Biowaste to Biogas!

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Agenda

- Structure of the German Biogas Association
- Possibilities of biogas production
- German biogas market
- Commonly used techniques for the anaerobic digestion
- Digestate application
Over 400 honorary experts

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
6 employees

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

23 Regional groups in Germany

4,900 Members
Operators of biogas plants
Providers of feedstock
Research Institutions

Interested private individuals
Public authorities
Lawyers

Companies and manufacturers
Corporate finance
Planners, advisers, laboratories
Possibilities of biogas production (I)

- CO$_2$ neutral energy production by the digestion of organic waste
- Production of a primary energy source which is available for manifold applications
- If used for electricity production: Flexible application and easing the strain of electricity grids
- Especially in developing countries utilisation by cooking, heating and gas lightning
- Improvement of the standard of living by the reduction of the waste volume
- Production of humus rich fertiliser and closing of the nutrient circles
Possibilities of biogas production (II)
Development of the stock of German biogas plants (11/2015)

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Feedstock used in German biogas plants

% by weight
- Biowaste: 48% (6%)
- Liquid & solid manure: 2% (44%)
- Energy crops: (13%)
- Industrial and agricultural residues: (77%)

% by energy output
- Biowaste: 13% (7%)
- Liquid & solid manure: 3% (3%)
- Energy crops: (77%)
- Industrial and agricultural residues: (2%)

Source: Motoringbericht DBFZ, June 2014
Energy yield of possible feedstock

Methane output (m³/fresh biomass)

Power yield (kWhₚₑₜ/f wet weight)

- Cattle manure
- Fruit and grape mash
- Food leftovers
- Potato peels
- Biowaste from households
- Animal blood
- Corn
- Fat separator content
- Old bread

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Waste digestion plants in Germany

- About 400 plants for the digestion of biological wastes and residues

- Feedstock categories:
  - Biowaste from households
  - Industrial and commercial wastes
  - Animal by-products
  - Vegetable by-products

- Approved capacity ~ 8.9 Mio. Mg/a

- Installed electrical capacity ~ 266 MW
Approved capacity of German biogas plants

- Varying approved capacities between 510 and 500,000 tonnes (or Mg) per year

- Approved capacity in areas with less biogas plants (Eastern Germany) markedly higher than in areas with a higher plant density

- Average installed capacity: 975 kW
**Overview of technologies depending on dry matter content for the possible operating mode***

<table>
<thead>
<tr>
<th>Dry matter content</th>
<th>2%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
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<td>UASB**</td>
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<td>Wet digestion</td>
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<td>Dry continuous digestion</td>
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<td>Composting</td>
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<td>Dry batch digestion</td>
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<td>Incineration</td>
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*Mostly every feedstock can be diluted to the needed dry matter content of each digester technology.

**UASB**: Upflow anaerobic sludge blanket technology is a form of anaerobic digestion designed for materials with high water content (e.g. sewage sludge). UASB reactors are installed for waste or process water treatment.
Wet digestion

Continuously stirred tank reactor (CSTR)

Hydraulic digester

1 Input  2 Biomass  3 Agitator  4 Heating system  5 Biogas storage  6 Biogas utilisation  7 Output
Dry continuous digestion

Plug flow reactor

1 Input  2 Biomass  3 Agitator  4 Heating system  5 Biogas storage  6 Biogas utilisation  7 Output
Dry batch digestion

1. Gastight door
2. Biomass
3. Drainage system for percolation liquid
4. Heating system
5. Biogas storage
6. Biogas utilisation
7. Percolation liquid distribution
8. Percolation liquid storage tank

Garage systems
Closing nutrient cycles with organic fertiliser

- Application of digestate
  - depending on nutrient content
  - depending on nutrient demand of the crop
  - depending on region and soil
- Application rate approx. 10 - 40 m³ liquid digestate / ha
- Best harvest with combination with anorganic fertiliser
- Additional revenue potentials for plant operators
Upgrading of the digestate

- Separation
- Drying
- Pelletising
- Composting
- Liquid Upgrading

Separated digestate → Dried digestate → Pelletised digestate → Composted digestate → Liquid digestate

Source: Data of the RAL-quality assurance (2012)
Clean waste streams
Contaminated waste streams
Current marketing of upgraded digestate

- Hobby gardening - 4%
- Landscaping - 4%
- Market gardening, horticulture - 1%
- Agriculture (conventional/ecological) - 91%

Source: Data of the RAL-quality assurance (2012)

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Conclusion

• Various technologies are available for the digestion of waste and residues
• Nearly 400 of this plants are operated in Germany and 8,9 Million Mg residues can be utilised in an environmentally friendly manner each year
• The digestion of waste is a cascade utilisation as the energetic potential of the feedstock is not wasted
• The production of organic fertilisers can be an additional revenue for biogas plant operators
• Especially the marked segment of private consumers contains a huge potential
For more information...
Thank you for your attention!