Overview table for shining examples of biogas plants – Biogas Regions

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Biogas Regions
Shining Example

Biogas plant “Wolfring Biogas Plant“

The Family Graf zu Eltz biogas plant was planned and built by the Rücken Engineering Office, Neukirchen, Bavaria, in 2002 in Fensterbach, Schwandorf County, Bavaria. The plant was connected to the local electricity grid in November 2002. In March 2004, the biogas plant was expanded with an additional fermenter with 1000 m^3 effective fermentation volume; a permanent storage tank with 2,000 m^3 storage volume and a gas-tight cover was under construction during the specialist jury onsite inspection.

The zu Eltz Family farming operation, along with potato and grain breeding, a fallow deer and red dear paddock with direct marketing and an adjoining garden market, is focused on energy production from regenerative energy sources.

In the Wolfring biogas plant, along with solid chicken manure, renewable raw materials maize silage, grain whole-plant silage and CCM-meal are fed in. The operation’s fish pond water is used to provide the liquid.

The controlled variable here for the water feed volume is the N-concentration in the fermenter contents.
The solid chicken manure is delivered to the biogas operation free of charge by a cooperation partner, the maize silage is purchased for 17 €/t ex field plus harvesting, chopping and stacking costs. The whole-plant silage is self-produced; the CCM meal is procured free-farm.
The fermentation remnants are handed over cost-free ex-storage to the substrate-provision companies or applied on the own fields.

Photo:
Carl Graf zu Eltz

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Biogas Regions
Shining Example

key data

Start of Operation ……**2002**

Planning/ Construction……..**Ingenieurbüro Rückert**

Operator…….....**Carl Graf zu Eltz**

Amount of gas produced ……..**2,19 Mio m³** per year

Cost ……..**1.700.000 Euros**

feedstock

Chicken manure (spelt chaff litter) ……..…. **500 tons** per year

Corn Maize silage ……**500 tons** per year

Grass cuttings……...**500 tons** per year

Whole plant silage (grain, rape, sunflowers)……**2.500 tons** per year

Silo maize silage……...**6.000 tons** per year

60% own production, 40% purchase

Strategy for substrate procurement:

- Close, good contacts with surrounding farmers
- Ratio procurement – own production 40:60
- Parcel exchange – annual lease - cultivation contracts
- Free delivery of manure and fermentation substrate to the suppliers
- Inter-organisational machine use
- Participation in the machine community
- Procurement through dealer (corn maize coarse meal)

production data

Available area for the output of the biogas fertilizer …….. **150ha**

Thermal power of the gas engine ……...**421 kW**

Electric power of the engine……**330 kW**

Generated thermal energy…….. **4,504 Mio kWh/a**

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Utilisation of heat ……..**:**

20% green houses

10% houses

10 % paintshops

5% corn drying

15% woodchips

10% home requirements

Generated electric energy …….. **4,47 Mio kWh/a**

Power consumption (electricity) of the plant itself ……..**223.500 kWh/a**

Annual delivery of electricity to the (regional) electric grid company

4,4 Mio kWh per year

Electric grid company…….**EON Bayern**

technical plant description

Horizontal fermenter, feed with briquetted cobs……..**650 m³**

Horizontal fermenter, feed with snail……**900 m³**

2 Paddle-type agitators

Re-fermentation vessel (round) (concrete ceiling)…… **1.800 m³**

2 Hydraulic propeller mixers

Manure storage (open)……**4.500 m³**

Gas accumulator foil sack with desulphurization…… **250 m³**

External desulphurization with Biosulfex from ATZ

Activated carbon filter

Screw-extruder separator

BHKW Jenbacher gas motor

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Operating temperature……**40°C**

Residence time in the digester …… **~ 90 days**

Average expenditure of human labour ……..**5 hours** per day

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Biogas plant „Gehrung“

ltd. liability company as general partner

The little farm proves itself to be a waste disposer of the region for the most part and provides good organic fertilizer. The plant works well without a lot of assistance. It has no specific components requiring special supervision. Regarding the averaged feeding there is actually still a space for increasing the substrates. The population that lives within spitting distance to the biogas plant does not complain about the noise or about the odeurs of the plant.

Biogas plant Gehrung

Farming activities: Dairy cows + offspring, arable land, permanent grassland

key data

Start of Operation …… **2006**

Type of corporation…….. **Ltd. Company & Co KG**

Investment costs …….. **500.000 €**

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feedstock

Food leftovers …….. **1.100 tons per year**

Maize…… **740 tons per year**

Grass silage…….. **640 tons per year**

Liquid manure and dung…… **700 tons per year**

Offcuts of farming…… **500 tons per year**

production data

Available area for the output of the biogas fertilizer …….. **75 ha own land, rest is picked up**

Thermal power of the gas engine …….. **1,0512 Mio kWh/a**

Electric power of the engine……..**875.000 Mio kWh/**

Generated thermal energy……**788.400 kWh/a**

Utilisation of heat ……**For the sanitation (70°C), houses and biogas plant, nearly all thermal energy is used**

Generated electric energy …….. **650.000 kWh/a**

Power consumption (electricity) of the plant itself ……..**30.000 kWh/a**

Annual delivery of electricity to the (regional) electric grid company **609.000 kWh per year**

Electric grid company……**EnBW**

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technical plant description

Digester ……..…**800 m³**

manufactured by Weltec Biopower GmbH, stainless steel

Mixing: propeller mixers Mixing vessel liquid manure

CHP by AVS Aggregatebau GmbH, gas engine, 100 kW_{el}

Pasteurisation of food leftovers

Fermenter……**950 m³**

Final storage……**1.200 m³**

Operating temperature……**40°C**

Residence time in the digester …… **68 days**

Average expenditure of human labour ……... **1,5 hours** per day

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Biogas plant „ Biowerk Hamburg”

ltd. Company Co. KG

The joint venture **BioWerk Hamburg GmbH & Co. KG has been operating the** Stellinger Moor biogas plant since April 2006. It is the first one in Hamburg and one of the most modern and most powerful in Germany. There, about 20,000 t/a of food wastes and leftovers, both packed and unpacked, are being utilised to generate electricity and heat by applying biological conversion.

The Stellinger Moor biogas plant operates in the sense of the Renewable Energy Sources Act which Directive 2001/77/EC from the European Parliament and the Council of 27 September 2001 put into force to promote electric power generation from renewable energy sources in the domestic electricity market.

Disposing of food leftovers using biogas plants corresponds to the EU Hygiene Stipulation (EU no. 1774/2002) of 3 October 2002. Whereas in the past it was allowed to process leftovers into fodder for use as animal food, that has no longer been possible since November 2006 as, from that time on, the European feeding ban started.

The plant processes

- Fruit and vegetable waste
- Foodstuffs in the trade that have been stored too long
- Leftovers from gastronomy, old people’s homes, hospitals and company canteens
- Fats and oils

A special feature is that even packed foods can be treated.

Pre-treatment starts after delivery of the waste: the waste is crushed and foreign particles such as the packing are separated out. The pumpable waste substrate reaches a sanitization system in the large fermenting containers.

At a temperature of ca. 38°C, bacteria ensure conversion of the biological waste into gas here. With a methane content of ca. 65%, that is very energy rich.

After processing (drying and desulphurization), the gas drives an internal combustion engine in a combined heat and power plant, facilitating generation of electric and thermal power. The electric and heat energy produced in the Stellinger Moor biogas plant is climate neutral and covers the energy needs of ca. 2,500 households. The heat from the biogas plant also heats both nearby arenas.

Source http://www.biowerk-hamburg.de/

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Biogas Regions
Shining Example

Biogas plant
Biowerk Hamburg © IBBK

key data

Submission of application……**07.03.2005**
Foundation of BIOWERK Hamburg GmbH……**15.07.2005**
Official Opening……**24.04.2006**
Digestion Residue ……**17.350 tons** per year
Biogas ……..**3.350 tons** per year
Packaging and Metals……....**2.250 tons** per year
Investment costs ……....**5 000 000 €**

feedstock

Expired foodstuff …… **15.000 tons** per year
Water …… **3.450 tons** per year
Mixed Waste…… **2.000 tons** per year
Oil and Fat …… **2.850 tons** per year

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Shining Example

production data

Engine …….. **MWM Deutz 12 Zylinder V**

Electrical power …… **1.021 kW**

Thermal power ……**1.070 kW**

Overall Efficiency …….. **82,6%**

Electrical energy……..**6,7 Mio kWh** per year

Thermal energy……..**7,0 Mio kWh** per year

technical plant description

Heat utilisation……**The heat is provided to the nearby stadium for hot water supply an air conditioning**

Gas Production rate……..**330 m³ per hour**

Energy content Biogas……..**approx 6,5 kWh/m³**

Residence time in the digester …… **~ 40 days**

Temperature of the anaerobic digestion (operational) ……**37° - 41° C**

Waste pre-treatment with Shredder, Separation, Hydrolysis, thermal treatment

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Biogas plant Karl-Heinz Engert

A biogas plant is presented below which predominantly ferments grains. Pure grain fermentation has barely asserted itself up to now even though from an energy point of view it is very interesting because gas extraction of up to 400 litres of methane per kg o DS have been measured and the high level of energy density promises low spatial needs for transportation, storage, fermentation and application on top of that. One major reason for that is certainly the rapid acidification tendency of this substrate. Grain decomposes extremely quickly and leads to rapid acidification in the fermenter. Using the conventional one-stage process, the acidification cannot be buffered if there is too much grain and the process comes to a standstill.

However, a two-stage system in which the acidification occurs in a separate stage, preventing interference in the methane formation process in the 2nd stage, was seldom economical in the past. But now the context has been improved and, through the NaWaRo bonus, it is easier to get financing for the accessories required for the process engineering. For that reason, interest in pure grain fermentation has grown. Practical experiences, however, will only be available in some years.

The plant in the Engert operation (97258 Uffenheim, OT Rodheim) was completed at the end of 2005 and exhibits the state of the art: daily, about 5 tons of corn (grain, maize) and ca. 6 m^3 cattle manure from the hydrolysis stage (the 1st fermentation stage) are conveyed into the actual fermenter. The cattle manure comes from four local operations and is picked up by the operator himself. In return, the farmers pick up the fermented manure from the 2000 m^3 disposal site, which is located on the plant premises.Part of the required substrates is grown on the operation's own areal (40 ha) and the remainder is procured externally.

In the grain delivery hall, 630 tons of grain is processed for a dry silo and ca. 350 t (500 m3) for a wet silo (ligavator from the company Lipp). The advantage of wet storage is that corn threshed longer during harvesting and corns with a moisture content of up to 25% in grains and up to 40% in maize corns can be stored. The dry grain is threshed, mixed in a paste maker (Ligamix from Lipp Co.) with water and pumped into the ligavator. This substrate, as compared with silo maize, has three times the energy density.

About every 6 days, a new mixture is charged in the hydrolysis container. To do that, 30 m^3 ligavator pulp, already acidified through storage (pH 3.9 and 50% solids), is pumped into the hydrolysis pit. In addition, the cattle manure and recirculated product from final storage are added so that the dry content of the mixture is about 26%. The hydrolysis container with 160 m^3 capacity is equipped with a powerful, stationary paddle-type agitator (from the company Rohn, 12 kW power) so other substances like silo maize can also be co-processed. The agitator runs approximately every three hours for 2 minutes. The hydrolysis is heated; the temperature is set between 10 and 40°C depending on the type of substrate.

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The retention time in hydrolysis is about 6 days. Every 3 hours, ca. 2.5 m^3 substrate are pumped into the fermenter (1000 m^3 steel fermenter from the company Lipp with integrated 300 m^3 gas accumulator). That amounts to a retention time of 50 days. The agitator in the fermenter is a flow conduction pipe with an integrated rod mixer and a power of 2 x 18 kW. It is run 8 times daily 8 for ca. 15 minutes.
The fermenter is run at an operating temperature of 38°C. The loading rate lies at about 3 kg o DS/ m^3 and day. The plant is automatically controlled by a PC. Remote data monitoring is possible. The desulphurization is performed by flowing in air. The gas analyzer from the company Chemec continuously measures sulphur, methane, CO, and oxygen.

The gas is converted into electricity in a 324 kW gas engine unit from the company MDE. It has an electrical efficiency of 36.5%. One can then calculate that an average power of 300 kW can be generated continually (365 days/a). The heat is utilised nearly 100% by ten connected residential houses and 2 stalls. For that reason, the plant receives the cogeneration of heat and power bonus. The local heating network and the substitute heating oil burner with 220 kW power were financed by the 10 participating households. Per household, about 6,000 to 7000 € investment costs arose, which are accounted for via heat delivery. 50% of the heating oil price will be calculated as the heating price.
According to the planners, the investment costs of the plant without heat connection lies at 3000 - 3500 € /kW.

The operating costs cannot be exactly estimated at this time. The plant designers calculate 1 hour per day as the labour-time expenditure. In comparison with other renewable raw materials plants, that is extremely little (ca. 30%). As charging with grain or corn requires much less time and everything is more or less automatic, the labour-time expenditure can even be significantly reduced.

Photo IBBK

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