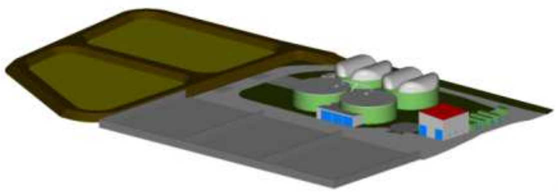
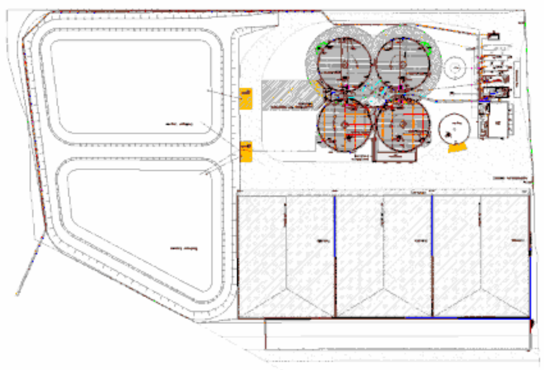
ING GERHARD AGRINZ GMBH

Design of biogas plants

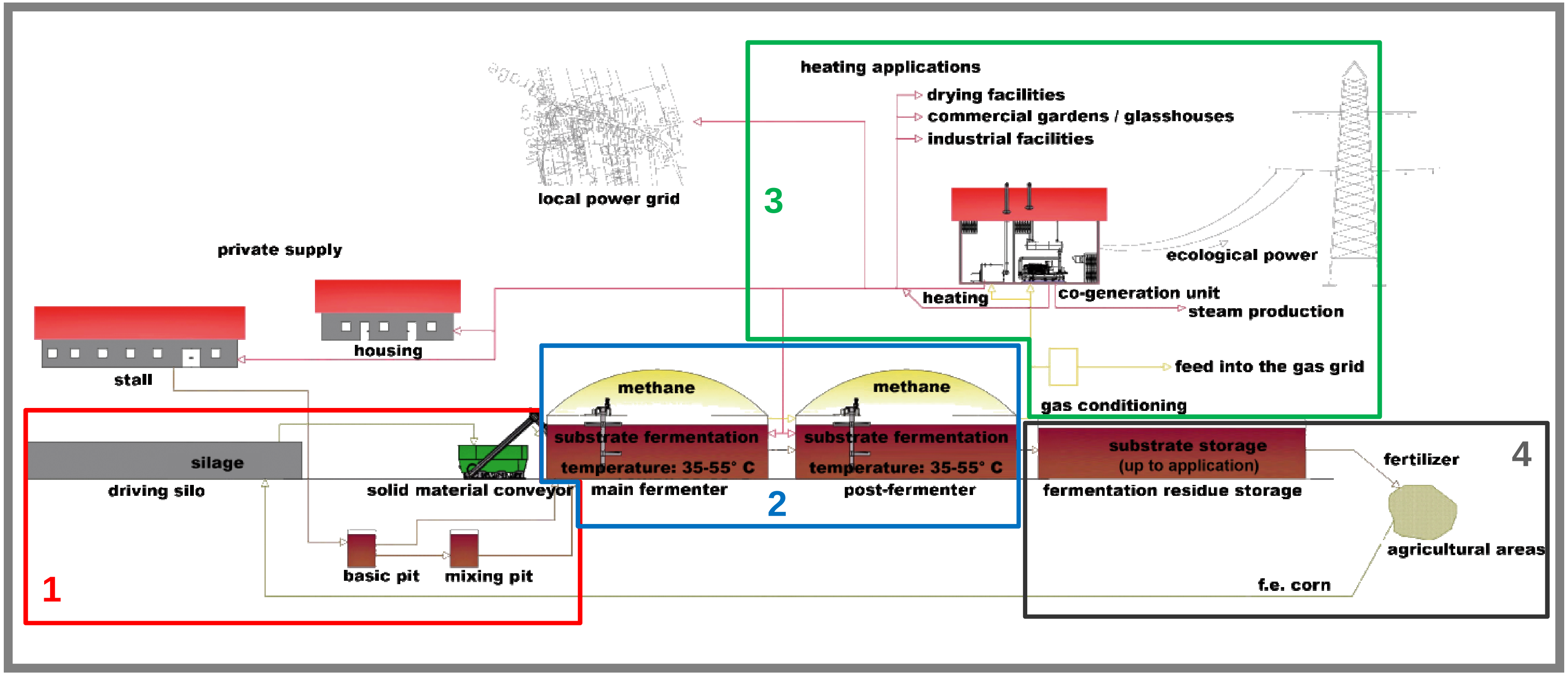




BiG>East
Biogas for Eastern Europe

Leibnitz, 20.04.2009

Process flow of a biogas plant



1 Feeding system 2 Gas production 3 Gas utilisation 4 Fermentation residue

1. Feeding system

After delivery, the liquid substrates are stored in the pre-processing pit and fed into the main digester via a pump station.

The dry substrates are stored in the bunker silo (drive-in silo) and then fed as required to the main digester via the dry loading unit (loading funnel with feed screw conveyor).

Bunker silo or drive-in silo

Silage making


LIEBHERR
LIEBHERR
550
2plus2
40


LIEBHERR
550
STETZL Kipper
STETZL Kipper

Dung storage

Feeding system, stackable feedstock


FIAT-HITACHI
FIAT-HITACHI
FB160.2
MAI 5 2006


MANISCOPIC
MT 732
EDER STAPLER
20

Feeding system, pumpable feedstock

Sanitation unit

European (*Animal By-Product Regulation EC 1774/2002*) and national legislations regulate waste treatment practices.

Sanitation must be done before pumping the feedstock in the digester. It takes place in separate, heated stainless steel tanks, connected to the digester feeding system.

Parameters for sanitation: temperature, retention time, pressure and volume.

Treatment of animal by-products:

Category 1 is not permitted in biogas plants.

Category 2 must be steam pressure sterilised at 133℃, 3 bar, at least 20 minutes (at core temperature), particle size < 50 mm.

Category 3 the following applies: Thermal pasteurisation must be carried out at 70℃ for 60 minutes, particle size < 12 mm.


BGS – AWA
UMWELTTECHNIK GMBH

2. Gas production

The substrate is fermented in the **digester** (heated and insulated) in an air-tight anaerobe environment at a temperature of between 35℃ and 55℃, i.e. the carbohydrates, fats and proteins contained in the substrates are decomposed and, in the last stage of decomposition, converted into methane (CH_4) and carbon dioxide (CO_2) by methane forming bacteria.

On feeding in fresh feedstock, the fermented substance is forced into the post-digester through the overflow pipe. Here the remaining gas forming potential in the ferment substrate is extracted, making full use of the energy contained within.

digester or digester or reactor

The digester and its equipment are at the heart of a biogas plant.

There are a various types of biogas digesters. digesters can be made of concrete, steel, brick or plastic, shaped like silos, troughs, basins or ponds, and they may be placed underground or on the surface.

The size of digesters determine the scale of biogas plants and varies from few cubic meters in the case of small household installations to several thousands of cubic meters, like in the case of large commercial plants, often with several digesters.

Process temperature and mixing

Constant **process temperature** inside the digester is one of the most important conditions for stable operation and high biogas yield. Temperature fluctuations must be kept as low as possible. Large fluctuations of temperature lead to imbalance of the process, and in worst cases to complete process failure.

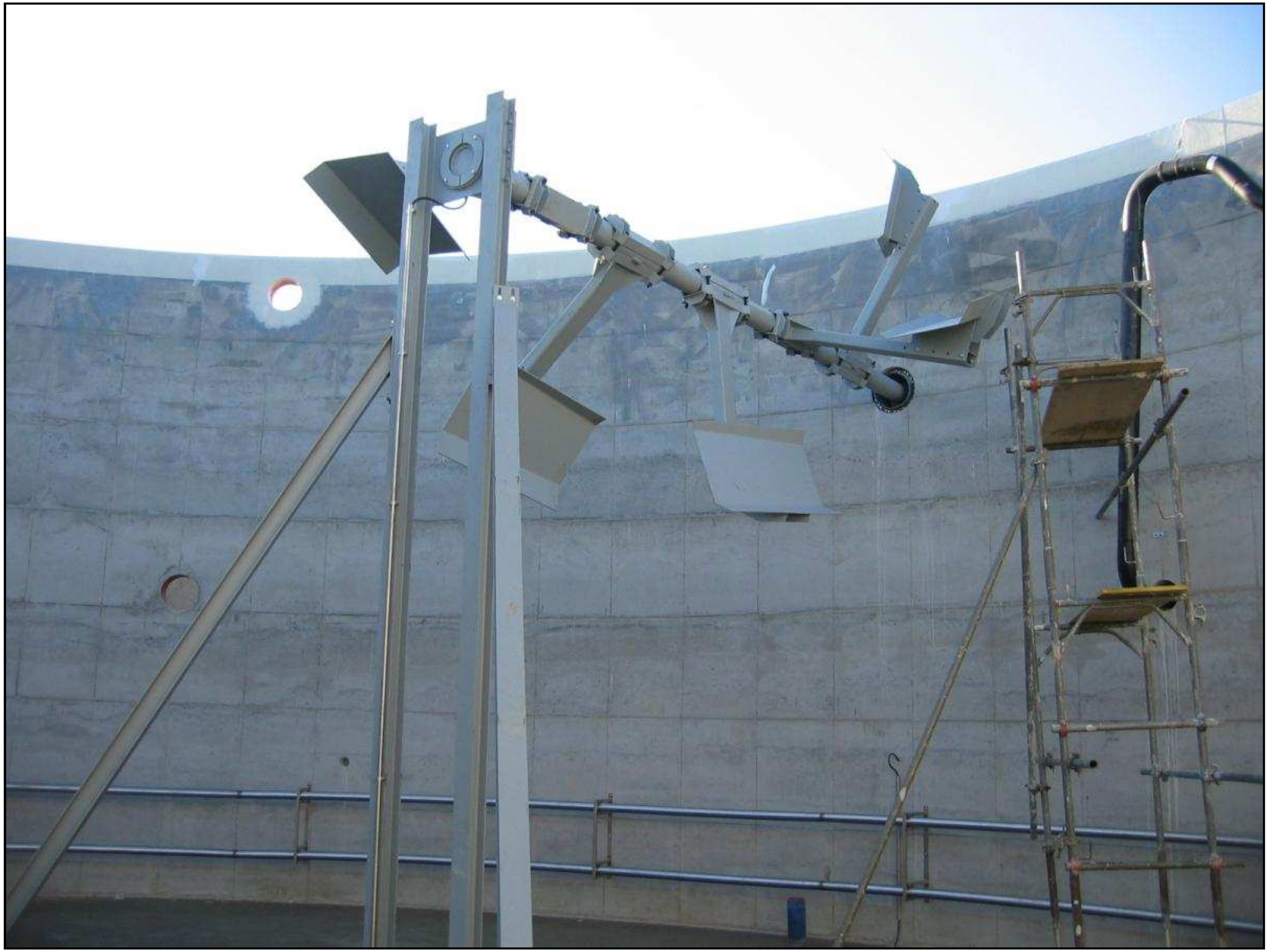
The digester content must be stirred several times per day with the aim of **mixing** the new feedstock with the existing substrate. Stirring prevents formation of swimming layers and of sediments, brings the micro-organisms in contact with the new feedstock particles, facilitates the up-flow of gas bubbles and homogenises distribution of heat and nutrients through the whole mass of substrate.

Heating system - digester heating

Stirrer or mixer

Paddle stirrer, hanging, replaceable

Paddle stirrer, horizontal

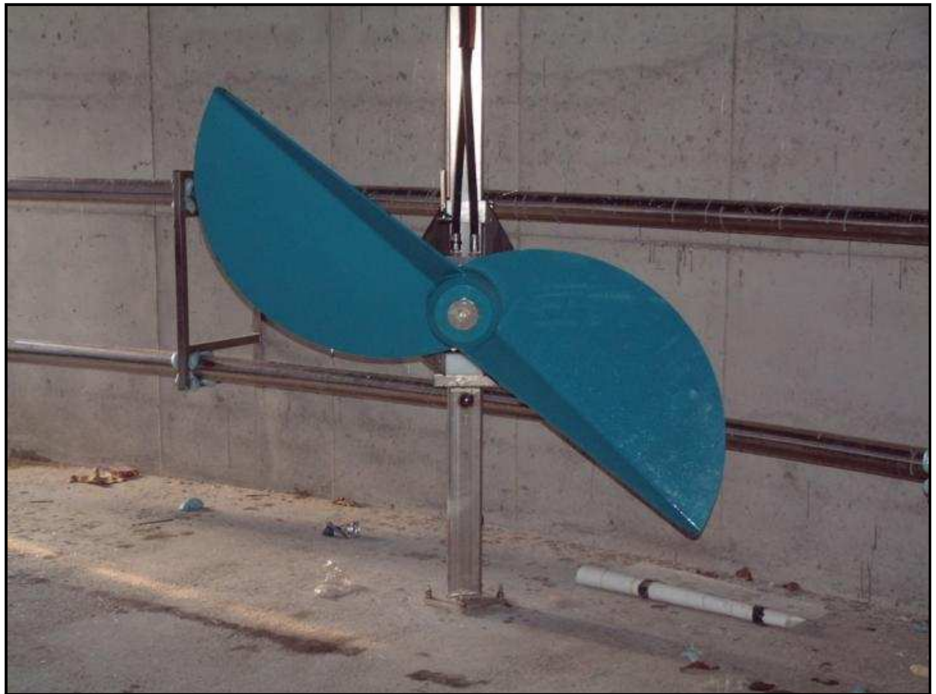


Paddle stirrer, inclined

Power take off stirrer

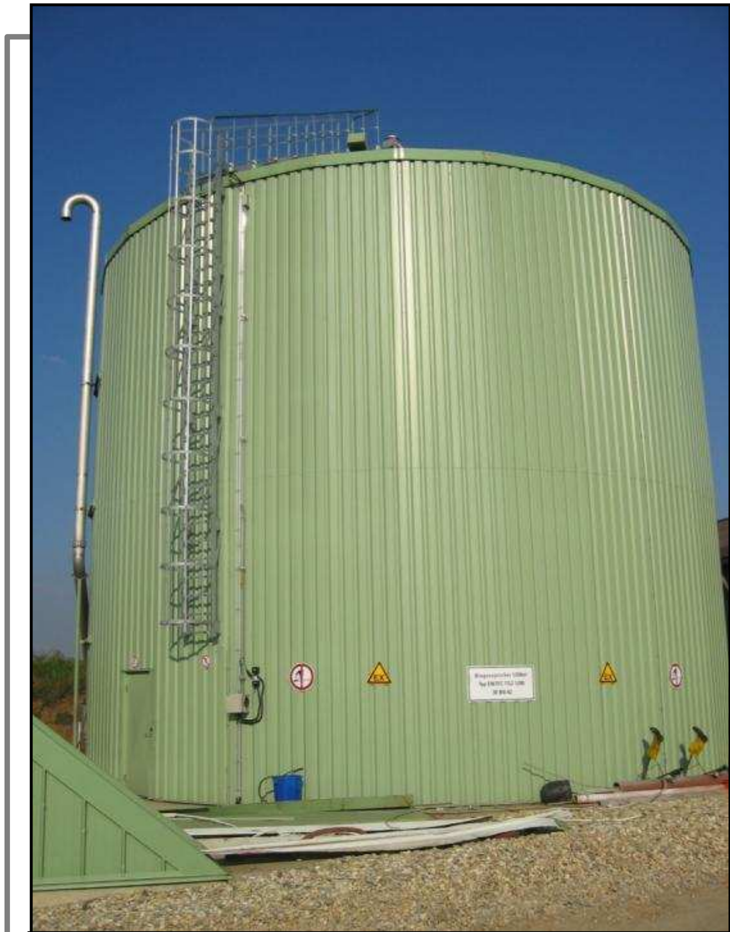
Submersible motor propeller stirrer

Hydraulic propeller stirrer



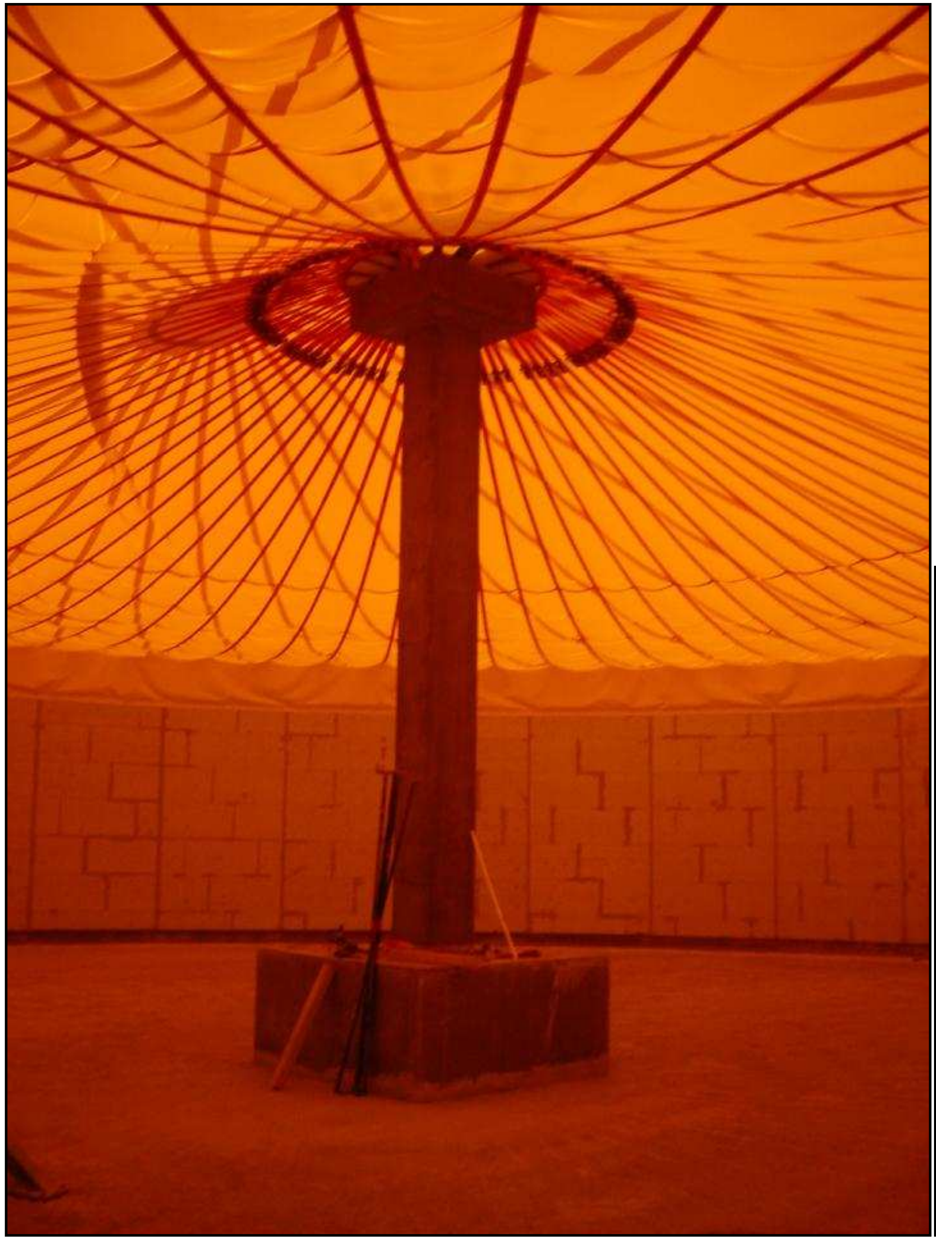
Biogas storage

The biogas produced in the digester is collected and stored in gas storage tanks which are high-strength, reinforced and have double gas-impermeable membranes.



Gas hood, u-shaped

Gas hood, split



Gas hood,
from inside

3. Gas utilisation

The biogas extracted in the digester and stored in the gas storage is typical used in a co-generation plant (CHP such as a gas motor) and converted into thermal and electrical energy. The electric energy produced is fed into the national electricity grid. The thermal energy is generally for own use and other various consumers.

Other possibilities of biogas utilisation

- Direct combustion and heat utilisation
- Biogas upgrading - vehicle fuel
- Biogas upgrading (biomethane production) - injection to public natural gas grid

CHP, gas motor

CHP, gas motor
in container

Gas boiler

Biogas filling station

Biogas feed-in

4. Fermentation residue

The fermentation residue is pumped from the post-digester into the final storage facility via the pumping station. This fermentation residue is stored here until required for agricultural or other use. Fermentation residue is an excellent agricultural fertiliser.

Fermentation residue storage

- Storage tank
- Lagoon

Storage tank

Lagoon

Utilisation of fermentation residue as fertiliser

The process in biogas plants results in biodegradation of organic matter to inorganic compounds and methane. For example, the anaerobic degradation rate of organic matter from animal manure and slurries is about 40 % for cattle slurry and of 65 % for pig slurry.

The degradation rate depends at large on feedstock type, HRT and process temperature. Due to degradation of organic matter, fermentation residue is easier to pump and easier to apply as fertiliser, with reduced need of stirring, compared to untreated slurry.

Pros of fermentation residue as fertiliser

The utilisation of fermentation residue as a fertiliser is a cost-effective method of soil recovery and regeneration of groundwater.

- Higher fertiliser value (fertiliser improvement)
- Saving of mineral fertilisers
- Improvement of direct nitric-fertiliser properties by increasing ammonium nitrogen content
- Marked reduction in aroma-building substances (reduction of odours)
- Reduction of harmful germs (sanitation)

To avoid the loss of ammonium from the fermentation residue, low emission application technology is required (dragging hose sprayer).


M&S
M&S

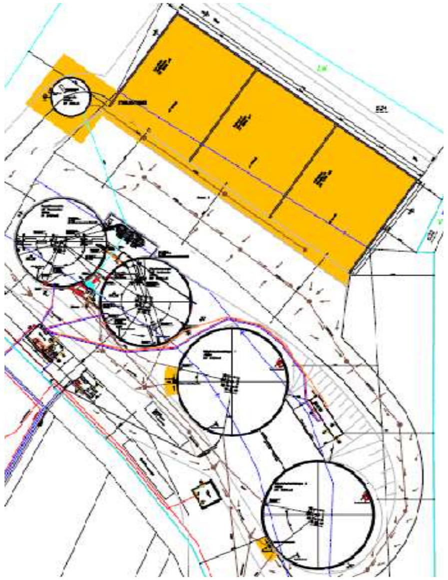

Unbefugten
ist der Zutritt
verboten!
Hex
bringt Energie für Sie
0664/46 96 000


GRAZ


Vakutec
Callisto TURBO
13000
ANTONIO
ALFONSO

References

Agricultural Biogas Plant - 500 kW

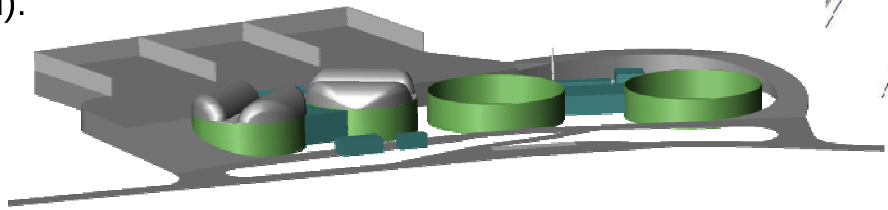


Biogas plant Japons

Location:
Japons, district of Horn, Lower Austria, Austria

Operator:
Bio-Energie aus Japons, comprising 42 farms and 36 real estate owners

Substrate used (14.250 t/a; 41 t/d):
corn silage, rye, manure



Output:
Electrical: 500 kW_{el}
Thermal: 535 kW_{therm}

Annual energy output:
Electricity: 3,9 Mil. kWh/year
Heat: 4,2 Mil. kWh/year
Biogas: 1,8 Mil. Nm^3/year

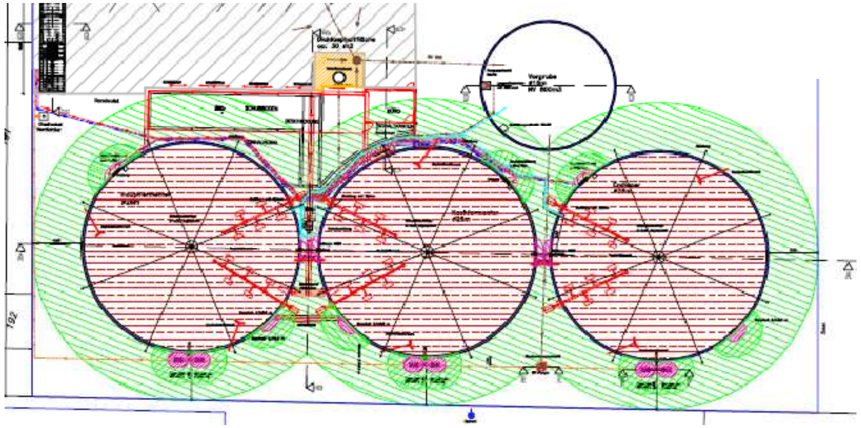
Energy provided:
Input of 3,7 Mil. kWh of electrical current per year into the public power grid of the EVN.
Year round heating of 8 public buildings, one industrial operation and 31 private households in the community of Japons.

Environment:
Through the substitution of heating oil, this means a reduction of approximately 2.200 tons per year of CO_2.

Agricultural Biogas Plant - 500 kW

Biogas plant Japons

Agricultural Biogas Plant - 1 MW



Biogas plant Gabersdorf

Location:
Gabersdorf, district of Leibnitz, Styria, Austria

Operator:
Bioenergie Gabersdorf GesmbH

Substrate used (30.000 t/a; 86 t/d):
corn silage, sudan grass, sun flowers, rye-greenery

Output:
Electrical: 1.000 kW_{el}
Thermal: 1.060 kW_{therm}

Annual energy output:
Electricity: 7,8 Mil. kWh/year
Heat: 8,4 Mil. kWh/year
Biogas: 3,5 Mil. Nm^3/year

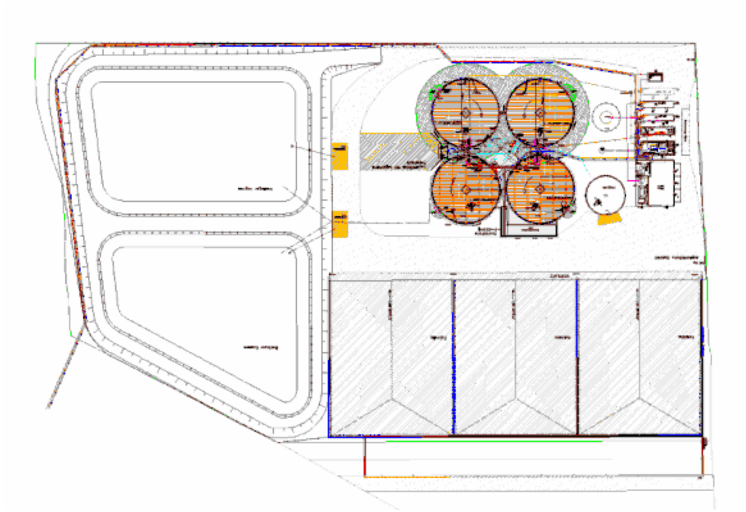
Energy provided:
Input of 7,4 Mil. kWh electrical current into the public power grid of EW Ebner. Heating of the neighbouring factory for window production.

Environment:
Through the substitution of heating oil, this means a reduction of approximately 4.400 tons per year of CO_2.

Agricultural Biogas Plant - 1 MW

Biogas plant Gabersdorf

Industrial Biogas Plant - 2,12 MW



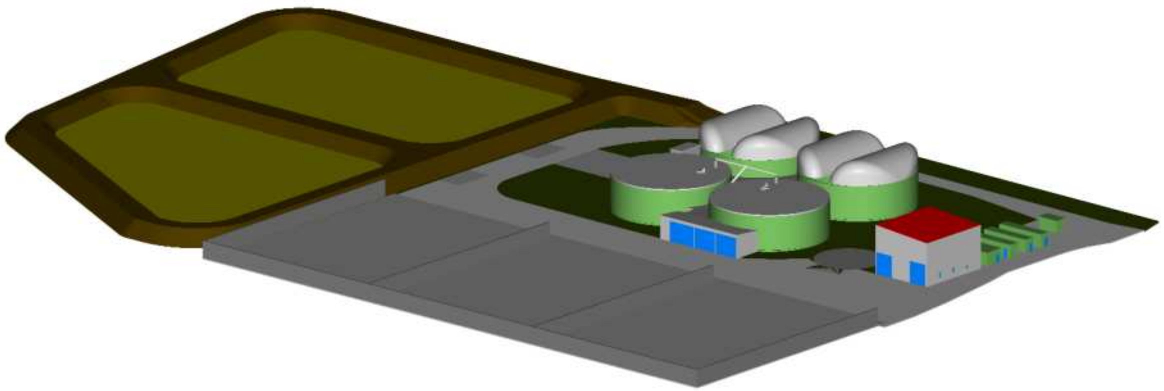
Biogas plant Casar, Mlajtinci

Location:
Mlajtinci, Moravske Toplice, Murska Sobota, Slovenia

Operator:
Bioplin Casar d.o.o., comprising one farm and several investors

Substrate used (86.100 t/a; 239 t/d):
corn silage, cattle dung, pig dung, slaughter waste, blood, leftovers

Output:
Electrical 2.120 kW_{el}
Thermal 2.420 kW_{therm}



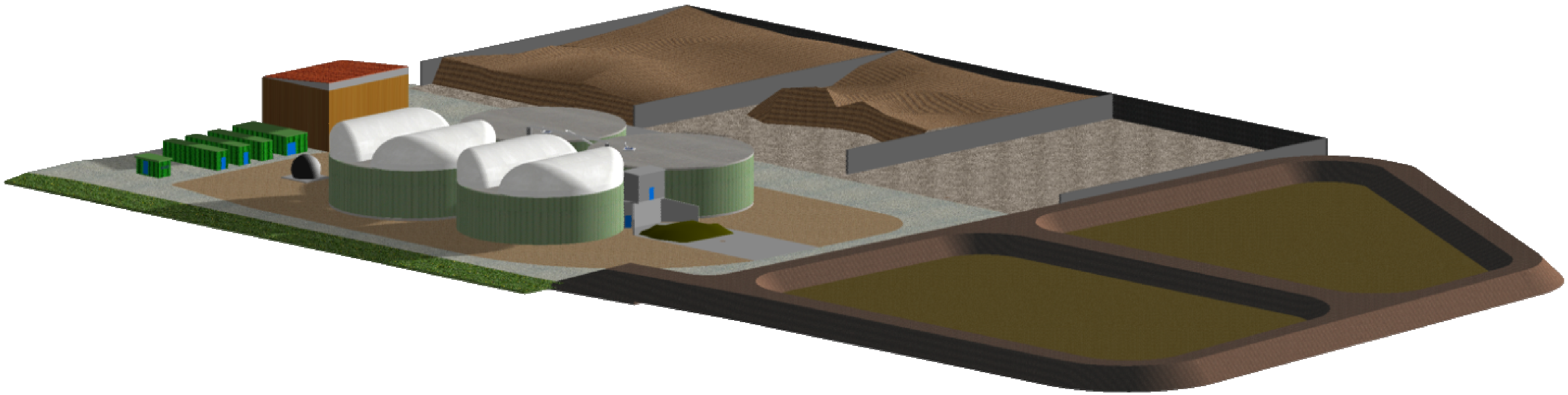
Annual energy output:
Electricity 16,9 Mil. kWh/year
Heat: 19,4 Mil. kWh/year
Biogas: 8,2 Mil. Nm^3/year

Energy provided:
Input of 16,3 Mil. kWh electrical current per year into the public power grid of the Elektro Maribor.
Year round heating of two glass houses (total area 2 ha).

Environment:
Through the substitution of natural gas, this means a reduction of approximately 8.200 tons per year of CO_2.

Industrial Biogas Plant - 2,12 MW

Biogas plant Casar, Mlajtinci



Thank you for your attention !!

Ing. Gerhard Agrinz GmbH

A-8430 Leibnitz, Emmerich-Assmann-Gasse 6
E-Mail: office@agrinz.at, Home: www.agrinz.at
Tel.: +43 3452/73997-0, Fax: +43 3452/73997-9