

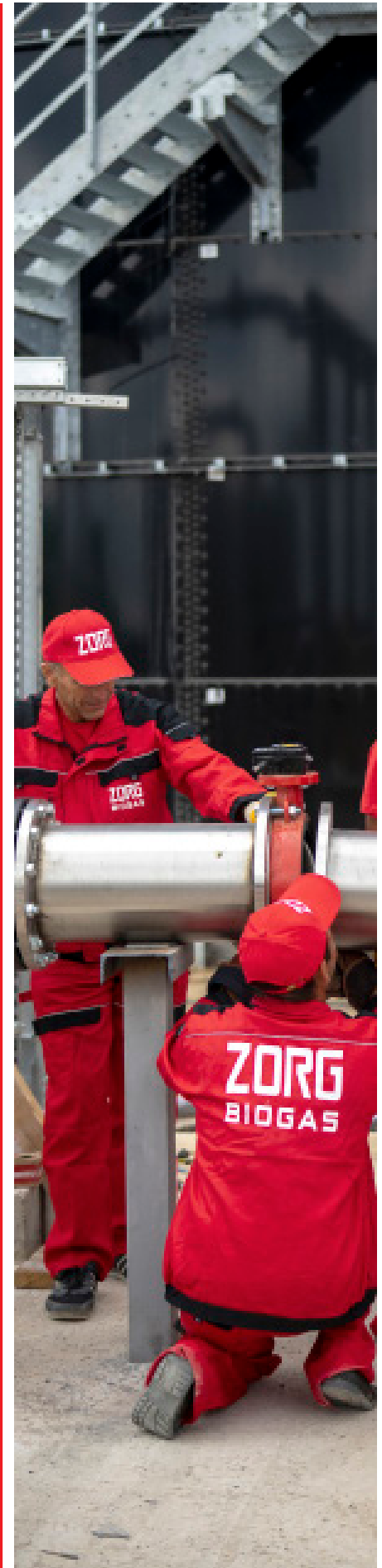
# PROPOSAL

Biogas plant 1063 kW el.  
for a milk farm 5000 cows



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## OVERVIEW

We offer a solution to process cow slurry from a milk farm 5000 cows into biogas and electric power. A proven and reliable CSTR technology is used. Biogas reactor made out of reinforced concrete. Biogas is burned in a co-generator with the production of 1MW electric power and 1MW heat.

## Raw material potential

Substrate	Quantity (tonnes/day)	Quantity (tonnes/year)	DM content: (%)	ODM content (%)	DM quantity (tonne s/ day)	ODM quantity (tonnes / day)	Biogas yield (m <sup>3</sup> / tonneODM)	Biogas (m <sup>3</sup> /day)	Methane content (%)	Biogas (m <sup>3</sup> / year)
Cow manure	250	91 250	10,0	82,5	25,0	20,6	460	9 488	60	3 462 940
Remnants of cow feed	3	1 095	35,0	94,0	1,0	0,9	700	691	52	252 180
Total	253	92 345			26,0	21,5		10 179	60	3 715 120

## Biogas plant technical performances

Characteristics	Values	Figures
Number of digesters	units	1
Digester		
a) volume:		
Work	m <sup>3</sup>	5900
Overall	m <sup>3</sup>	6250
b) Organic load	kgODM/ m <sup>3</sup>	3,5
c) Hydraulic retention time (gross)	days	25
d) Overall dimensions of the digester (diameter / height)	m	30/8,8
e) Temperature	°C	+38
Gasholder		
a) Volume	m <sup>3</sup>	1690
b) Number of gasholders	units	1
c) Dimensions of the gasholder (diameter / height)	m	30/6,0

## Number of personnel

Position	Shift 1	Shift 2	Shift 3
operator	1	1	1
chief	1		



## WORKING PRINCIPLE

The technology is based on the biochemical conversion of organic materials from high molecular weight compounds to low molecular weight compounds. The first stage of this process is hydrolysis. Hydrolysis produces organic acids and alcohols.

Organic compounds + H<sub>2</sub>O → C<sub>5</sub>H<sub>7</sub>N<sub>0</sub>2 + HCO<sub>3</sub>.

Further conversion of obtained dissolved compounds like organic acids and alcohols (C<sub>5</sub>H<sub>7</sub>N<sub>0</sub>2, HCO<sub>3</sub>) into gases - CH<sub>4</sub>, CO<sub>2</sub>. C<sub>5</sub>H<sub>7</sub>N<sub>0</sub>2 + HCO<sub>3</sub> + H<sub>2</sub>O → CH<sub>4</sub> + CO<sub>2</sub> + NH<sub>4</sub>.

Biological process of consecutive (phasic) conversion of organic compounds take place in anaerobic environment i.e. in oxygen-free tank (biological reactor). At the first stage of fermentation, substrate hydrolysis take place under acidogenic bacteria influence. At the second stage, elementary organic compounds come through hydrolysis oxidation by means of hetero-acidogenic bacteria with production of acetate, carbon diox-

ide, and free hydrogen. The other part of the organic compound including acetate forms C<sub>1</sub> compounds (elementary organic acids). Produced substances are the feedstock for methanogenic bacteria of the third type. This stage flows in two processes of A and B type the character which depends on caused by different bacteria type. These two types of bacteria convert the compound obtained during the first and second stages into methane CH<sub>4</sub>, water H<sub>2</sub>O and carbon dioxide CO<sub>2</sub>. Methanogenic bacteria are more sensitive to the living environment compared to acidogenic bacteria. They require a complete anaerobic environment and a longer reproduction period. The speed and scale of anaerobic fermentation depends on bacteria metabolic activity. That is why the biogas plant chemical process includes hydrolysis stage, oxidation, and methanization stage. For that kind of substrate, these processes take place in the same reactor

## Technological process of biogas production

Cow manure and cow feed remnants is loading into a receiving tank. The receiving tank is equipped with a submersible mixer, level sensors. Substrate from receiving tank is loaded into digester by portion with pump. In digester the substrate is brought up to a temperature of +38C. Constant temperature is sustained for the entire digesting period. The digester operating regime is mesophilic. The heated substrate in the digester is blended periodically by mixers. The average time of processing in the digester is 25 days (gross).

After the digester, the substrate is fed by pump to the separator area where it is separated into solid and liquid bio-fertilizer. Solid bio-fertilizer is discharged to the separation area and transported for composting site; liquid filtrate is directed to a filtrate tank.

Digester are equipped with a gasholder for accumulating of biogas. The gas holder's weather protective film protects the gasholder from precipitation and damage by foreign objects. The weather protective film is fixed firmly by a special system. To protect the gasholder from overpressure, digester is equipped with safety valve, which start working at a pressure of 5 mbars and bleeds biogas to the atmosphere. Air is supplied in portions to the fermenter for the 1st stage of biogas purification from hydrogen sulfide.

The biogas then goes through a gas pipeline to a ground heat exchanger, where

a condensate is discharged. Then biogas goes to biogas cooling system. Cooling system provides biogas cooling for 20C. Then the biogas goes to the compressor, where the pressure is raised up to 80-150 mbar to meet engine requirements. After the compressor, biogas passes the 2nd stage of purification from hydrogen sulfide - a coal column. After the final purification, the biogas goes to the co-generator to produce electric and heat energy.

All technological processes are controlled and operated by an automatic system. Biogas plant work is monitored at the central control room monitor. The control room is equipped with a central control unit, which allows the switching of any biogas plant module into automatic or manual mode with local or remote control.

# MAIN EQUIPMENT







## Digester (D-01)

Digester is a tank of cylindrical form (for better mixing during the fermentation). It is built of cast-in-situ reinforced concrete based on sulphate-resistant cement with thickness of walls and bottom - 0,25m. In the center of the digester there is a column with chapter. Overlap of digester is reinforce concrete plate. On the tank's wall and in the bottom there is to be installed pipelines for heating, intended for assurance and maintenance of the optimal fermentation process temperature at thermophilic conditions. For heat conservation and reduction of heat energy con-

sumption, the digester walls, overlap and bottom are insulated outside with 100 mm slabs of extruded polystyrene foam. Over the heater, the substructure walls and bottom are insulated with roll damp proofing. Superstructure and substructure heat insulation is protected by shaped sheet from the outside mechanical damages and rodents. The digester bottom has a slope 1%.

### Specifications

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<b>Height :</b>	8,8 m
<b>Diameter :</b>	30 m
<b>The total volume :</b>	6250 m <sup>3</sup>
<b>The substrate volume :</b>	5900 m <sup>3</sup>
	1 pcs



## Receiving part of the tank (PT-01)

The tank is divided by a partition. In the receiving part, a hatch, agitator and the necessary raw material control sensors are installed. Constructed from sulphate-resistant concrete and partly buried underground

### Specifications

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<b>Diameter:</b>	12,0 m
<b>Height</b>	3,0 m
<b>Total volume:</b>	339 m <sup>3</sup>
<b>Receiving part</b>	170 m <sup>3</sup>



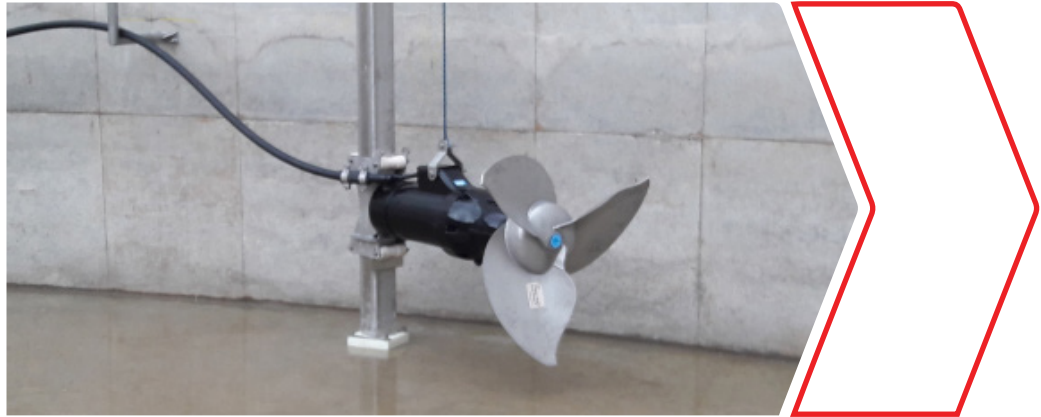
## Filtrate part of the tank (FT-01)

Filtrate part serves to collect the filtrate after the separator. The tank is equipped with level sensors

### Specifications

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<b>Diameter:</b>	12,0 m
<b>Height</b>	3,0 m
<b>Total volume:</b>	339 m <sup>3</sup>
<b>Filtrate part</b>	170 m <sup>3</sup>



## Submersible mixer (AG 01..07)

The submersible motor agitator serves for mixing renewable raw materials (RRM), liquid substrate as manure and similar substrates. The electro-motor driven submersible agitator is designed for submersion operations in potentially explosive environments of Ex zone 2 and complies with Directive 94/9 EC. The submersible agitator can be attached to most sliding masts by means of the motor support. A mounting option for a hauling cable is provided on the motor support for height adjustment purposes.

Due to the 4-roller guidance of the motor support, the agitator can be lifted and lowered without friction and the square mast, even if the pull of the hauling cable is slightly angular. The motor support is designed for a 100 x 100 mm square sliding mast as standard, but can also be used for an 80 x 80 mm sliding mast by changing the rollers. The strain relief of the connecting cable can be positioned in the extension of the motor or towards the top on the motor support, depending on the requirements.

This enables universal utilization with the most various installation kits.

The geared motor is made of spheroidal graphite iron (GGG40) and painted, the propeller is galvanized and the motor support is made of stainless steel. The submersible motor agitator is designed as a water pressure-tight monoblock unit for driving the three-vane propeller. The submersible agitator is of modular design, submersible electro-motor with flange-mounted planetary gear and bearing flange for holding the propeller. The conical shaft in the bearing flange is mounted in the oil bath by two angular roller bearings and sealed off from the agitating substrate with a mechanical seal.

## Specifications

### Mixer for receiving tank

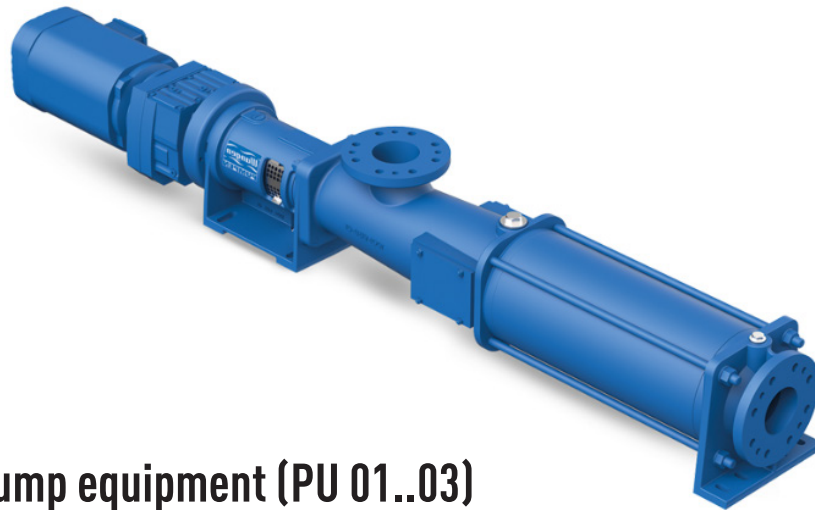
**Nominal power**  
**Quantity:**

N= 15.0 kW  
1 pcs

### Mixer for digester

**Nominal power**  
**Quantity:**

N=15.0 kW  
6 pcs



## Pump equipment (PU 01..03)

Pumps are used to transport substrate to the equipment and facilities in the biogas plant and away. Biogas plant design allows to access easily to all pumps. Pumps are driven by helical geared motor. Stator has hopper inlet for optimum filling of the pumping chamber, wear-protected, robust universal joint with feeding screw, robust bearing pedestal with close-coupled drive and self-centering of the drive shaft. Pumps have modular design for high flexibility, low life-cycle-costs.

### Specifications

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#### Substrate feed pump

Flow rate:	40 m <sup>3</sup> /hour
Engine power:	11,5 kW
Pressure:	4 bar
Quantity:	1 pcs

#### Substrate pump to separator

Flow rate:	40 m <sup>3</sup> /hour
Engine power:	11,5 kW
Pressure:	4 bar
Quantity:	1 pcs

#### Filtrate pump

Flow rate:	40 m <sup>3</sup> /hour
Engine power:	11,5 kW
Pressure:	4 bar
Quantity:	1 pcs



## Gasholder (GH-01)



The gasholder provides for biogas storage and for equalizing pressure and biogas composition. The gasholder system has a two-layer construction. The external material consists of a weather-proof film of PVC-coated polyester fabrics with UV protection. Both sides are finished with an external N/5cm, internal membrane PE (gasholder) membrane.

The gasholder has a methane permeation maximum of  $260 \text{ cm}^3/\text{m}^2 \cdot 1 \text{ bar}$  biogas resistance. The gasholder film temperature range allows operation from  $-30^\circ\text{C}$  to  $+60^\circ\text{C}$ .

The internal film is stretched under normal biogas pressure. Air is blown into the space between the external and internal membranes to pressurize the internal membrane and form the shape of the external membrane.

The biogas pressure in the gasholder is 2-5 mbar. The membranes are designed and cut out on NC machines. Welding is executed by high frequency currents. These steps yield substantial improvements for quality and service life compared to hand-made membranes welded by standard welding equipment.

To prevent damage to the gasholder as a result of overpressure conditions, a safety valve is installed. To survey the internal membrane, an inspection window is installed on the external membrane.

### Specifications

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<b>Height :</b>	6,0 m
<b>Diameter :</b>	30,0 m
<b>The total volume :</b>	1690 m <sup>3</sup>
<b>Quantity:</b>	1 pcs.



## Window with spotlight (SG-01)

Inspection windows are designed for visual control of processes inside the fermenter and post-digester. Spotlights were made in explosion-proof with automatic disconnec-

tion. Inspection windows are equipped with a cleaning washing system.

### Specifications

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Inspection windows Ø300  
Spotlight VISULUX UL50 -G -H  
230V, 50W, IP65



## Separator (SR-01)

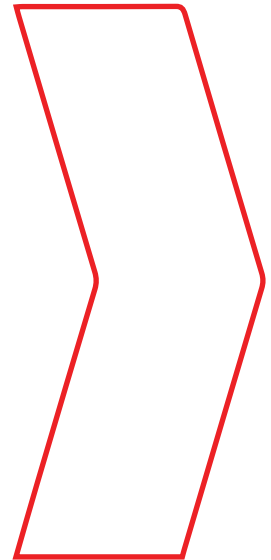
The Press Screw Separator covers a broad spectrum of applications, from agriculture to biogas and bioethanol plants. The innovative technology separates substrates in its solid and liquid elements. The secret of the versatility of the press screw separator is that it can adjust to different dry matter contents and Thick liquids (20% dry matter content). Slotted screens have different assortment and width of table cells and give possibility work with small solids and fiber contents. In the slotted screen, the solids are screened out from the liquid. The solids build up a layer which also acts as a filter to separate finer particles from the liquid. The auger flights convey this layer to the solids outlet. The screen surface is cleaned and a new filter layer is formed. The design of the screens is not conducive to plugging. The pressure in the first part of the screen is low but increases with the solid consistency to the solid output. The consistence of the gained solid can be varied with the help of a output regulator by the amount and position of counter weights. This way the required consistency of the final product for either further storage, use as fertilizer or the basis for compost can be reached. The liquid phase can easily be drained through a pipe or hose system.

## Specifications

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<b>Engine power</b>	<b>7,5 kW</b>
<b>Flow rate</b>	<b>30-40m<sup>3</sup> / h</b>
<b>Quantity</b>	<b>1 pcs.</b>
<b>Equipment</b>	
<b>Frame</b>	
<b>Screw</b>	
<b>Sieve for the filtration</b>	
<b>Counterweights</b>	
<b>The design of the protective room</b>	





## Biogas compressor (BC-01)

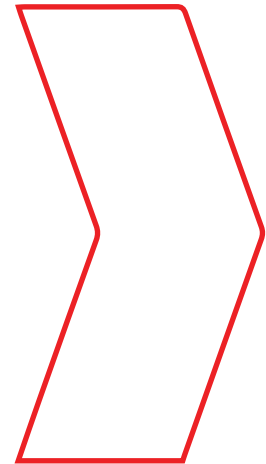
Biogas blower is a device used to move gas and increase pressure thanks to a rotating impeller within a toroidal channel, so there is a progressive increase of energy.

Blower is used to transporting biogas from gasholder storage to consumer.

### Specifications

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Flow rate	450 m <sup>3</sup> /h
Pressure	150 mbar
Engine	4,2 kW
Quantity	1 pcs.



## Biogas dryer and cooling (CHL-01)

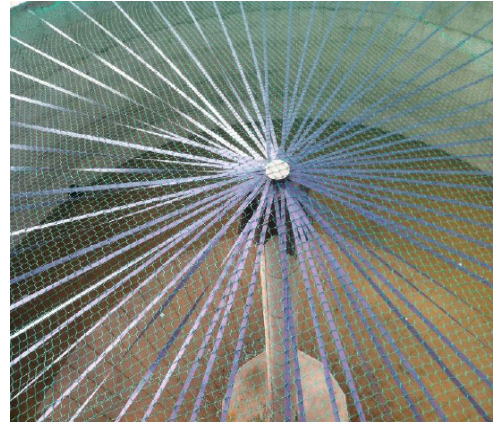
Biogas dryer and cooling are provided with special equipment as GAS COOLER and AIR-COOLED LIQUID CHILLER. Biogas plants thanks to an extensive range of dedicated Biogas solutions, low pressure heat exchangers, a comprehensive range of water chillers and RWD Dry Coolers. Designed as one-way shell-and-tube heat exchanger. Process gas inside of the tubes; cooling water in the shell.

All parts in contact with the process gas made of stainless steel 316Ti or 316L; heat exchanger shell made of stainless steel/ Designed with gas outlet chamber outlet connection radial; inspection opening axial. Official acceptance according to PED 2014/68/EU in accordance with ADMerkblätter and factory pressure test.

### Specifications

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<b>Gas volume flow</b>	450 m <sup>3</sup> / h
<b>Gas inlet temperature</b>	+35 C
<b>Gas outlet temperature</b>	+20 C
<b>Engine power</b>	18 kW
<b>Quantity:</b>	1 pcs



## Desulphurization system (CF-01)

The desulphurization system is a two-step purification of biogas to remove sulfur. Stage 1 - biological. Adding a certain portion of air to the fermenter (under the gas holder net). Air interacts with hydrogen sulfide, decomposing it into safe components. Stage 2 - activated charcoal filtration, as activated charcoal has the capability to absorb sulfur. After passing through activated charcoal filters, the sulfur concentration is reduced to 0 ppm.

### Specifications

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<b>Air compressor</b>	5m <sup>3</sup> /h 100 kg
<b>The volume of charcoal</b>	
<b>Numbers of charcoal columns</b>	1 pcs



## Dry cooler (digester cooling) (DC-01)

The device is designed to cool the heat-carrier in a heat supply system. When using highly temperature substrates, there is a chance of uncontrolled self-heating of the digester. The cooler is connected to the heating pipes, and when it is active according to temperature sensors, the same lines of heating supply are used. One cooler works with related spiral heat exchanger to cool the input substrates. Another one works with second heat exchanger to control temperature inside the digester.

### Specifications

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Power:	50 kW
Engine power:	2.0 kW
Quantity:	1 pcs



## Gas analyzer (CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>S) (BG-01)

The gas analyzer is a combined measuring device. It consists of a fixed Control block and a mobile gas measuring device. The Control block is designed for the automatic measurement and monitoring of the amount\* and composition of gases produced in biogas plants. The device measures the gas compositions at the individual measuring locations sequentially. The mobile gas measuring device is usually docked to the Control box via the docking station (stationary measurements).

As an option, mobile measurements can be taken at selected measuring locations. The gas measuring device is removed from the Control docking station to carry out the measurement. When it is replaced in the docking station, the calculated measurement values are transmitted to the Control block and displayed.

## Specifications

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### Set includes

Device for wall mounting  
LCD display menu  
Flow meter / control valve  
Sensors



## Biogas flare (BF-01)

The flare is designed for the temporary or periodical complete combustion of the biogas produced by biogas plants without the possibility of its use as an energy source. The burn system consists of a burner and additional equipment. The burner is designed on the principle of injection and consists of a combustion nozzle with an injector with an air supply control system, flame protection tube, fitting and burner control system. The biogas combustion system is made of stainless steel.

The supporting structure holds the burner and vertically mounted socket. The burn control system is installed in a case, which is mounted on the supporting structure of the combustion system and contains all the elements for monitoring and controlling ignition and flame.

## Specifications

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Flow rate

450 m<sup>3</sup>/h



## Heating system

Heating equipment is used for biogas plant heating and for sustaining constant temperature in the fermenter. Heating equipment includes circulation pumps, heat exchanger, heating manifold and pipes. The heat from the boiler is transferred to the biogas plant by using heat exchanger, and then is pumped through of biogas plant by circulation pumps. A heat carrier prepares water with an additive of ethylene glycol. Inlet temperature in the fermenter is 60C, the outlet is 40C.

### Specifications

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Circulating pump feeding heat carrier heating

Flow 25 m<sup>3</sup> / h;  
Pressure 1 bar,

Circulating pump feeding heat carrier to the digester

Flow 12 m<sup>3</sup> / h;  
Pressure 1.1 bar

The pumping station feeding propylene glycol

Flow 0.8 m<sup>3</sup> / h;  
Pressure 4 bar,



## Co-generation Power Plant (CHP-01)

A co-generation power plant (CHP) is used for producing electricity and heat. CHP is a very efficient technology for generating electricity and heat together. A CHP plant is an installation where there is simultaneous generation of usable electric power and heat in a single process, and it can provide a secure and highly efficient method of generating electricity and heat at the point of use. Due to the utilization of heat from electricity generation and the avoidance of transmission losses, due to electricity being generated on site, CHP typically achieves a 35 per cent reduction in primary energy usage compared with power stations and heat only boilers. This allows for economic savings where there is a suitable balance between heat and power loads. Another important factor, showing the benefits of cogeneration and CHP, is its low environmental impact. CHP produces lower quantities of pollutant emissions and heat pollution of the atmosphere. The current mix of CHP installations achieves a reduction of over 10 per cent in CO<sub>2</sub> emissions in comparison with combined-cycle gas turbines.

### Specifications

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Produced electric power	1063kW
Produced heat power	580kW
Emissions	NO <sub>x</sub> < 500 mg/Nm <sup>3</sup> (5% O <sub>2</sub> )
Generator	400 V, 50Hz



## Water supplying and sewerage system



Water supplying system provides biogas plant feed water, water for network circuits, the domestic water and fire safety systems. As used centrifugal single stage pumps as main pumping elements. These pumps are designed for pumping waste water, household / domestic water and sewage. Pressure Boosting Systems are designed for pure water pressure boosting in industrial plants. The booster comprises 2 to 3 (connected in parallel pumps) installed on a common base frame, and provided with all the necessary fittings.

### Specifications

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Drain pump  
Pressure 4m  
Flow 2-3 m<sup>3</sup> / h  
Engine 0,24 kW

Equipment  
Pump case control  
Stove-base  
gauges  
Check valves  
Float switches  
Brackets  
Valves

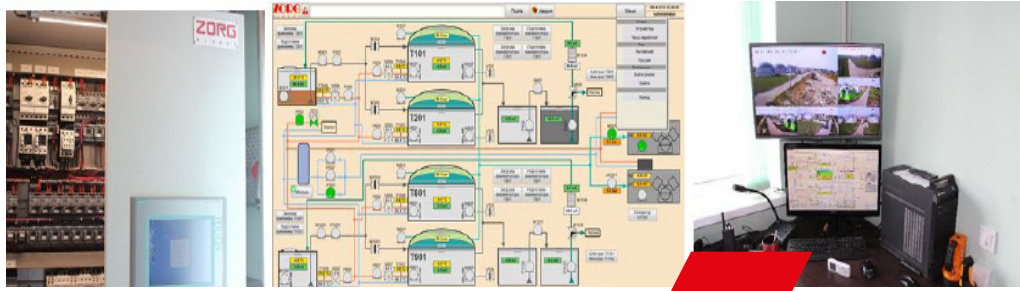
## Air supply system

Air supply system ensures retention of the protective dome digester. This is achieved by installing a pneumatic lock and maintain the required pressure therein.

### Specifications

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<b>Flow rate</b>	200l/min
<b>Max. Pressure</b>	8Bar
<b>Speed</b>	2850 rev/min
<b>Receiver capacity</b>	9,5l



## Automation and electrical equipment

Process control equipment is used for supervision and regulation operation of the plant and for the limitation of damage. In case of emergency (for example, breakdown of the electrical power supply) the biogas plant is automatically transferred to safe operating conditions by the process instrumentation. Critical electrically driven devices are supplied with emergency power. An automatic system allows the supervision of the plant in real time and to recognize and correct aberrations immediately; to run the plant at its optimum saving resources and costs; and to record for the electronic database operation parameters. The automatic system consists of a control cabinet and sensors for parameter control of technological processes and execution devices.

The control cabinet is designed based on the industrial controller Siemens CPU315-DP2, using periphery distributing system Simatic ET200S, and operator panel OP277 Touch with touch-sensitive controls. Communications is executed by PROFIBUS and MPI with physical interface RS-485. The control program is designed based on the Simatic Step7. The control cabinet is a modular design. The upper part has a power box with central and front-end processor. The periphery distributing system, Simatic ET2005, is installed with input - output units. The lower part with interface relay and clips is installed for connecting execution devices. The entire plant is controlled by a single operator.

### Specifications

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**Incoming control case with automatic set ASE-1, 2, 3**

**Base Siemens CPU315-DP2 controller**

**Peripherals Simatic ET200S**

**Control panel OP277 touchscreen**

**Communication PROFIBUS and MPI**

**Interface RS-485**

**Control system Simatic Step7**



## Sensors

Sensors are used to measure physical quantities (temperature, pressure, level of moisture) data collection.  
installation kits

## Specifications

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**Conductometric sensor**  
**Pressure Sensor / level**  
**Ultrasonic sensor**  
**Gas Pressure Sensor**  
**Temperature converters with protective sleeves**  
**The moisture sensor and the gas temperature**

# SPECIFICATION LIST



Nº	Equipment	Characteristic	Q-ty
<b>1</b>	<b>Submersible mixer for digester</b>	<b>N=15,0kW</b>	<b>6</b>
1.1	Airtight motor gearbox		6
1.2	Hydraulic screw (wear-resistant steel)		6
1.3	Mixer control mechanism		6
1.4	Electric motor mount		6
1.5	Set of fasteners		6
<b>2</b>	<b>Substrate feed pump</b>	<b>40 m3/hour N=11,5 kW</b>	<b>1</b>
<b>3</b>	<b>Gasholder</b>	V = 1690m3	1
3.1	Dome level sensor		1
3.2	Gasholder film PELD methane permeation max.260 cm3/m2*d*1 bar, 650 N/5cm bio- gas resistant		1
3.3	Air blower		1
<b>4</b>	<b>Safety valve of digester</b>		<b>1</b>
<b>5</b>	<b>Window with a searchlight</b>	<b>set</b>	<b>1</b>
5.1	Inspection window RD300 (mounts and sealant included)	Ø300	2
5.2	Spotlight (mount system bundled) VISULUX UL50 -G -H	230V, 50W, IP65	1
<b>6</b>	<b>Submersible mixer for pre-tank</b>	<b>N=15,0kW</b>	<b>1</b>
6.1	Airtight motor gearbox		1
6.2	Hydraulic screw (wear-resistant steel)		1
6.3	Mixer control mechanism		1
6.4	Electric motor mount		1
6.5	Set of fasteners		1

Nº	Equipment	Characteristic	Q-ty
7	Substrate pump to separator	40 m3/hour N=11,5 kW	1
8	Separator	N=7,5 kW, Q=40m3/h	1
9	Biogas compressor	Q=450 m <sup>3</sup> /h H=150mBar N=4,2 kW	1
10	Electromagnetic flow meter		1
11	Biogas analyzer (CH <sub>4</sub> , CO <sub>2</sub> , H <sub>2</sub> S)		1
12	Flare	450 m3/h	1
12.1	Compressor		1
12.2	Manual locking element		1
12.3	Deflagration fuse		1
13	Biogas cooling system	450 m3/h	1
14	Desulphurization system (2nd stage)	100 kg	1
15	Digester cooling system	50 kW	1
16	Heat supply system, complete, disassembled	set	1
17	Air compressor (1st stage desulphurization)		1
18	Water supply and sewerage system, complete, disassembled		1
19	Automation with electrical equipment complete, disassembled		1
19.1	Incoming distribution cabinet with a set of automation DB-1		1
19.2	Incoming distribution cabinet with a set of automation DB-2		1
20	Sensor set		1
20.1	Conductivity sensor		1

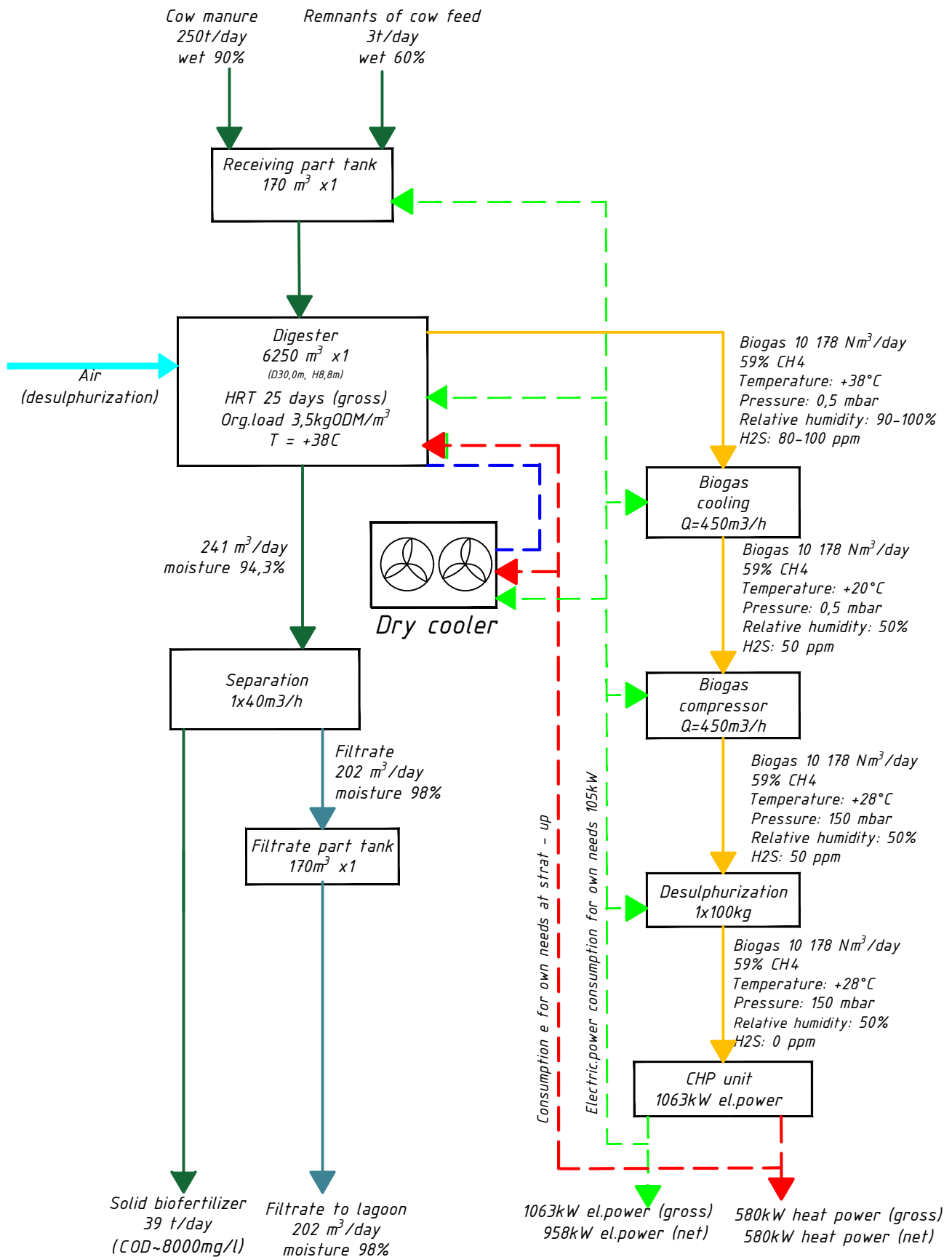
Nº	Equipment	Characteristic	Q-ty
20.2	Pressure / level sensor		2
20.3	Ultrasonic sensor	SPA-380-08 (0-6m)	2
20.4	Gas pressure sensor	SEN 3276 B156 G1/2 0,4Bar	1
20.5	Thermal converter	TR10-B-M-DZ	1
20.6	Thermowells for thermocouples	TR10-B	1
20.7	Thermal converter heating circuit	TR30-P-Z-Z- A-ZZZ-13R-	1
20.8	Substrate pressure sensor	SEN-3251 G1 4Bar	2
20.9	Substrate pressure sensor	SEN-3251 G1 2,5Bar	2
20.10	Coolant pressure sensor	SEN 3276 B065 G1/2 6Bar	1
20.11	Immersion level sensor	LS-10 0,6Bar 4-20 mA	1
20.12	Humidity and gas temperature sensor	ESFTF-I	1

# APPENDICES





Material flow diagram



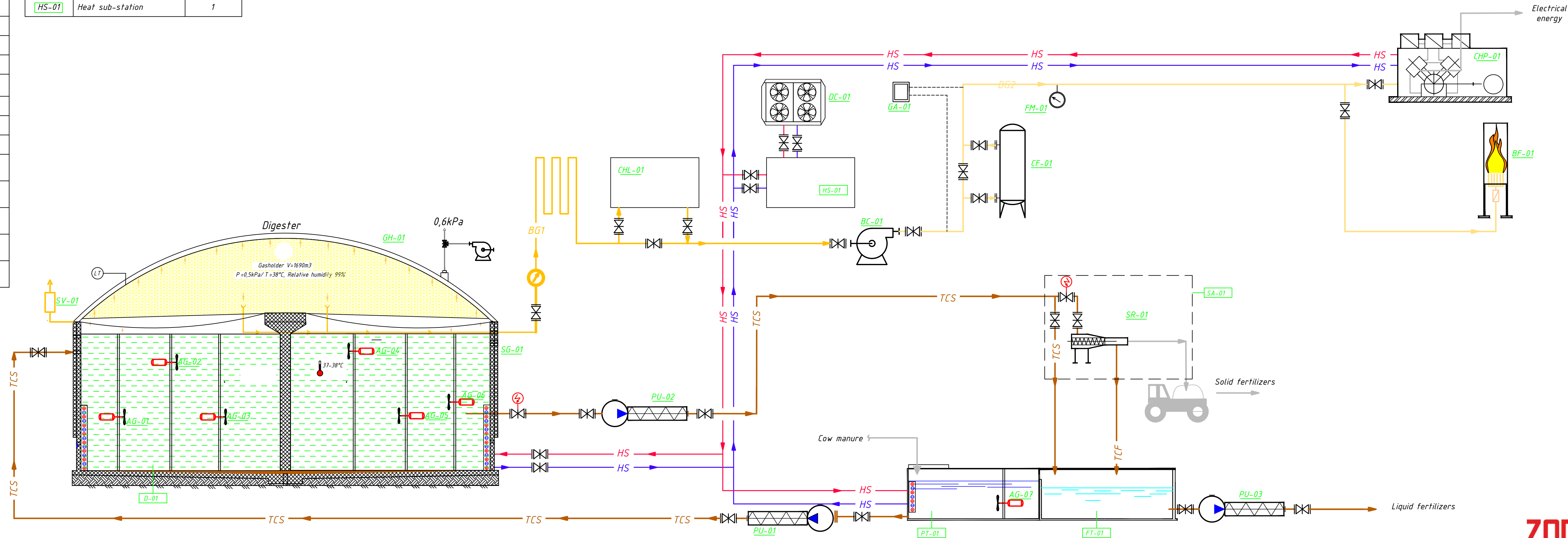
Specification		
N/Nº	Name	Q-ty
AG-07	Pre-tank submersible mixer	1
PU-01	Substrate pump to Digester	1
AG-01.06	Digester submersible mixer	6
GH-01	Gasholder	1
SV-01	Safety valve	1
SG-01	Inspection windows	1
CHL-01	Biogas cooling system	1
BC-01	Biogas blower	2
PU-02	Substrate pump	1
SR-01	Separator	1
PU-03	Filtrate pump	1
CF-01	Carbone filter	1
BG-01	Biogas analyzer	1
FM-01	Biogas flow meter	1
BF-01	Biogas flare	1
CHP-01	Cogeneration power plant	1
DC-01	Digester cooling system	1

Structure		
N/Nº	Name	Quantity
D-01	Digester	1
PT-01	Pre-tank	1
FT-01	Filtrate tank	1
SA-01	Separator area	1
HS-01	Heat sub-station	1

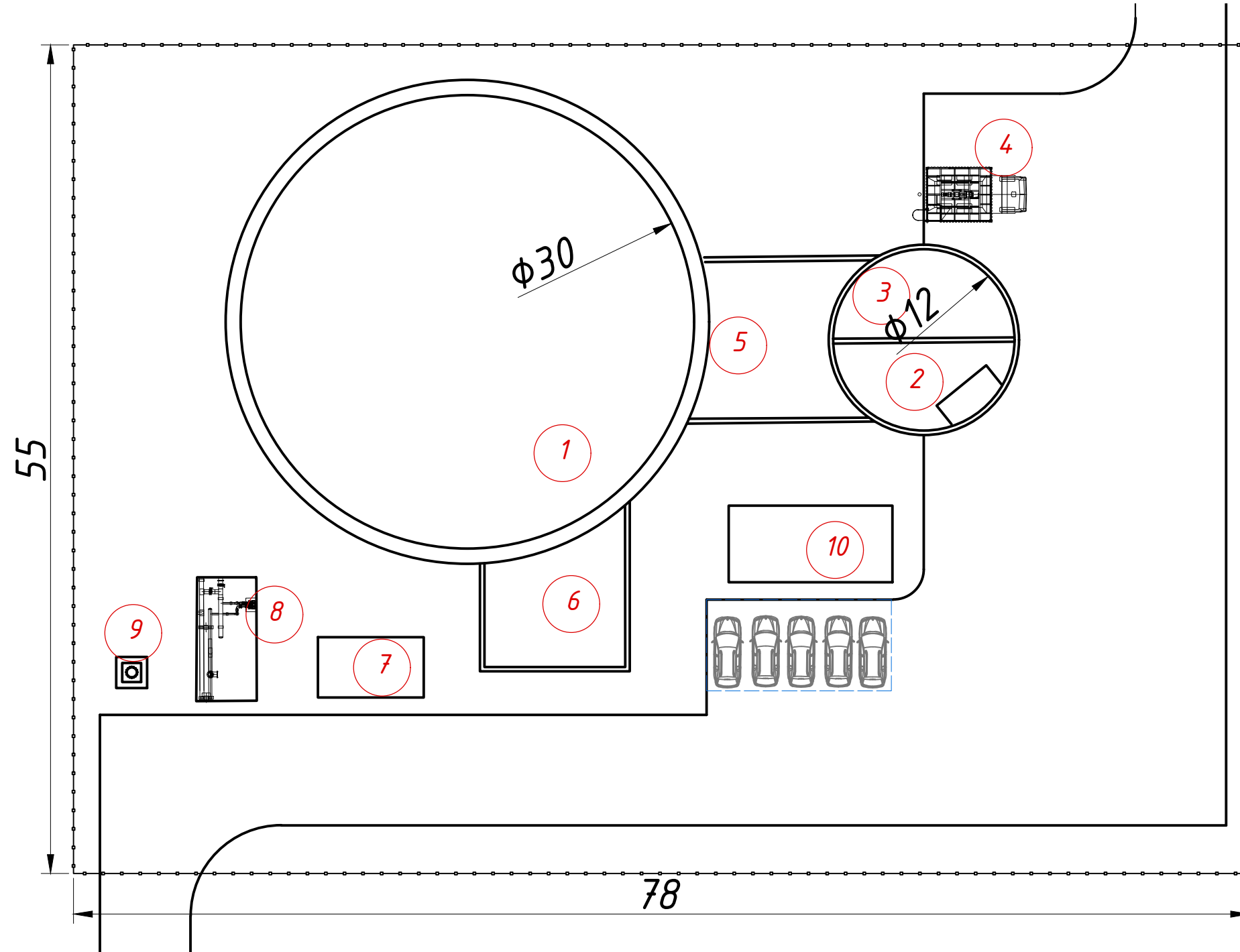
Basic diagram

Legend main pipelines

- TCS — Substrate
- TCF — Filtrate
- BG1 — Biogas
- BG2 — Biogas
- HS — Heat system pipeline
- HS — Heat system pipeline



Plan



Explication

N/Nº	Name	Q-ty
1	Digester	1
2	Pre-tank	1
3	Technical room	1
4	Filtrate tank	1
5	Separator platform	1
6	Equipment room	1
7	Gas compressor	1
8	CHP room (In a buiding)	1
9	Biogas burner	1
10	Staff trailer	1

**Annex 4**

Name equipment	Instal. Pow. (kW)	Q-y (pcs)	Total installed power (kW)	Working hours per day	Consumption kWh per day
Submersible mixer (Digester)	15,0	6	90,0	16,0	1440,0
Submersible mixer (rec.tank)	15,0	1	15,0	6,0	90,0
Substrate feed pump	11,5	1	11,5	4,0	46,0
Biogas compressor	4,2	1	4,2	24,0	100,8
Biogas cooling system	18,0	1	18,0	24,0	432,0
Separator	7,5	1	7,5	5,0	37,5
CHP	9,8	1	9,8	24,0	235,2
Substrate pump to separator	11,5	1	11,5	4,0	46,0
Filtrate pump	11,5	1	11,5	4,0	46,0
Air compressor for gasholder lock	1,5	1	1,5	1,0	1,5
Air blower for double membrane	1,0	1	1,0	24,0	24,0
Circulation pump for supplying at carrier to the digester	0,8	1	0,8	24,0	18,0
Circulating pump feeding hot water at technical building	0,1	1	0,1	only ambient temp +15°C	
Propylene glycol pump station	0,8	1	0,8	0,5	0,4
Drainage pump	1,0	1	1,0	0,5	0,5
Lighting of the biogas plant territory	1,0	1	1,0	8,0	8,0
Spot light for digesters inspection windows	0,1	1	0,1	0,5	0,0
Working lighting of switchboard	0,1	1	0,1	0,5	0,1
Total installed power, kW			<b>185</b>		
Total consumed electric energy, kWh per day					<b>2526</b>
Total consumed power, kW					<b>105</b>

### Prices for equipment and services for 1063kW el. Biogas plant for a milk farm 5000 cows

Pos	Name	Number of units	Unit price, EUR	Discounts*	Discounted unit price, EUR	Discounted price sub-total, EUR
A	Project documentation	1	69 000	0%	69 000	69 000
B	Supervision	1	30 000	0%	30 000	30 000
C	Startup and training	1	30 000	0%	30 000	30 000
D	Living and travel expenses	1	40 000	0%	40 000	40 000
E	Delivery of the equipment to any port worldwide (container)	4	12 000	0%	12 000	48 000
F	Laboratory	1	15 000	0%	15 000	15 000
1	Separator 7,5 kW	1	48 000	0%	48 000	48 000
2	Gasholder D=30 m	1	127 000	0%	127 000	127 000
3	Over- and under pressure safeguard	1	8 250	0%	8 250	8 250
4	Sight glasses/viewing windows with projector	1	4 900	0%	4 900	4 900
5	Submersible mixer for digester 15 kW	6	26 000	0%	26 000	156 000
6	Submersible mixer for receiving tank 15 kW	1	24 000	0%	24 000	24 000
7	Separator supply pump 11,5kW	1	27 000	0%	27 000	27 000
8	Digested substrate pump 11,5kW	1	27 000	0%	27 000	27 000
9	Filtrate supply pump 11,5 kW	1	27 000	0%	27 000	27 000
10	Motorized valves (set)	2	5 600	0%	5 600	11 200
11	Biogas chiller (Biogas cooling system) 450m3/hour	1	63 000	0%	63 000	63 000
12	Biogas blower 450m3/hour	1	12 000	0%	12 000	12 000
13	Desulphurization column with active coal 100kg	1	15 000	0%	15 000	15 000
14	Portable gas analyzer	1	5 200	0%	5 200	5 200
15	Gas conditioning unit	1	19 000	0%	19 000	19 000
16	Biogas burner	1	45 000	0%	45 000	45 000
17	Heat supply station	1	29 000	0%	29 000	29 000
18	Dry-cooler (Substrate cooling system for fermenter) 50 kW	1	15 000	0%	15 000	15 000
19	Automation and electric cabinet	1	129 000	0%	129 000	129 000
20	Sensors (set)	1	25 390	0%	25 390	25 390
21	Water supply and canalization system	1	13 300	0%	13 300	13 300
22	CHP Jenbacher 1063kW el.	1	530 000	0%	530 000	530 000
G	Construction	1	850 000	0%	850 000	850 000
			<b>TOTAL, EUR</b>			<b>2 443 240</b>

## Implementation terms and payment

Months	1	2	3	4	5	6	7	8	9	10	11
Collection of initial data (by customer)											
Detailed project design		50%		50%							
Equipment supply		50%		20%	10%	20%					
CHP		30%						70%			
Construction											
Supervision		50%						50%			
Plant start-up										50%	50%

% - Payment from the amount of the contract

## Contracts

Project implementation is executed simultaneously under several contracts

- Engineering contract
- Equipment supply contract
- Supervision contract
- Start-up and training contract

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