Management of solid wastes in India - Status and initiatives

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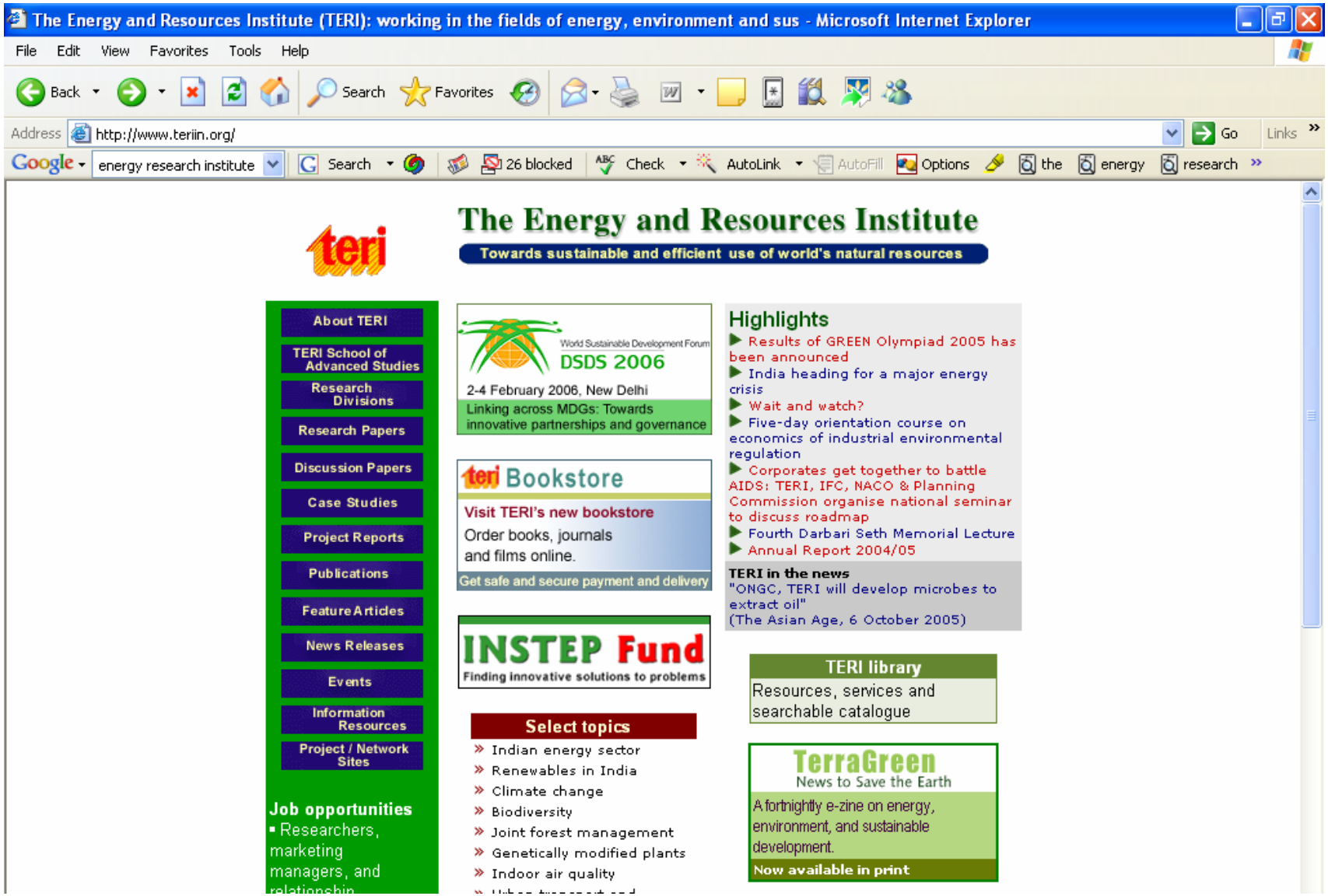
TERI – www.teriin.org



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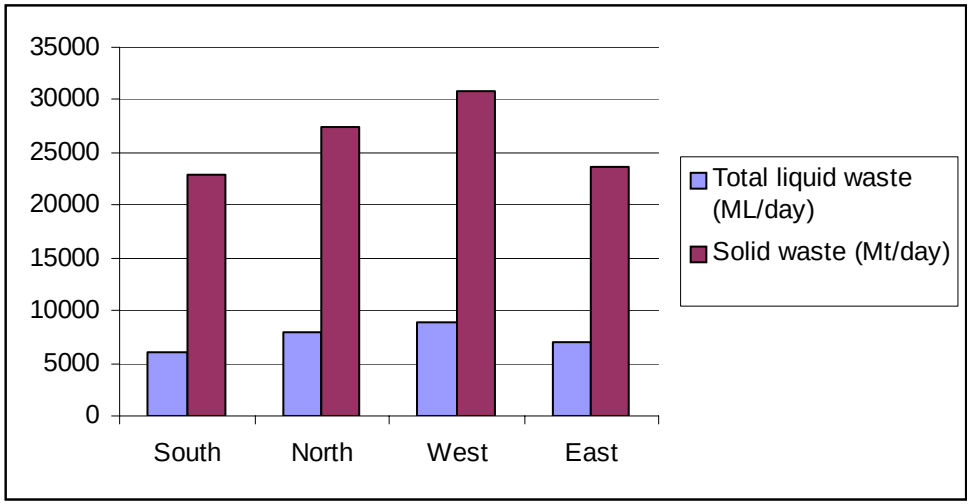
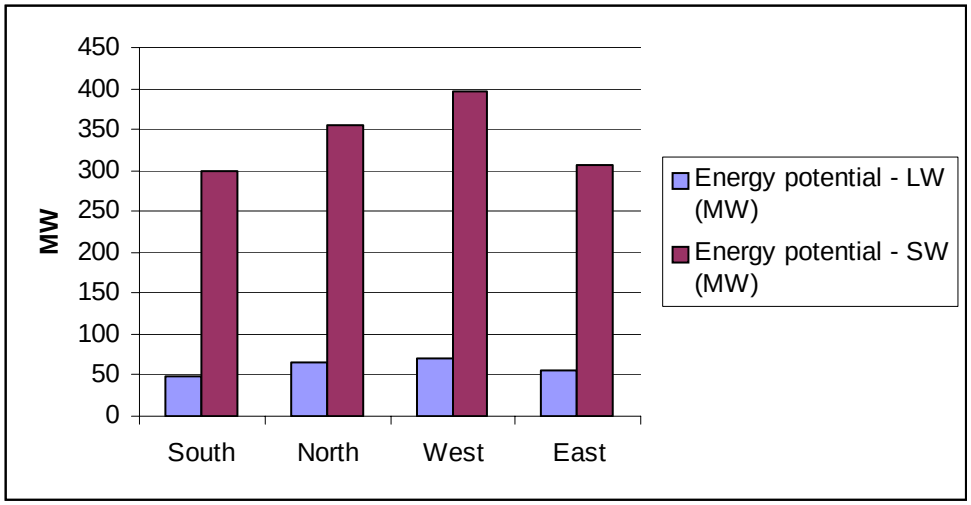
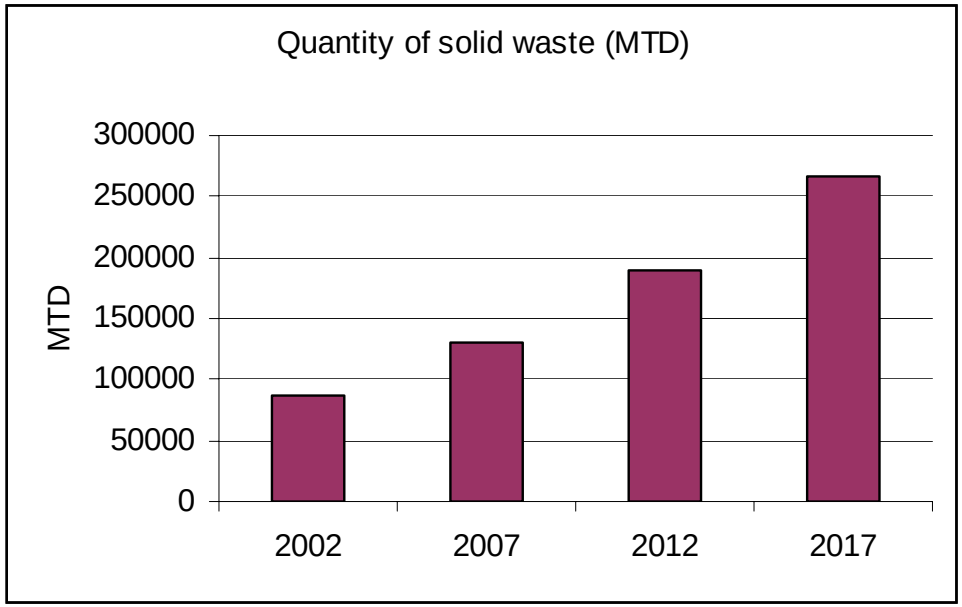
- Overview of waste in India
- Technological Options and Implementation Status
- Overall Challenges
- Summary

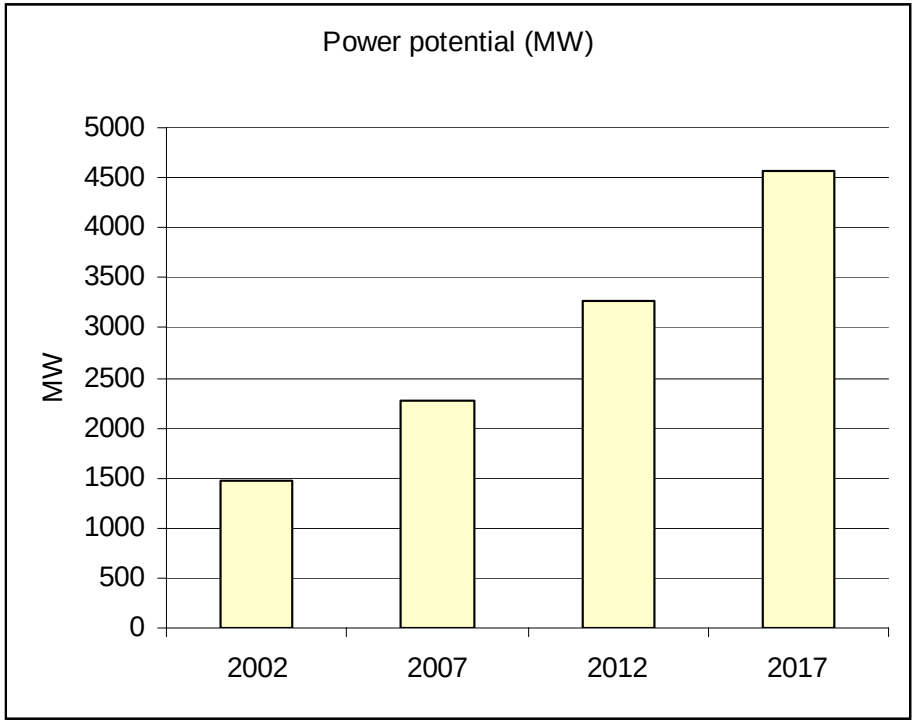
Energy Generation Potential of Wastes



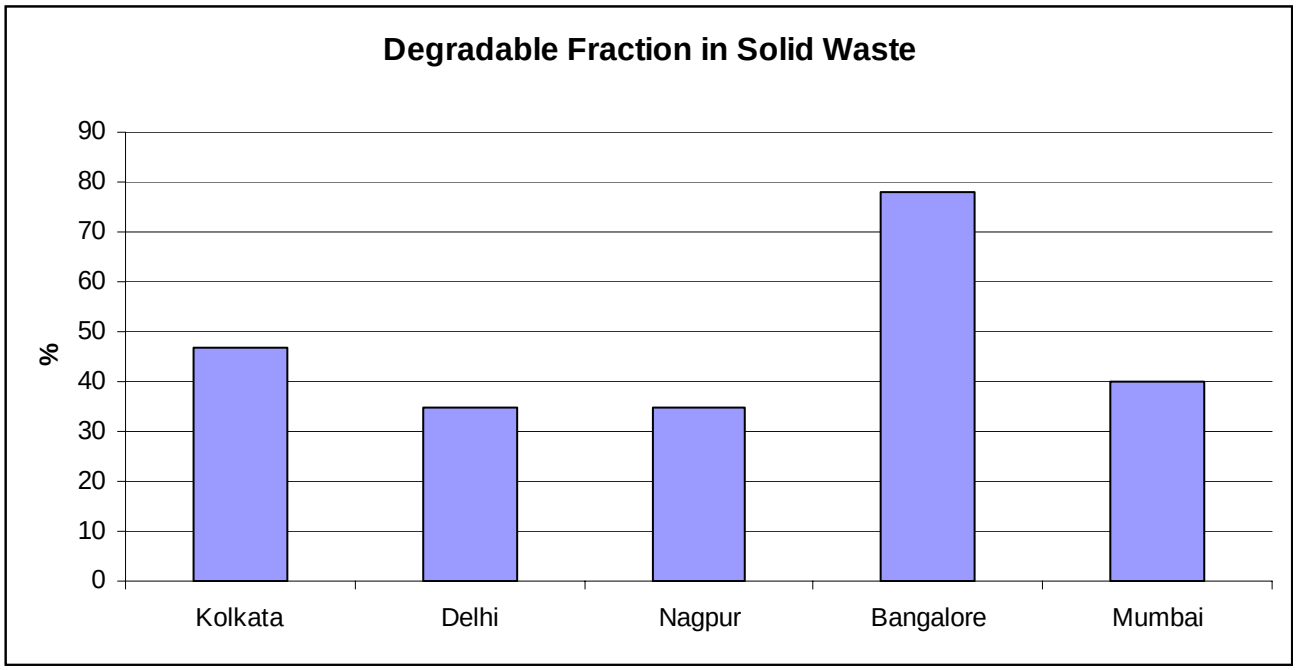


Energy Generation Potential (contd.)



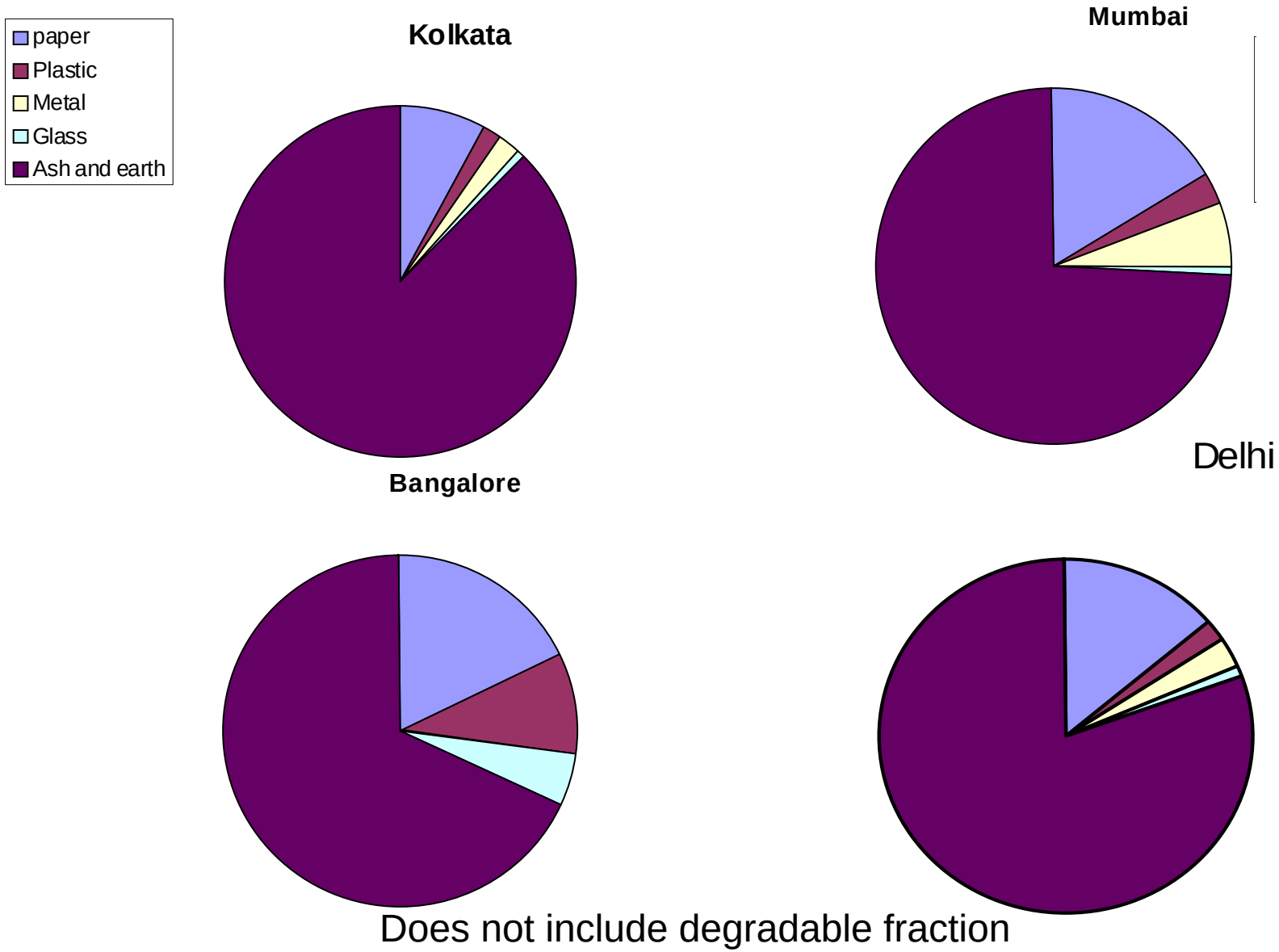


Degradable Fraction in Solid Waste



•Refers to organic biologically degradable fraction such as: food materials, leaves, vegetable and fruit peels etc

Waste Compositions



Does not include degradable fraction

Technological Options and Implementation

Municipal solid waste

Combustible fraction

Biodegradable fraction

Refuse derived fuel

Anaerobic digestion

Sanitary landfilling

1. Landfill Gas Recovery

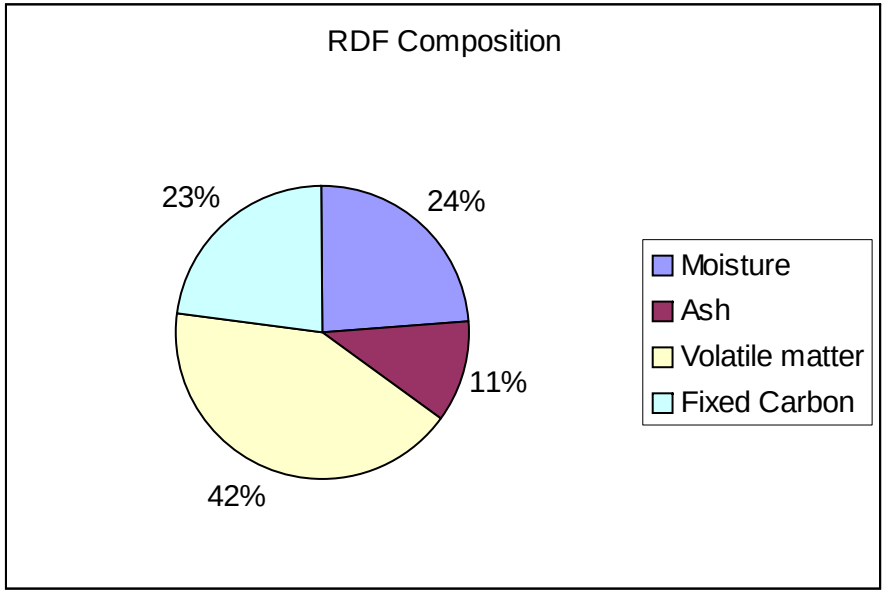
- Status
  - More than 90% of the waste is currently just dumped in low lying areas
  - Few engineered landfill sites
- Advantages of LFG Recovery:
  - Reduced GHG emissions
  - Energy generation (~500 BTU/ft3)
    - Used for – power generation, thermal use (cooking)
- Limitations
  - Landfills have huge land requirement – so large land requirements (for energy captured)
  - May only be able to collect 30-40% of LFG
  - Presence of hazardous materials can lead to potential toxic emissions along with methane
  - Possible accidents due to leakage of methane and escape of methane
  - High cost associated with gas collection and cleaning (remove H_2S)
  - Difficulty in methane use in remote areas

2. Incineration

- Attempted to set up 300 TPD plant for recovery of 3.8 MW of power in New Delhi [5x lower than US where ~500 kWhr/ton]
  - Unsuccessful due to:
    - Low calorific value of waste (550-850 kcal/kg = ~2.9 GJ/ton)
    - Developed World: ~10 GJ/ton
    - Most high calorific value items removed by rag pickers (they have economic value).
      - Remaining MSW has large amounts of ash and earth
      - Some efforts towards source segregation, but may take time to achieve this
- Limitations
    - Not suitable for low calorific value, high moisture content
    - Presence of some toxic metals in wastes
    - Emissions- particulates, SOx, NOx, dioxins, heavy metals requiring pollution control equipments
    - High cost

3. Refuse Derived Fuel (RDF) production

- RDF fluff or pellets for thermal/power generation
- Proximity to waste generation site and ease of transportation to user industries such as cement plants
- Indigenous technologies and operational plants
  - Addition of biomass/other fuel to improve calorific value
  - Drying arrangements to bring down the moisture content



Status:

- Plants set up at Mumbai and Bangalore
- Vijaywada and Hyderabad in Andhra Pradesh (6 MW, 500 tpd)
- In Delhi (proposed 1500 TPD)
- Calorific value of 3500 kcal/kg

4. Anaerobic digestion

- Microbiological decomposition of organic fraction
  - Suitable for wastes with high organic and moisture content
- Successful for segregated waste (decentralized)
  - Energy and manure
  - Waste composition and efficiency of biodigester key factors

- **Implementation:**
- Biogas plants based on animal dung
  - Family size (4.1 million)
  - Community/Institutional/night soil based (2362)
- Power generation from cattle manure
  - 1 MW power project (235 mt of animal waste/day)
  - Using Austrian Technology
- Also have implemented in wastewater treatment plants associated with:
  - Distilleries
    - Biogas generated used for replacement of coal/fossil fuel in boiler or for power generation (150 biomethanation units)
  - Pulp and paper, Tannery, Domestic wastewater, Food processing (starch/tapioca)

Anaerobic Digestion (contd.)

- Advantages
  - Indigenous technologies available
  - Successfully tried at a small scale (<20 TPD)
  - Family sized biogas plants based on cowdung
  - Can avoid GHG emissions and odor
  - Less land area
- Disadvantages
  - Capital intensive
  - For larger plants:
    - Imported technologies
    - Controlled conditions and requirement of high-end technical expertise
  - Not suitable for non biodegradable waste

- Current initiatives (low cost decentralized)
- Modified rural biogas plants
  - For food wastes
  - For water hyacinth
  - Vegetable market wastes
- Plug flow digester (Indian Institute of Science)
  - For leafy biomass
- Biphasic process (TERI)
  - Leafy wastes, food wastes, coffee processing, press mud

Economic analysis of indigenous Plug Flow Digester

Details	
Daily treatment capacity	800-1000 kg/d
Biogas yield	150-200 m^3/d
LPG equivalent	75-100 kg/d
Cost of the plant including pipings	Rs. 750000 [$15k]
O&M cost	Rs. 66000 [$1320]
Rev (Biogas @ Rs. 3.75/m3(8c) and manure@ Rs. 630/ton ($12.6))	Rs. 411720 [$8234]
Payback period	2.84 years

Anaerobic Digestion (contd.)

- Advantages
  - Indigenous technologies are available
    - Have been successfully tried at a small scale (<20 TPD)
  - Possible at small/decentralised level
    - Family sized biogas plants based on cow dung have been successful
  - Can avoid GHG emissions and odor
  - Less land area
- Disadvantages
  - Capital intensive
  - For larger plants:
    - Imported technologies
    - Controlled conditions and requirement of high-end technical expertise
  - Not suitable for non biodegradable waste

5. Projects Implemented

With support of the Ministry of Non-Conventional Energy Sources

- Biomethanization plants for solid wastes
  - Palm oil industry waste (3 MW)
  - Poultry waste (2.5 and 1.5 MW)
  - Municipal Solid Waste (5 MW)
  - Vegetable market waste (0.3 MW)
  - Slaughterhouse wastes (0.5 MW)
  - Tannery fleshings and sludge (0.03 MW)
- Power generation from
  - Municipal waste
  - Sugarcane press mud
  - Poultry waste
  - Starch industry waste

- Current Status:

	Implemented	Under Implmentation
Biogas/Biometh	12 MW (15 projects)	26 MW (8 projects)
MSW-based	14 MW (5 projects)	23 MW (2 projects)

Other initiatives

- Financial incentives
  - Ministry of non-conventional energy sources
    - Capital subsidy
    - Interest subsidy
  - Indian Renewable Energy Development Agency and state nodal agencies
- Legislations
  - Ministry of Environment and Forests (Solid wastes management and handling rules), 2000
    - Biodegradable wastes for generation of useful resources
    - Landfill sites for inert wastes
- Public private partnerships
  - Municipal corporations (Delhi, Surat, Ahmedabad)
    - Schemes initiated for collection and source segregation of biodegradable and non biodegradable waste

Overall Challenges

- High capital cost and dependence on imported technologies/designs
  - Adapting imported technology to Indian conditions
- Financial support and associated risk
- Integration of all aspects of solid waste management including collection, segregation and transportation
- Lack of adequate infrastructure and finance available from municipalities

Summary

- A sustainable waste management system depends on
  - Site and availability of land
  - Nature of waste
  - Availability of segregated waste
  - Technology
  - Financing
  - Market for products recovered
  - Environmental impacts
  - Enforcement of legislations,

Overall:

An integrated approach with mix of technological options at both centralized and decentralized levels