Tour Schedule:

09:00 Depart Park Inn for Grodziec Slaski (approx. 2 hour ride)
11:00 Introduction and Presentation of the Experimental Station,
National Research Institute of Animal Production, Coffee Break
12:00 Visit the Agriculture Biogas Plant in Kostkowice, Coffee Break
14:00 Depart Kostkowice for Krakow
16:00 Approx. arrival time at Park Inn, Krakow

AGRICULTURAL BIOGAS PLANT
of the Experimental Station of National Research Institute of Animal Production in Grodziec Śląski

- **Implementation timeline**

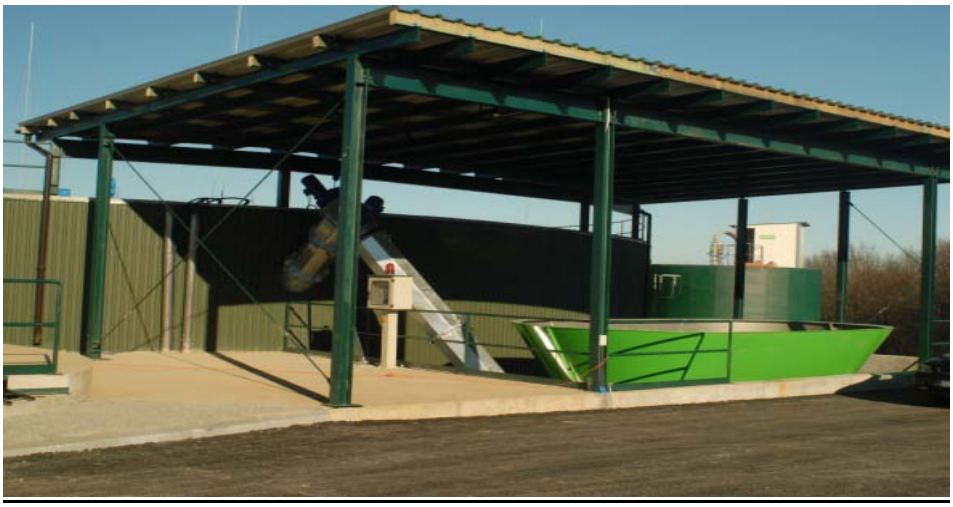
Building permit obtained in 14.12.2009.
Works were started in 12.04.2010. Construction and assembly lasted continuously till November 15th, 2010.

10.02.2011 obtained occupancy permit for Agricultural biogas plant.
04.03.2011 asked the first liquid substrate
28.06.2011 was the first engine start
20.07.2011 obtained a license of Energetic Regulation Office to produce electricity for the period from July 20th, 2011 to December 31st, 2030

- **Location**

The investment was carried out at the Kostkowice farm using for his purpose plot number 114/6, on the surface of 1.5 ha.
In order of foundations of buildings excavation were made of the total volume ca 5000 m^3.

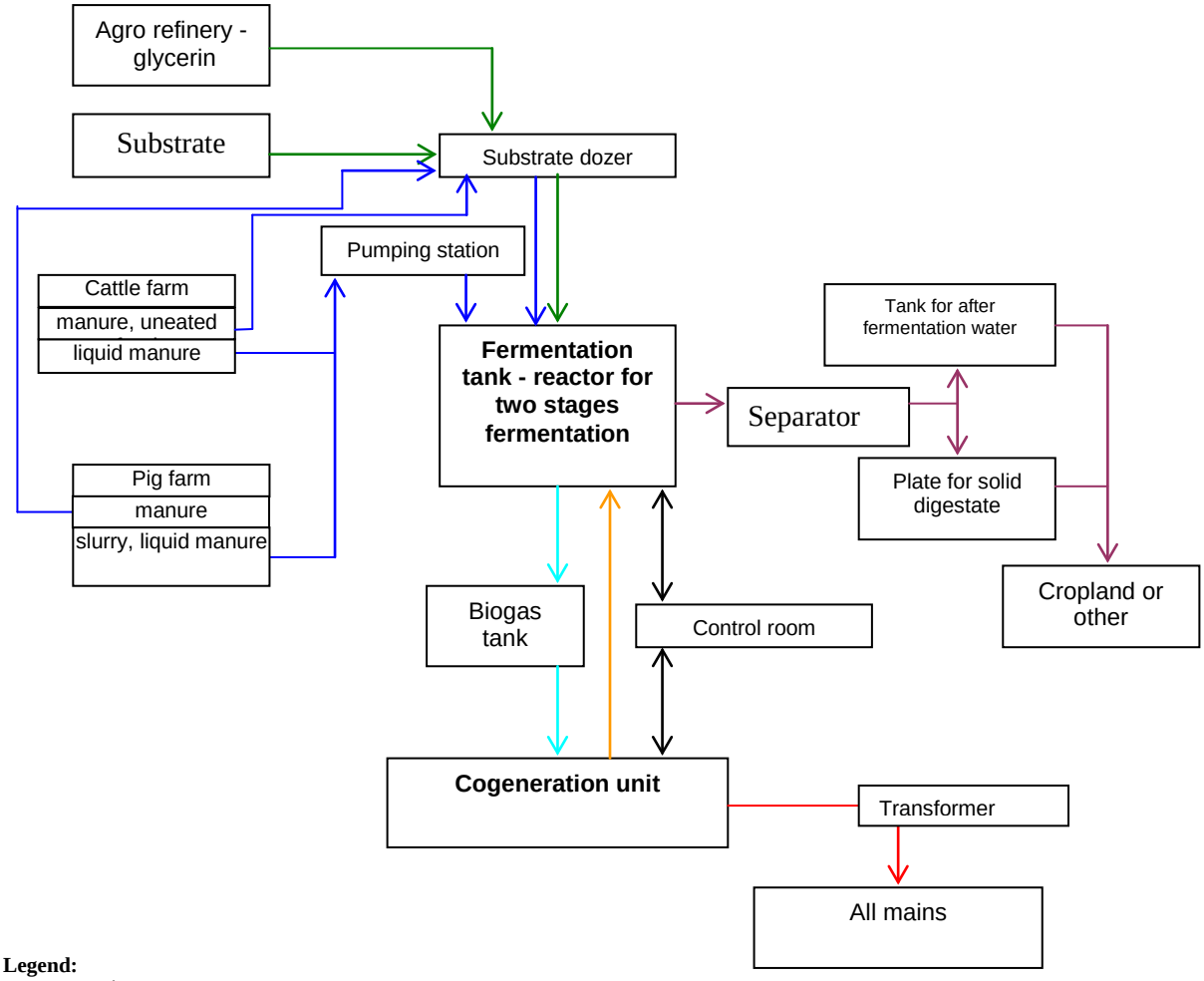
Fermentation reactor



Solid substrate feeder

Gas engine 600 kW power

- **Operation scheme of biogas plant**



- **Agricultural biogas plant units**

- fermentation tank
- liquid substrate tank
- hopper with weighing and mixing the solid substrate
- digestate tank and separator
- after fermentation water tank
- biogas tank
- cogenerator building with generator and cogeneration
- container transformer station
- internal roads and land with fencing along

from left biogas tank, in depth fermentation reactor

- **Technology**

The primary purpose of agricultural biogas plant is the production of electricity and heat. For this purpose, a biogas engine drives the generator coupled. Biogas production is realized in fermenter.
Fermenter design is two cylindrical tanks stacked one on another.
Outer ring-shaped tank acts as the main fermenter, while the inner cylindrical tank serves as a secondary fermenter.
Inside the outer tank is located the security system of the heating temperature of fermenting substances at 38-40 ^{O}C. Heating is accomplished through the use of heat gained from cogeneration.
Due to the placement of internal fermenter, the heating is not necessary.
Another advantage is to place the gas tank outside the fermenter chamber - as a separate object.
This solution allows better use of space fermenter, and provides a safer solution.
The whole fermentation process is controlled by a special computer system that allows optimization of the quantities of substrate inflicted by the amount of biogas produced.
This allows full automation of the production process.

Construction elements of technology unit	
slurry tank capacity	315 m^3
capacity of the container of a substrate „Eckart“	Basic 23 m^3, with superstructure 50 m^3
fermenter capacity	4 400 m^3

- **Cogenerator**

In the cogeneration building comes into use of produced biogas.
Dosing and mixing system converts the biogas delivered in an appropriate gas-air mixture.
This mixture is burned in a gas engine, like in the classic engine equipped with spark ignition.
The electricity produced by control-measuring system and the transformer is transferred to the grid.
Another factor obtained by combustion of biogas energy is heat. The amount of heat generated is comparable to the amount of electricity produced.
For the electric power of 600 kWe power heat gain in a row 610 kWc.
Some thermal energy is used to heat the digester.
Depending on fermentation conditions and weather, for this purpose consumes 100 to 200 kW, the remainder of the heat can be used for economic purposes.

Cogenerator building

Deutz cogeneration engine

- **The parameters of engine designed for biogas burning:**

Type TCG 2016 V12 C /company DEUTZ/
Generator / Type Marelli MJB 400 LA4
Operating voltage / frequency [V / H]z 400 / 50
Rounds [min^{-1}] 1500
Electric power [kWel] 600
Thermal power of the engine cooling system [kWc] 305
Thermal power from exhaust heat [kWc] 303
Exhaust temperature ca. [°C] 447

- **Production volumes**

In order to safeguard the continuity of the production process must have a constant supply of substrates in the quantities:

Demand for substrates per year		**Monthly dose**	**Daily dose**
manure	5 216 t	435 t	14,30 t
bovine liquid manure	3 750 t	312,5 t	10,27 t
pig slurry	8760 t	730 t	24,0 t
uneaten feed - milk cows feed	350 t	29,2 t	0,96 t
glycerin	68 t	5,67 t	0,19 t
grass silage	3200 t	266,67 t	8,77 t
corn silage	4 118 t	343,17 t	11,28 t
crop residues	1 000 t	83,3 t	2,74 t

Depending on the quantity and quality of the substrate provided the maximum amount of energy produced by cogeneration generator can oscillate at:

Annual production of biogas	2 030 017m^3
Annual production of methane [CH_4]	1 075 909 m^3
Average content of methane	53%
Annual gross energy production Electric energy + heat	9 741,312 MWh
Annual production of electric energy	4 838,400 MWh
Annual production of heat energy	4 902,912 MWh