TÜRKISCH-DEUTSCHES
BIOGAS PROJEKT

2. Biogas-Training

Basic Aspects

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T.C.
ÇEVRE VE ŞEHİRCİLİK
BAKANLIĞI

Bundesministerium
für Umwelt, Naturschutz
und Reaktorsicherheit

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

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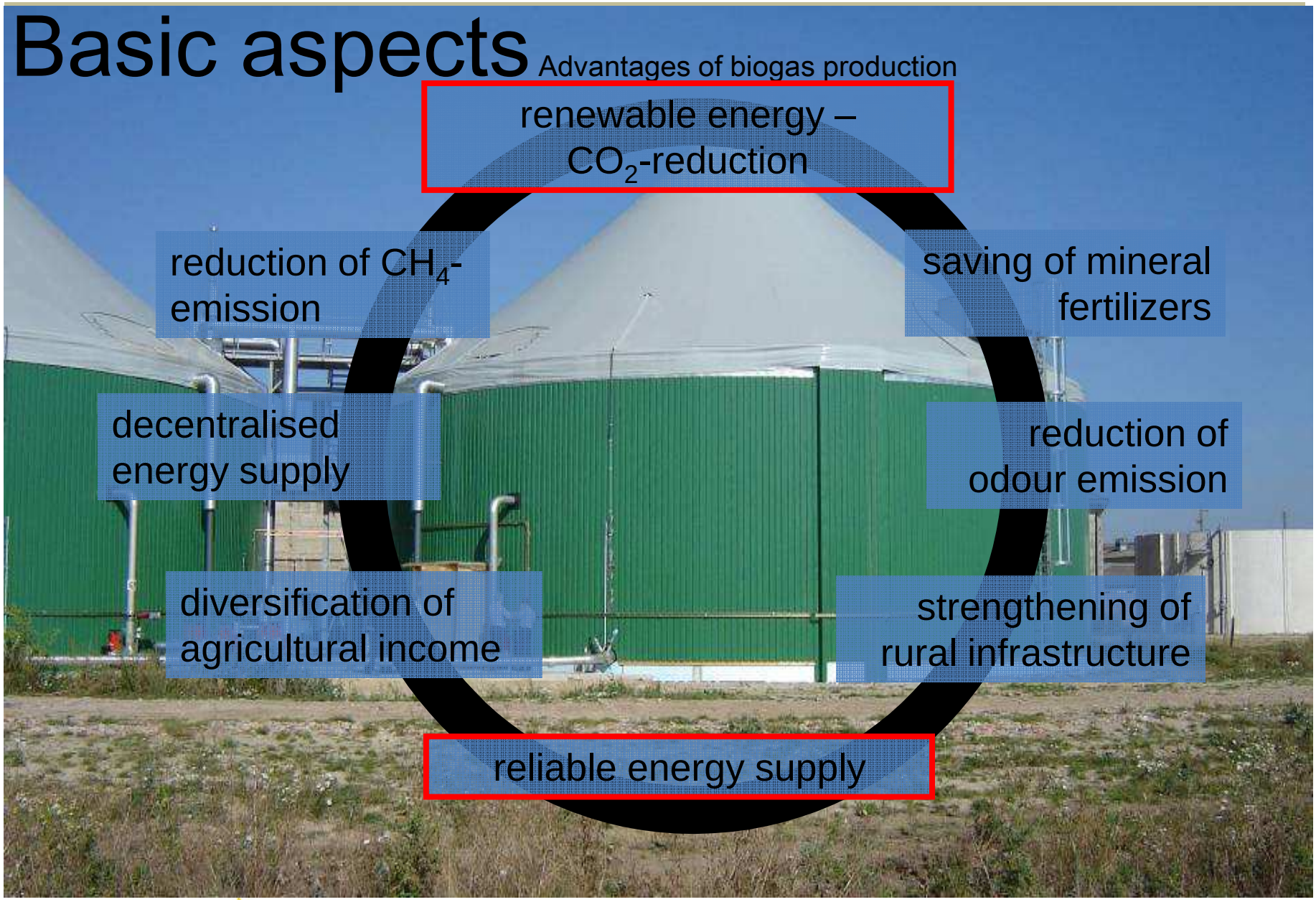
Basic aspects

Advantages of biogas production



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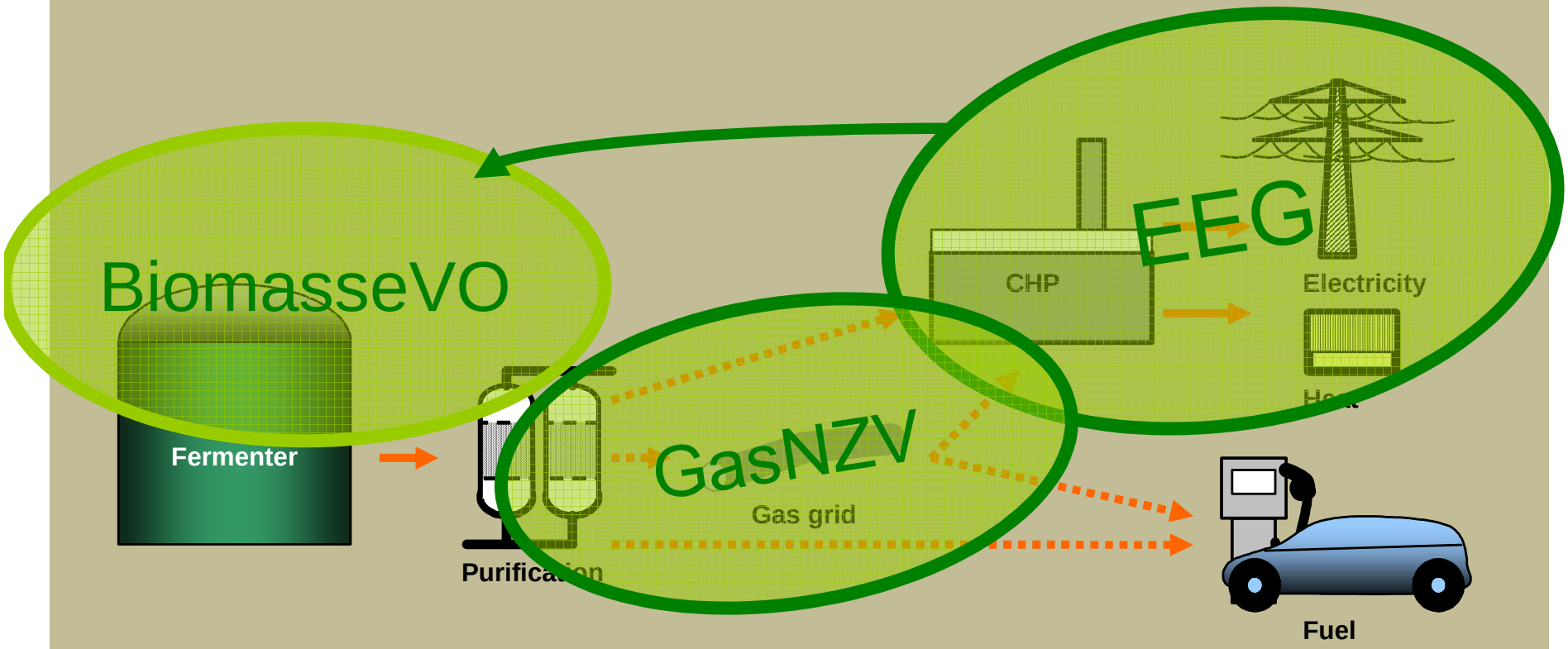
Basic aspects usage pathways



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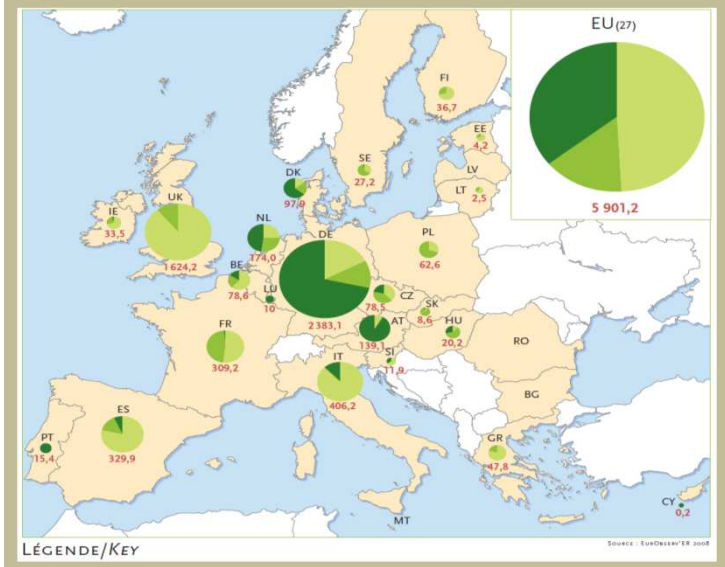
Development in Europe

Production of Biogas in Europe

Source: Biogasbarometer/EUROBSERV'ER



Germany plays a leading role in biogas production

High share of Substrates from agriculture in Germany

The word „biogas" is defined differently

Production d'énergie primaire de biogaz de l'Union européenne en 2007 (en ktep)/
Primary energy production of biogas of the European Union in 2007 (in ktoe)

- Biogaz de décharges/*Landfill gas*
- Biogaz de stations d'épuration/*Sewage sludge gas*
- Autres biogaz (unités décentralisées de biogaz agricole, etc.)/*Other biogases (decentralised agricultural plant, etc.)*

5 901,2 Les chiffres en rouge indiquent la production totale en ktep/*Red figures show total production in ktoe*

* Estimation/*Estimate.*

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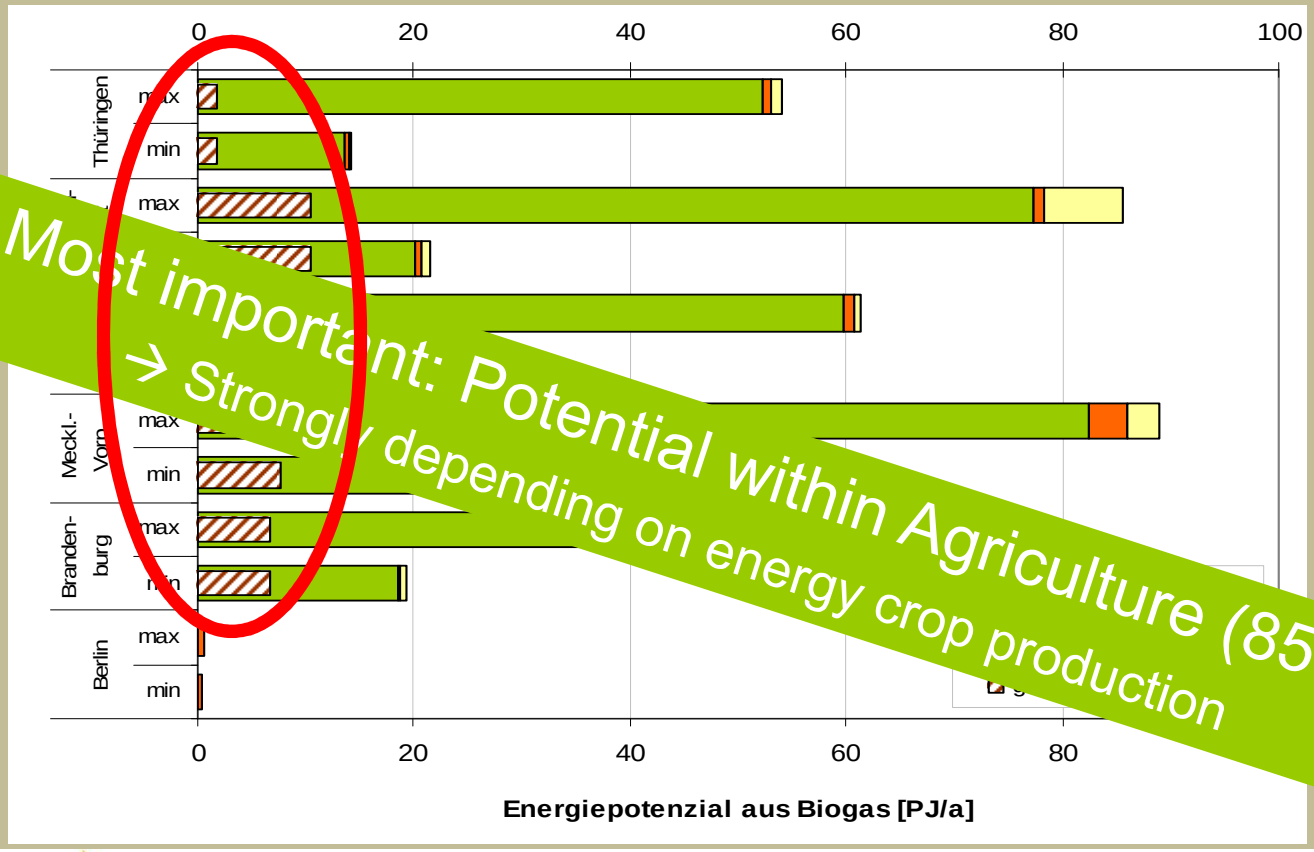
Biogas Potentials



Most important: Potential within Agriculture (85 %)
→ Strongly depending on energy crop production

Source: study for private customer

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Technology

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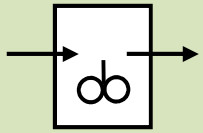
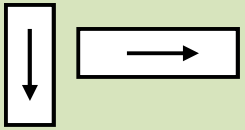
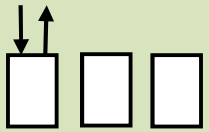
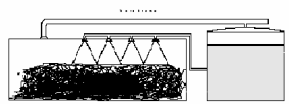
Suitable AD-Technologies

System	**Continous**		**Batch**	
Category	CSTR	PFR	Batch	Batch / Percolation
Symbol				
Example				
Content of fermenter	liquid	Free flowing or liquid	Free flowing	
Pretreatment	Strong homogenisation, high energy demand	Strong homogenisation, high energy demand	strong recirculation, no hackling or mincing required, low energy demand	

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Substrates Origin

- **Agriculture**
  - **liquid manure**
  - **energy crops such as:**
    →hole-plant silages from maize, rye, sunflowers, grass, sorghum
    →corn-cob-mix, all kinds of grain
  - **agricultural byproducts**
- **Organic waste (commercial and industrial)**
  - **food residues**
  - **market waste**
  - **residues from production processes (e.g. beer, sugar, wine, milk, alcohol, juice, meat products, vegetable processing)**
  - **fats**
- **Organic source separated municipal waste**

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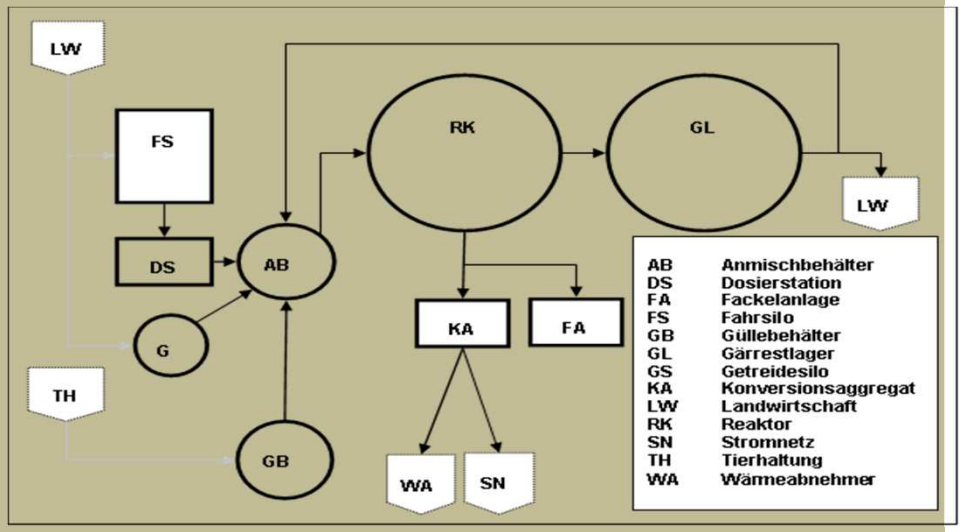
Application typical farm-scale digestion of energy crops

- farm-scale, single step
- startup 10/2005
- inst. CHP capacity 500 kW_{el}
- approx. 12.000 t Substrates y^{-1}
- approx. 2.500m^3 Digester volume



- Energy crop acreage ~ 250 ha
- Substrates: corn silage, liquid manure, rye
- Participant on scientific evaluation programme

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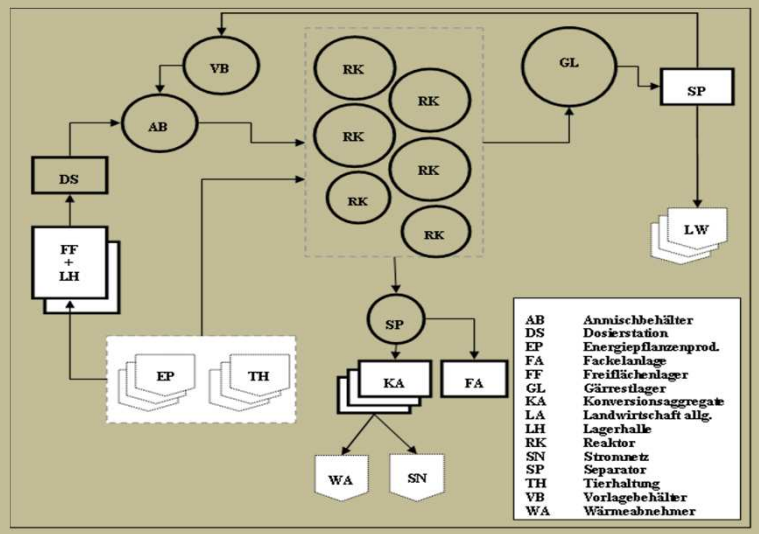
Application industrial-scale digestion of energy crops

- startup 12/2004
- 3 engines, total inst. capacity 4.2 MW_{el}
- excess heat used for industrial process
- approx. 70.000 t substrates y^{-1}
- Approx 17.000m^3 digester volume



- 24h hydrolysis step
- originally two-step process, now parallel single-step digestion in 4 fermenters and 2 smaller stores,
- acreage ~ 1.500 ha / 60 suppliers
- separation of effluent
- substrates: silages and grist from different crops, CCM, grass and other

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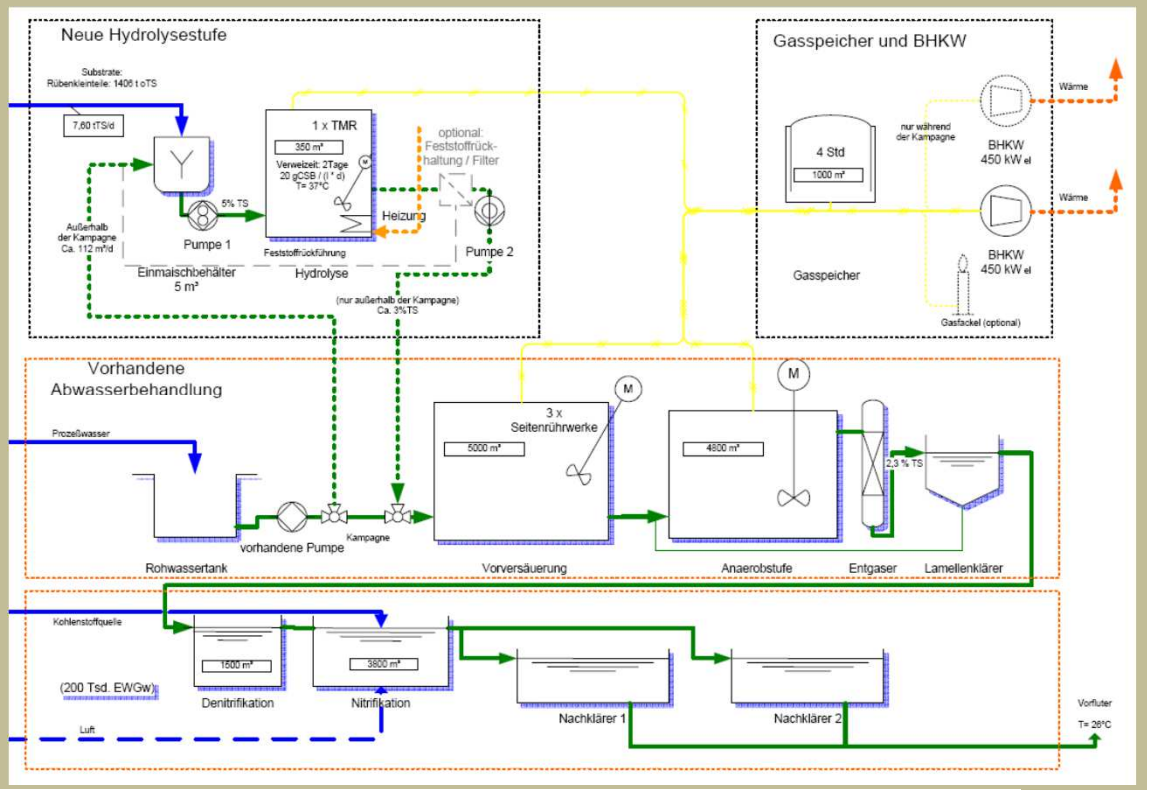
Application sugar industry

- **Byproducts from sugar beet processing**
  - Anaerobic treatment of waste-water only 3-4 mon/y
  - AD-technology and know-how from over 20 years
  - Fast and stable process



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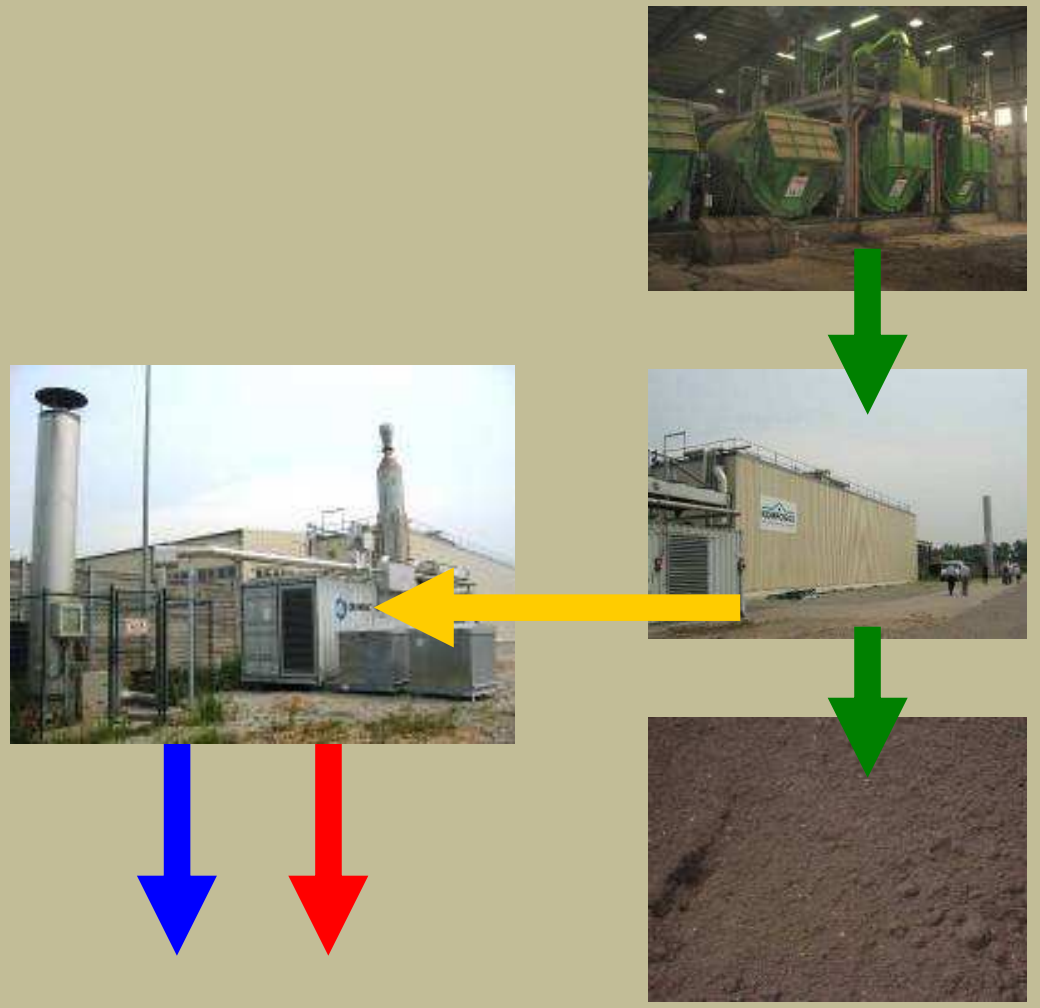
Application Digestion of Biowaste

- Dry Fermentation of biowaste
  - biowaste 24.000 t y^{-1}
  - Aerobic pretreatment
  - Plug-Flow-Reactor
  - Composting of effluent
  - CHP-device
  - Complete housing/low odour emissions



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Operation of a single biogas plant

Electricity to energy supplier

Heat to heat user

Fuel for transportation

Energy production company
Electricity, Heat, Fuel

Operating Company
Biogas Production

Service Provider
Transport and Fertilization

Farmer
Crop Production, Storage

Service Provider
Transport

All processes can be in one hand, transparent operation, few contracts, Investment by the farmer or combined

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Operation of a joint biogas plant

Electricity to energy supplier

Heat to heat user

Fuel for transport

Energy Production/Uprgrading Company
Electricity, Heat, Biomethane,

perating Company biogas production

Service Provider
Transport
of residues and fertilization

Service Provider
Transport, central storage

Farmer
Farmer
Farmer
Farmer
Farmer
Substrate
Farmer
Farmer

Substrate provision is shared, central storage
For better quality, standardized contracts, effective waste heat usage

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Operation of a biogaspark

Electricity (up to 20MW)

Heat

Fuel

Energy production Upgrading company Electricity, heat, fuel

Biogas plant

ogas plant

Biogas plant

Biogas plant

Biogas plant

Service Provider
Transport
of residues, fertilization

Farmer
Farmer
Farmer
Farmer
Production, Storage
Farmer
Farmer

Service Provider
Transport
Storage

Source: NAWARO-AG

Substrate supply is shared, central storage is possible at few sites with defined quality, central Gas upgrading could be possible, risks are shared by more plants, more contracts central administration and biological control by experts

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Innovative Applications

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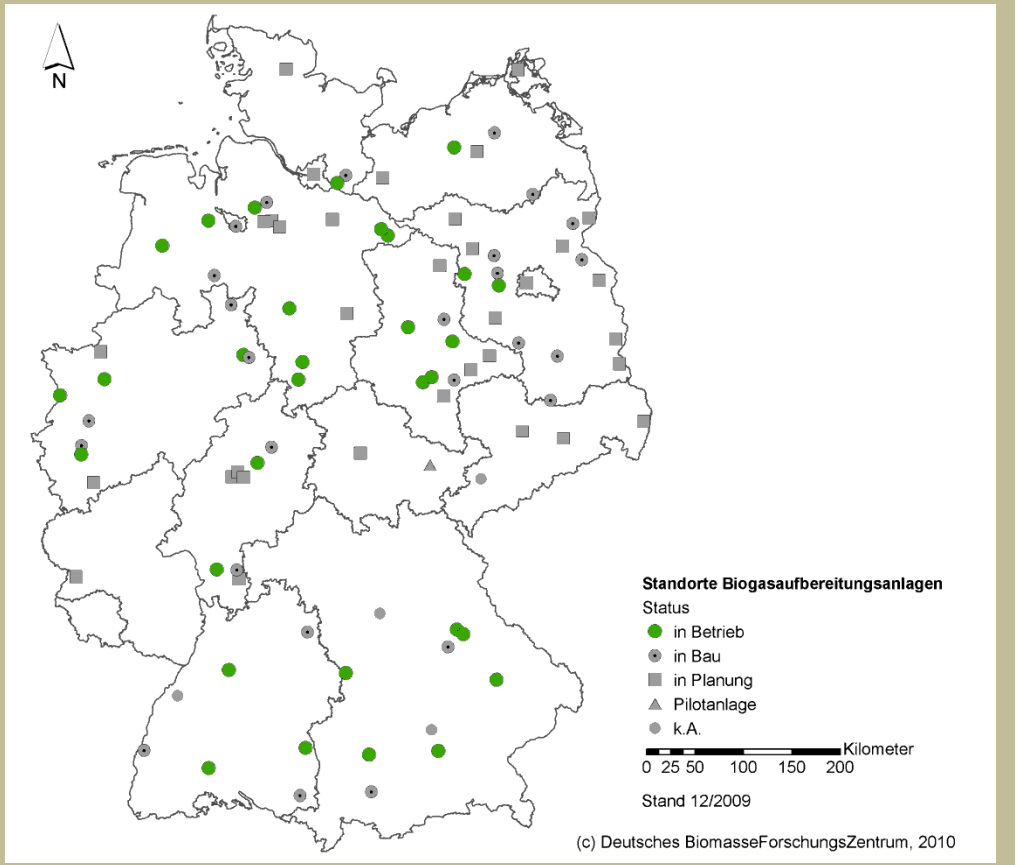
Innovative Applications

Upgrading and Feeding to gas grid

- **legal framework**
  - GasNZV guarantees access to grid and sets important complementary regulations
  - EEG for Cogeneration → Bonus for innovative Technologies 2€ct/kWh$_{el}$ up to 350Nm^3/h and 1€ct/kWh$_{el}$ up to 700Nm^3/h
- **at least 33 plants (04/2010) in service**
  - beginning with *Pliening* and *Straelen* working with PSA in Dec 2006; inst. (eq.) P$_{el}$ 2MW
- **large scale biogas plants**
  - Up to > 20MW (eq)
  - Common size is 300-500Nm^3/h biomethane
- **further plants under construction**
  - municipal utilities and energy su highly engaged



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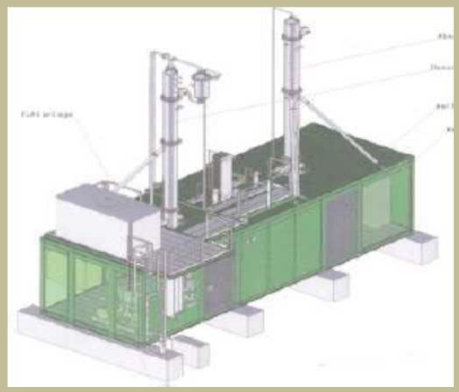
Innovative Applications Biomethane as a fuel

- **1st petrol station in Germany with upgraded Biogas in service (Jameln/Northern Germany, June 2006)**
  - Biogas plant using energy crops and manure
  - Upgrading by drying, desulphurization, drying and chemical absorption of CO_2
  - Input Raw 140 m^3/h 52% CH_4
  - Output Upgraded 70 m^3/h 96% CH_4
  - Biomethane can be used in CNG powered cars without modification
- **Economic aspects**
  - Cng powered cars are more expensive (1.500-3500€)
  - price for biomethane is equivalent to CNG →0,929 € kg^{-1} and lower than for diesel and petrol (due to tax exemption)

*April 19th, 2010; source: www.adac.de



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Innovative Applications

- Further Innovative Biogas-Technologies -

- **Fuel Cells**
  - el. efficiency is up to 48% (55%); pilot plants, causes less noise, useful for urban applications
- **ORC-Modules**
  - 10% raise in el. efficiency; at least 3 plants in service
  - advantageous in combination with micorturbines
- **Microturbines**
  - less sensitive, low maintenance costs, high durability
  - compared to gas engines low el. efficiency (38% → 28%)


Source: MTU


Source: Köhler & Ziegler


Source: ISET

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Conclusions

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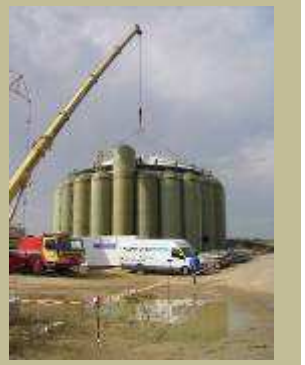
Conclusions and Outlook

- flexible technology to provide electricity, heat, fuel and fertilizer
- Available from small to large scale applications (several kW until MW)
- The EEG and GasNZV are the most important regulations for Biogas in Germany
- EEG will amended in 2012 → simplification of complex tarifs
- Technology for production, conversion and provision is state-of the-art
- Even in Germany biogas has still high potentials

Increasing importance all over Europe!



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Thank you for your attention!

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