Waste-to-Energy: The Environmental Perspective in Europe

Bettina Kamuk
Project Director, Rambøll Denmark
Vicechair, ISWA,
Working Group on Hazardous Waste

bkc@ramboll.dk
www.ramboll.dk/wte
Rambøll waste-to-energy

- Leading waste-to-energy consultant
- Long track record of waste-to-energy plant projects
- Independent consulting services
- High-quality plants and solid commercial conditions
Waste-to-energy plant references

- Kiev, Ukraine
- Budapest, Hungary
- Oporto, Portugal
- Moscow, Russia
- St. Petersburg, Russia
- Torshavn + Leirvik, Faroe Islands
- Isle of Man
- South East Region, Ireland
- Alderney, UK
- Guernsey, UK
- Oporto, Portugal
- Gibraltar
- Mallorca, Spain
- Brescia, Italy
- Cairo, Egypt
- Delhi, India
- Guangzhou, China
- Manila, Philippines
- Hong Kong
- Uddevalla, Sweden
- Halmstad, Sweden
- Malmö, Sweden
- Uppsala, Sweden
- Murmansk, Russia
- St. Petersburg, Russia
- Moscow, Russia
- Kiev, Ukraine
- Budapest, Hungary
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Waste-to-energy plants in Denmark
EUROPE 2002

Total number of plants:

400

Total treated waste in million tonnes/year:

52
EU directives – Waste-to-energy

- 1999/31 on the Landfill of Waste
- 2000/76 on the Incineration of Waste (WID)

- Landfill ban introduced
  - Denmark 1997
  - Switzerland and Austria 2000
  - Sweden 2002/2005
  - Germany 1 July 2005
Waste Incineration Directive

- More stringent operating conditions
- Technical requirements
- Air and water emission limit values
- New plants 28 December 2002
- Existing plants 28 December 2005

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<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Dust</td>
<td>0.1 ng/Nm³ TEQ</td>
</tr>
<tr>
<td>HCl</td>
<td>10 mg/Nm³</td>
</tr>
<tr>
<td>SO₂</td>
<td>50 mg/Nm³</td>
</tr>
<tr>
<td>NOₓ</td>
<td>200 mg/Nm³</td>
</tr>
<tr>
<td>Dioxins</td>
<td>0.1 ng/Nm³ TEQ</td>
</tr>
</tbody>
</table>

(Dry gas, 11% O₂, 24 h averaging time)
Advantages of common EU directives

- Low environmental impact – no cross border problems
- Common market for further development of:
  - Grate/boiler system
  - Flue gas cleaning system
- High standards for energy recovery
- Increased public acceptance
I/S Nordforbrænding, Denmark
Energy recovery

1 tonne of waste

2 MWh heat

2/3 MWh electricity
## CO₂ – Waste-to-energy

<table>
<thead>
<tr>
<th>Waste disposal: Energy production:</th>
<th>Composting Oil</th>
<th>Waste-to-energy Waste-to-energy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy production</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating value</td>
<td>GJ/tonne</td>
<td>43</td>
</tr>
<tr>
<td>Thermal efficiency</td>
<td>%</td>
<td>90</td>
</tr>
<tr>
<td>Thermal output</td>
<td>GJ</td>
<td>10.0</td>
</tr>
<tr>
<td>Mass flow, fuel</td>
<td>tonne</td>
<td>0.26</td>
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<tr>
<td>( CO₂ ) from oil/fossil part of waste</td>
<td>tonne</td>
<td>0.82</td>
</tr>
<tr>
<td>( CO₂ ) from conversion of biodegradable waste</td>
<td>tonne</td>
<td>0.64</td>
</tr>
<tr>
<td><strong>Total CO₂ emission</strong></td>
<td>tonne</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Disposal of 1 tonne of waste and production of 10 GJ heat and power
Malmö, Sweden

Client: SYSAV
Capacity: 600 t/d
Commissioning: 2003
Supplier: MARTIN
Halmstad, Sweden

Client: RenhållingsBolaget
Capacity: 360 t/d
Commissioning: 2003
Supplier: Fisia Babcock Environment
Isle of Man

Client: Isle of Man Govt. (DLGE)
Capacity: 200 t/d
Commissioning: 2004
Supplier: Fisia Babcock Env.
Operator: SITA
Brescia, Italy

Client: ASM Brescia
Capacity: 3x552 t/d
Commissioning: 1998/2005
Supplier: Martin
Sønderborg, Denmark

Client: Sønderborg KVV
Capacity: 192 t/d
Commissioning: 1996
Supplier: Babcock Wilcox Vølund
Cost of waste-to-energy

New plants built in Europe in accordance with EU directive 2005

Treatment cost per tonne of waste, including:
- Amortisation
- Operation
- Maintenance

÷ Income from sale of electricity
÷ Income from sale of heat/steam

Example – Scandinavia:

Total treatment cost
÷ Sale of electricity (2/3 MWh/t x USD 60/MWh) = USD 40/tonne
÷ Sale of heat (2 MWh/t x USD (max. 40/min. 20)/MWh) = USD 40-80/tonne

Net treatment cost: Waste-to-energy = USD 15-50/tonne
Hot topics in the EU

- Implementation of directives
  - Technical upgrading
  - Lack of capacity – 50 new plants

- BREF notes
  - Reference notes for Best Available Technique (WtE)
  - BATAOEL (Best Available Technique Associated Operational Emission Levels - lower than directive)

- POPs (Persistent organic pollutants - dioxin)
  - POPs’ destruction by WtE
  - Safe storage
POPs and residues

'Low POP content waste' (residues could be recovered)

- Safe underground disposal (salt mines)
- Landfill sites for hazardous waste (if solidified)

POPs should undergo further destruction

'x' and 'y' are yet not known

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International organisations

- ISWA – International Solid Waste Association
- CEWEP – Confederation of European Waste-to-Energy Plants
Conclusion – Waste-to-energy in Europe

- Lowest CO₂ emission
- Best possible recovery of waste
- Low environmental impact
- Landfill ban
- Denmark has – for the past century! – had the most efficient treatment system in Europe