Biogas - Trends in Germany
Biogas as a key in future energy systems

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Outline

- German Biogas Association
- Development of biogas production and political framework in Germany
- Actual trends in Germany
German Biogas Association - Objectives

Objectives:

• Promotion of the biogas sector
• Promotion of a sustainable energy supply
• Definition of legal framework for reliable and long-term investments
• Creation of adequate technical rules and standards
• Promotion of R & D
• Exchange of information
• Members service

Lobbying on federal state, federal and EU level in the following fields:

• Renewable Energy Act (EEG)
• Energy management
• Regulatory approval
• Environmental law
• Laws on agricultural issues
• Tax law
• ...
Structure of the German Biogas Association

**Steering Committee**
- 7 members, elected for a 4-year-period

**Board of Trustees**
- Elected honorary spokesmen of regional groups, working groups and advisory boards

**Advisory Boards, Working Groups**
- Advisory boards of plant operators, companies, the legal profession, funders; Working groups for the areas permissions, safety, feeding-in of biogas, environment, heat, waste and fertiliser law

**Headquarters in Freising**
- 23 employees, organised in 10 departments

**Berlin Office**
- 5 employees

**Regional offices (North, South, East, West and Editorial Office Biogas Journal**
- 5 employees

**23 Regional groups in Germany**

**4,800 Members**
- Operators of biogas plants
- Providers of feedstock
- Research Institutions
- Interested private individuals
- Public authorities
- Lawyers
- Companies and manufacturers
- Corporate finance
- Planners, advisers, laboratories

Member of the European Biogas Association (EBA)
European Biogas Association

26 countries
Provision of electricity in Germany in 2012

- **Renewables**: 23%
- **Lignite**: 26%
- **Nuclear power**: 16%
- **Hard coal**: 19%
- **Natural gas**: 11%
- **Others**: 5%

Total: 618 TWh

Source: FvB based on AfEE 2013
More than 50% of the RES are fluctuating.

Overall: 136 TWh

- Wind: 33.8%
- Photovoltaic: 20.6%
- Hydro: 15.6%
- Biomass: 30.0%
- Biogas: 15.1%
- Solid biofuels: 9.2%

Share renewable energies on overall consumption: 23%

Source: FvB based on BMU 2013
Flexibility instead of base load: The new role of bioenergy

- With increasing share of RES baseload loses importance
- Flexible systems fill the valleys of wind and sun
  - CHP with bioenergy & natural gas
  - New role of biogas

20% Renewable Energy Sources

40% Renewable Energy Sources

80% Renewable Energy Sources

Capacity [GW]

Demand (2010)
Production
Wind & Solar

red
green
Why Biogas?

Input:
- Biowaste, energy plants & manure

Output:
- Power, heat & transport fuel
- Fertiliser
- Reduction of greenhouse gases
- Reduction of fossil imports
- Biogas

Reduction of fossil imports
Reduction of greenhouse gases
The biogas principle – like a concrete cow

Products: heat and power

Product: slurry

Feed

Digester

Engine
Scheme of an agricultural biogas plant

- **Local heat**
- **Manure storage**
- **Biogas**
- **Heat**
- **House**
- **Barn**
- **Animal excrements**
- **Input material**
- **Second digester & digestate storage**
- **Digester with gas storage**
- **Upgrading of biogas**
- **Biomethane**
- **Natural gas grid**
- **Biogas**
- **Electricity**
- **Gas engine & generator in CHP**
- **Electric grid**
- **Renewable primary products & residues / waste**
- **Digestate**
- **Energy plants**
- **Agricultural utilisation**

Source: FvB based on FNR e.V.
Fields of Application for Biogas
Biogas plant in maize field

©Fachverband Biogas e.V.
Stainless steal digester under construction

Foto: Weltec
Inside a digester

The inside of a digester

©Fachverband Biogas e.V.
Gas storage facilities

Gas hood with EPDM foil

Fotos: Biolene, Cenotec

Foil roof (tight)

Transport air foil roof

Fotos: Cenotec, Sattler

External gas storage facilities
Gas utilisation in CHP
Feedstock of biogas plants

<table>
<thead>
<tr>
<th>Excrements</th>
<th>Energy plants</th>
<th>Agricultural residues</th>
<th>Organic waste of plants</th>
<th>Organic waste of animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid &amp; solid manure</td>
<td>Grass, maize, potatoes, mustard, silage..</td>
<td>Beet leaves, harvest residues...</td>
<td>Brewer grains, vegetable waste, old fat, distiller’s wash...</td>
<td>Food residues, grease...</td>
</tr>
</tbody>
</table>

Source: FvB based on VLK (2002)
Feedstock in German biogas plants in 2012

<table>
<thead>
<tr>
<th>% by weight</th>
<th>% by energy output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy plants</td>
<td>43.1%</td>
</tr>
<tr>
<td>Biowaste</td>
<td>0.3%</td>
</tr>
<tr>
<td>Liquid &amp; solid manure</td>
<td>3.8%</td>
</tr>
<tr>
<td>Industrial &amp; agricultural residues</td>
<td>52.8%</td>
</tr>
</tbody>
</table>

Source: FvB based on DBFZ-Betreiberumfrage (2012/2013)
Collection of catering waste in Germany
Number of biogas plants & installed electric capacity (as of 05/2013)

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# Biogas sector at a glance

<table>
<thead>
<tr>
<th></th>
<th>2011*</th>
<th>2012*</th>
<th>Forecast 2013**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of biogas plants (thereof plants feeding-in biomethane )</td>
<td>7.180 (77)</td>
<td><strong>7,500 (109)</strong></td>
<td>7.770 (124)</td>
</tr>
<tr>
<td>Additional installations per year</td>
<td>1270</td>
<td>340</td>
<td>257</td>
</tr>
<tr>
<td>Installed electric capacity in MW (without feeding-in of biomethane)</td>
<td>2,980</td>
<td>3,200</td>
<td>3,360</td>
</tr>
<tr>
<td>Installed electric capacity in MW (with feeding-in of biomethane)</td>
<td>3,100</td>
<td><strong>3,350</strong></td>
<td>3,530</td>
</tr>
<tr>
<td>Overall capacity for upgrading of raw gas to biomethane (Nm³/h)</td>
<td>86,000</td>
<td>116,000</td>
<td>132,000</td>
</tr>
<tr>
<td>Additional electrical capacity new installations in MW per year</td>
<td>806</td>
<td>255</td>
<td>177</td>
</tr>
<tr>
<td>Annually net generation of electricity inTWh</td>
<td>19.1</td>
<td><strong>22.8</strong></td>
<td>24.4</td>
</tr>
<tr>
<td>Households supplied with electricity from biogas in Mio.</td>
<td>5.5</td>
<td>6.5</td>
<td>7.0</td>
</tr>
<tr>
<td>Share of German electricity generation in %</td>
<td>3.2</td>
<td><strong>3.9 %</strong></td>
<td>4.1</td>
</tr>
<tr>
<td>Volume of trade in billion Euro</td>
<td>8.3</td>
<td>7.3</td>
<td>6.9</td>
</tr>
<tr>
<td>Jobs</td>
<td>63,000</td>
<td><strong>45,000</strong></td>
<td>42,000</td>
</tr>
</tbody>
</table>

* own extrapolation on the basis of data of the German states
** on basis of an expert survey

All values rounded!
German Renewable Energy Act (EEG)

- Priority connection, purchase and transmission for electricity from renewable energy sources
- A consistent fee for this electricity paid by the grid operators for a 20-year period

The core elements of the EEG guarantee:
- Mid and long term planning and investment security
- Calculable cost for consumers
- Specific fees for different technologies
- Low bureaucratic effort
- Participation for local and regional players
The EEG is one of the world’s most efficient support mechanism for RES (copied by nearly 50 countries)

**But:**
Germany’s success of RES would not be possible with today’s law and the relatively low tariffs – so it is worthwhile to have a look at the older versions of the EEG

- **EEG 2000**
  - Consistent fee for 20 years
  - Priority connection
  - 250 new plants a year

- **EEG 2004**
  - Bonus for energy crops
  - Bonus for using heat
  - 450 new plants a year

- **EEG 2009**
  - Bonus for new techniques
  - Bonus for emission reduction
  - Bonus for manure
  - 1000 new plants a year

- **EEG 2012**
  - New system
  - New requirements on efficiency and ecology
  - 340 new plants a year
Additional biogas plant installations per year

- EEG 2000
- EEG 2004
- EEG 2009
- EEG 2012

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EEG 2012

- Reduction of compensation, but possibility of mixture of input material (compensated according to methane production), advantages for big plants.
- Limitation of maize as feedstock (not more than 60% maize silage over the year - by weight)
- Obligation for covering of digestate storage and necessity of hydraulic retention time of at least 150 days
- Either 60% heat utilization or 60% manure utilization (by weight)
- Minimum external heat utilization (at least 35%)
- Direct marketing possible due to market premium and flexibility premium
Promotion of Direct Marketing of Electricity

• Increasing share of renewable energy leads to a more volatile electricity production
• Increasing importance of controlled power stations: e.g. biogas
• EEG 2012 (market bonus – management bonus, flexibility bonus) offers opportunities for additional income
• Special biogas plants for electricity production according to market need
• Storage capacity
• Higher installed capacity
New feed-in system EEG 2012

Biogas

- Small manure installations (0-75 kW) - 80% manure -
- Basic tariff for biogas installations
- Biowaste installations - 90% biowaste -

Input material category I

Input material category II
New Feed-In Tariffs under the EEG 2012 (ct/kWh$_{el}$)

<table>
<thead>
<tr>
<th>Category</th>
<th>Basic compensation</th>
<th>Input material category I</th>
<th>Input material category II</th>
<th>Digestation of biowaste$^b$</th>
<th>Bonus for upgrading of biogas</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 75 kW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 ct/kWh$^{a)}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 150 kW</td>
<td>14.3 ct/kWh</td>
<td>6.0 ct/kWh</td>
<td>8.0 ct/kWh</td>
<td>16 ct/kWh</td>
<td>3 ct/kWh to 700 Nm³/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 ct/kWh to 1,000 Nm³/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 ct/kWh to 1,400 Nm³/h</td>
</tr>
<tr>
<td>≤ 500 kW</td>
<td>12.3 ct/kWh</td>
<td>6.0 ct/kWh</td>
<td>8.0 ct/kWh</td>
<td>16 ct/kWh</td>
<td>Nominal output of feed-in plant</td>
</tr>
<tr>
<td>≤ 750 kW</td>
<td>11.0 ct/kWh</td>
<td>5.0 ct/kWh</td>
<td>8.0/6.0$^{(c)}$ ct/kWh</td>
<td>14 ct/kWh</td>
<td></td>
</tr>
<tr>
<td>≤ 5,000 kW</td>
<td>11.0 ct/kWh</td>
<td>4.0 ct/kWh</td>
<td>8.0/6.0$^{(c)}$ ct/kWh</td>
<td>14 ct/kWh</td>
<td></td>
</tr>
<tr>
<td>≤ 20,000 kW</td>
<td>6.0 ct/kWh</td>
<td>0.0 ct/kWh</td>
<td>0.0 ct/kWh</td>
<td>14 ct/kWh</td>
<td></td>
</tr>
</tbody>
</table>

a) No combination with basic compensation and/or compensation for input material of category I and II possible!
b) No combination with basic compensation and/or compensation for input material of category I and II possible!
c) Electricity from manure and dung
Advantages of using manure and waste as substrates for biogas

- Reduction of waste volume by 50-80% (depending on share of biowaste)
- Production of organic fertilisers and reduction of mineral fertilisers by closed nutrient cycles (e.g. phosphorus)
- Sustainable energy production and substitution of fossil energy carriers
- Increasing independence and security of energy supply
- Reduction of greenhouse-gas-emissions (by substitution of fossil energy carriers and mineral fertilisers, avoidance of methane emissions digesting manure and biowaste)
- Creating jobs
Example

10.000 t rejected vegetables
7.500 t waste from vegetable processing
2.000 t food left overs
2.000 t green cuttings from privat/public garden
20.000 t manure from 1.000 cows

500 kW electric power $\rightarrow$ electricity for 1.000 households
$\rightarrow$ heat for 300 households
Conclusion

• Biogas as allrounder
• Biogas as key in Energy Turnaround
• High interest for biogas all over the world
• Four main trends in Germany:
  1. Small farm-sized plants based on manure and agricultural by-products
  2. Using of the natural gas grid as storage
  3. Specialized direct marketing: Balancing the fluctuating power generation from wind und sun (flexibility)
  4. Export Business (40 % up to may 2013)
Thank you for your attention!

... we will see us in Nuremberg!
14.01 – 16.01. 2014

- Export Workshop!
- International Panel on opportunities and experiences in Development & Emerging Countries!

www.biogas.org
www.biogas-kanns.de
www.biogas-tour.de
www.farbe-ins-feld.de
www.biogas-in-sh.de
www.biogas-in-bayern.de
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