

# Municipal Solid Waste Management

(Public Private Partnership)

- Experience & Solution

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# Environment Protection - International Realization

- The United Nations, on 5th June 1972, organized an international conference on Human Environment at Stockholm, Sweden.
- This was first comprehensive international attempt to articulate sustainable development – Environment protection in view of growing world population and economic growth.
- The conference recognized the need for specific international and national actions to ensure that economic growth takes place with due regard to environmental protection and natural resources conservation.
- The United Nations Environment Program (UNEP) was created in this conference.
- The opening day of the conference, June 5 was declared as the World Environment Day.

# Environmental Legislation in India

- The Water (Prevention and Control of Pollution) Act, 1974
- The Air (Prevention and Control of Pollution) Act, 1981
- **The Environment (Protection) Act, 1986**
  - ▶ Hazardous Wastes (Management & Handling) Rules, 1989
  - ▶ Bio-medical Wastes (Management & Handling) Rules, 1998
  - ▶ Municipal Solid Wastes (Management & Handling) Rules, 2000

## Note

Only Union Parliament is competent to make laws on Environment.

GOI Ministry: Ministry of Environment & Forests

# Environment Protection Act, 1986 (Section 15)

the fear of law....

Whoever fails to comply with or contravenes any of the provisions of this Act, or the rules made or orders or directions issued there under, shall, in respect of each such failure or contravention, be punishable with **imprisonment** for a term which may extend to five years with **fine** which may extend to one lakh rupees, or with both.

And in case the failure or contravention continues, with additional fine, which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.

# India – from ‘Developing’ to ‘Developed’ nation

- India is midst of tremendous infrastructure & industrial growth.
- Greater growth means greater waste generation.
- The growing waste is impacting Environment (Air, Water, Soil) like never before.
- We need proactive approach to create ‘Waste Management Infrastructure’ for scientific management of waste.
- Waste management infrastructure is a ‘must utility’ in Master Plans of all developed cities across the world.
- India has to do lot of catching up to be truly called modern country.

# Solid Wastes

- Industrial Waste (Hazardous Waste)
- Hospital Waste (Bio-medical Waste)
- **Domestic Waste (Municipal Solid Waste)**



# Common Sight in our Cities !



These are our drainage Nalas !





# Garbage Dump Site – Potential Fire Risk



# Mass fire at MSW Dump

Courtesy: Methane

$\text{CH}_4$



# The Methane Gas from Waste Dump – Burning & Smoke





## The River of Leachate

Toxic liquid oozing out of  
waste dump at  
Jawaharnagar, Hyderabad  
(Previous Picture)

# Burning Mountains of Waste and Dirty Leachate



# PPP in MSW Management

- As per law, the responsibility of collecting, processing & safe disposal of the waste is with the generator of waste.
- This legal obligation covers all waste generators— households, hotels, offices etc which produce MSW.
- The Urban Local Body (ULB) charges property tax from its residents for providing civic services.
- The ULB is responsible to collect, process and dispose the MSW in a scientific manner.
- The 'Waste Management' Companies join hands with the ULB to do the job in partnership.
- The Private Company, in partnership with the ULB, establishes 'Processing & Disposal Facility' for scientific management of the municipal waste.
- The Private Company may as well collect & transport the waste from the households to the Processing Site.

# Why PPP in Waste Management ?

- The world's experience demonstrates that government agencies cannot manage waste.
- Waste management is a 24x7, highly specialised and zero tolerance service – which is best provided by private sector 'Operator'.
- The PPP (Public–Private–Partnership) in waste management is the best solution for scientific waste management.
- The government agencies select the competent private Operator through a transparent, competitive bidding process.
- The government provides suitable land to the Operator for the establishment of Processing & Disposal Facility.
- The government signs a long term 'Concession Agreement' with the Operator (called Concessionaire) for providing the service.
- The Private Operator brings in Capital, Technology and Manpower to establish and operate the 'Waste Processing & Disposal' Facility as a commercial entity.

# PPP in Waste Management

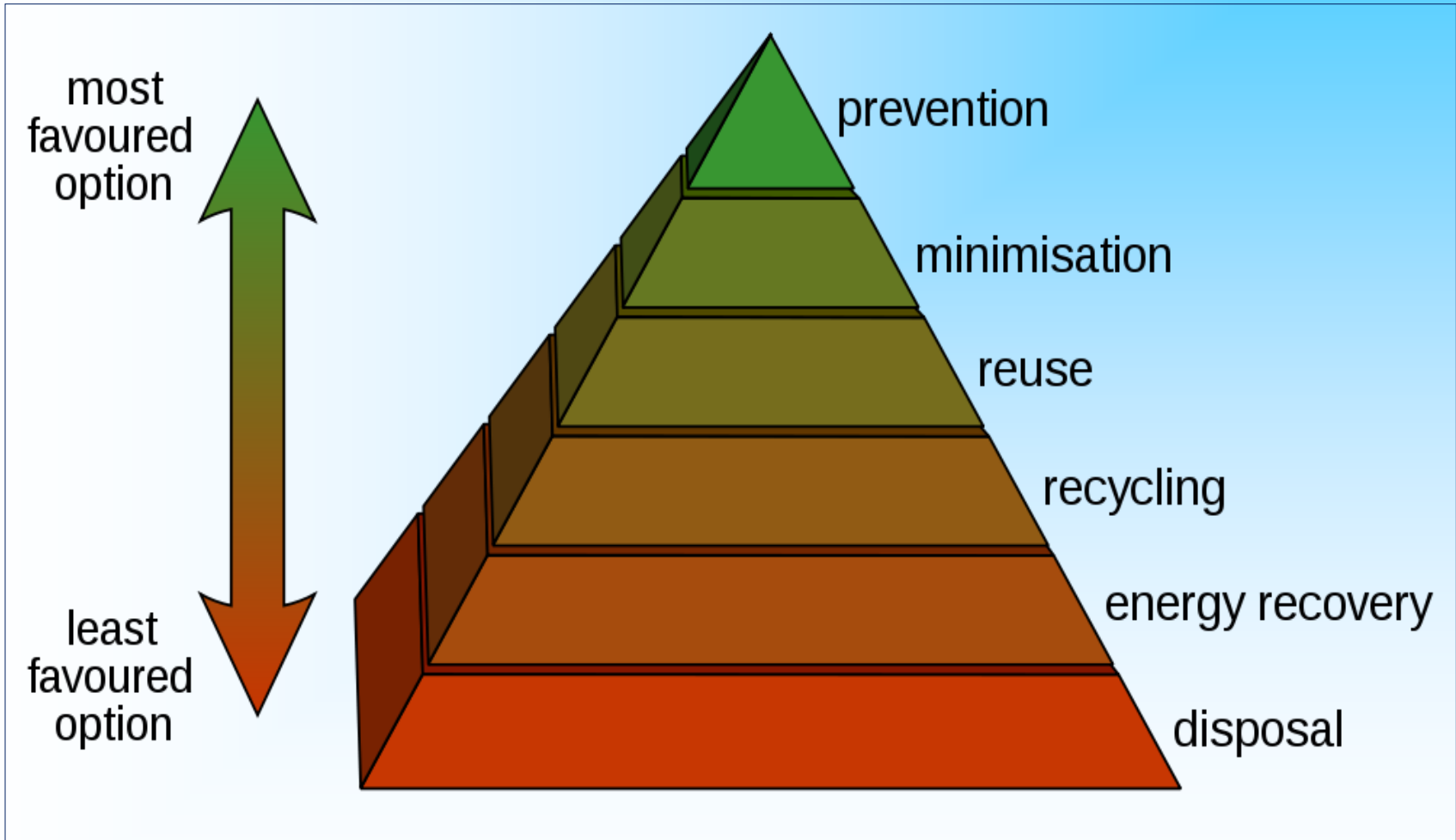
- The Operator manages municipal waste generated in the ULB area.
- The Operator charges 'Tipping Fees' from the ULB for providing the service.
- Tipping Fees – say Rs. 750 per ton of waste to be processed & disposed.
- The Operator recovers his investment & operational expenditure over the period of Concession Agreement (say 20 years).
- The PPP in waste management is a 'win-win-win' proposition for the Waste Generator, the Government and the Operator.
- Of course the greatest winner is the 'Environment'.
- We will have sustainable growth & development only when we manage our waste scientifically and protect environment.



# MSW Management – National Priority

- On an average, every urban Indian generates 400 grams of MSW per day.
- This means urban India generates 1.6 lakh tons of MSW every day.
- This also means 58 million tons per annum.
- So far around 17% of MSW is scientifically managed.
- Governments & Municipalities are obliged to ensure scientific management of MSW as per Rules.
  - ▶ *Municipal Solid Wastes (Management & Handling) Rules, 2000*
- GOI (Ministry of Urban Development) is supporting ULBs under “Swachh Bharat Mission”.
- Major ULBs have entered into PPPs with private Operators for MSW management:
  - ▶ Processing & Disposal
  - ▶ Collection & Transportation

# Waste Management Hierarchy



# Concept of Waste Management

- Waste Management:
  - Reduce
  - Reuse
  - Recycle / Recover
  - Dispose
- All waste material, after exhausting the options of recycling and recovery, needs to be safely disposed.
- The scientific Disposal is done in two ways namely:
  - **Bury** (Engineered Landfill)
  - **Burn** (Incinerator)
- Waste management has to be done without causing any damage to Environment (Air, Water & Soil)

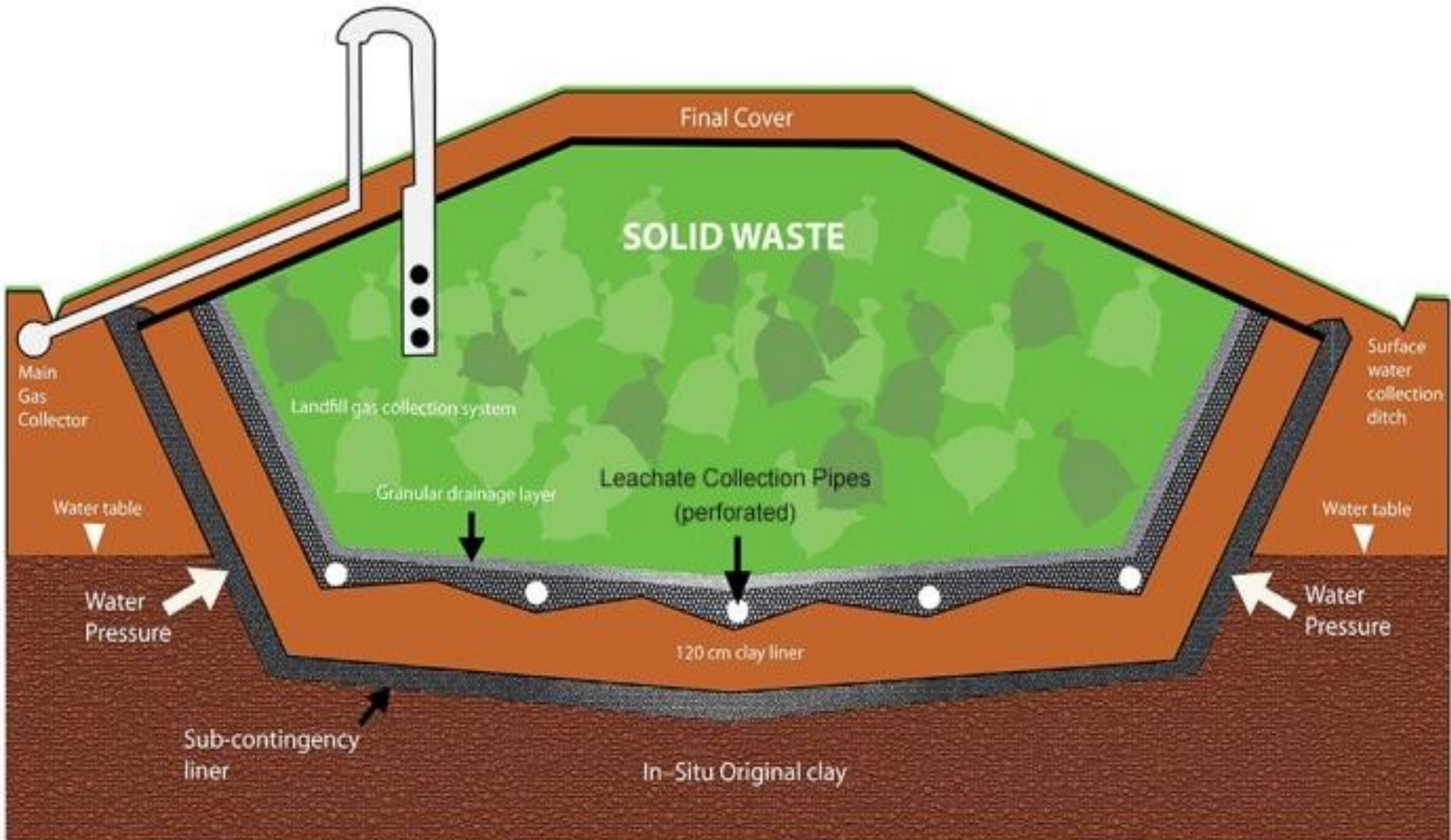
# Bury (Engineered Landfill)

- The waste material is permanently deposited in engineered landfills.
- This is a waste containment system, which separates the waste from surrounding environment – air, water & soil.
- It prevents Leachate (waste liquid) from percolating and contaminating the sub-surface water.
- It controls gaseous emissions.

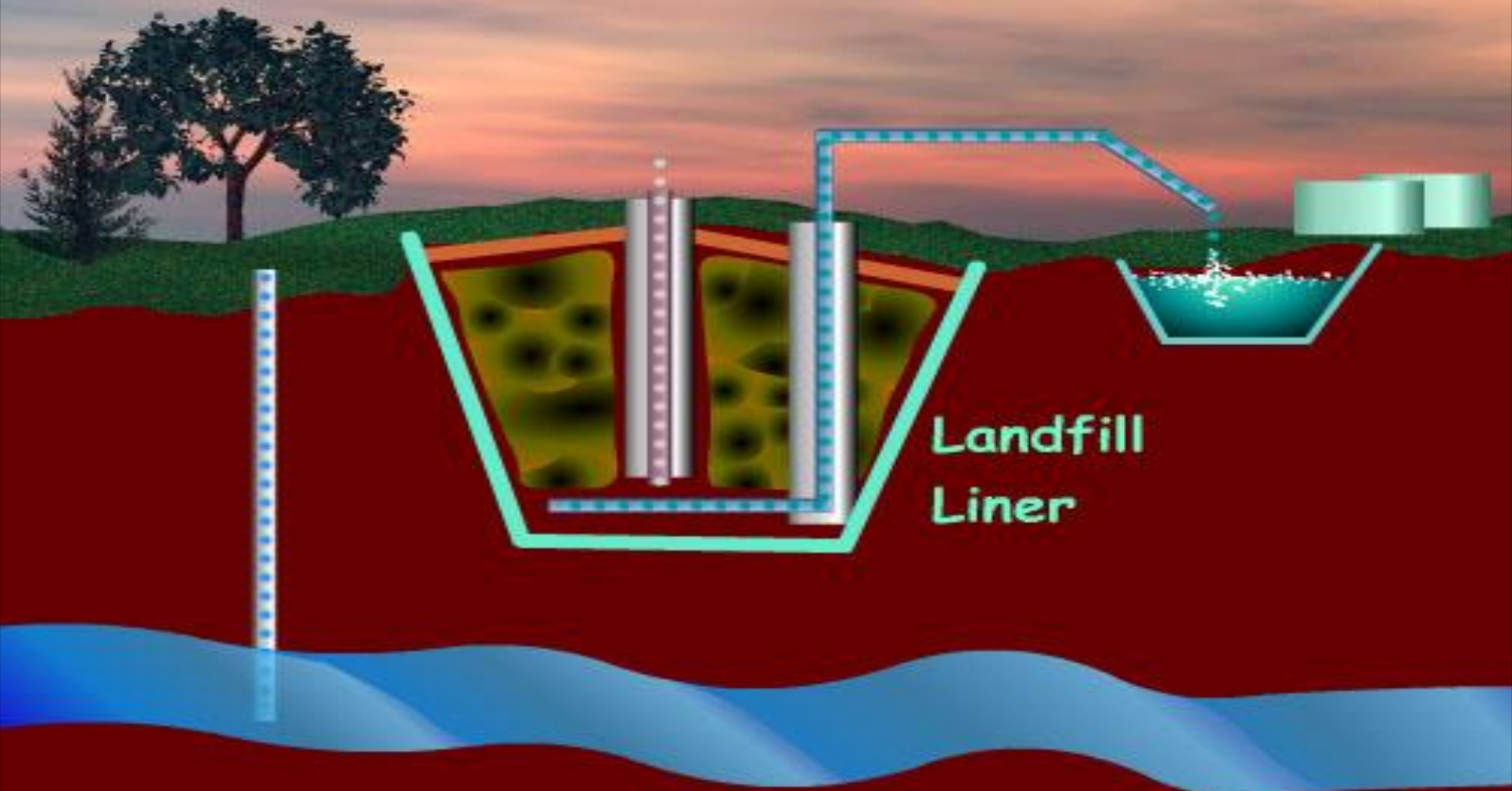
# Scientific Landfill – Concept Diagram



# Scientific Landfill – Concept Diagram



# Modern Landfill



The bottom and sides of the landfill are lined with more clay or a plastic liner. This lining is intended to prevent water that has been exposed to the waste (this liquid is called leachate) from escaping into the environment.

# Making of a Landfill - the final disposal



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# Landfill in making

HDPE Liner over Clay  
(Secondary Liner)



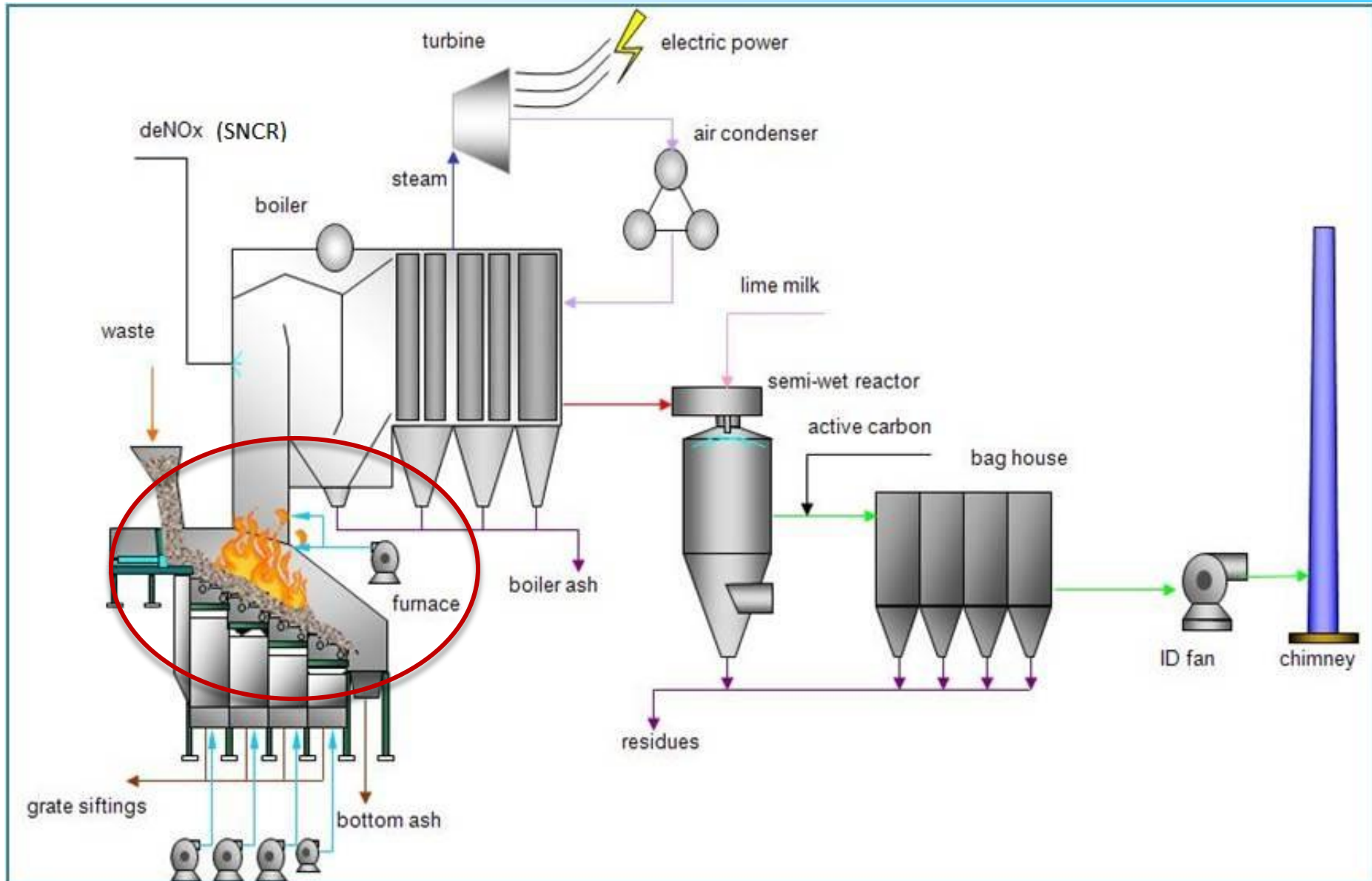
# Closure & Capping of Landfill (Once the capacity is full)



# Burn (Incinerator)

- The waste material is scientifically burnt in an Incinerator.
- Incineration is high temperature, thermal oxidation process.
  - ▶ The toxic Ash is collected safely.
  - ▶ The acidic gases, formed due to combustion, are neutralised (Dry & Wet Scrubber)
  - ▶ The Particulate matter is captured (Cyclone Separator, Bag Filter)
  - ▶ Carcinogenic gases formation, like dioxin, are avoided.

# MSW – Burning to produce Power



# Municipal Solid Waste - Components

- Recyclables (Paper, Plastic, Glass, Metal etc) 20%
  - ▶ Informal, unhygienic system operates through rag pickers & most of Recyclables are recovered before these reach the Processing Site.
- Organic Matter (Green Waste) 50%
  - ▶ Dead organic matter decays with oxygen (Aerobic) and without oxygen (Anaerobic) – if uncontrolled, causes damage to environment.
  - ▶ The decay of organic matter needs to be controlled by human intervention.
  - ▶ The organic matter is processed & stabilized – Converted into Compost, Bio Gas (Bio-methanation).
- Inerts (Silt, Ash, Rejects of Composting) 30%
  - ▶ Deposited in Sanitary Landfill.

**Waste Segregation is Key to Waste Management**

# Integrated Municipal Waste Management (Cradle to Grave approach)

## Collection & Transportation

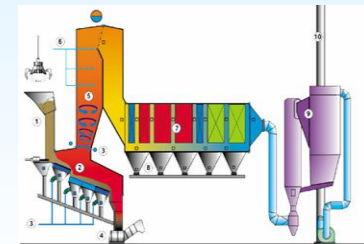
- House to House Collection to Bins
- Bins to Transfer Stations
- Transfer Stations to Processing & Disposal Site

## Processing at Site

- Composting (Aerobic)
- Bio-Methanation (Anaerobic)
- RDF (Refuse Derived Fuel)
- Waste-to-Energy

## Disposal at Site

- Sanitary Land filling



# Waste Segregation is Key to Waste Management



- Every establishment/household should have two Bins – one for Dry waste and the other for the Wet waste.
  1. **Dry Waste** – Recyclables
  2. **Wet Waste** – Kitchen Waste
- The ULB should collect these separately and transport these separately to the Processing Site.
- If implemented, 90% of waste management is done.
- It is easier said than done!
- This needs lots of IEC (Information, Education & Communication) to be done by the ULB, NGOs and Resident Welfare Associations.

# Windrow Composting (Aerobic)



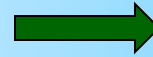


# Compost Processing Plant

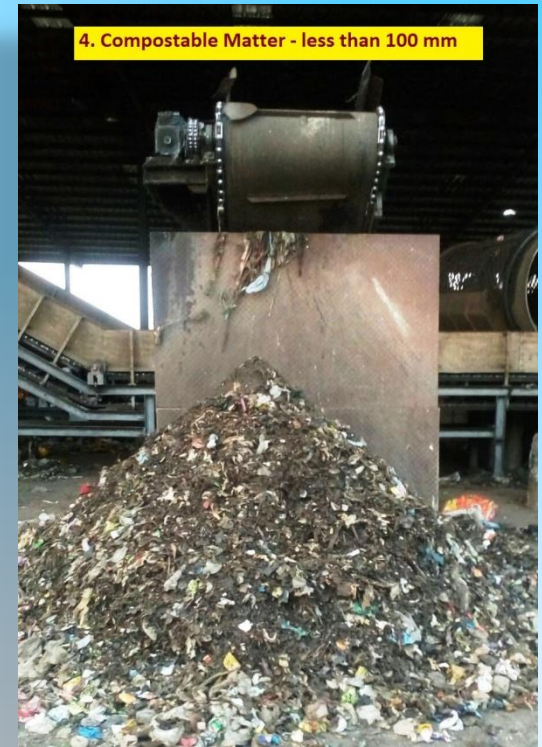


# Composting – Various Stages

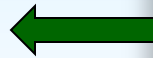
1. Incoming Raw Waste



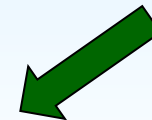
4. Compostable Matter - less than 100 mm



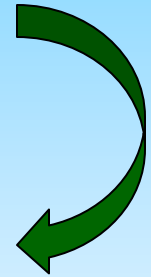
5. Semi Finished Compost - less than 16 mm



6. Final Compost



# Various Stages of RDF (Refuse Derived Fuel)



# MSW Dump Reclamation – ‘Gorai’ Success Story

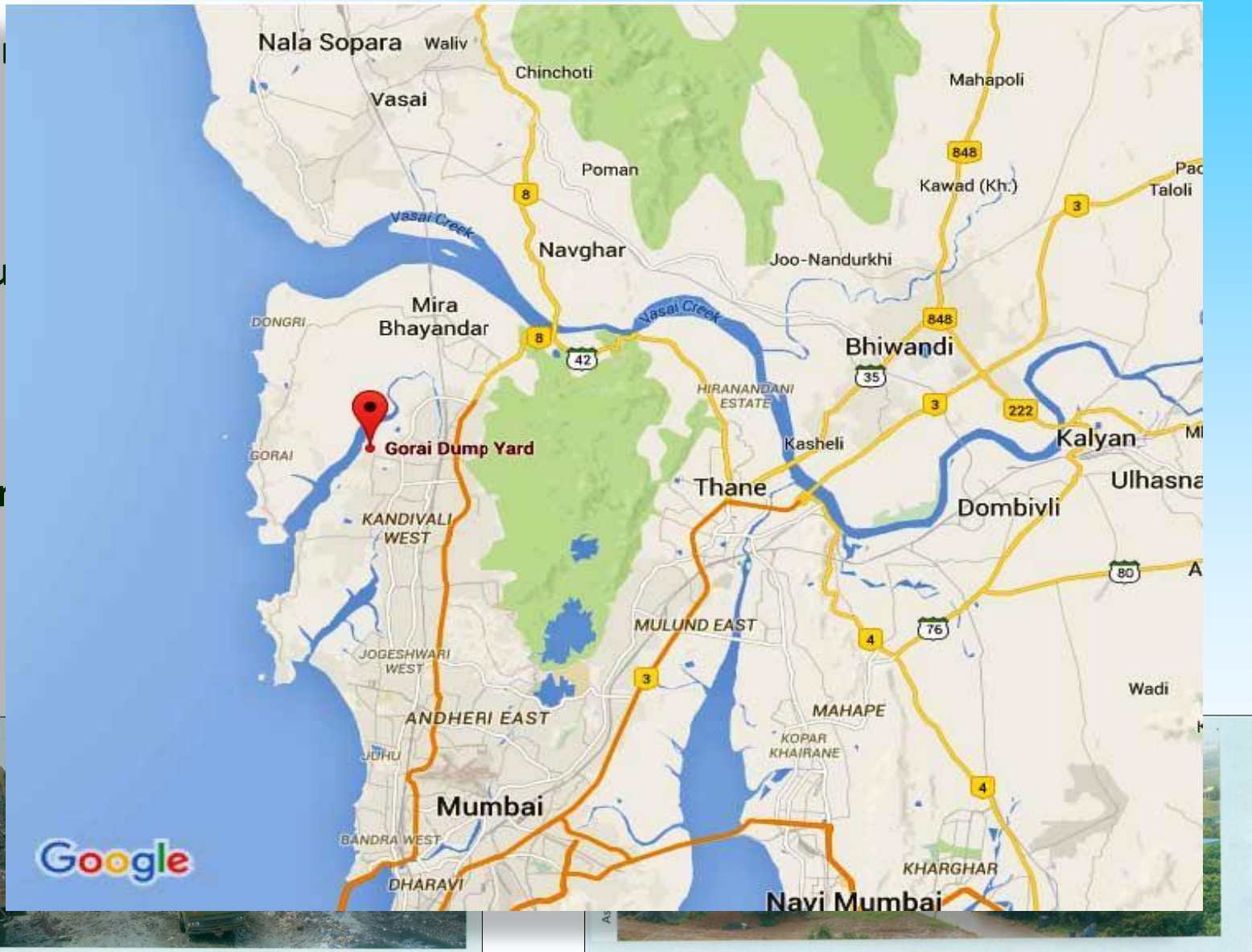
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# MSW - PPP Roadmap

- Let us remember that wholesale privatization in one go is not the answer to effective MSW management.
- The privatization process needs to happen in steps.
- It makes sense to privatize high technology, capital intensive operations first and gradually move towards labour intensive operations where local sentiments and interests are entrenched.
- **The priority towards PPP route is as follows:**

## Existing Dump Remediation

- ▶ Remediation of existing Dump site and freeing of land for MSW Facility.  
(This is the trump card to reclaim land !)

## Processing & Disposal

- ▶ Composting/ RDF
- ▶ Bio-Methanation (If Organic Waste is segregated)
- ▶ Waste to Energy (If waste is more than 500 TPD)
- ▶ Sanitary Landfill – Construction and O&M

## Collection & Transportation

- ▶ Secondary Collection and Transportation
- ▶ Primary Collection & Street Sweeping

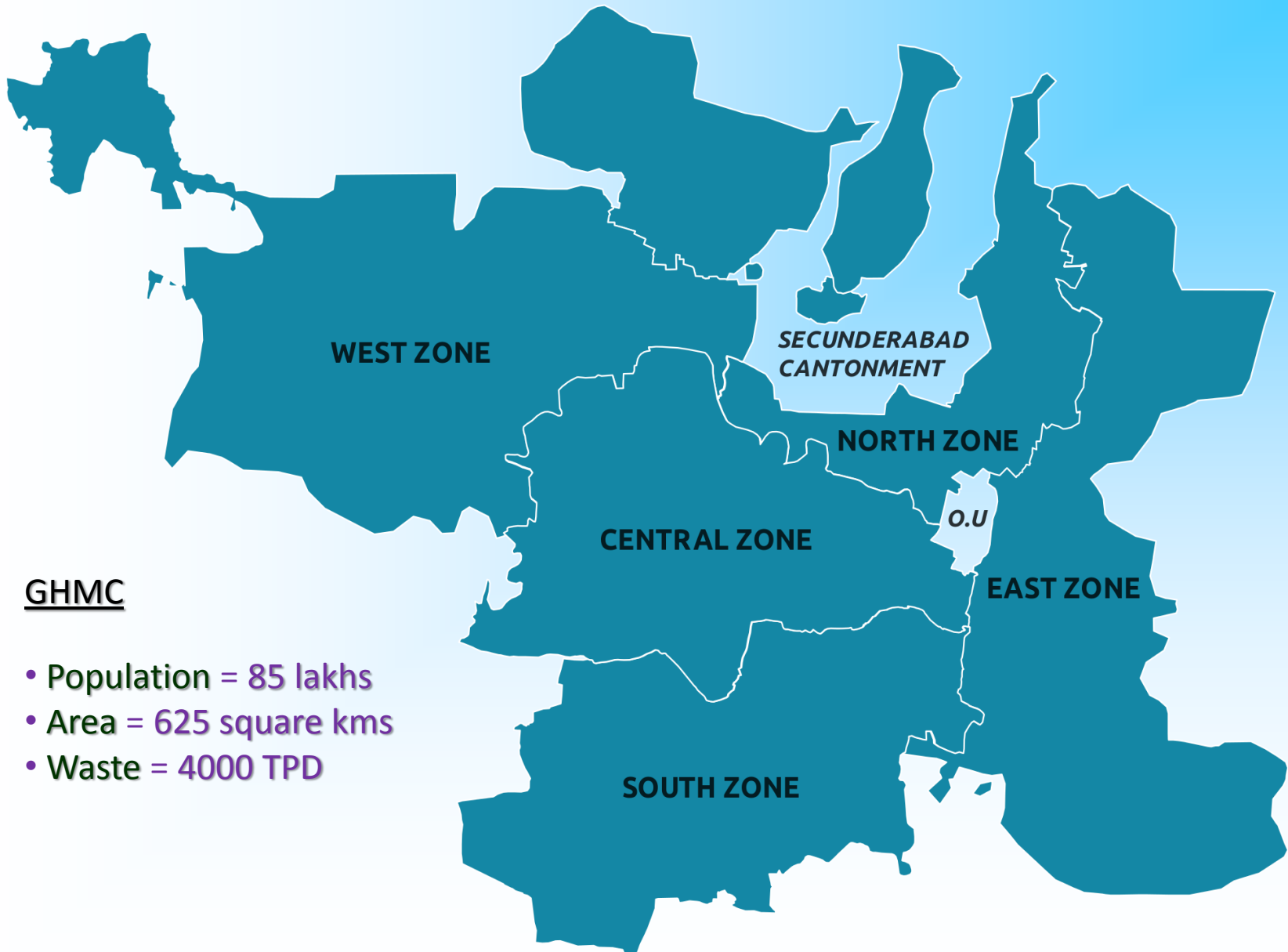


# Tipping Fees - Considerations

- The Tipping Fees is money charged per ton of waste (for any or all of below activities):
  - ▶ **Collection and Transportation** to the Site
  - ▶ **Processing** – Compost / Bio-methanation / Waste to Energy
  - ▶ **Disposal** – Sanitary Landfill
- The Operator, however, takes into consideration the following Revenue Streams for working out the Tipping fees:
  - ▶ Sale of Compost (FCO Compliant), RDF, Recyclables
  - ▶ Sale of Power
  - ▶ Capital Grant (GOI – Swachh Bharat)
  - ▶ User Charges by Households?
- The world experience demonstrates ‘Tipping Fees’ as the sustainable model.

Polluter Pays Principle

# GHMC – Greater Hyderabad Municipal Corporation



## GHMC

- Population = 85 lakhs
- Area = 625 square kms
- Waste = 4000 TPD

# Hyderabad – 4000 TPD MSW Project



- Largest MSW Management Project in India.
- ‘Greater Hyderabad Municipal Corporation’ signed the Concession Agreement with ‘Ramky Enviro Engineers Ltd’ on 21st February, 2009.
- The Concession Period is 25 Years.
- SPV: Hyderabad Integrated MSW Ltd (HiMSW Ltd)
- Date of Commissioning (Processing & Disposal): February, 2012
- Processing & Disposal Site: 300 Acres, Jawaharnagar, Hyderabad.
- Project Brief: Aerobic Windrow Composting, RDF, Plastic Recycling, Sanitary Landfill, Dump Management.
- First Project Director: Ravi Kant, former IAS(1985)



# Hyderabad MSW Project – Before/After (Approach Road to the Site: Jawaharnagar)



# Hyderabad MSW Project – Before/After

## (Entry to the Site Jawaharnagar)



# Hyderabad MSW Project – Before/After (Entry of Garbage Trucks)



# Hyderabad MSW Project – Before/After (Existing Waste Dump)



# Hyderabad MSW Project – Earlier/Now

(Earlier Waste Dumping – Now Waste Processing)



# Jawaharnagar Site today – The Big Picture



# MSW Trucks approaching Weigh Bridge



# Incoming Waste – Primary Screening





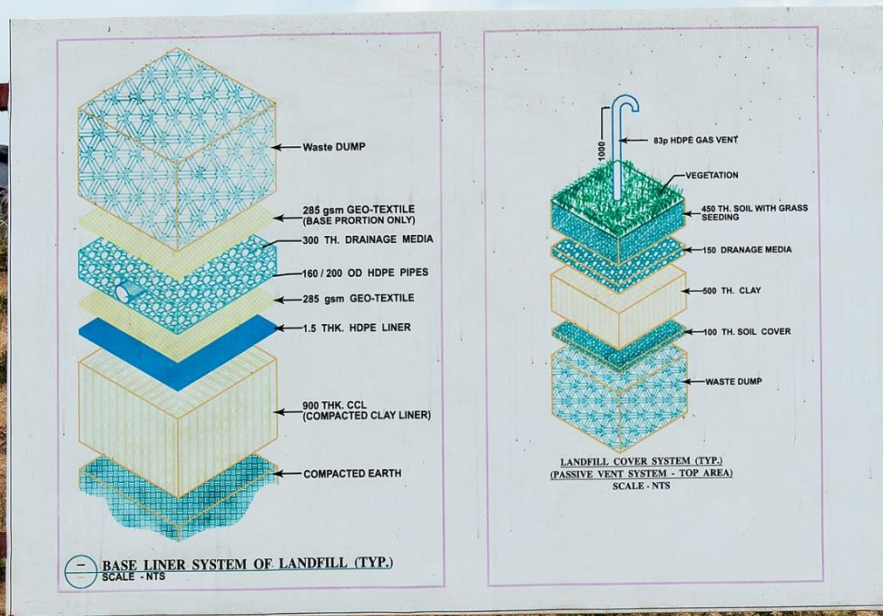
# MSW Composting - Windrows



# MSW Composting Processing Sheds



# Sanitary Landfilling



## LANDFILL

### SAFETY INSTRUCTIONS

 <b>UNAUTHORIZED ENTRY RESTRICTED</b>	 <b>SAFETY HELMETS, FOOTWEAR AND HIGH VISIBILITY CLOTHING MUST BE WORN AT ALL TIMES</b>
 <b>THE CONSUMPTION OF FOOD OR DRINK IS FORBIDDEN IN THIS ARE</b>	 <b>WEAR EYE, EAR, HAND AND RESPIRATORY PROTECTION WHERE EVER APPROPRIATE</b>
 <b>UNSUPERVISED REVERSING IS STRICTLY FORBIDDEN</b>	 <b>DANGER. STOP, LOOK, LISTEN. BEWARE OF HEAVY EQUIPMENT AND VEHICLES</b>
 <b>NO SMOKING OR NAKED FLAMES</b>	 <b>YOU MUST BE SAFETY INDUCTED START WORK ON THIS SITE</b>

# Site Landscaping



# Plastic Extruder – Making Plastic Granules



# The Plastic Granules



# Hyderabad MSW Project – Revenue Streams

- **Tipping Fees for Processing & Disposal** = Rs. 700 per ton of incoming



5. Plastic Granules (after Extrusion process) = Rs. 25000 per ton

# Composting – Material Balance

- 100 Tons Raw Wet MSW Composition

- ▶ Organics= 50 Tons
- ▶ Recyclables= 20 Tons
- ▶ Inerts= 30Tons

- Post Aerobic Composting

- ▶ Compost = 08 Tons
- ▶ RDF (Including Plastic\*) = 20 Tons
- ▶ Landfill Material = 40 Tons
- ▶ Loss (Moisture, Gas, Leachate) = 32 Tons

\* **Plastic is 4 Tons**



# India MSW Incineration

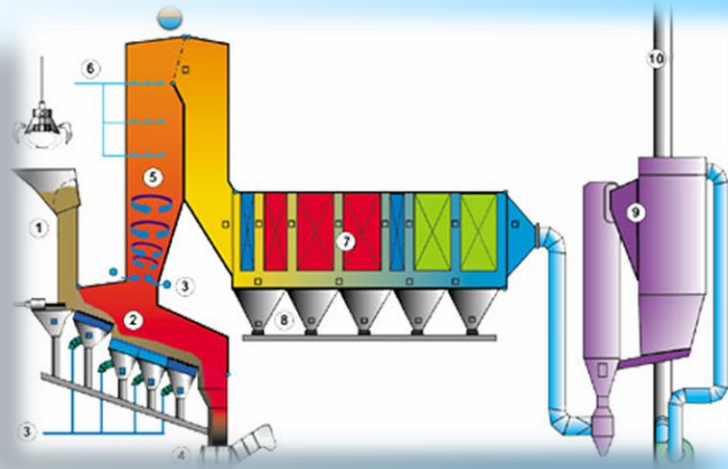
- Due to a lack of source segregation, the yield of composting plants is only 8% making them economically unfeasible. Rejects from these plants are more than 50% of the input waste, which require a huge landfill capacity.
- In India the MSW is not segregated- making 'Biomethanation' impossible and 'Composting' difficult with low yield.
- Incineration is an efficient way to reduce the burgeoning waste volumes (58 million tons per annum) and demand for scarce landfill space.
- Waste to Energy (controlled incineration) replaces 'base load' coal and gas fired power plants – saving fossil fuels and emissions thereof.
- Incineration provides the best way to eliminate methane gas emissions from waste management processes. It generates clean renewable energy.
- With skyrocketing urbanisation and ever increasing waste (with ever increasing heat content), the time for WTE is now for future sustenance<sub>70</sub>



# India MSW – amenable for Incineration

- 53 India cities have more than 10 lakh population amounting to 70,000 TPD of MSW– thus have WTE potential of 930 MW in the near future.
- The combustibles amount to around 40% of raw weight of MSW.
- LCV (Lower Calorific Value) is the heat value of the raw MSW expressed in KCal/kg or KJ/kg (1 Cal = 4.184 KJ)
- The MSW must have LCV of 6000 KJ/kg – to qualify for WTE process.
- The LCV values of Indian Cities are: Mumbai = 8000 KJ/Kg, Delhi = 7000 KJ/Kg, Bangalore = 6070 KJ/Kg, Hyderabad = 6000 KJ/Kg
- Waste to Energy means– burn MSW to heat water, produce steam, which runs Turbine to produce electricity
- Typically in India 80 TPD of waste generates = 1 MW of Electricity.

# India – Cost & Economics of WTE Plant



- The cities with MSW of 500 TPD or more are suitable for WTE projects.
- The capital cost of establishing a WTE Plant is over Rs. 16 crores per installed MW capacity (thanks to dollar escalation!)
- The annual Operating Cost of WTE Plant is 10% of the Capital Cost.
- Proven successful models in the world– a combination of ‘Tipping Fee’ & ‘Preferential Tariff’ – to be the guiding principle for India.
- ‘Model Concession Agreement’ for MSW management including WTE need to be developed – Ministry of UD & MNRE

# AEB, Amsterdam, WTE Plant – World's Best!



photo: Marcus Köppen

# Waste to Energy –Beauty !

## Spittelau WTE Plant, Vienna, Austria



# MSW Management – Tipping Fees (Current)

No	Item	Tipping Fees etc (Assume 5% escalation every year)
1	<b>Collection &amp; Transport</b> (From Household till Site)	<b>Rs. 2000 per ton</b>
2	<b>Processing &amp; Disposal</b> (Aerobic Composting+ RDF + Landfill)	<b>Rs. 750 per ton</b>
3	<b>Waste to Electricity</b>	<b>Sale of Power @ Rs. 7.90 per Unit</b> [Sale of Power at Preferential Tariff @ Rs. 7.90 per unit (KWH) with No Tipping Fees]

# MSW Management – Success Factors

1. Municipal Waste Management is not a rocket science – it needs committed management and discipline in the ULBs.
2. The ULB Commissioner should have at least 3 years tenure.
3. The Policy makers in the Government need training and exposure – emulate success stories !
4. The Urban Local Bodies need capacity building for its functionaries.
5. The Urban Local Bodies need professional help to engage Private Partners after due assessment of their technical capability and financial quote.
6. Proactive guidance and enforcement by ‘Pollution Control Boards’
7. The Concession Agreement should incorporate pragmatic technical & commercial considerations.
8. The Concession Agreement should have fair “risk balancing” between Public & Private Partners.

# The Key Factor



# Political Will



**Our dynamic Chief Minister – Mr. KCR**  
Committed to Swachh Telangana, Swachh Hyderabad !



# Swachh Hyderabad Review Meeting



# CM & Ministers taking Oath for Swachh Telangana (6<sup>th</sup> May, 2015)



# Training for Officers of Telangana Government Swachh Abhiyan (06.05.15), HICC, Hyderabad



# Training for Officers of Telangana Government HICC, Hyderabad – 06.05.15



# Training for Ministers, MPs, MLAs of Telangana on Swachh Telangana



# Mr. KCR, Chief Minister Telangana encourages Training on Swachh Telangana



# Thank You

**You also take pledge to Clean India !**