Regional Solid Waste Management Plan Review:
Engaging solutions for tomorrow

Garbage School 301:
Waste to Energy

Earth tech

Waste – a source of energy

- All organic materials contains energy
  - Plant or animal based
- Plastics are also source of energy if burned
- Proper equipment and air pollution control is required
- Waste can become a refuse derived fuel

Earth tech

Types of Waste to Energy Systems

- Incineration → energy from waste
- Advanced thermal
- Anaerobic digestion
- Bioreactor landfills

Earth tech

Incineration

- Rapid combustion of waste in a controlled environment
- Recovery of energy by heating water in a boiler
- Air pollution control system required
- Essentially a thermal power plant, using waste instead of coal, oil or gas

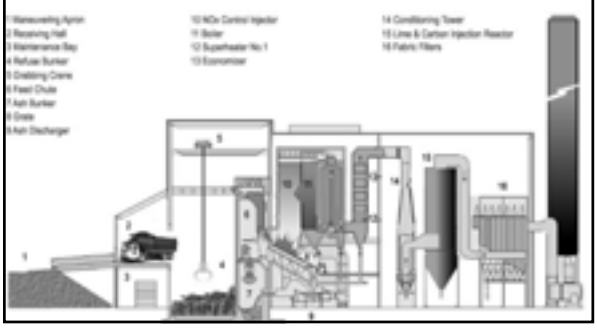
Earth tech

Incineration

- Controlled air
  - 2 or 3 stage combustion
  - Up to 100 tons per day
- Fluidized bed combustion
  - 50 to 500 tons per day
  - Rarely used for MSW
- Mass burn
  - More than 200 tons per day

Earth tech

Conventional WTE System



Environmental Controls

- Incineration meets strict environmental standards
- In Europe and North America, this is the most highly regulated form of waste management
- Air emissions are cleaner than those from power plants, cement kilns and other industrial facilities
- Rigorous emissions testing requirements
- Disposal of ash is still necessary

Costs

- Air pollution control can double the cost of incineration
- Energy can be recovered and sold to help offset costs
- Disposal of ash may be costly if additional treatment required
- In North America, incineration costs $70 to $150 per ton of waste burned

Incineration

Pros	Cons
Well proven – economically and technically	Poorly perceived by public
Cheaper to build and operate	Ash may need special handling
Good air pollution control equipment is available	Wet waste does not burn well

Incineration

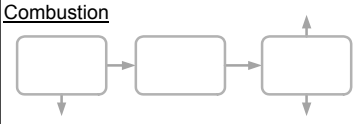
- Currently used in:
  - Burnaby – 200,000 tonnes per year
  - Islip, NY – 160,000 tonnes per year
  - Poughkeepsie, NY – 132,000 tonnes per year
  - Wainwright, AB
  - Region of York

Advanced Thermal

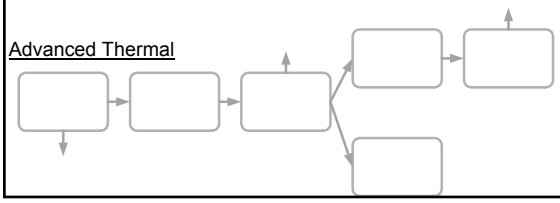
- Gasification
- Pyrolysis

What's the Difference?

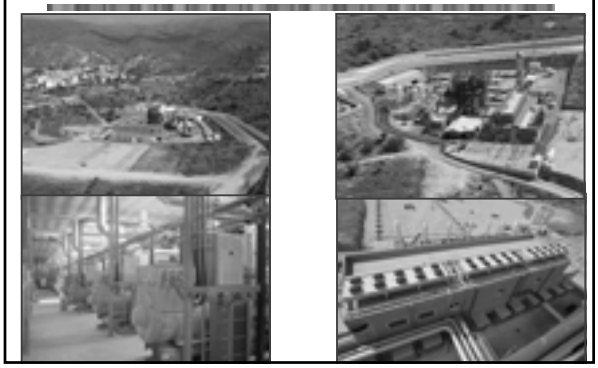
Combustion



Advanced Thermal



Sample system – Enerkem



Advanced Thermal

Pros	Cons
Production of syngas – can use gas turbines for efficiency	Waste may need significant processing
Syngas can be used as raw material for other petrochemical products	Higher capital and operating costs
Better public acceptance	Not proven with MSW
Grants may be available for capital costs	

Advanced Thermal

- Currently used in:
  - Spain (for plastic waste)
  - Germany (MSW)
  - Japan (MSW)
  - Quebec (demonstration scale)
  - California (not MSW)
- Currently being investigated for use in Edmonton

Anaerobic Digestion

- Converts organic matter into burnable gas
- No stack emissions from burning of wastes
- Complex process
- Handles only well segregated organics
  - Common for biosolids
- Generally uneconomical when compared to incineration

Anaerobic Digestion

Hydropulper at BTA facility in Newmarket, Ontario

Digester at BTA facility in Newmarket, Ontario

Anaerobic Digestion

Pros	Cons
Production of burnable gas	Needs clean feedstock (<15% contaminants)
Green energy	Sludge requires further processing
No stack emissions	Handles organic waste only
Good public acceptance	

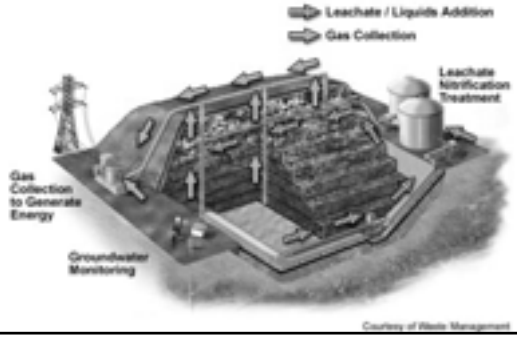
Anaerobic Digestion

- Currently used in Europe with assistance from green energy subsidies
- Difficulties encountered in Newmarket, Ontario

Bioreactor Landfill

- Highly controlled landfill that promotes accelerated decomposition of organics
- Generates methane – source of energy

Bioreactor Landfill



Bioreactor Landfill

Pros	Cons
Green energy	Large land base needed
Accelerated waste decomposition	May not be publicly acceptable as a waste treatment technology
Less expensive than other WTE facilities	Requires skilled operators
No separation of organics required	

Bioreactor Landfill

- Currently used in:
  - Sainte-Sophie Landfill, Montreal, PQ
    - Has the potential to generate 8 MW of electricity, enough to power approximately 8,000 homes
  - Experimental basis in USA

Financing a WTE facility

- Tipping fee
- Electricity sales
- Green Power credits
- Greenhouse gas reduction grants

Cost Comparison

	Incineration	Advanced Thermal	Anaerobic digestion	Bioreactor landfill
Capital Cost	$50 million	$90 million	$33 million	1.5x landfilling costs
Operating Cost* (per tonne)	$50	$60	$40	$20

* Including revenue from sale of power and GHG credits, but not tipping fees

Costs are based on a capacity of 100,000 tonnes per year