- 4 TPD of waste is Processed

# Separating dry waste and motivating through gifts!



# Recommendation IV

Sustained education and capacity  
building through community awareness  
and motivation programmes

# Involving young minds and hearts



Streets  
need to be  
cleaned



# AN EFFORT TO INCREASE PARTICIPATION

- ▣ **STREET PLAY ON SOLID WASTE MANAGEMENT BY STUDENTS CONDUCTED DURING WMC ELECTIONS AND AT OTHER LOCATIONS IN THE PROJECT AREA**



**FACULTY OF ENGINEERING AND TECHNOLOGY  
DEPARTMENT OF BIOTECHNOLOGY**

***Dr. O.P. Bhalla Foundation***

**Sub.: Solid waste segregation – Training for House Keeping Staff on 13<sup>th</sup> June 2014**



# Motivation and survey

- Students and youth can be trained and involved in survey and motivation of residents for waste segregation at source





**Clean Up was a success!!!!**

**Now WHAT DO WE DO with  
all the collected waste Plastic  
shopping bags and waste  
paper?**



PROGRAMMES FOR WOMEN  
INCLUDE BEST GARDEN  
COMPETITION, ROOFTOP  
GARDENING ETC

**AN EFFORT TO IMPART  
LITERACY TO THE  
WASTE RETRIEVERS  
WORKING IN OUR  
PROGRAMME  
ACHIEVES SOCIAL  
UPGRADATION AND  
EFFICIENCY**





Start talking to people about hazards of plastics and Garbage menace

Banners can be used all over





Gather School  
Children &  
Volunteers

Start the  
Clean up





Create  
awareness  
through  
street plays

Young  
volunteers  
can motivate





Talking to people about hazards of plastics is important

Rallies defying the rain





Door to Door  
Campaigning  
is required

Nothing to  
substitute  
women  
power





# Conduct Surveys & Workshops





Carry bags  
converted to  
Ecofriendly  
Recycled  
products

No carry  
bags, use  
Paper or  
Cloth bags

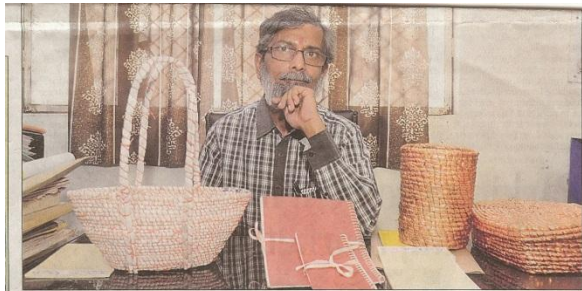


# Recommendation V

Conversion of source separated dry waste into useful products & earning revenue from sales and marketing.

Establish Ecofriendly Recycling Units  
(ERU)

# Zero-waste centre at Lakkadpur, Faridabad



Tapas Chatterjee, CEO, ACT, says they are now educating ragpickers to segregate waste.

## Utility items from waste paper

Pawan Pandita  
#pawpandita@indiafornews.com

While the authorities as well as the citizens are sceptical about the success of the Swachh Bharat Abhiyan without awareness and community participation, here is a non-government organisation, Action in Community & Training (ACT), that has already taken the lead in the direction. It has started recycling waste paper.

For their efforts in the last few years in community led waste management, ACT has been awarded by the United Nations Development Programme (UNDP), Global Environment Facility (GEF) Small Grants Programme (SGP) for the same. Established in 1992, the year of the Rio Earth Summit, the GEF SGP embodies the very essence of sustainable development by thinking globally



A group of women working in the waste paper recycling plant.

acting locally. By providing financial and technical support to projects that conserve and restore the environment while enhancing people's well-being and livelihoods, SGP demonstrates that community action can maintain the fine balance between human needs and environmental imperatives. Says ACT founder member Gurpreet Kaur, "We have been working in Lakkarpur Village, Faridabad, with ragpickers and other working children for the last five years. Together, we had stepped into waste recycling initiative as a source of livelihood for the underprivileged women about two years back. This women's group began with recycling tetrapacks, paper plates, etc into handmade paper last year. This year we took it a step forward into community led waste management and have been awarded aid from UNDP SGP GEF for the same."

a linkage with the Department of Biotechnology, Manav Rachna International University (MRIU).

Head of the Biotechnology Department, MRIU, Dr Sarita Sachdeva said MRIU had been supplying 10 kg of waste paper a day for recycling to ACT. "Eventually, we will supply them waste paper generated in our schools," she said.

Since ACT's project has qualified for UNDP aid, they have contacted Deputy Commissioner, Faridabad. "We have met the regional officer, Haryana State Pollution Control Board, Faridabad," says Kaur.

They are now educating the ragpickers or Safai Mitras as they call them to segregate the throwaway waste such as tetrapacks, chips and biscuit wrappers, gift wrapping papers and polybags, which does not sell in the market. These are then purchased by ACT for their waste recycling centre, which is run by a group of seven underprivileged women from Lakkarpur. "This enhances the livelihood of the ragpickers as well as these poor women. The products developed at the recycling centre are being marketed to institutions," said Tapas Chatterjee, chief executive officer, ACT.

Linkages for waste collection is also being now initiated with the National Institute of Urban Affairs, Centre of Environment Education, Ministry of Environment & Forests and a few other NGO offices in Delhi. In Faridabad ACT has been able to establish

Chatterjee says that as a way forward ACT had plans to tie up with the RWAs of nearby colonies such as Eros Garden and Charmwood Village and generate awareness for segregation of waste at the household level. "The residents will be mobilised to segregate dry and wet waste at the household level. Waste collectors will be trained to collect this waste separately during door-to-door collection," he said.

Added Kaur, "We know inculcating behaviour change is difficult but not impossible. Talks in this regard have already been initiated with the RWAs and some RWA members and participants have already begun to hand over their dry waste to ACT by recycling. We look forward to make Charmwood Village a model with the cooperation of the RWAs, residents, market associations, schools and neighbourhood corporates."



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An  
alternative to  
plastic carry  
bags

Cost effective  
**STURDY**  
News paper  
bags



# STEPS IN PAPER MAKING



1. Pulp Making

2. Making Sheets



## 4. Calendaring & Cutting the sheets



## 3. Drying of Sheets

## 5. Designing



## 6. Turning Paper into different Products



# Recycled Paper Products





# ESTABLISHING Eco-friendly Recycling Units (ERU)

## PLASTIC WEAVING UNIT FOR CONVERTING SHOPPING BAGS TO USEFUL PRODUCTS

1. Green loom (Multi Activity Loom) set comprising a set of five looms of 48” width + warping (spooling) machine + Charkas + all accessories
2. Shed of 300 sq. ft. covered.
3. Raw material – cotton thread, liner cloth and plastic carry bags OR SHOPPING BAGS
4. Human power to do the weaving
5. Cleaning and drying of waste shopping bags





# Collection and Segregation



- Plastic Waste is collected from the municipalities through SWM projects
- Segregated at the primary collection level for water pouches and plastic carry bags
- Segregation and collection are done by 180 women and men green ambassadors employed by EGP at Pammal and at Kalpakkam
- Green ambassadors are from the SC community



## Stage : 2

# Resources supply and logistics



- ◎ Segregated plastic waste is collected from the wards at Pammal and from the township at Kalpakkam



- ◎ Segregated Plastic Waste is transported to the project site at Natham-kariacheri
- ◎ Frequency of transportation – once in 15 days

# Steps in Making recycled Plastic Products



1. Collection of Raw Material and Transportation to CEE-ERU

2. Sorting of Plastics





## Stage : 3

# Cleaning and Washing



- **Cleaning is an important process**
- **Segregated plastic water pouches and carry bags from the SWM projects will have soil and other debris and pollutants on it**
- **Further segregation of clean and useful plastics – ensuring quality**
- **Plastics are cleaned and washed using detergents and water**
- **SHG women belonging to MBC community from the nearby areas are employed**



Stage : 4

# Drying and cutting into strips

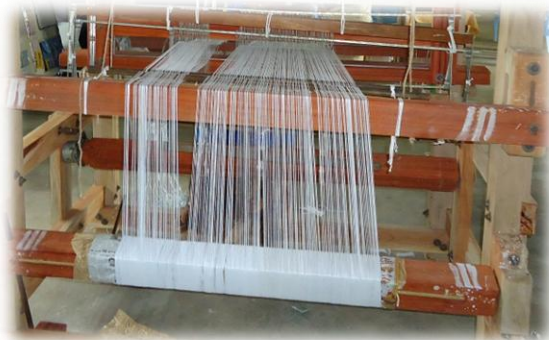
- ◉ Washed and cleaned plastic water pouches and carry bags are dried in the sun
- ◉ Each water packet and carry bags are cut into long strips using hand and scissors
- ◉ SHG women from MBC community from the nearby areas are employed for this process





Stage : 5

# Bobbins and warping threads







## Stage : 6

# Plastic strips on handloom

- ◎ Two handloom structures are available and functional
- ◎ Water pouches and plastic carry bag strips are woven together on handloom
- ◎ Warp is the cotton thread and Weft is the plastic water pouches and carry bags
- ◎ Lakshmi from the nearby areas got trained on the job
- ◎ Plastic woven material for making 20 pieces are woven in a day





## Stage : 7

# Designing and tailoring



- ⦿ A part-time designer designs trendy and useful products
- ⦿ We have designed more than 40 varieties of products
- ⦿ Plastic woven materials are woven and stitched according to designs
- ⦿ Production is based on the demand for a product
- ⦿ Completing 7 to 10 products per day
- ⦿ 2 professional tailors do the stitching





## Stage : 8

# Marketing of Avthar products

- ◉ Marketing through word of mouth
  - ◉ People with Eco inclination
  - ◉ People who want to contribute their part to the cause
- ◉ Visitors to EGP
- ◉ Sales at Exhibitions
  - Ebay – Pay pal Road show – October 2012
  - Rotary Exhibition – Eat Festival – Nov 2012
  - Infosys, Bangalore – Dec 2012
  - Virtusa, Chennai – Dec 2012
  - AECS School, Kalpakkam – Jan 2013
  - Great Lakes Management Institute - Feb 2013
  - L&T Green Day celebration – March 2013





- **SWM calls upon peoples' movement rather than a technical issue at Pammal**
- **Waste generation from communities to women who find alternate sources for their livelihoods**





**WASTE**

**COSTS**

**ENVIRONMENTAL COSTS  
(GLOBAL CLIMATIC CHANGE)**

**SOCIAL COST  
(HEALTH HAZARD)**

**ECONOMIC COSTS  
(High cost paid by municipalities)**



**Education and Awareness  
in the area of  
Waste Management  
Is important**



**From the global perspective of  
Resource Management**





**Simple machinery for making interesting things!**



**Training on polyloom for weaving Plasticot fabric and fabricating products from it**





# Products



# PolyAl products made from metalized plastics & straw





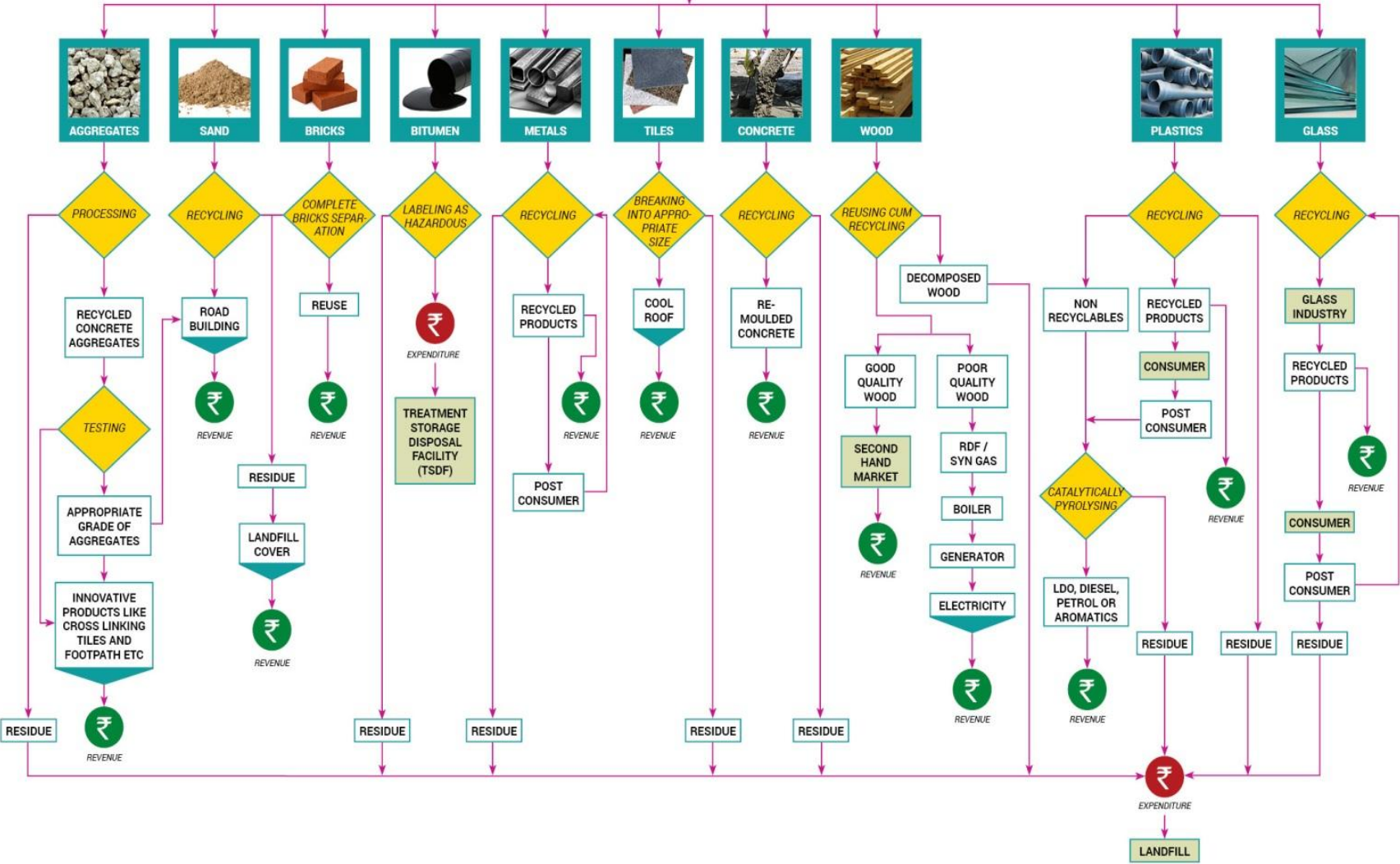
PolyAl products

# Recommendation VI

Consider non-burn options for End of Life Solutions for Non-biodegradables after Reuse and Recycling

# CONSTRUCTION AND DEMOLITION WASTE

LARGE SCALE CONSTRUCTION, RECONSTRUCTION AND MODIFICATION PROJECTS





# Equipment for C&D Waste Recycling



# Shastri Park C&D Plant

**Products from C&D waste recycling**



**Separation of Brick aggregates**





# Roads of plastics vs Plastic Roads



# Waste Tyres to Oil



Waste tires oil refining: [www.huayinenergy.com](http://www.huayinenergy.com)

Waste tires oil refining: [www.huayinenergy.com](http://www.huayinenergy.com)

# Waste Plastics to Oil



# CSIR-IIP technology for waste plastics to Diesel



# Educating about Plastics



## Types of Plastics You're Using (And which ones you shouldn't)



■ Safest Choice   ■ Use with Caution   ■ Avoid

# Sustained Behavioral Change



# Recommendation VII

Integration into Municipal Functions and  
Providing space, facilities and opportunities  
for Decentralized Waste Management and  
Livelihoods within city preferably ward wise

# LIFT MOVEMENT

## PANCITY SEGREGATION AT SOURCE



**LIFT – Litter Free Tirunelveli**



# LIFT MOVEMENT



Swachh Bharat Urban  
Ministry of Urban Development, Government of India



About SBM (Urban) States/Cities Knowledge Repository Households & Citizens IEC Material Swachh Survekshan 2017 Key Resources Tenders Help

• National Urban FSSM Policy released • SBM (Urban) Apps | <http://msbmun.gov.in> • Compost / Fertilizer Monitoring System



Congratulations  
**TIRUNELVELI**



Tirunelveli in Tamil Nadu becomes the first city among those with 4 lakh population in the country to achieve 100% segregation of waste across all its households and establishments





# Award for “LIFT” from Mr. Praveen Prakash , I.A.S., SBM Director, New Delhi (Ministry of Urban Development)



# LIFT MOVEMENT



# LIFT MOVEMENT



# LIFT MOVEMENT

## Plastic waste collection from houses elicits good response

SPECIAL CORRESPONDENT

**TIRUNELVELI:** The proposal of Tirunelveli Corporation to collect nondegradable plastic waste directly from the residents on Wednesdays from December 21 elicited good response on the first day.



Corporation staff collecting plastic waste from houses in Tirunelveli on Wednesday.

waste directly from the residents on Wednesdays from December 21, and publicised the scheme among the residents through the media and other means.

"When the 1,000 and odd personnel, including conservancy workers, commenced the exercise in all four zones of the Corporation on Wednesday, we managed to collect 9,420 kg of

plastic waste - 2,070 kg in Thatchanallur Zone, 2,940 kg in Palayamkottai Zone, 2,220 kg in Melapalayam Zone and 2,190 kg in Tirunelveli Zone. While we thank the residents, we seek their cooperation to continue in the days to come to make the scheme a success," S. Sivasubramanian, Commissioner of Tirunelveli Corporation, said.

Of the 106 tonnes of garbage being generated in the Corporation every day, the 1.50 lakh households in the city are the major source of generating a bulk of waste including plastic waste. Though the Corporation has appealed to the residents to hand over plastic waste separately when the conservancy workers visited their area to collect garbage or dump nondegradable waste in the bin meant for the purpose, it failed to yield the desired result to make the task tough for the urban civic body. Consequently, the Corporation came out with a plan of collecting plastic

# LIFT MOVEMENT

## 90 tonnes of plastic waste collected in Tirunelveli

SPECIAL CORRESPONDENT

**TIRUNELVELI:** The plastic collection exercise, carried out by Tirunelveli Corporation on Wednesdays, which attracted Union Ministry of Urban Development's attention, has ensured collection of over 89.50 tonnes of non-degradable waste from the residents so far.

According to Commissioner S. Sivasubramanian, who conceived the idea of collecting plastic waste from the public on Wednesdays while ensuring removal of other waste every day, said collection of plastic waste by conservancy workers from the residents on a dedicated day (Wednesday) started on December 21, 2016 under 'Litter-Free Tirunelveli' programme, and it evoked a very good response from the public. Besides appealing to traders not to stock, sell and distribute 'use-and-throw' plastic carry bags and cups that clogged drainage chan-

nels repeatedly to cause untold hardship to the urban civic body, the Corporation started exerting pressure on business establishments through repeated surprise checks that led to the seizure of a few tonnes of the banned products.

Moreover, the traders were encouraged to use degradable cloth and paper bags for packing their products.

When the system of plastic waste collection on Wednesdays was introduced towards the end of last year, the sanitary workers collected over nine tonnes of hazardous waste and it increased sharply in the next couple of Wednesdays with the quantum of collection crossing even 13 tonnes.

However, this graph showed downward trend from mid-January, thanks to the awareness campaigns organised by the Corporation against using plastic bags and cups.

### CLEANING UP

Collection of plastic waste from households on Wednesdays was introduced by Tirunelveli Corporation on December 21 as part of the 'Litter-free Tirunelveli' initiative. Following is the volume of plastic waste collected once a week



December 21, 2016  
**9,420 kg**



Dec 28, 2016  
**11,576 kg**



January 4, 2017  
**12,989 kg**



January 11  
**13,110 kg**



January 18  
**11,134 kg**



January 25  
**10,966 kg**



February 1  
**10,692 kg**



February 8  
**9,675 kg**



**Total**  
**89,562 kg**

# Recommendation VIII

Waste water can be treated by decentralized systems and the treated water can be used for agriculture, aquaculture and water recharge in dry zones

# Compact oxidation pond system







A Mini Ratna  
Schedule 'A' PSE

# WASTE WATER TREATMENT PLANT (MBBR)



30.10.2013

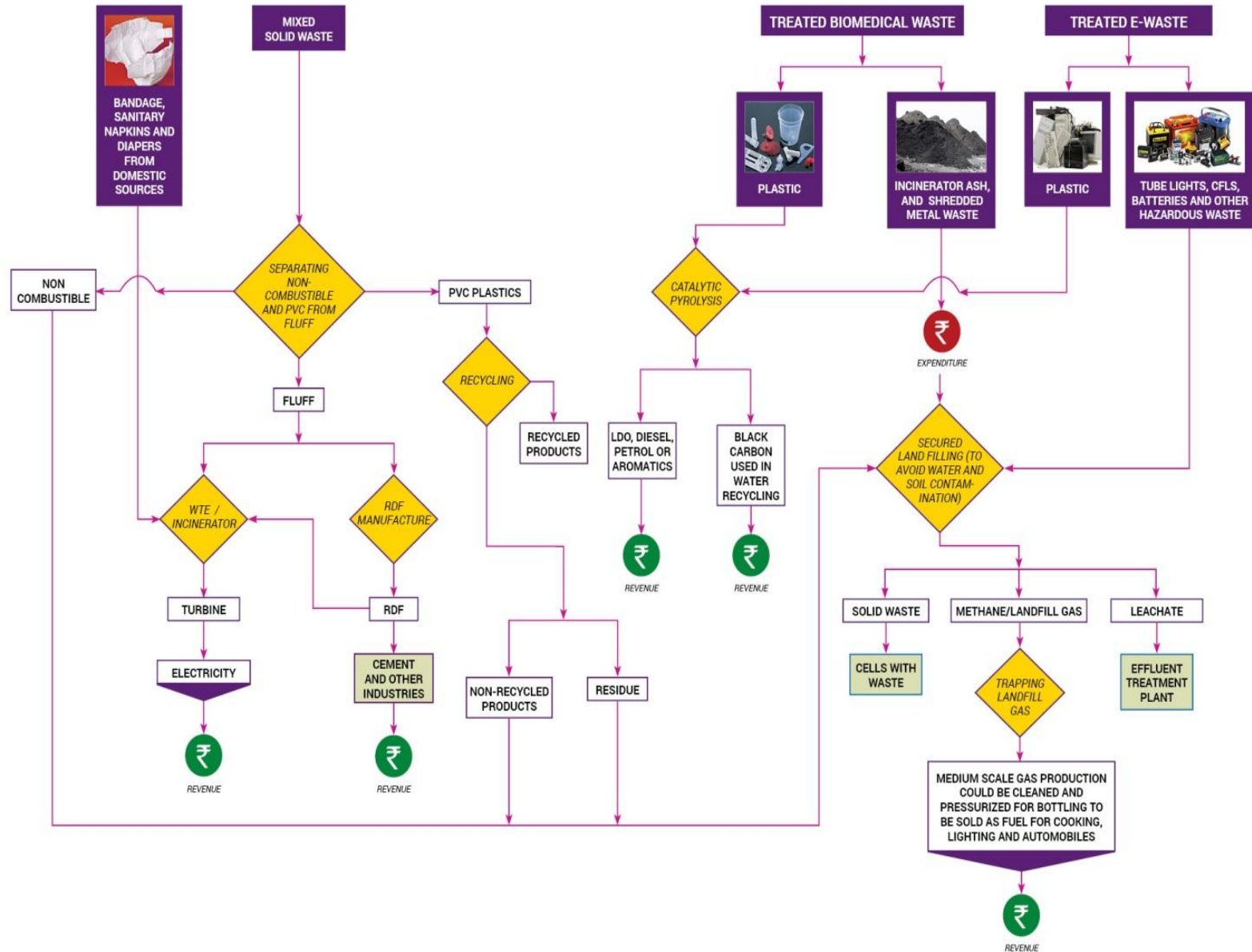
# Thank you



**Sustainable Cities - "Anathema → Utopia"**

**Centre for Environment Education**

# COMMON SOLID WASTE TREATMENT FACILITY



# Common waste treatment facility

**Old dumpsites**



**Capping and gas recovery**



# Landfill gas trapping

**LFG scrubbing and electricity generation**



**Leachate treatment**



# Waste to Energy through RDF

**RDF preparation**



**Air Pollution Control Devices**



# Electricity generation

## Turbines



## Leachate treatment



# Conclusion

- There are plenty of opportunities for ULBs and Corporates in Waste Management from Decentralised to Centralised, from investment to CSR, from collection to treatment and from empathy to engagement.
- Working alongside communities, local bodies and achieving compliance is the best road forward for Swachh Bharat.



Thank you

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# Waste Managers' woes

- 432 million soiled pads (even at 12% usage) of mixed cotton+wood pulp fibre/plastic to be safely disposed of every month
- Contamination of water bodies, blocking sewer lines, adding more non-biodegradable waste to landfills
- Posing an occupational hazard to those who handle solid waste, often with bare hands

## **In rural and urban areas especially Class II, III, IV and census towns we recommend**

- Manufacture and distribution of STs which are totally degradable including all its components
- Identification of land and construction of deep burial pits with proper specs as per BMWM Rules 1998 and its implementation guidelines
- Deep burial of used degradable STs, diapers etc. and proper maintenance of pits/ constructed structures (in states with high water table, the entire structure would have to be over-ground) through addition of lime etc.

# Deep burial in rural areas in India is possible if the Sanitary napkin is completely degradable

