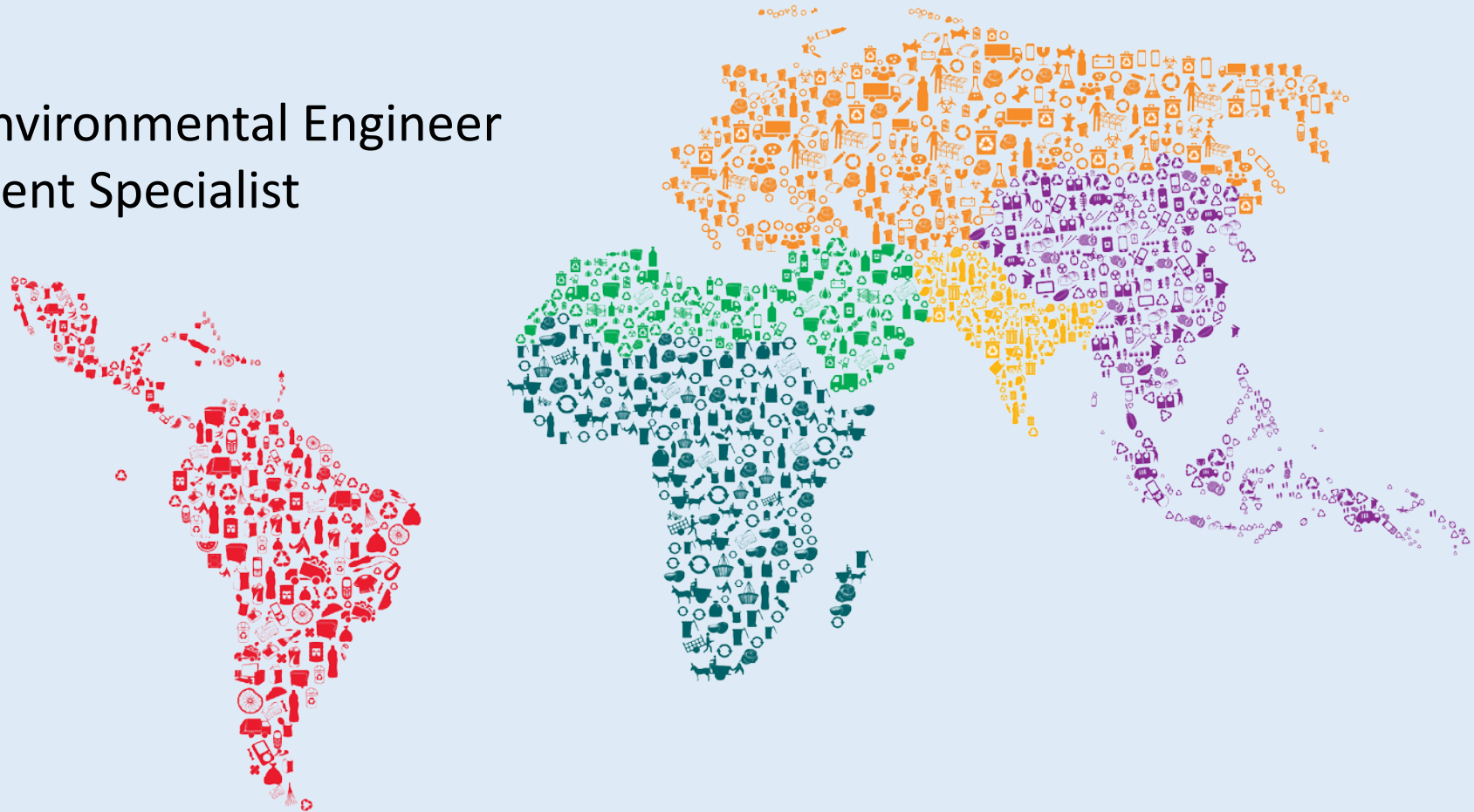


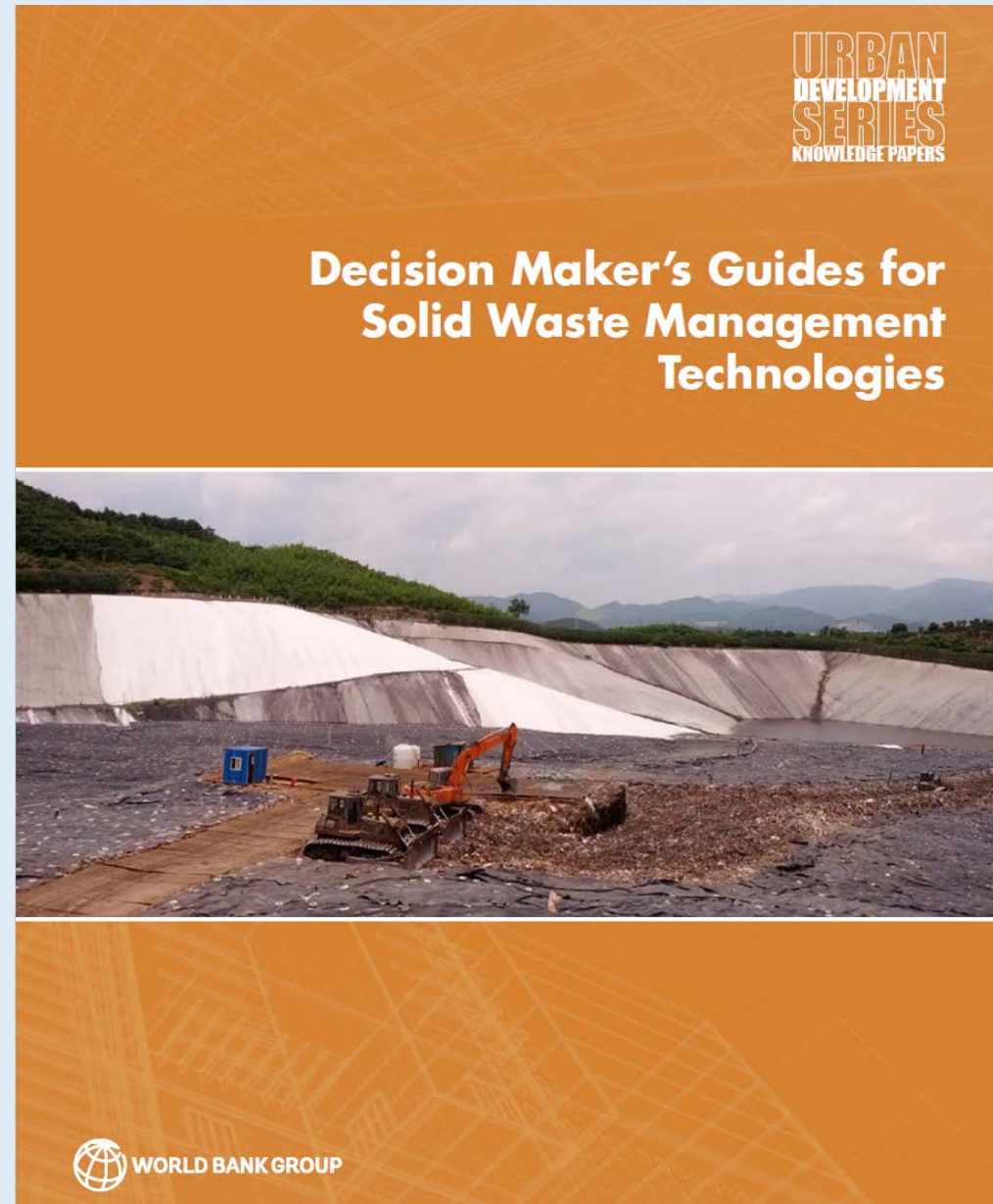
# Decision Maker's Guides to Solid Waste Management Technologies

Frank Van Woerden, Lead Environmental Engineer  
Silpa Kaza, Urban Development Specialist



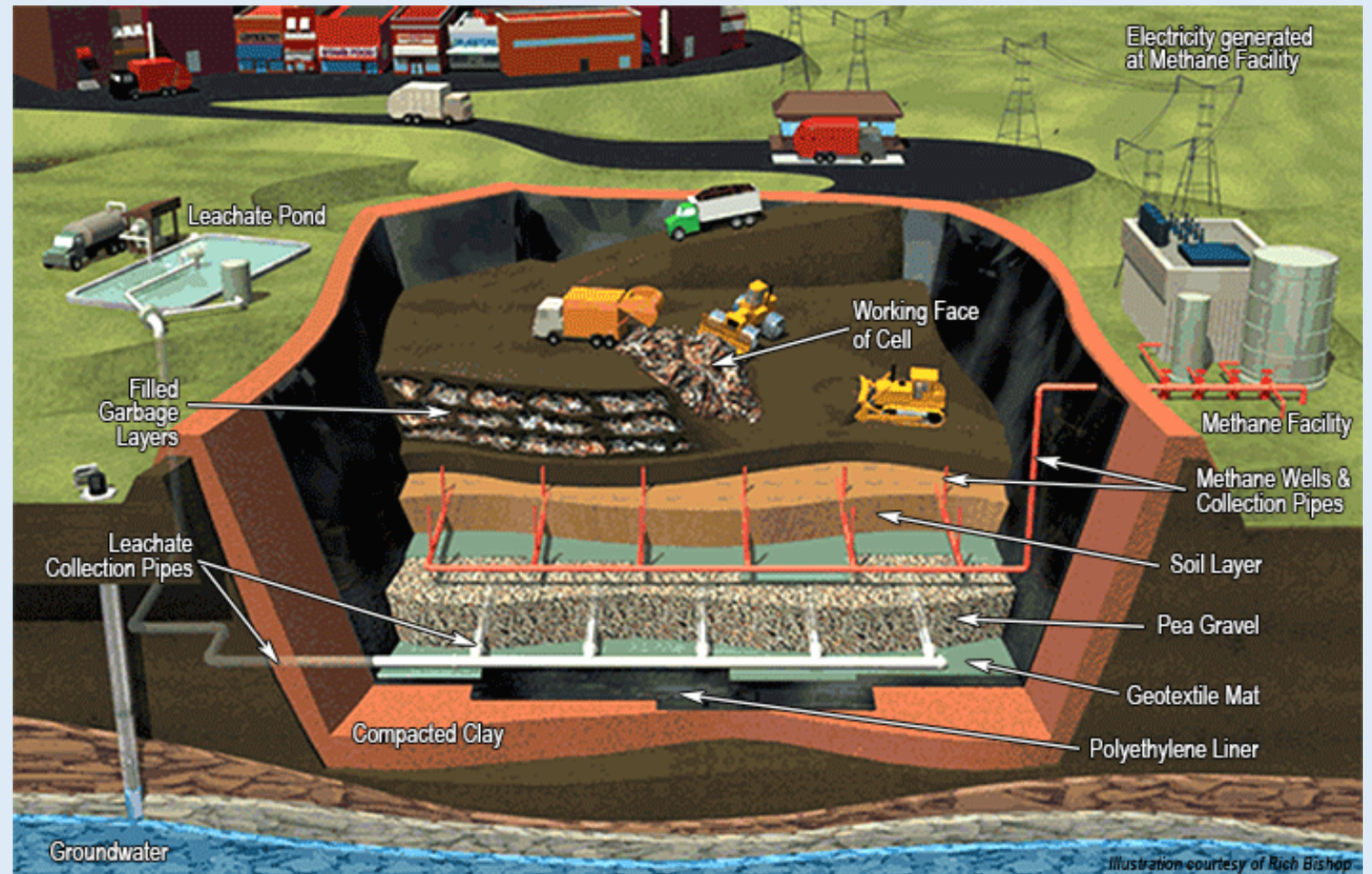
# Upcoming Publication

- Basic description
- Key considerations
- Financial implications
- Examples
- Mayor's Corner



# Sanitary Landfills – The Basics

- Linear
- Leachate management
- Landfill gas collection
- Daily and final cover



# Sanitary Landfills – What to think about?

## Pre-Construction

- Landfill capacity
- Siting
- Recovery of recyclables or reusable materials

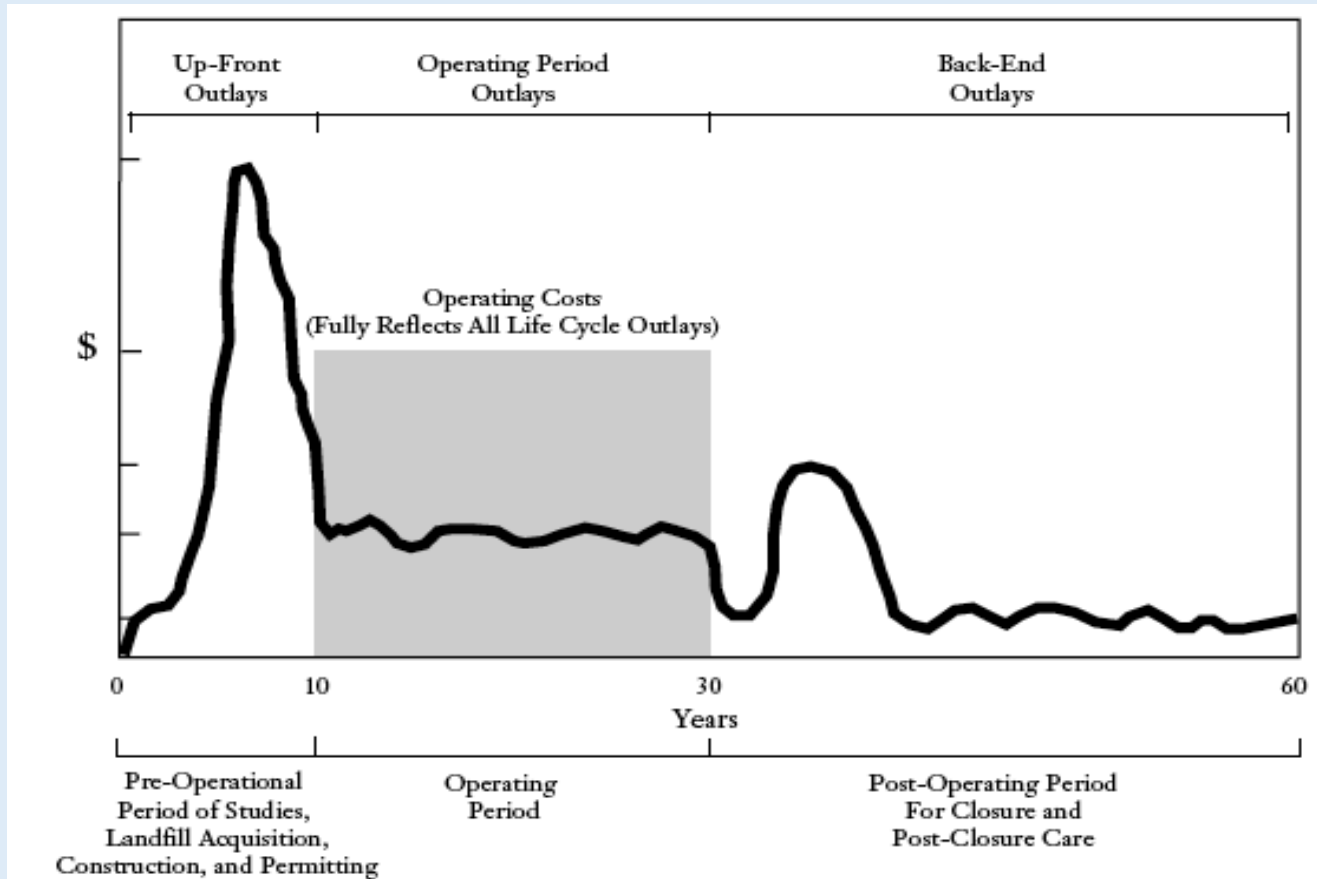
## Construction/Operations

- Liner
- Leachate monitoring, collection, treatment
- Landfill gas collection
- Storm water management
- Waste compaction
- Cover
- Monitoring

## Closure/Post-Closure

- Final cover
- Monitoring
- Post-closure use

# Sanitary Landfills – How much will it cost?



## Capital Costs (25-50%)

- \$1M-50M, 20,000-2M t/yr

## Operating Costs (60-80%)

- \$7-30/tonne

## Post-Closure Costs (10-15%)

- \$80,000-500,000/acre

# Is your landfill too expensive?

- Regional landfill
- Pool or bundle landfills
- Carbon finance
- Preferred tariffs for renewable energy
- Sale of byproducts or services
- Tipping/gate fess
- Public-private partnerships



# Composting – What is it?

- Breaking down of organic matter by microorganisms in the presence of oxygen
- Volume of organic waste can decrease by 60-90% as a result.

Windrow/Static Piles



In-Vessel



# Composting – Selecting Method

Scale of operation	Large/ regional/ municipal Windrow/Static Piles	Small/ community In-Vessel
Processing capacity (tonnes/day)	1 – 1,000	20 – 350
Time required	Several weeks	Few days to weeks + 2-4 weeks
Leachate production	Low	Minimal
Sensitivity to weather	If feedstock freezes, the decomposition process stalls	Functions in all climates
Capital cost (US\$/tonne)	\$40-60	\$300-500
Operating cost (US\$/tonne)	\$12	\$130



# Composting – What to think about?

- Quality of input
- Types of input
- Siting
- Facility size
- Storm water & leachate management
- Sensitivity to weather
- Speed of composting process
- Market for compost & product certificate

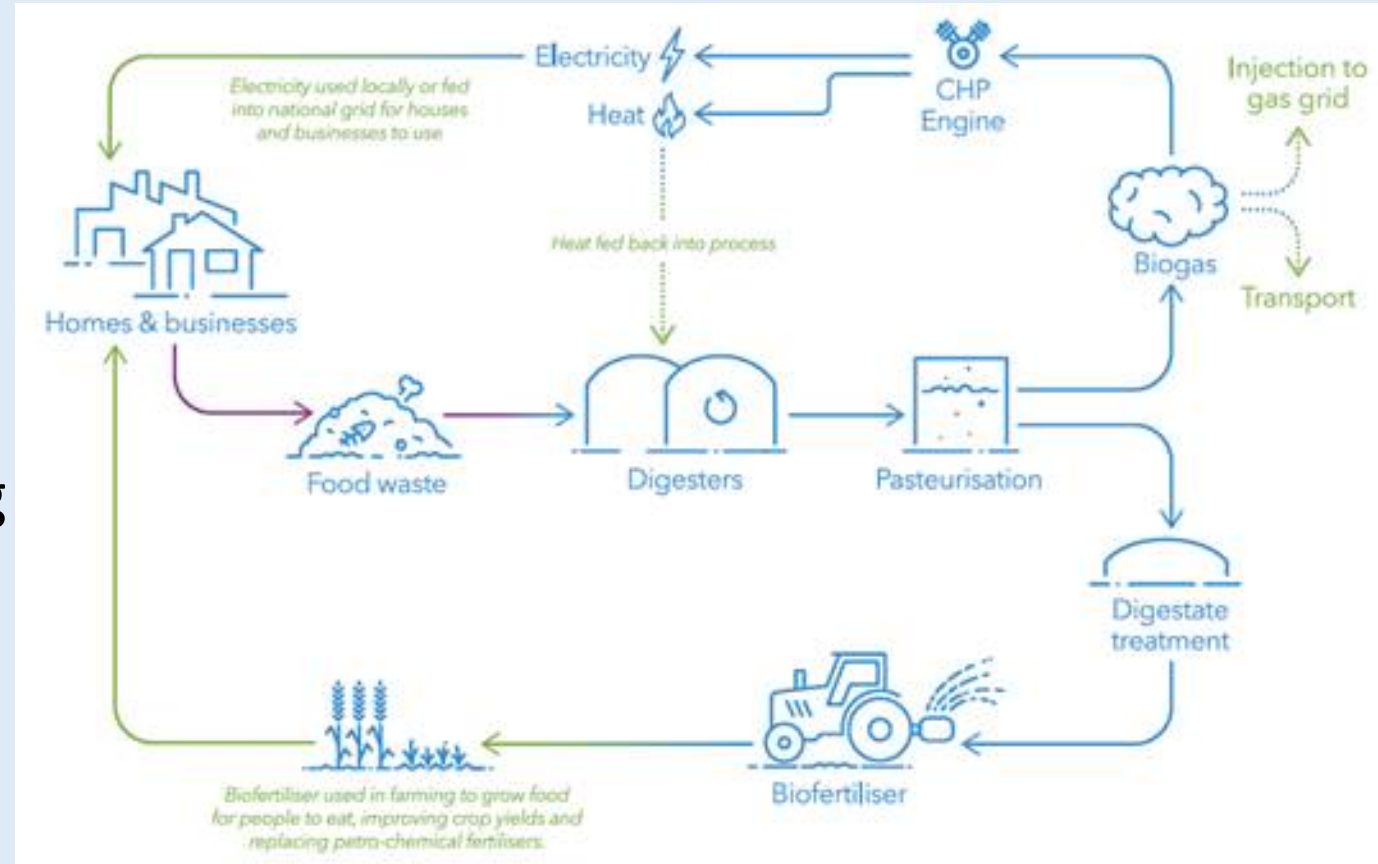


# Spending too much on organic waste management?

- Think in total system terms
- Charge a fee for private sector access to your composting facilities
- Offer related services
- Find a partner
- Share a regional facility
- Pool or bundle facilities
- Carbon finance
- Encourage on-site composting
- Try a targeted approach

# Anaerobic Digestion – What is it?

- Outputs are semi-solid fertilizer & biogas
- Naturally occurring microorganisms break down waste in the absence of oxygen & emit gases
- Decreases volume by 50-60% while conserving nutrients for soil & killing up to 95% of any disease-causing organisms
- Biogas created can be used to generate electricity or refined & supplied to natural gas utilities



# Anaerobic Digestion – What to consider?

- Infrastructure
- Feedstock
- Biogas production
- Biogas uses
- Cleaning of the biogas



# Anaerobic Digestion—Costs & Financing

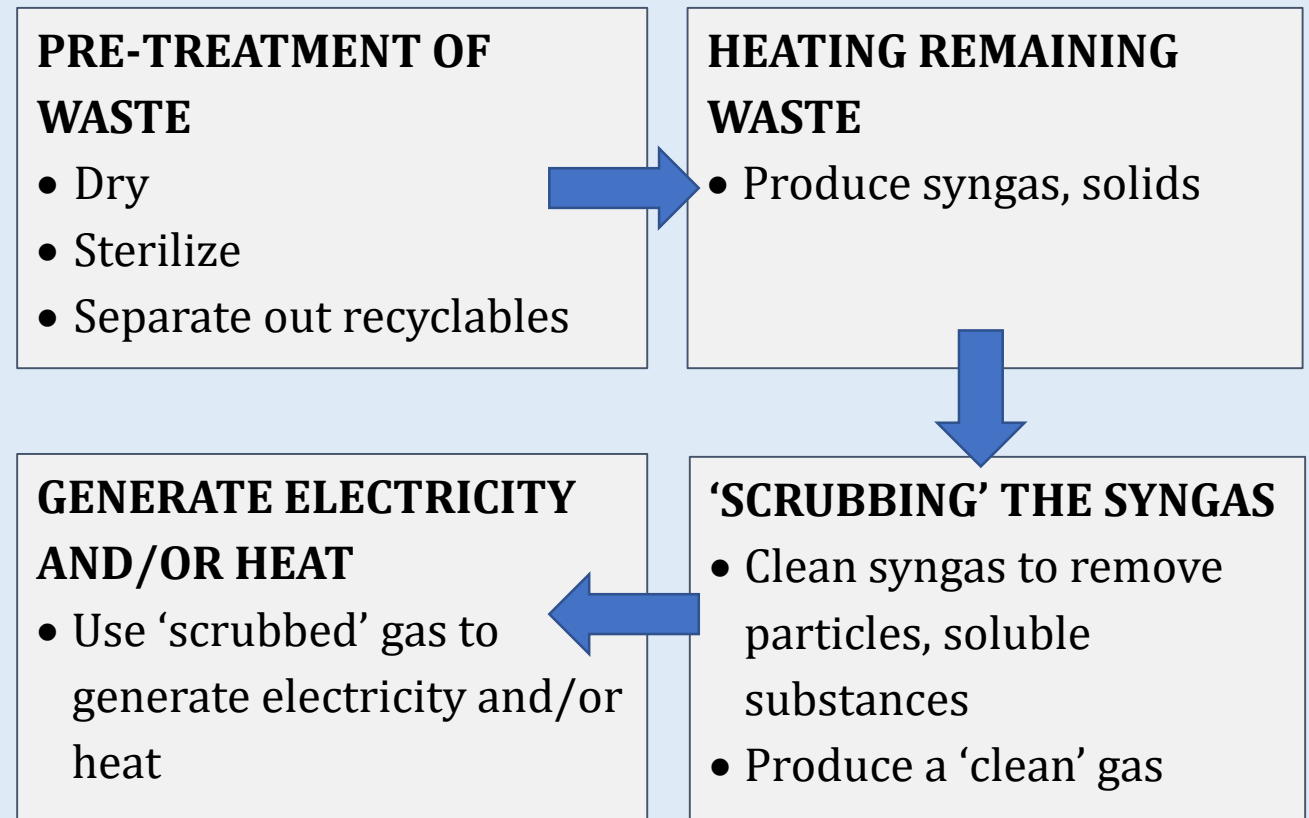
	Capital Expenditures (US\$/annual tonne)	Operational Expenditures (US\$/tonne)
Europe	\$345-600	\$31-57
United States	\$220-660	\$22-55

## Financing

- Think in total system terms
- Tipping fees
- Sale of fertilizer
- Sale of biogas as an energy source
- Preferred tariffs for renewable energy
- Carbon finance
- Public-private partnership

# Pyrolysis & Gasification – The Basics

- Advanced Thermal Treatment technologies convert waste primarily into a synthetic gas or fuel
- Heating waste to high temperatures without oxygen, producing (1) a synthetic gas (syngas), (2) tar, & (3) char



# Pyrolysis & Gasification – What to think about?

- Energy
- Feedstock
- Controlled facility
- Flexible capacity
- Siting
- Enclosed facility
- Residual waste disposal
- Air pollution control



# Pyrolysis & Gasification – Costs & Financing

## Costs

- Capital
  - \$15-80 M for 25,000-100,000 tonnes facility
  - \$699/tonne
- Operational
  - \$3-6.6M
  - \$35/tonne

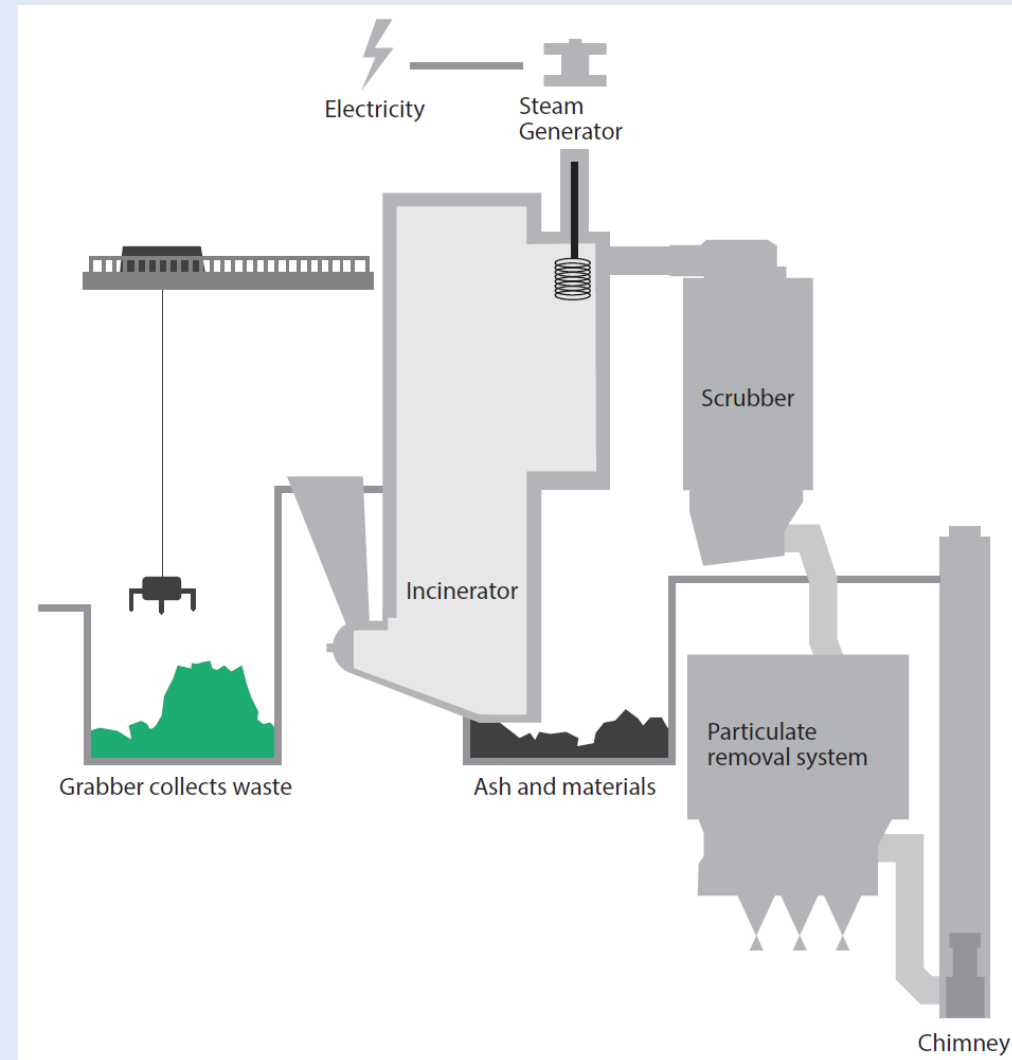
## Financing

- Think in total system terms
- Tipping fees
- Sale of electricity and/or heat generated
- Sale of recyclables
- Renewable energy credits
- Carbon finance
- Public-private partnership



# Incineration with Energy Recovery – The Basics

- Combustion of waste under controlled conditions to generate electricity and/or heat
- Storage area
- Combustion chamber
- Heat recovery system
- Ash handling system
- Air pollution control system



# Incineration with Energy Recovery – What to think about?

- Feedstock requirements
- Siting
- Air pollution control
- Ash disposal
- Electricity & heat generation
- Public perception
- Contract duration
- Contractual requirements for waste quantities & composition
- Informal waste pickers
- Integrated solid waste policy



# Incineration with Energy Recovery – Costs & Financing

	Capital Expenditures (US\$/annual tonne)	Operational expenditures (US\$/tonne)
Europe	\$600-1000	\$25-30
United States	\$600-830	\$44-55
China	\$190-400	\$12-22

## Financing

- Think in total system terms
- Tipping fees
- Sale of electricity and/or heat generated
- Generation efficiency
- Preferred tariffs for renewable energy
- Carbon finance
- Materials recovery

Thank you