Pocket digestion – a solution for agroresidues?

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What is pocket or small scale anaerobic digestion?

- **Flanders**: no real definition, max. 5000 ton/yr input, engine < 200 kW\textsubscript{el}
- **Germany**: max. 75 kW\textsubscript{el} (~ stimuli)
- **Ireland**: n.a.
- **Luxembourg**: max. stimuli < 150 kW\textsubscript{el}
- **The Netherlands**: < 500 kW\textsubscript{el} (less administration)
- **United Kingdom**: 25-250 kW\textsubscript{el} (industry accepted definition)
Why is it so succesful in Flanders?

- 2011-2015: 86 small installations (~40 large AD)

- Success factors:
  - Inputs on farm
  - Only manure → no extra animal-based nutrients
  - <10 kW: back rotating counter for electricity use
  - Modular system - payback period 5-8 years
  - Measure for reduction of GHG emissions from manure storage (support Climate Fund)

Biolectric (BE, 10-40 kW)
Small scale AD in surrounding regions

<table>
<thead>
<tr>
<th>Region</th>
<th>SMALL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>500 inst. &lt;70 kW\textsubscript{el}</td>
<td>8000 plants</td>
</tr>
<tr>
<td>IRL</td>
<td>None</td>
<td>7 plants</td>
</tr>
<tr>
<td>LUX</td>
<td>8 inst. &lt;200 kW\textsubscript{el}</td>
<td>21 plants</td>
</tr>
<tr>
<td>NL</td>
<td>24 &lt;500 kW\textsubscript{el}</td>
<td>95 plants</td>
</tr>
<tr>
<td>UK</td>
<td>18 inst. &lt;200 kW\textsubscript{el}</td>
<td>63 plants</td>
</tr>
</tbody>
</table>
Preconditions

1. Sufficient qualitative biomass

2. Sufficient electricity demand

3. External storage for digestate

4. Heat valorisation

5. Fast & good follow-up

6. Low Δ (cost digestate - ’gate fee’)
### Dimensioning – example of Hooibeekhoeve

- **Energy demand** 121 MWh\textsubscript{e} & 66 MWh\textsubscript{th}

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Input</th>
<th>El. power</th>
<th>Energy coverage</th>
<th>Remarks</th>
<th>€</th>
</tr>
</thead>
</table>
| 1 x micro (100%)       | 2395 t| 9,7 kW\textsubscript{e} | E: 64% Th: 100%* | - no additional storage required  
  - *additional heating cost (2800€/y) | +     |
| 2 x micro (72%)        | 3440 t| 13,9 kW\textsubscript{e} | E: 92% Th: 100% | - potential expansion of capacity  
  - investment not fully valorised at this moment  
  - additional storage required | 0     |
| 2 x micro (100%)       | 4715 t| 19,4 kW\textsubscript{e} | E: 100% Th: 100% | - potential expansion of capacity  
  - 35 cows / external manure supply  
  - energy production not fully valorized | + +   |
| Pocket                 | 3440 t| 15,1 kW\textsubscript{e} | E: 100% Th: 100%* | - *additional heating cost (1246€/j)  
  - additional storage required  
  - high investment compared to additional return | - -   |
### Potential for further implementation

- **Cattle husbandries > 80-100 cows***

<table>
<thead>
<tr>
<th></th>
<th>Flanders</th>
<th>GER</th>
<th>IRL</th>
<th>LUX</th>
<th>NL</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of farms</td>
<td>&gt;900</td>
<td>&gt;38000</td>
<td>1300</td>
<td>&lt;600</td>
<td>5615</td>
<td>6900</td>
</tr>
<tr>
<td>Estimate % with AD**</td>
<td>&lt;13%</td>
<td>21%</td>
<td>0.5%</td>
<td>&lt;1%</td>
<td>&lt;2%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

* For Flanders, Ireland the numbers are farms with over 80 cows, for Germany, the Netherlands & the United Kingdom the numbers listed refer to farms over 100 cows, for Luxembourg only numbers were available for >55 cows.

** This estimate was calculated by dividing the number of (agricultural) AD by the number of farms owning 80-100 cows. These numbers will be overestimates since in some countries also AD from other sectors can be included.
### Potential for using other inputs than cattle slurry

- **Crop residues in the NWE region**

<table>
<thead>
<tr>
<th>Area (ha)</th>
<th>BE</th>
<th>GER</th>
<th>IRL</th>
<th>LUX</th>
<th>NL</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leek</td>
<td>3350</td>
<td>2399</td>
<td>60</td>
<td>1.1</td>
<td>2593</td>
<td>1718</td>
</tr>
<tr>
<td>Brussel sprouts</td>
<td>2544</td>
<td>517</td>
<td>176</td>
<td>-</td>
<td>2729</td>
<td>3041</td>
</tr>
<tr>
<td>Cabbages</td>
<td>3931</td>
<td>17 009</td>
<td>1748</td>
<td>3.4</td>
<td>6597</td>
<td>23 155</td>
</tr>
<tr>
<td>Maize (corn)</td>
<td>73 955</td>
<td>466 600</td>
<td>-</td>
<td>196</td>
<td>12 593</td>
<td>2500</td>
</tr>
</tbody>
</table>
Potential for using other inputs than cattle slurry

- Crop residues in the NWE region

- Results experiences scoping study → CS report agro residues
Potential for using other inputs than cattle slurry

- Technical feasibility?
- Market study constructors of small scale AD in the NWE region

**Small-scale Anaerobic Digestion**
Case studies in Western Europe

- GreenWatt (BE, 100 kW-MW)
- Kompoferm Smart (D, 75-150 kW)
# Feasibility-study: small scale AD of chicory roots

1. Scenario for 1 average chicory farm (25 ha): not profitable
2. Scenario for cluster of companies: 4 scenario’s proposed based on 3 variables

<table>
<thead>
<tr>
<th></th>
<th>++ opt. scenario based on heat fuel</th>
<th>++ opt. scenario based on gas heating</th>
<th>+- medium scenario</th>
<th>-- negative scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity</strong></td>
<td>100% coverage</td>
<td>100% coverage</td>
<td>100% coverage</td>
<td>100% power in the grid</td>
</tr>
<tr>
<td><strong>Heat</strong></td>
<td>100% coverage heat fuel 0,78€/L</td>
<td>100% coverage gas 0,04€/kWh&lt;sub&gt;th&lt;/sub&gt;</td>
<td>100% thickening digestate</td>
<td>100% thickening digestate</td>
</tr>
<tr>
<td><strong>Cost digestate</strong></td>
<td>low 6,5€/t</td>
<td>low 6,5€/t</td>
<td>low 6,5€/t</td>
<td>high 15€/t</td>
</tr>
</tbody>
</table>

- Digestate separation with screw press: liquid fraction for fertilization, thick fraction composted
- No synergies with accommodation (pre-treatment, separator, digestate storage)
Feasibility-study: small scale AD of chicory roots

Scenario’s for 5000 (81 kWe) & 10 000 ton (188 kWe)

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<th>++ opt. scenario based on gas heating</th>
<th>+- medium scenario</th>
<th>-- negative scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5000 ton</strong></td>
<td>13.77€/ton IRR 4.73%</td>
<td>6.91€/ton IRR &lt; 0</td>
<td>0.6€/ton IRR &lt; 0</td>
<td>-6.84€/ton IRR &lt; 0</td>
</tr>
<tr>
<td><strong>10.000 ton</strong></td>
<td>20.96€/ton IRR 23.65%</td>
<td>15.59€/ton IRR 15.04%</td>
<td>10.65€/ton IRR 6.10%</td>
<td>-3.81€/ton IRR &lt; 0</td>
</tr>
</tbody>
</table>

- Prices are expressed in yield per ton of input (gate-fee)
- Excl. transportation costs, costs for personnel, …
Feasibility-study: small scale AD of chicory roots

Conclusion - 3 key elements:

1. Suited site where residual heat can be valorised sufficiently

2. Low cost use of digestate by fertilization on proprietary land (6.5€/ton)

3. Sufficiently large amount of chicory roots, at least 10 000 ton/y

Take these elements in account while forming cooperations. Different cooperation strategies are possible.

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Conclusions: small scale AD

- can be a profitable way
  - to produce renewable energy from manure
  - to reduce GHG emissions during manure storage

- Close follow-up during exploitation is very important
  - by the farmer
  - by the constructor

- Further expansion towards other (crop) residues is uncertain
  - Other developments ranked higher in the biomass cascading system (e.g. feed)?
  - Technical feasibility?
  - Profitability?
  - Stimuli?
Special thank you to:

- European Regional Development Funding through Interreg IVb
- The provinces of West-Flanders, East-Flanders & Flemish Brabant
- The Flemish Energy Agency (Hermes fund)
- Enterprise Flanders

Icon sources: Schmidt Sergey, Luis Prado, anna, Till Teenck, Jacopo Mencacci & Chris Pyper from the Noun Project.
Thank you!

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