BIOGAS
Energy and nutrient solutions

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WP leader - Manure Energy Use

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GABBS 2013, Helsinki, Finland
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Biogas technology...

- makes use of microbiological degradation of organic materials, such as manure, in anaerobic, closed digesters
- produces two end-products
  - Energy-rich biogas (methane + carbon dioxide)
  - Nutrient-rich digestate (more soluble nitrogen)
- enables mitigation of emissions from manure with other proper choices
- can be designed for different scales from farms to large plants

Photos: Sari Luostarinen / MTT

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• Undegraded organic matter in manure can be turned into biogas
• Different manures have different energy content
Biogas from manure - energy (2)

- Energy yield of manure based biogas can be increased with suitable co-substrates

The project is partly financed by the European Union Regional Development Fund.
Biogas from manure – Nutrients and emissions

• Nutrients are preserved during digestion
  • Organic nitrogen mineralised into soluble and readily plant-available ammonium
  • Possibility to recycle also nutrients from other organic materials (co-substrates)
• Direct GHG emissions from manure can be reduced
  • Also reduction of GHGs by replacing fossil energy
• Ammonia emissions and nutrient run-off can be reduced

• TO ACHIEVE ALL THESE GOOD EFFECTS, THE WHOLE MANURE MANAGEMENT CHAIN MUST BE OPTIMISED
  – Quick collection from barn
  – Sufficient retention time in digester
  – Post-digestion
  – Covered storage
  – Optimal timing and method for digestate spreading
  – Optimal dose of digestate as fertiliser
## Manure energy potential in the BSR

<table>
<thead>
<tr>
<th>Country</th>
<th>Manure (t/a)</th>
<th>Theoretical EP</th>
<th>Techno-economical EP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min (TWh/a)</td>
<td>Max (TWh/a)</td>
</tr>
<tr>
<td>Finland</td>
<td>13 543 967</td>
<td>2.41</td>
<td>5.20</td>
</tr>
<tr>
<td>Sweden</td>
<td>21 743 000</td>
<td>3.38</td>
<td>7.04</td>
</tr>
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<td>Denmark</td>
<td>34 395 100</td>
<td>4.38</td>
<td>9.13</td>
</tr>
<tr>
<td>Germany*</td>
<td>23 765 348</td>
<td>2.95</td>
<td>6.16</td>
</tr>
<tr>
<td>Poland</td>
<td>69 775 669</td>
<td>20.0</td>
<td>36.8</td>
</tr>
<tr>
<td>Lithuania</td>
<td>12 321 471</td>
<td>2.69</td>
<td>5.69</td>
</tr>
<tr>
<td>Latvia</td>
<td>7 585 496</td>
<td>1.16</td>
<td>2.62</td>
</tr>
<tr>
<td>Estonia</td>
<td>3 621 000</td>
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<td><strong>TOTAL</strong></td>
<td><strong>186 751 051</strong></td>
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*Mecklenburg Western-Pommerania & Schleswig-Holstein only

Including cattle, pig and poultry manure


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## Manure energy use as biogas in 2012

<table>
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<tr>
<th>Country</th>
<th>No of biogas plants</th>
<th>No of biogas plants treating manure</th>
<th>Amount of manure digested (t/a)</th>
</tr>
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<tbody>
<tr>
<td>Finland</td>
<td>35</td>
<td>17</td>
<td>180 000</td>
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<tr>
<td>Sweden</td>
<td>50</td>
<td>40</td>
<td>350 000</td>
</tr>
<tr>
<td>Denmark</td>
<td>150</td>
<td>80</td>
<td>2 500 000</td>
</tr>
<tr>
<td>Germany</td>
<td>7320</td>
<td>NR</td>
<td>3 500 000… 6 000 000</td>
</tr>
<tr>
<td>M-WP*</td>
<td>325</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-H**</td>
<td>561</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>28</td>
<td>16</td>
<td>269 000</td>
</tr>
<tr>
<td>Lithuania</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Latvia</td>
<td>30</td>
<td>30</td>
<td>725 000</td>
</tr>
<tr>
<td>Estonia</td>
<td>10</td>
<td>2</td>
<td>140 000</td>
</tr>
</tbody>
</table>

NR = not reported

* Mecklenburg-Western Pommerania; **Schleswig-Holstein

4.2 million t manure/a to biogas out of 187 million t/a available (excluding the two German states)

**SIGNIFICANT POTENTIAL STILL AVAILABLE**
Manure based biogas

Incentives and bottlenecks NOW
Incentives for manure biogas in the BSR

• Investment grants
  – Usually max 30% of the investment costs, but may come with prerequisites
• Feed-in tariffs / fixed prices
  – Vary significantly between BSR, detailed prerequisites
• Tax exemptions
• Other observations
  – Manure valued differently in different countries
    • EXAMPLE 1: the target in Denmark is to have 50% of manure in energy production (=biogas) by 2020 – subsidies available / planned to promote manure based biogas in particular
    • EXAMPLE 2: the feed-in tariff for biogas electricity in Finland is not available for plants with less than 100 kVA of efficiency – rules out all smaller, manure based biogas plants
Bottlenecks for manure biogas in the BSR

- Profitability
  - High investment cost, mostly rather modest subsidies
  - Manure alone not sufficient for income – need for co-substrates
- Changing political scene and legislation
  - Avoidance of risky investments due to uncertainties
- Heavy permission processes (in some countries)
- Value for nutrient recycling and avoided emissions
- Lack of knowledge
- Attitudes: NIMBY
Technological bottlenecks

• **Significant share of the energy potential in solid manure**
  – Ratio of slurry : solid manure about 50:50 in the BSR
    • Differences between countries: 80% slurry in Denmark, 10% slurry in Poland
  – Better solutions for solid manure are needed
    • Co-digestion with slurry
    • Pre-treatments to pulp into pumpable form and to increase degradability
      – Beneficial also for other ligno-cellulosic materials
    • Possibly new digester designs for high dry matter contents
      – E.g. two-stage process (separate hydrolysis and leachate digestion)

• **Challenges with plant operation**
  – Technical problems: no sufficient knowhow
  – No operation strategy
Incentives for the future

WHAT SHOULD BE DONE?
Recommendations for manure based biogas

**Farmer / entrepreneur**
- Plan biogas plants to answer to farm-specific requirements and ensure constant feed supply
- Take time to find all possibilities to increase profitability
- Understand manure based biogas as part of the entire manure management chain in order to take full advantage of all the benefits involved

**Policy / decision maker**
- Understand manure based biogas as part of the entire manure management chain in order to support the right actions
- Create well-defined and stable subsidy systems and give extra credit to solutions including manure
- Create support for not only renewable energy, but also nutrient recycling and emission mitigation
Manure based biogas offers...

- Renewable energy
- Recycling of nutrients from different organic by-products
- Enhancement of nitrogen utilisation
- Mitigation of emissions
- More efficient food production by decreasing the agricultural use of fossil fuels and mineral fertilisers

**WHEN IT IS DONE IN THE RIGHT WAY!**
More information:

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