Co-digestion of animal manure and organic household waste - the Danish experience

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Co-digestions of manure and organic waste

- Introduction
- Waste handling
- Energy aspects of waste handling strategies
- Co-digestion of animal manure and organic waste
- Regulatory framework
- Summary and conclusions
Waste handling routes for organic household waste

- Recycling
  - Anaerobic treatment
  - Composting
- Incineration
- Landfill
## Organic household waste - composition

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter, DM, %</td>
<td>25</td>
<td>(17-31)</td>
</tr>
<tr>
<td>Ash, % of DM</td>
<td>12</td>
<td>(9-17)</td>
</tr>
<tr>
<td>Heating value, MJ/kg DM</td>
<td>20</td>
<td>(19-21)</td>
</tr>
<tr>
<td>K, potassium, % of DM</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>P, phosphorous, % of DM</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>N, nitrogen, % of DM</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Pre-treated org. Waste % ww</td>
<td>67</td>
<td>(52-76)</td>
</tr>
</tbody>
</table>
Pretreated organic household waste
Co-digestions of manure and organic waste

- Household waste
- Non-organic fraction
- Source separated organic waste
- Pre-treated organic waste
- Reject

Relative amount vs. Calorific value

MJ/kg

Ministry of Environment and Energy  Danish EPA
Co-digestions of manure and organic waste

![Bar chart showing energy output in MJ/tons for different processes: Incineration, Biogas, Composting. The chart compares the energy output for Fertilizer sub., Organic matter, and Reject.]

Ministry of Environment and Energy  Danish EPA
Centralised Biogas Plant
Location of centralised biogas plants
Organic waste for improvement of gas yield

- Gas yield from manure: 15-20 m³/tonne
- Addition of organic waste to improve gas yield
- Average 60% of gas production originates from addition of waste
- Industrial waste, organic household waste and sludge can be used to improve production
Organic waste for improvement of gas yield

- Concentrated fat, fish silage etc.
  
  200 - 1,000 m³/tonne

- Fish waste, fat and flotation sludge, slaughterhouse waste, dairy waste, organic household waste etc.
  
  50 - 200 m³/tonne

- Fruit and vegetable waste, industrial wastewater, sewage sludge
  
  10 - 50 m³/tonne
## Biogas potential in Denmark

<table>
<thead>
<tr>
<th></th>
<th>Estimated Potential</th>
<th>Production in 1999</th>
<th>Production in 2000</th>
<th>Danish energy plan 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PJ</td>
<td>PJ</td>
<td>PJ</td>
<td>PJ</td>
</tr>
<tr>
<td>Animal manure</td>
<td>24.0</td>
<td>0.50</td>
<td>0.56</td>
<td>14.0</td>
</tr>
<tr>
<td>Sewage sludge</td>
<td>4.0</td>
<td>0.79</td>
<td>0.86</td>
<td>1.5</td>
</tr>
<tr>
<td>Industrial waste, Danish</td>
<td>2.5</td>
<td>0.51</td>
<td>0.56</td>
<td>1.5</td>
</tr>
<tr>
<td>Industrial waste, imported</td>
<td>2.5</td>
<td>0.30</td>
<td>0.35</td>
<td>0.0</td>
</tr>
<tr>
<td>Organic household waste</td>
<td>2.5</td>
<td>0.01</td>
<td>0.01</td>
<td>2.0</td>
</tr>
<tr>
<td>Garden waste</td>
<td>1.0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.8</td>
</tr>
<tr>
<td>Landfill gas</td>
<td>1.0</td>
<td>0.55</td>
<td>0.58</td>
<td>0.2</td>
</tr>
</tbody>
</table>

|               | 35.0                | 2.67              | 2.91              | 20.0                   |
Will organic household waste to biogas plants increase?

- High quality necessary
  - low heavy metal content
  - low content of organic micropollutant
  - sanitation at the biogas plant

- Pre-treatment necessary

- Reliable disposal route
Regulatory framework

- Statutory order on utilisation of waste products in agriculture
  - all waste, including industrial waste, organic household waste and sludge
  - quality demands for heavy metals, organic micropollutants
  - hygienic treatment requirements
  - rates of application (kg N, kg P pr. ha. and year)
  - supervision by local author
Summary and conclusions

• Higher energy production through biogas production than incineration
• Nutrients are utilized in agriculture
• Co-digestion with animal manure results in a stable process
• Reliable disposal route if the organic waste has high quality
• Research on energy aspects and cost-benefit analysis are ongoing