Content

German Biogas Association
Renewable energy in Germany
The biogas market in Germany
Political framework in Germany
Different operation techniques in use
Trends on the international biogas markets
Conclusions
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
28 employees, organised in 10 departments

Berlin Office
6 employees

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

23 Regional groups in Germany

Operators of biogas plants
Providers of feedstock
Research Institutions

4,800 Members
Interested private individuals
Public authorities
Lawyers

Companies and manufacturers
Corporate finance
Planners, advisers, laboratories

Member of the European Biogas Association (EBA)
**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 laws
- Laws on agricultural issues
- Tax law
- …
European Biogas Association
26 countries – 34 National Organisations – 40 Companies

www.european-biogas.eu
Content

- German Biogas Association
- Renewable energy in Germany
- The biogas market in Germany
- Political framework in Germany
- Different operation techniques in use
- Trends on the international biogas markets
- Conclusions
Reasons for the energy transition in Germany

- Climate and environment protection
- Sustainable development of energy production
- Reduction of costs for German national economy by incorporating long-term external effects
- Conservation of fossil resources
- Independency from imports of fossil fuels
- In the long term costs for fossil fuels will rise; „fuel costs“ for RE are for free or will probably increase lower
- Technology development
- Creation of employment, especially in rural areas
- Development of new markets and sales
Advantages of Biogas I

- Production of energy
  - Electricity
  - Heat
  - Vehicle fuel
- Storable and flexible energy source
- High employment rate
- Business creation
  - planning
  - operation
  - maintenance
Advantages of Biogas II

• Fertilizer production

• Climate and environment protection
  • Avoidance of methane emissions
  • Substitution of fossil energy
  • Substitution of synthetic fertiliser
  • Nutrient recycling
  • Odor reduction
Structure of the German electricity production from renewable energy sources (2014)

30% of electricity production from RES

More than 50% of the RES are fluctuating
Content

• German Biogas Association
• Renewable energy in Germany
• The biogas market in Germany
• Political framework in Germany
• Different operation techniques in use
• Trends on the international biogas markets
• Conclusions
Number of biogas plants & installed electric capacity

© Fachverband Biogas e.V. / German Biogas Association
Biogas sector at a glance

<table>
<thead>
<tr>
<th></th>
<th>Forecast 2014*</th>
<th>Forecast 2015**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of biogas plants</td>
<td>8.726 (178)</td>
<td>8.928 (190)</td>
</tr>
<tr>
<td>(biogas plants with biomethane injection)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed electric capacity in MW</td>
<td>3.905</td>
<td>4.177</td>
</tr>
<tr>
<td>Gross electricity production in TWh per year</td>
<td>32.08</td>
<td>32.67</td>
</tr>
<tr>
<td>Housholds supplied with biogas-based electricity in millions</td>
<td>9.2</td>
<td>9.3</td>
</tr>
<tr>
<td>CO₂ reduction by biogas in million tons</td>
<td>18.0</td>
<td>21.2</td>
</tr>
<tr>
<td>Turnover in Germany in Euro</td>
<td>9.1 Billion</td>
<td>9.2 Billion</td>
</tr>
<tr>
<td>Jobs in the biogas sector</td>
<td>45.000</td>
<td>44.000</td>
</tr>
</tbody>
</table>

* Own extrapolation based on country data/data from energy supplier
** Based on a expert survey

Frank Hofmann
05.04.2016
Feedstock in German biogas plants

Excrements: Liquid and solid manure, dung…

Energycrops: Grass, maize, corn, potatoes, fodder beet, mustard, silage…

Agricultural by-products: Beet leaf, straw, harvest residues, vegetable matter…

Vegetable waste: Brewer grains, vegetable waste, old fat, molasses, distiller’s wash, Marc, garden and park waste…

Residential and industrial waste: separate collected residential, waste, organic fraction of mixed waste, fat separator contents, flotation tailings, food waste, leftovers, expired food, grease, blood, residues from milk production, sewage sludge, …

Agriculture → Biogas plant

Fertilizer → Biogas

Heat, electricity, fuel

Biogas plant → Digestate

Biogas → Heat, electricity, fuel
Fields of Application for Biogas
Content

• German Biogas Association
• Renewable Energy in Germany
• The biogas market in Germany
• Political framework in Germany
• Different operation techniques in use
• Trends on the international biogas markets
• Conclusions
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 costs for consumers
- Specific fees for different technologies
- Low bureaucratic effort
- Participation for local and regional players

- **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

- **EEG 2014**
  - 200 new plants in 2015

Frank Hofmann
05.04.2016
Content

• German Biogas Association
• Renewable Energy in Germany
• The biogas market in Germany
• Political framework in Germany
• Different operation techniques in use
• Trends on the international biogas markets
• Conclusions
# Technologies in use in Germany

<table>
<thead>
<tr>
<th>Wet digestion Complete Mixed Reactor</th>
<th>Dry continuous digestion Plug Flow Reactor</th>
<th>Dry batch digestion Garage Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15 % dm</td>
<td>15 – 30 % dm</td>
<td>&gt; 30 % dm</td>
</tr>
<tr>
<td>Thermophilic</td>
<td>Thermophilic</td>
<td>Thermophilic</td>
</tr>
<tr>
<td>Mesophilic</td>
<td>Mesophilic</td>
<td>Mesophilic</td>
</tr>
</tbody>
</table>

- **Wet digestion**
  - Complete Mixed Reactor
  - < 15 % dm
  - Thermophilic
  - Mesophilic

- **Dry continuous digestion**
  - Plug Flow Reactor
  - 15 – 30 % dm
  - Thermophilic
  - Mesophilic

- **Dry batch digestion**
  - Garage Systems
  - > 30 % dm
  - Thermophilic
  - Mesophilic
Inside a digester

The inside of a digester

©Fachverband Biogas e.V.
Plug flow reactor

Input

biogas

digestate
Garage System

Frank Hofmann
05.04.2016
The new role of biogas in electricity production: Flexibility instead of base load

With increasing share of RES baseload loses importance
Flexible systems fill the valleys of the 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
Content

• German Biogas Association
• Renewable Energy in Germany
• The biogas market in Germany
• Political framework in Germany
• Different operation techniques in use
• **Trends on the international biogas markets**
• Conclusions
Biogas in Europe

17,240 biogas plants in Europe (31/12/2014)
Total installed capacity of 8,293 MW_{el}
Motivation / Trends in developing and emerging countries

- Clean Development Mechanism (CDM) – focus on the reduction of methane rather than electricity production
- Decentralized energy solutions driven by industry – avoid energy black outs and high costs of importing fossil fuels
- Environmental regulations (waste water, municipal waste, agricultural waste, landfills, etc.)
- Feed in Tariffs / Quotas
- Biogas upgrading to Biomethane
- MSW, Agricultural residues, Landfill gas, Sewage gas, Energy crops?
- Establishment of National Biogas Associations!
Promotional material

biogas.org

german-biogas-industry.com
New promotional material in 2016

„Biowaste to Biogas – production of energy and fertilizer from organic waste“
Brochure will be published at IFAT in Mai 2016

Links
Firmenliste Export
FvB Marketplace
Content

- German Biogas Association
- Renewable Energy in Germany
- The biogas market in Germany
- Political framework in Germany
- Different operation techniques in use
- Trends on the international biogas markets
- Conclusions
Conclusion

• Germany is a **frontrunner in renewables**
• Biogas is as an **all-rounder** and a key in the energy mix
• Three main trends in Germany:
  1. Feedstock: manure/waste - no energy crops
  2. Flexibility (balancing the fluctuating power generation)
  3. Export business of the manufactures (60%)
• Huge potential and interest for biogas worldwide (biowaste digestion, agricultural residues, industrial residues and waste)
  → **know-how is necessary**
• Lot of experience and know-how in Germany!
Frank Hofmann

Consultant
Development Cooperation
German Biogas Association

Email: frank.hofmann@biogas.org
Internet: www.biogas.org