

## Country updates:

### Germany

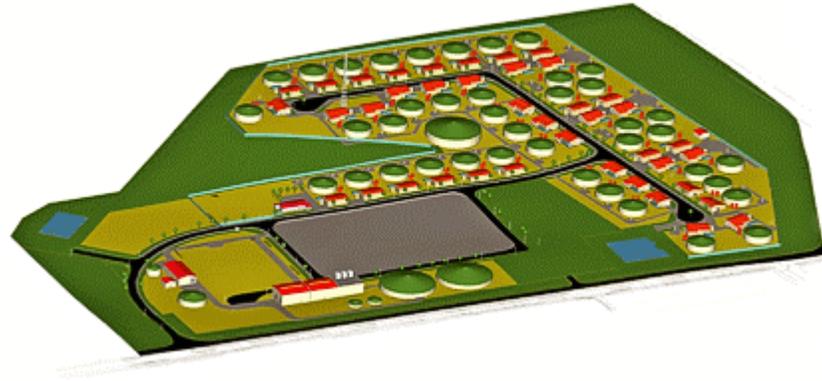
P. Weiland

Federal Agricultural Research Centre (FAL)  
Institute of Technology and Biosystem Engineering



- 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<sub>el</sub>.
- A first industrial biogas energy park “Klarsee” with 40 biogas plants (total capacity: 20 MW<sub>el</sub>) 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.

## PLAN OF THE "KLARSEE" BIOENERGY PARK



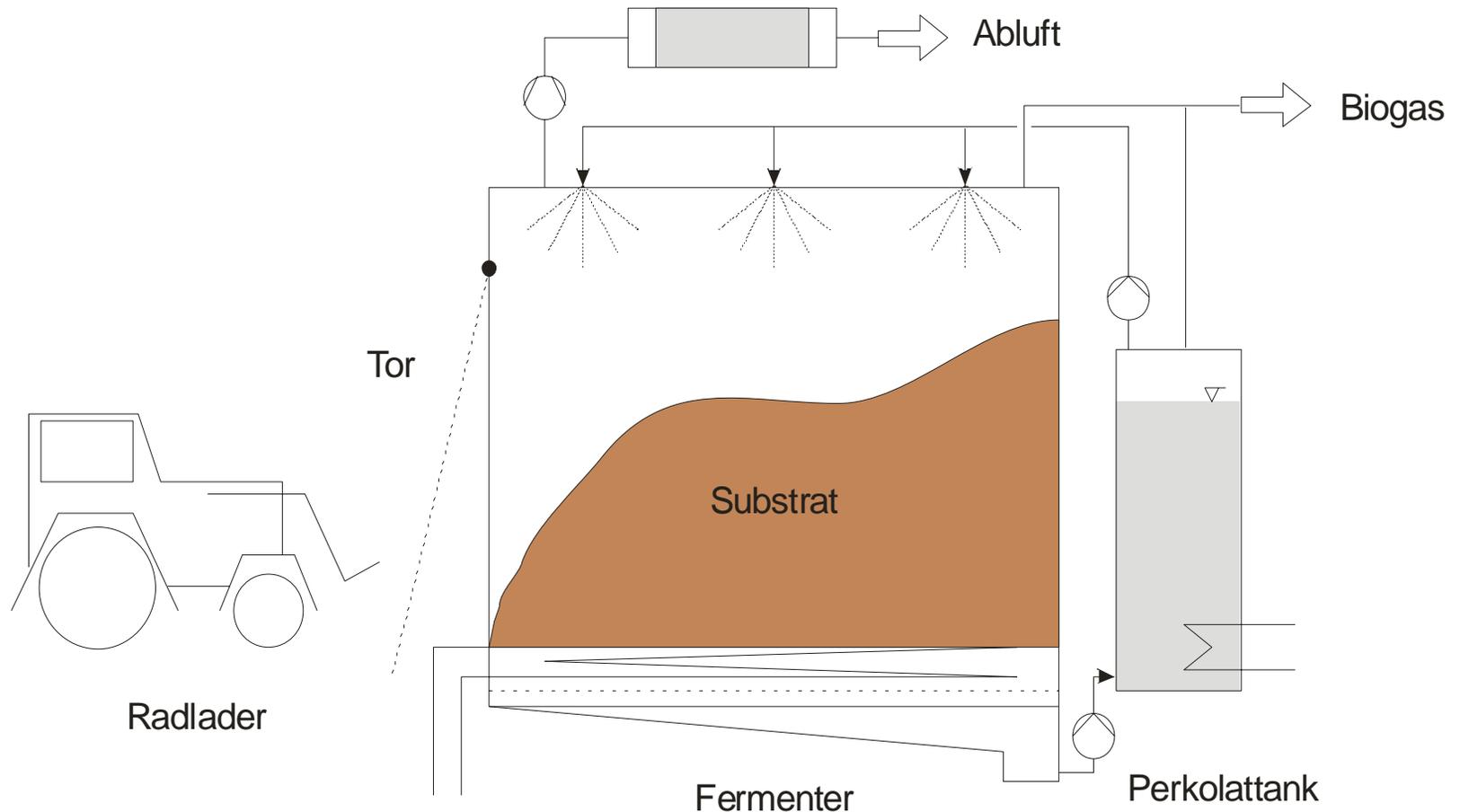
- Total electric capacity  $20 \text{ MW}_{el}$  using 40 standardized biogas plants of  $500 \text{ kW}_{el}$ .
- Each digester has a volume of  $2,400 \text{ m}^3$  with 28 d retention time.
- The plant needs 300,000 t/a maize, 60,000 t/a manure and 20,000 t/a cereals.
- The digestate is dried and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

- **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 kW<sub>eI</sub> 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.**

## 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/(m<sup>3</sup>\*d)
- The total volatile fatty acid content of the digestate is limited by 2,000 mg HAc<sub>equ</sub>/l.
- The storage tank for the digestate should be covered gas-tight and must be connected with the gas utilization system.

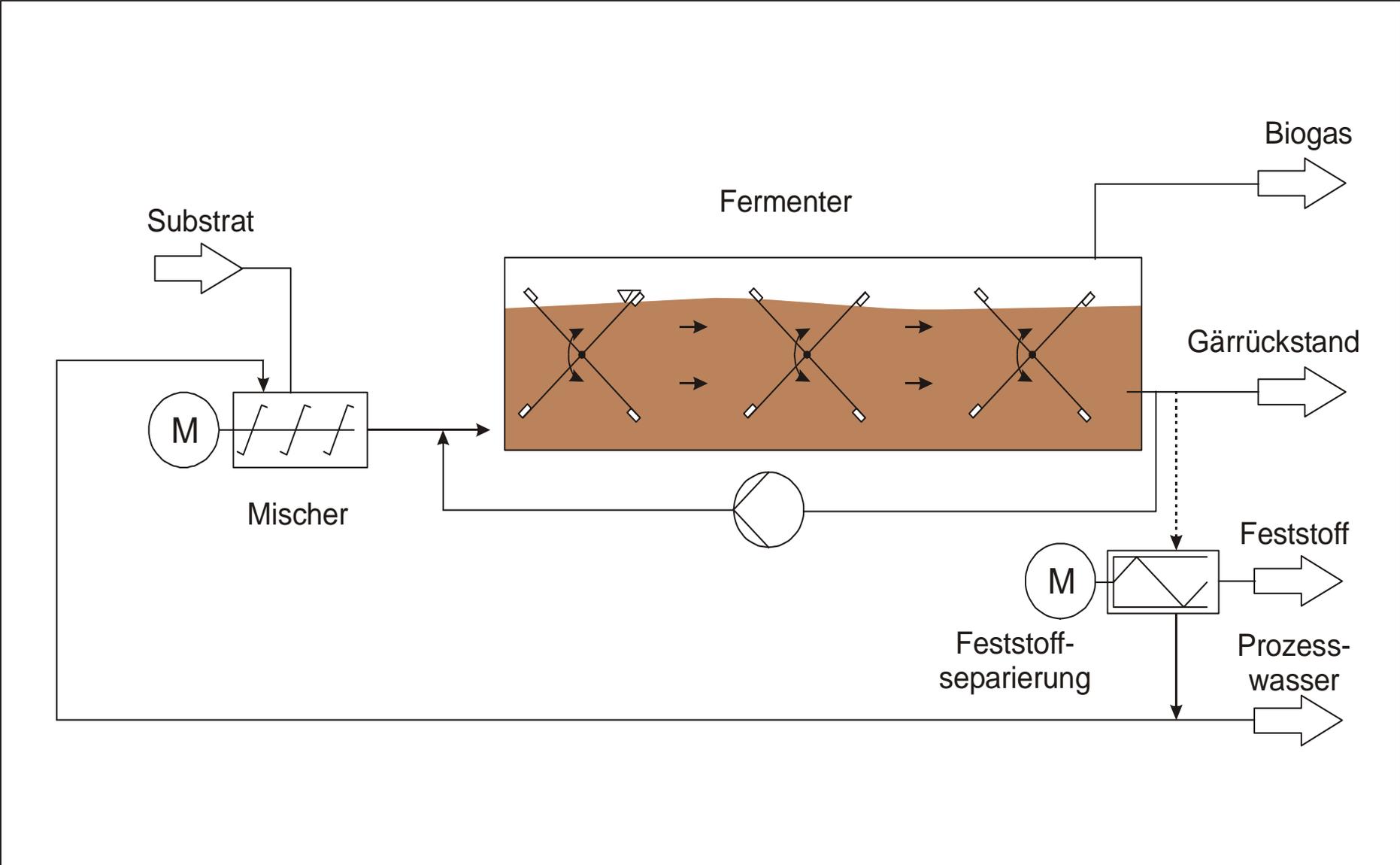
# Discontinuously dry-fermentation system with percolation (Bioferm, Loock)



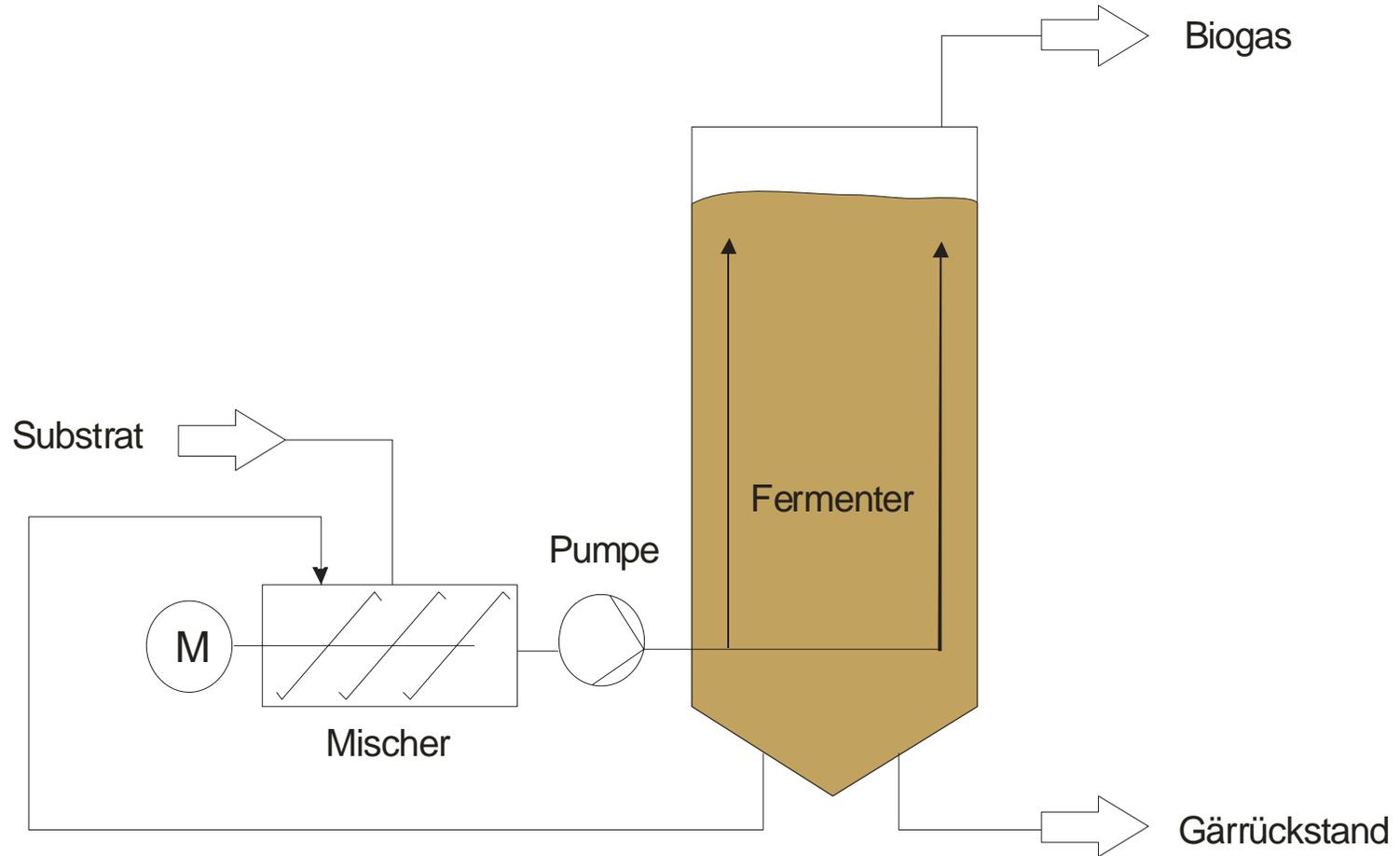
# Dry-fermentation plant with 4 garage digesters (Plant Pirow)



# Continuously dry-fermentation plug-flow digester (LINDE-LARAN)



# Continuously dry-fermentation silo-reactor (DRANCO-FARM)



# DRANCO-FARM plant in Bassum

**$V = 1.200 \text{ m}^3$**

**$H = 26 \text{ m}$**

**$D = 8,5 \text{ m}$**

**$Br = \leq 7 \text{ kg oDM/m}^3\text{d}$**

***Substrates:***

**Silage maize**

**Rye TPS**

**Grass silage**

**Sunflower silage**



- **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).**

- **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.**

- **The application of residues and wastes for biogas production must be increased in order to achieve additional effects on CO<sub>2</sub>-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.**