Country Report Germany

Bernd Linke
Leibniz-Institute for Agricultural Engineering
Share of renewable energy in Germany 2010

http://www.unendlich-viel-energie.de/
Area under cultivation for renewables ($10^3$ ha)

Plants for material and energy supply (2150)

- fibre: 10
- combustion: 160
- medical and color plants: 136
- sugar: 240
- oil: 650
- starch: 4
- Bioethanol: 10
- Biogas: 940
- biodiesel: 1200

Agricultural crop land in Germany: $12000 \times 10^3$ ha

Source: FNR (Agency for Renewable Resources), 2011
Biogas plants in Germany

Source: German Biogas Association
## Figures of agricultural biogas sector in Germany

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2009</th>
<th>2010</th>
<th>Outlook 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of biogas plants</td>
<td>4984</td>
<td>6000</td>
<td>6800</td>
</tr>
<tr>
<td>Grid injection of that</td>
<td>30</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>Installed electric power (MW)</td>
<td>1893</td>
<td>2279</td>
<td>2559</td>
</tr>
<tr>
<td>Generation of electricity (MWh/a)</td>
<td>11,6 Mio</td>
<td>15,0 Mio</td>
<td>17,1 Mio</td>
</tr>
<tr>
<td>households provided with electricity</td>
<td>3.5 Mio</td>
<td>4.3 Mio</td>
<td>4.9 Mio</td>
</tr>
<tr>
<td>Share of electricity (%)</td>
<td>2,0</td>
<td>2,6</td>
<td>3,0</td>
</tr>
<tr>
<td>Volume of business</td>
<td>4,44 Mrd</td>
<td>4,70 Mrd</td>
<td>4,71 Mrd</td>
</tr>
<tr>
<td>Number of jobs</td>
<td>16,000</td>
<td>19,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Share of export (%)</td>
<td>10</td>
<td>16</td>
<td>23</td>
</tr>
</tbody>
</table>

Source: German Biogas Association, 2011
Main substrates for biogas production

Mass proportion

- Biogas crops: 43%
- OFMSW: 10%
- Agroindustry: 6%
- Animal waste: 10%

Energy proportion

- Biogas crops: 73%
- OFMSW: 11%
- Agroindustry: 9%

Source: German Biomass Research Centre (DBFZ), Results from 420 German Biogas plants (2010)
Distribution of costs

- Depreciation: 22.3%
- Base rate: 8.5%
- Personnel costs: 14.7%
- Biogas crops costs: 4.9%
- Operating costs: 5.9%
- Other costs: 4.9%
- Costs for service contract: 2.0%

Source: Bundesmessprogramm, 2009, supported by Agency for Renewable Resources (FNR)
### Investment costs

<table>
<thead>
<tr>
<th></th>
<th>average</th>
<th>minimum</th>
<th>maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment costs</td>
<td>€ 1,358,603</td>
<td>€ 288,559</td>
<td>€ 5,000,000</td>
</tr>
<tr>
<td>Specific investment cost - electric power</td>
<td>€/kWel. 3,087</td>
<td>€ 1,529</td>
<td>€ 6,140</td>
</tr>
<tr>
<td>Specific investment cost - reactor</td>
<td>€/m³ AV 643</td>
<td>€ 209</td>
<td>€ 2,922</td>
</tr>
<tr>
<td>CHP</td>
<td>€/kWel. 610</td>
<td>€ 251</td>
<td>€ 868</td>
</tr>
<tr>
<td>Feeding system</td>
<td>€/kWel. 132</td>
<td>€ 43</td>
<td>€ 274</td>
</tr>
</tbody>
</table>

Source: Bundesmessprogramm, 2009, supported by Agency for Renewable Resources (FNR)
Income, costs and profit/lost

Source: Bundesmessprogramm, 2009, supported by Agency for Renewable Resources (FNR)
Value chain of biomethane feed-in and distribution

Source: dena, biogasregister 2011
Operation mode of "biogasregister"

Producer accounts biomethane in the biogasregister
Official reviewer checks the production and confirms the feed in
Producer and trader manage production chain and gas grid
Consumer gets a record on the consumed biomethane

Source: dena, biogasregister 2011
Amendment of the Renewable Energy Sources Act (EEG) 2012 in Germany

Position paper of the German Biogas Association, main topics

- Conservation of the status quo of existing biogas plants according EEG 2009
- Graduation of refund as a function of plant size have been proved
- Agriculture has the most potential for increase in biogas capacity, therefore
  Extension of biogas crops culture and utilisation of animal wastes
- Organic waste biogas plants have switched to NawaRos plants, therefore
  Separation of boni for biogas crops (NawaRos) and animal waste
- Biogas plants for organic wastes utilisation should get the animal waste boni
- Implementation of a renewable biomethane feed in law (EGE)
- Priority of biogas plants in comparison with fossil or nuclear plants
<table>
<thead>
<tr>
<th>Project Short title</th>
<th>Institution</th>
<th>Project expiry</th>
</tr>
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<tbody>
<tr>
<td>Micro wave analytic for process control</td>
<td>IBA Heiligenstadt</td>
<td>5/2011</td>
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<tr>
<td>upscaling for high performance microorganisms</td>
<td>Schmack Biogas</td>
<td>10/2011</td>
</tr>
<tr>
<td>Data collection of energy crops</td>
<td>KTBL, Darmstadt</td>
<td>7/2012</td>
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<tr>
<td>Methanogenic Archaea Culture Collection, MACC</td>
<td>ATB</td>
<td>8/2012</td>
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<td>membrane technology for higher biogas yields</td>
<td>FH Nordhausen</td>
<td>2/2013</td>
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<tr>
<td>Sugar beet breeding for high methane yield</td>
<td>KWS</td>
<td>3/2013</td>
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<tr>
<td>sun flower breeding for high methane yield</td>
<td>KWS, Univ. Hohenheim</td>
<td>10/2013</td>
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<tr>
<td>biofilms in CSTR and two phase digesters</td>
<td>ATB</td>
<td>08/2013</td>
</tr>
<tr>
<td>Application of enzymes in lab scale and practice</td>
<td>ATB, DBFZ, industry</td>
<td>9/2013</td>
</tr>
<tr>
<td>Climate impact of Biomethane economy</td>
<td>DBFZ</td>
<td>2/2014</td>
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</tbody>
</table>
Research on two phase biogas fermenters at ATB

- Fermentation in solid and liquid (2 phase), batch [A] and continuously feeding, [B] [C]
- Fractional separation of hydrolysis and methanogenesis
- Reduction of energy demand for mixing
- Integration of high performance anaerobic filter for VFA degradation
- Removal of ammonia from process liquor to prevent ammonia inhibition
Thank you for your attention

Source: Stiftung Rheinische Kulturlandschaft