Country updates:

Germany

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Biogas plants and substrates

- At the end of 2006 about 3,500 biogas plants with a total electric capacity of 1,100 MW are in operation.
- Most of the new installed biogas plants have an electrical capacity between 400 - 800 kW_{el}.
- A first industrial biogas energy park “Klarsee” with 40 biogas plants (total capacity: 20 MW_{el}) has come into operation.
- Energy crops are the main substrate and manure is only used with a share lower than 50%.
- Industrial companies mainly built plants for mono-fermentation of energy crops.
- 350,000 ha agricultural land (2%) is used for cultivation of biogas energy crops.
Bioenergy park „Klarsee“

- Total electric capacity $20 \text{ MW}_{\text{el}}$ using 40 standardized biogas plants of $500 \text{ kW}_{\text{el}}$.
- Each digester has a volume of $2,400 \text{ m}^3$ with 28 d retention time.
- The plant needs $300,000 \text{ t/a}$ maize, $60,000 \text{ t/a}$ manure and $20,000 \text{ t/a}$ cereals.
- The digestate is dried and conditioned to an organic fertilizer.
Process types

- More than 85% of the new erected plants are operated with wet-fermentation.
- About 2/3 of the new installed wet fermentation plants are operated with at least two process stages.
- Several discontinuously operated dry-fermentation systems with up to 7 garages and an electrical capacity between 50 and 500 kWel have come in operation.
- The first continuously operated dry–fermentation systems with horizontal plug-flow and silo fermenters are in the start-up phase.
- A more detailed definition for „continuously dry-fermentation“ has come into force.
Continuously dry-fermentation

Definition of the Federal Environment Ministry (01/07):

- The organic substrates must have a water content lower than 70 %.
- The organic loading rate must be at least 3.5 kg oDM/(m³*d)
- The total volatile fatty acid content of the digestate is limited by 2,000 mg HAc_{equ}/l.
- The storage tank for the digestate should be covered gas-tight and must be connected with the gas utilization system.
Discontinuously dry-fermentation system with percolation (Bioferm, Loock)
Dry-fermentation plant with 4 garage digesters (Plant Pirow)
Continuously dry-fermentation plug-flow digester (LINDE-LARAN)
Continuously dry-fermentation silo-reactor (DRANCO-FARM)
DRANCO-FARM plant in Bassum

V = 1.200 m³
H = 26 m
D = 8,5 m
Br = ≤ 7 kg oDM/m³d

Substrates:
Silage maize
Rye TPS
Grass silage
Sunflower silage
Gas utilization

- Biogas is mainly used in CHP. 2/3 of the new erected plants use gas engines, 1/3 dual fuel engines.

- Biogas upgrading and feeding into the gas grid finds increasing application:
  - Pliening (PSA, supplementary gas, 45 bar)
  - Straelen (PSA, exchange gas, 16 bar, addition of LPG)
  - Kerpen (PSA, industrial gas grid, 100 bar)
  - Teterow (in construction)
  - Werlte (in construction)

- A first biogas-CHP is coupled with an ORC-turbine in order to increase the electric efficiency by more than 8 %. A total electric efficiency of 45 % seems possible (pilot plant Biburg).
Heat utilisation

- Only 10% of the new erected biogas plants do not use the excess heat. About 50% use the thermal energy for heating of houses and stalls and 30% for drying processes (wood chips, green crops).
- Several villages have made a feasibility study in order to become a self-sufficient energy village according the model of Jühnde.
- In large biogas plants, e.g. biogas parks, the heat is completely used for upgrading the digester residues in order to produce a dry organic fertilizer.
Aims and future strategies

- The application of residues and wastes for biogas production must be increased in order to achieve additional effects on CO₂-reduction without the need of agricultural land.
- The research activities on energy crops breeding and cultivation will be increased in order to achieve higher biomass yields per hectare.
- The application of manure in biogas plants must be increased in order to reduce the methane emissions from storage tanks.
- The export of biogas plants must be increased because the growth of the German biogas market will decrease within the next years.