Waste characterisation, determining the energy potential of waste

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Competency Area: Solutions for a Green Economy
WtE should consider

**Fitness for purpose**
- Feedstock requirements compared to expected feedstock quality
- Mass and energy balance
- Scale of operation per unit

**Operational expectations**
- Reliability of operation assessment (expected availability)
- Maintenance requirements
Municipal solid waste
Why characterisation?

- Technologies address discrete segments of the waste stream
- Decision support - best management option for different materials/waste streams
- “Material flows” modelling
- Planning - recycling and composting programmes
- Sizing of facilities – WtE based on the residual waste
- Estimating costs - transport and separation costs
Why local studies?

- Provide baseline data to measure progress towards local goals i.e. waste diversion targets
- Project material flows in and out of the municipality
- Plan for local MSW infrastructure – size and location
- Seasonal variability in composition and generation rates
- Differences in urban, suburban and rural areas
- Extrapolations from other studies could result in costly mistakes
  - Equipment choices
  - Sizing of facilities
Elements of waste characterisation study

- Representative sampling – catering for variability across the City
- Four seasons – at least one full week per season
- Accurate sorting into multiple waste categories
- Waste quantities by generation source
- Estimation of the heat value if WtE is considered
- Survey of businesses, haulers and brokers to quantify commercial recycling activities and disposal practices
Changes in waste over time

• Changes in population
  – Birth rates
  – Death rates
  – Migration

• Changes in per capita generation
  – Socio-economic status
  – Degree of urbanisation
  – Household size

• Recycling, composting and source reduction initiatives
Cost of WCS

• You get what you pay for
  – Quick and dirty
  – Comprehensive

• Comprehensive studies are expensive (UNEP, 2015)
  – Good coverage
  – Detailed characterisation
  – Statistical analysis of results

• WtE requires multimillion Rand’s worth of investments
• High risk associated with poor/uninformed decision making
Energy potential of MSW

- Depend on the composition of the waste stream
- Self-sustained combustibility of the waste
- Ash content
- Moisture content
  - Varies by location
  - Varies by season
  - Due to rainfall
  - Causes a directly proportional change in real calorific value
WtE Technologies for MSW

- Anaerobic digestion
- Landfill gas recovery
- Solid waste incinerators
- Gasification
- Pyrolysis

Non-burn technologies
<table>
<thead>
<tr>
<th>Technology</th>
<th>Electricity production range kWhr/tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional incineration (older)</td>
<td>500-600</td>
</tr>
<tr>
<td>Conventional incineration (newer)</td>
<td>750-850</td>
</tr>
<tr>
<td>Gasification</td>
<td>400-800</td>
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<tr>
<td>Plasma Arc Gasification</td>
<td>300-600</td>
</tr>
<tr>
<td>Pyrolysis</td>
<td>500-800</td>
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</tbody>
</table>
MSW as energy source

- MSW is an inhomogeneous fuel with varying calorific value
- Incineration is only viable at lower calorific value above 7MJ/wet kg
- Electricity production range of MSW
  300 to 850 kWhr/tonne
- Electricity production potential range of low grade coal
  1 467 to 4 444 kWhr/tonne
Conclusions

- WtE requires huge capital investments
- Decisions on technologies must be based on sound evidence
- Technologies are often waste stream specific
- Waste characterisation studies provide evidence
- Comprehensive studies are costly
- Spending money upfront will save money in long run
- Calorific value of MSW is low compared to coal
- WtE is a by-product of integrated waste management not the driver
Thank You

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