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Biogas Production from Energy Crops and Biowaste

BIG>EAST Mobilisation Campaign
26. February 2008
Energetski institut Hrvoje Pozar, Zagreb, Kroatia

1. **Overview over the Biogas Potential**
2. **Technology overview**
3. **Review on regulatory climate in Germany and Europe**
4. **Feedstocks for Energy crop and biowaste plants**
5. **Use of digestate**
6. **Outlook on the technology development**

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The **International Biogas and Bioenergy Competence Center (IBBK)** is an amalgamation and network of experts and companies, as well as interest groups and educational institutes in the field of **biogas and bioenergy**. The work of the **IBBK** covers regional, national and international activities. The Competence Centre is setting up an additional impulse beyond the traditional lobby work and is striving to cover the growing demand for independent, neutral dissemination of information in the field of biogas and bioenergy. The main emphasis is in educational and project work.

The services of IBBK are:

- **Consulting**
- **Studies**
- **International Cooperation**
- **Seminars, Confernces**
- **Fieldtrips, Study Tours**
- **Lobby work**

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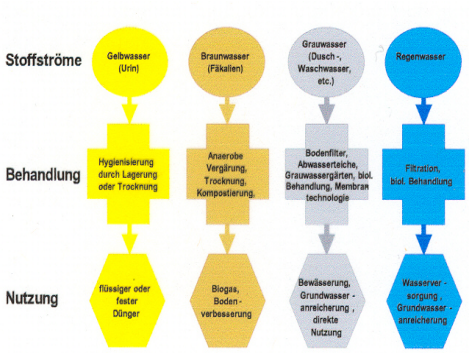
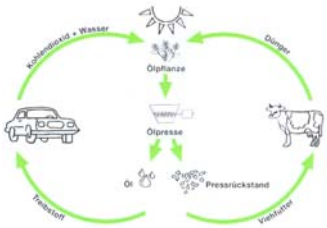
IBBK understands its work as an additional impulse to a tradidional associations- and lobby work and is striving to cover the growing demand in company independant, neutral knowledge transfere in the following subjects:

Biogas **Wood Gas** **Ecosan** **Plant Oil**



Geschlossene Kreisläufe bei der Nutzung von Ölpflanzen



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Result of conversion - Gaseous Biofuels -

Gaseous biofuels options:

- **Fuel gas (CH_4; CO, H_2; …)**
  - **Gasification**
- **Biogas (CH_4)**
  - **Waste water treatment**
  - **Landfill gas**
  - **Livestock husbandry**
  - **Energy crops**
  - **Biowaste**

Waste water treatment

Biogas plant

Landfill gas

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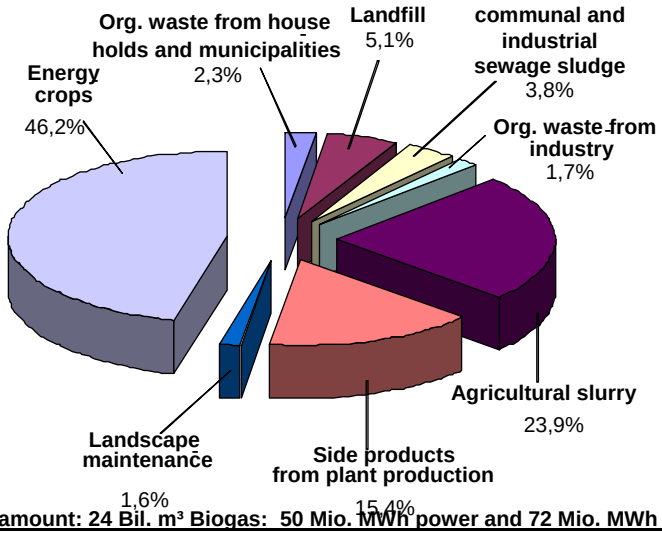
Biogas potential in Germany from...



Total amount: 24 Bil. m³ Biogas: 50 Mio. MWh power and 72 Mio. MWh heat

Quelle: P. Weiland FAL BS

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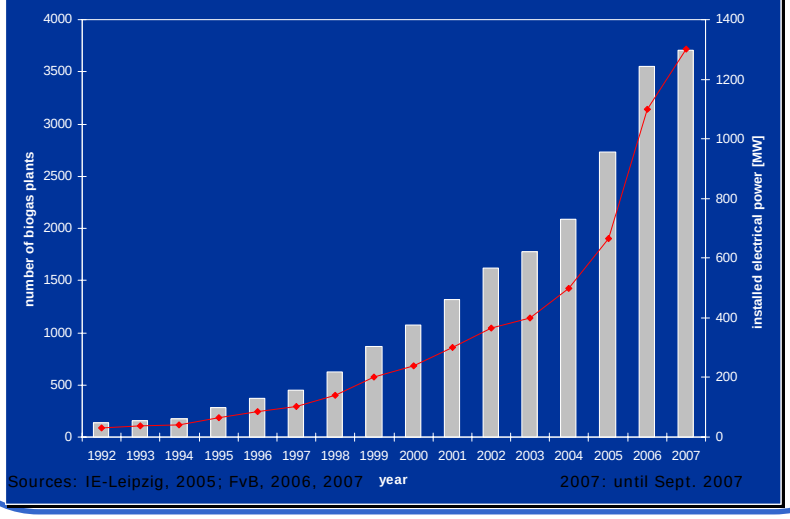
Agricultural Biogas Plants in Germany



Sources: IE-Leipzig, 2005; FvB, 2006, 2007 2007: until Sept. 2007

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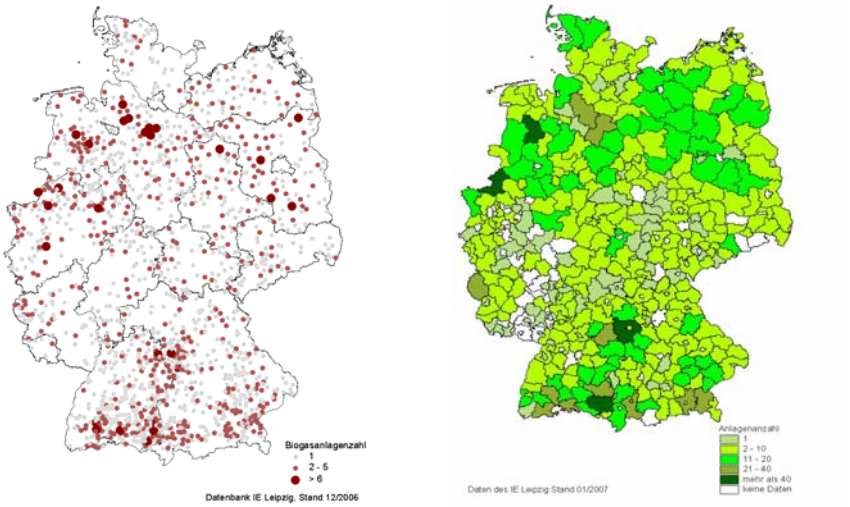
Biogas Plant Locations in Germany



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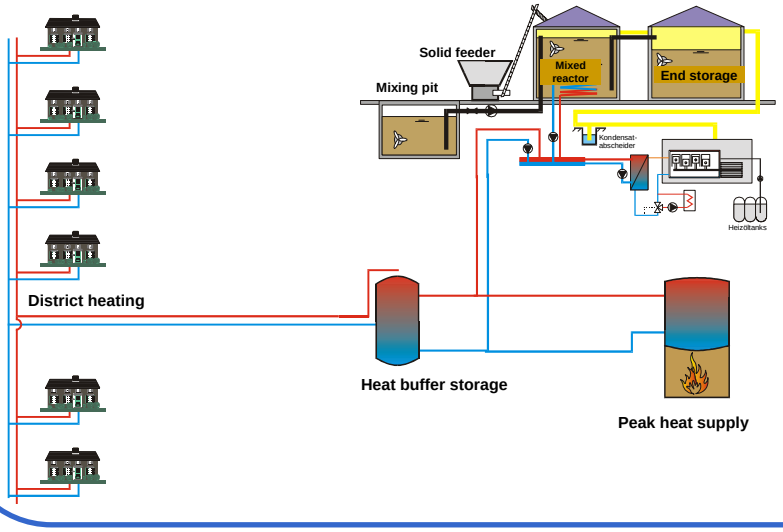
Components of an Agricultural Biogas Heat and Power Supply Station



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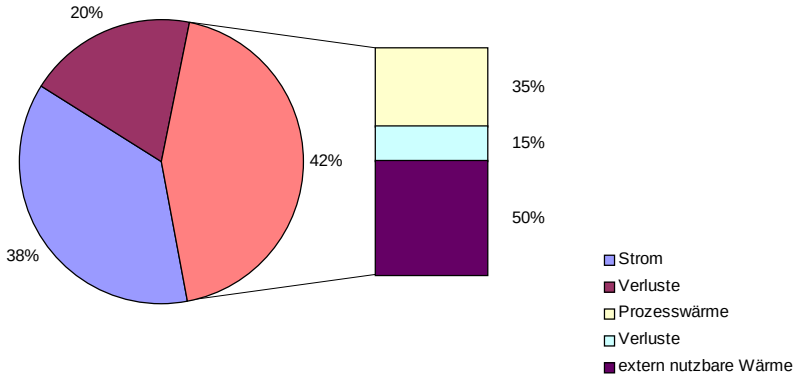
Energy utilisation from biogas plants



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Use of biogas digestate

1. Digestate can be spread on the fields
   - no hygiene restrictions with animal slurry and plant material
2. Improved Fertilizer
   - avoids nutrient losses
   - reduces the burning effect on plants
   - improves the flowing properties
   - improves the plant compatibility
   - improves the plant health
   - reduces the germination ability of weed seeds
3. Environmentally sound
   - reduces the intensity of odour
   - reduces the air pollution through methane and ammonia
   - reduces the wash out of nitrate
   - hygienizes liquid manure
   - recycles organic residues (co-fermentation)
   - can avoid costs for the connection to a central sewer

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Comparison between anaerobic digestion and composting of biomass

	Anaerobic digestion	Composting
Energy	**production (300-600 kWh/t) guaranteed under**	**consumption (20-100 kWh/t)**
Sanitation	**consideration of legal standards**	**guaranteed under consideration of legal**
Emissions	**low (odours, ammonia)**	**standards high (odours, ammonia, methane, nitrous oxide, hydrogen sulphate, germs)**
N-Fertilising effect	**fast**	**slow**
Unsuitable substrates	**tree and bush cuttings**	**half liquid substrates with no structure biomass without structure can only be composted after wood or other straw has been added**

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Biogas-technology: Cosubstrates

Since 2004 Trend

high returns through gate fees

Organic waste

Old bread
Apple marc
Brewers grains
Biowaste
Separation fat
Flotation fat
Greace
Vegetable waste
Grain cleanings
Destillery grains
Glycerin
Coffee draff
Cocoa shells
Potatoe greens
Potatoe peeling waste
Destilled potatoes
Leaves
Molasses
Wey
Fruit peelings
Rapeseed cake
Grass cuttings
Canteen waste
Onion peels
.....

Energy crops

CCM
Fodder peas silage
Fodder beet silage
Grain destillery waste
Straw
Grassilage
Green rye silage
Green oat silage
Potatoes
Potatoe destillery waste
Clover grass silage
Lucerene silage
Maize
Maizesilage
Rape seeds
Rye
Clover silage
Fodder beet silage
Sunflower silage
Triticale
Grassilage
Wheat
Green wheat silage
Sugarbeet silage
.....

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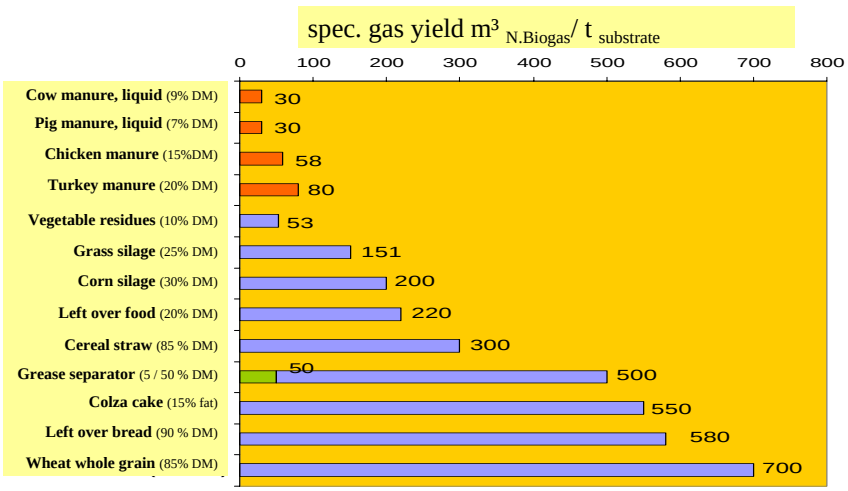
Biogas yields from different substrates



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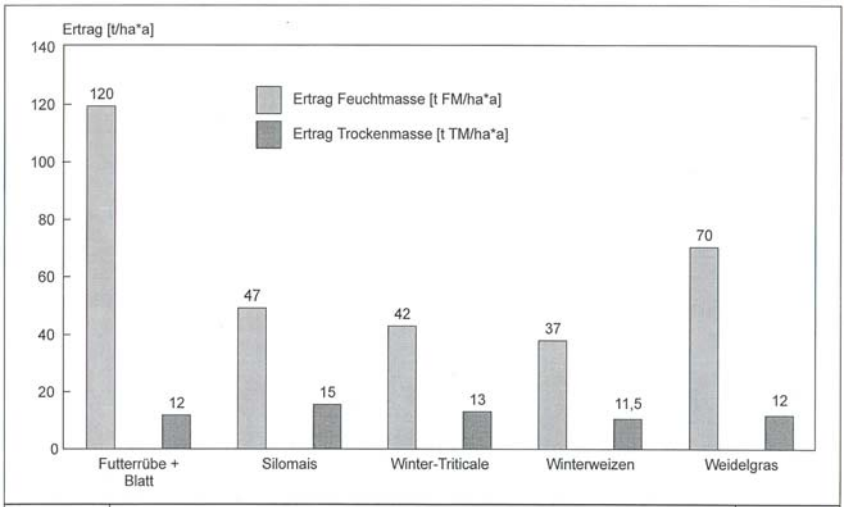

FAL-Tec Weiland	Biomass yields of different crops	W0107082 CDR

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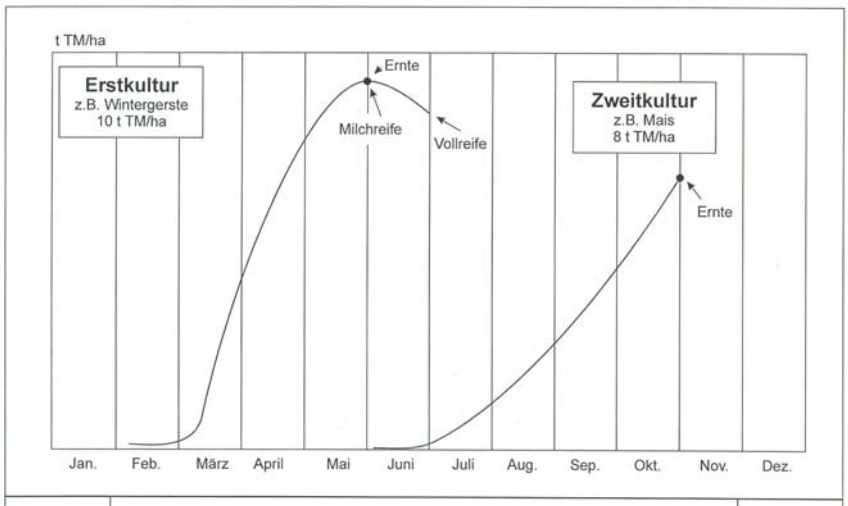

FAL-Tec Weiland | Two cultures crop production system | W0107084 CDR

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Advantages of energy crop digestion

- Undisturbed availability of substrates through crop production on demand in the vicinity of the biogas plant (up to 30% of the land)
- High biogas yields through a high energy density of easily digestable organic dry matter
- Possibility of an exact biogas production through easily digestable organic dry matter
- Patogen free, therefore unrestricted application on farms with animal husbandry
- No dependancy of the market availability of biowastes
- Unrestricted application of digestate as fertilizers as there are no toxic and heavy metal contaminants

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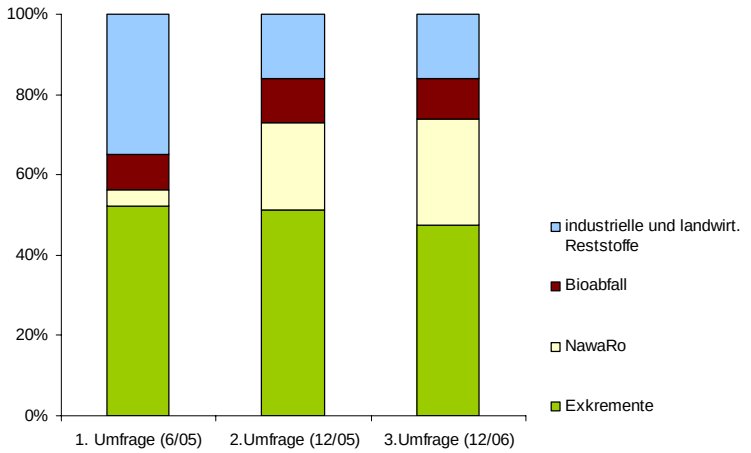
Feedstock Mix in German Biogas Plants



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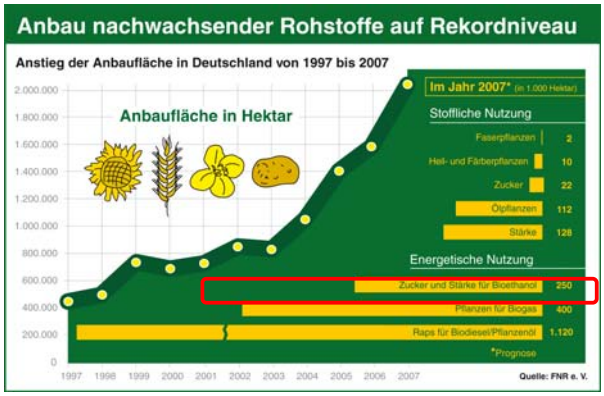
German status of energy crop utilisation



source: Fachagentur Nachwachsende Rohstoffe, 2007

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Price Development of energy crop utilisation

	1. Survey (2005)		2. Survey (Dec. 2006)		2007 *	
	average costs [€/ t]	variations [€/ t]	average costs [€/ t]	variations [€/ t]	average costs [€/ t]	variations [€/ t]
Corn silage	23,5	15 – 35	26	15 – 40	30	20 – 45
Cereals	101,8	95 – 110	112	70 – 150	180	120 – 250
Total plant silage	16	6 – 30	23	20 – 29	n.a.	n.a.
Grass silage	17,9	5 – 30	25	14 – 40	n.a.	n.a.

energy crops = biggest potential for energy production

→ energy crops will also be utilised in the future

rising prices → slower growth & utilisation of readily available inexpensive substrates (e.g. grass)

source: IEL, 2007, * own data

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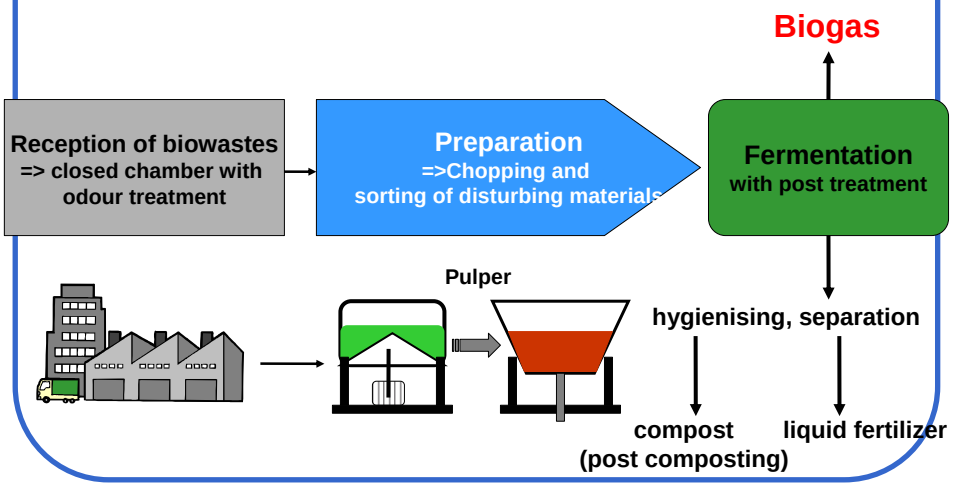
Proces chain for the wet digestion of biowaste



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Technological Requirements of Biowaste Treatment Plants:

- Dry fermentation or multistaged wet fermentation
- Incapsuled reception area for substrates
- Thermal treatment => epidemice hygiene requirements
- Direct/indirect process control
- Examination for heavy metals
- Pre treatment of substrates regarding disturbing materials => Pulper
- Separation and post treatment = composting
- Optional membership in a quality association
- Limited spreading of dry matter, nutrients and pollutants per hectar

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Economy of biowaste treatment plants:

- Income of gate fees and energy sales
- High technological standard => high investment costs
- High approval conditions => higher costs
- Abolition of agricultural subsidies
- Restricted spreading possibilities

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Summary:

1. **Biowaste, food waste and wastewater treatment only in especially designed and officially approved biogas plants**
2. **Strict spreading conditions of digestate from organic waste treatment plants on agricultural land, concerning pathogens and contaminants**
3. **Gate fees have to be paid for biowaste and food waste treatment for an economical operation of the plant**
4. **Recycling of nutrients through spreading of digestate on agricultural land and therefore savings of artificial fertilizer and chemicals**
5. **Energy Crops have less legal implications for approval and operation of the biogas plant**
6. **Energy Crops however have a certain cost to produce them but depend on the general market situation for food and fuel.**

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Thank you for your Attention!

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