Biogas in Germany:
Today 1400 MW biogas electricity and future targets

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Contents

- Current state of biogas in Germany
- Driving force for biogas production
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Biogas plants in Germany

Number of plants


Number of plants: 100, 120, 139, 159, 186, 274, 370, 450, 617, 850, 1050, 1300, 1600, 1750, 2050, 2700, 3500, 3700, 4000
Installed electric capacity of German biogas plants

Installed el. capacity [MW]

Substrate application in agricultural biogas plants (2005-2007)

- Energy crops and manure: 83%
- Energy crops: 15%
- Manure: 2%

Categories:
- Energy crops and manure
- Energy crops
- Manure
Use of renewable raw materials

Energy crops type:
- Silage maize
- Cereal grains
- Total cereals
- Grass silage
- Grass
- Corn Cob Mix
- Maize grains
- Sunflowers

Frequency of use [%]
Renewable Energy situation in Germany (2007)

- Wind energy: 11.5 TWh\textsubscript{el}
- Hydro power: 45.2%
- Biomass: 23.7%
- Biogas: 10.9%
- Photovoltaic: 4%

Total: 87.5 TWh\textsubscript{el}

Share on electricity consumption:
14.2%
(Biogas: 1.5%)
Reactor volume of farm based biogas plants

![Bar chart showing the frequency of total reactor volume in thousands of cubic meters.](chart.png)
Loading rate of biogas plants

- **ODM-Loading rate [kgODM/(m³d)]**
- **Relative frequency [%]**

Legend:
- **Orange** - one step process
- **Green** - multistep process

Categories:
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- >4

**Graph Details**:
- The graph shows the distribution of ODM-Loading rates for biogas plants, categorized by relative frequency and process type.
- The categories are represented by bars, with different colors indicating one step and multistep processes.
- The tallest bar is for the category 1 - 1.5, indicating the highest relative frequency.
Residual methane potential of digestate at 20 °C

The diagram shows the residual methane potential [% of CH4-yield] as a function of hydraulic retention time [d]. The data is categorized into three types:
- Onestage
- Multistage
- Discontinuously

The x-axis represents the hydraulic retention time in days, ranging from 0 to 300, while the y-axis represents the residual methane potential in % of CH4-yield, ranging from 0 to 10.
Full load hours of the CHP

Relative frequency [%]

Full load hours [1000 h/year]
Frequency of heat utilization

- only Biogas plant
- Farm
- Private house
- External utilisation
Biogas upgrading

- 16 upgrading plants are in operation
- PSA is the dominating technology
- Pressure water scrubbing is gaining market share
- 2 Selexol-washing plants are in operation
- 2 pilot plants use chemical washing by amine, and a first full scale plant is in construction
- For achieving the technology bonus the methane losses must be < 0.5 vol.-%.
The Government has decided to increase the renewable energy electricity production to 30 % and the portion of heat to 14 % by 2020.

40 % reduction of CO₂-emissions by 2020.

High dependency on foreign gas imports. 42 % of the natural gas is imported from Russia with a high risk for gas supply disruptions.

The Government is aiming to improve the share of biogas on the natural gas market to 10 % by 2030.

The most important growth driver is the Renewable Energy Sources Act (EEG).
Main factors of the Renewable Energy Act

- A guaranteed fixed fee for the electricity paid by the grid operators for a 20-year period.
- Priority for connection to the electric grid.
- Priority purchase and transmission of the produced electricity.
- Security for long term planning and investment.
- Calculable costs for the consumers.
- Specific fees dependent on plant size, substrate type and technology.
Compensation for electricity 2009 (EEG)

- Clean air bonus
- Landscape bonus
- Technology bonus
- CHP-bonus
- Manure bonus
- Biomass bonus
- Basic fee

<table>
<thead>
<tr>
<th>Capacity Range</th>
<th>Euro-Ct/kWhel</th>
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<tbody>
<tr>
<td>&lt; 150 kW</td>
<td>11.67</td>
</tr>
<tr>
<td>&gt; 150-500 kW</td>
<td>9.18</td>
</tr>
<tr>
<td>&gt; 500 KW-5 MW</td>
<td>8.25</td>
</tr>
<tr>
<td>&gt; 5-20 MW</td>
<td>7.79</td>
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</table>
Gas network access ordinance

- The gas grid operator must connect biogas upgrading plants to the grid.
- 50% of the connection costs must be paid by the gas grid operator.
- The gas grid operator is responsible for odorization, gas quality control and compression.
- Biomethane is fed into the grid by traders not by the producer.
Gas upgrading in Germany

- 16 biogas upgrading plants are in operation.
- Only one plant produces biomethane for vehicles.
- 15 plants are planned.
- Up to 2020 yearly 6 bill. m³ methane should be injected into the grid (2030: 10 bill. m³)
Biogas plants tomorrow

- Strong increase of the gas production capacity.
- The number of biogas plants will increase up to 10,000 – 12,000 facilities in 2020.
- Within the next 4 years mainly small biogas plants < 200 kW and large biogas plants > 1 MW will be installed.
- Small biogas plants will be operated mainly with 30 % manure and more (manure bonus).
- Large biogas plants will be used mainly for producing biomethane with gas injection into the grid.
Renewable energy crops will be the main substrate for biogas production also in future.

New energy crops which are not in competition to food and feed crops becomes more important, e.g. Sudan grass, sorghum, topinambur, silphium and intercrops.

The application of manure will strongly increase due to the manure bonus.

Pure plant by-products will be more often applied but wastes will play a minor role in agricultural biogas plants.
Gas utilization tomorrow

- Biogas and biomethane will be used mainly in combined heat and power plants.
- Most of the produced biomethane will be injected into the grid and the mixture of natural gas and biomethane is used in CHP, as vehicle fuel or for chemical processes.
- Micro biogas grids will be more often applied. 30% of the investment costs are supported by MAP.
- Local heat grids find increased application due to the financial support of 60 €/m - 80 €/m.
- Bioenergy villages with energy self sufficiency find increased application.
- Combined renewable power stations (biogas, wind, photovoltaic) will be applied for stabilizing the electric grid.
### Summary: Biogas today in Germany

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<tbody>
<tr>
<td>Workplaces</td>
<td>&gt; 10,000</td>
</tr>
<tr>
<td>Turnover (manufacturer, planner)</td>
<td>650 mil. €</td>
</tr>
<tr>
<td>Turnover electricity</td>
<td>1,000 mil. €</td>
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<tr>
<td>Export share</td>
<td>~ 20 %</td>
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<tr>
<td>Electricity production 2008</td>
<td>11 bill. kWh</td>
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<tr>
<td>CO$_2$-reduction 2008</td>
<td>9 mil. t/a</td>
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Source: GBA
Thank you for your attention!