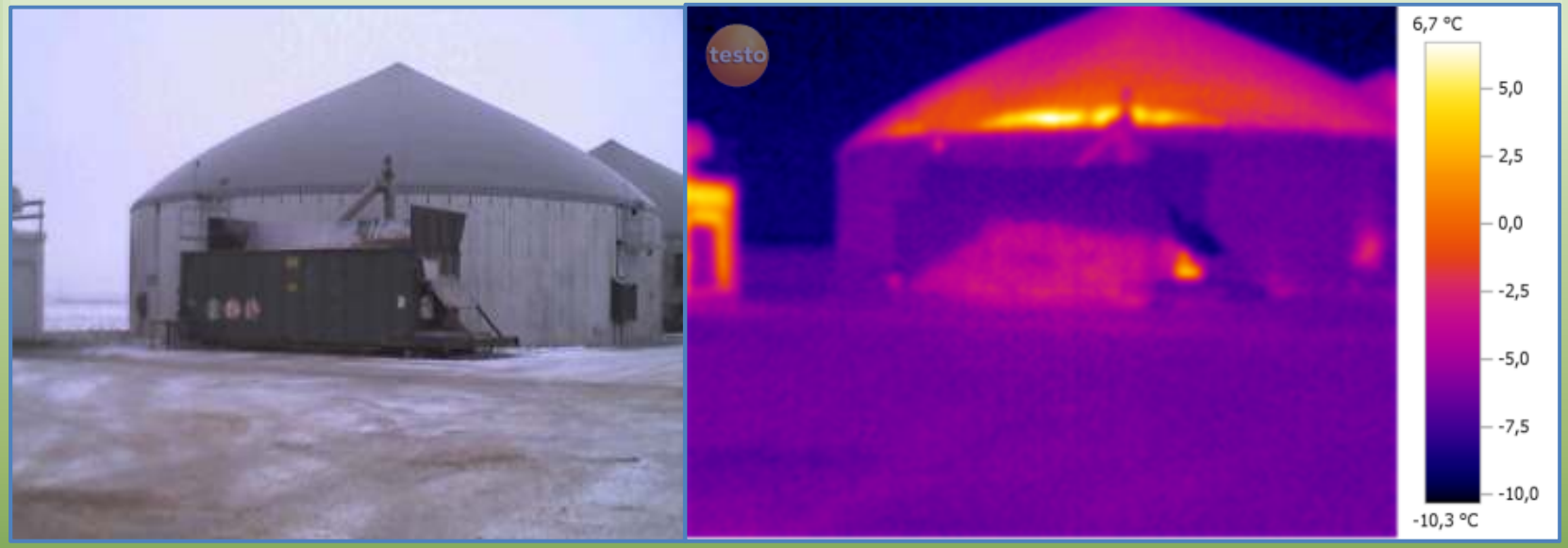
# *Analysis an optimization of energy flows in existing biogas plants for improved economic performance*

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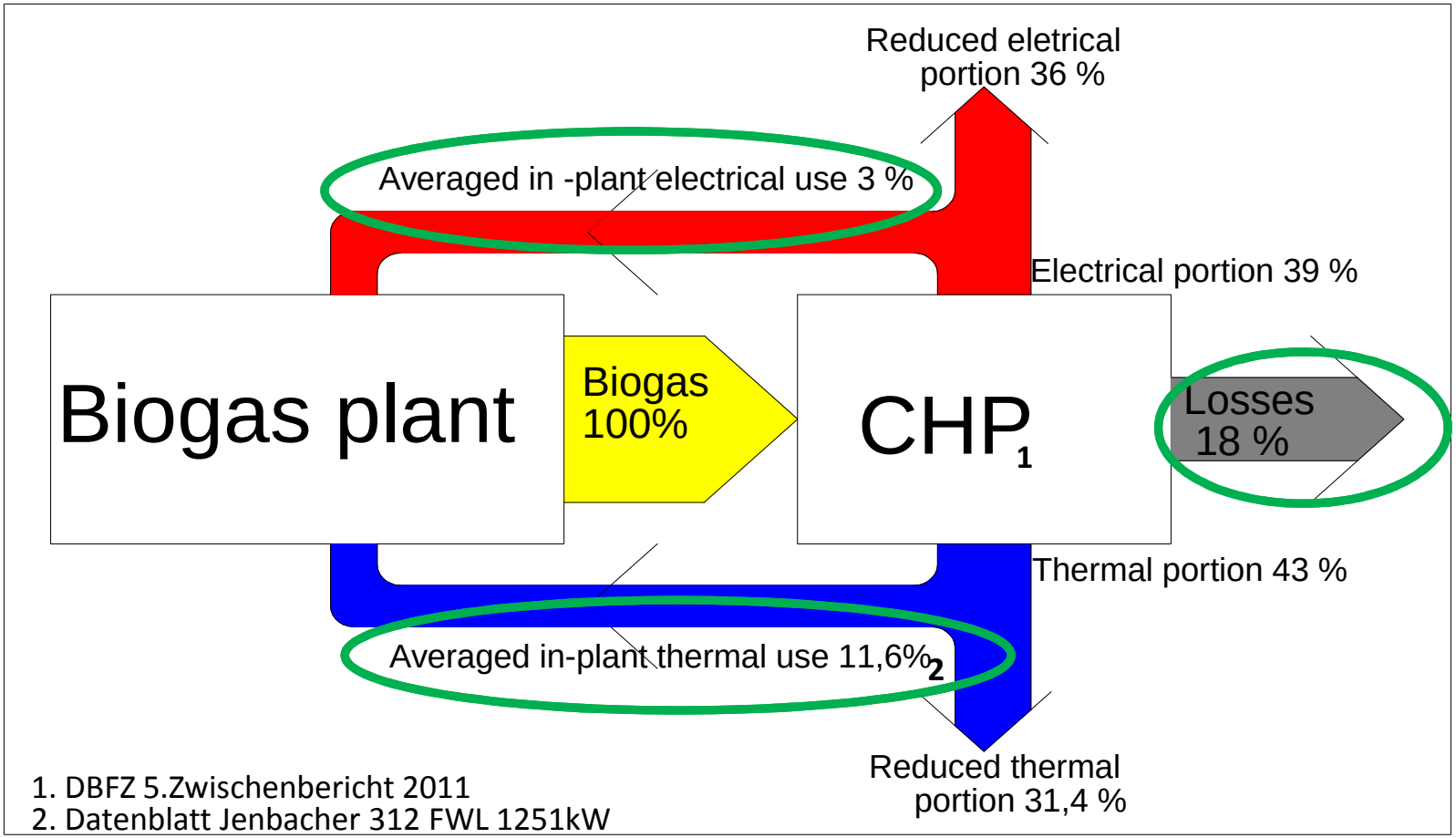
# The biogas plant

- *Reduction of thermal and electric energy due to own consumption*



# ***Area of biogas plants for analysis***

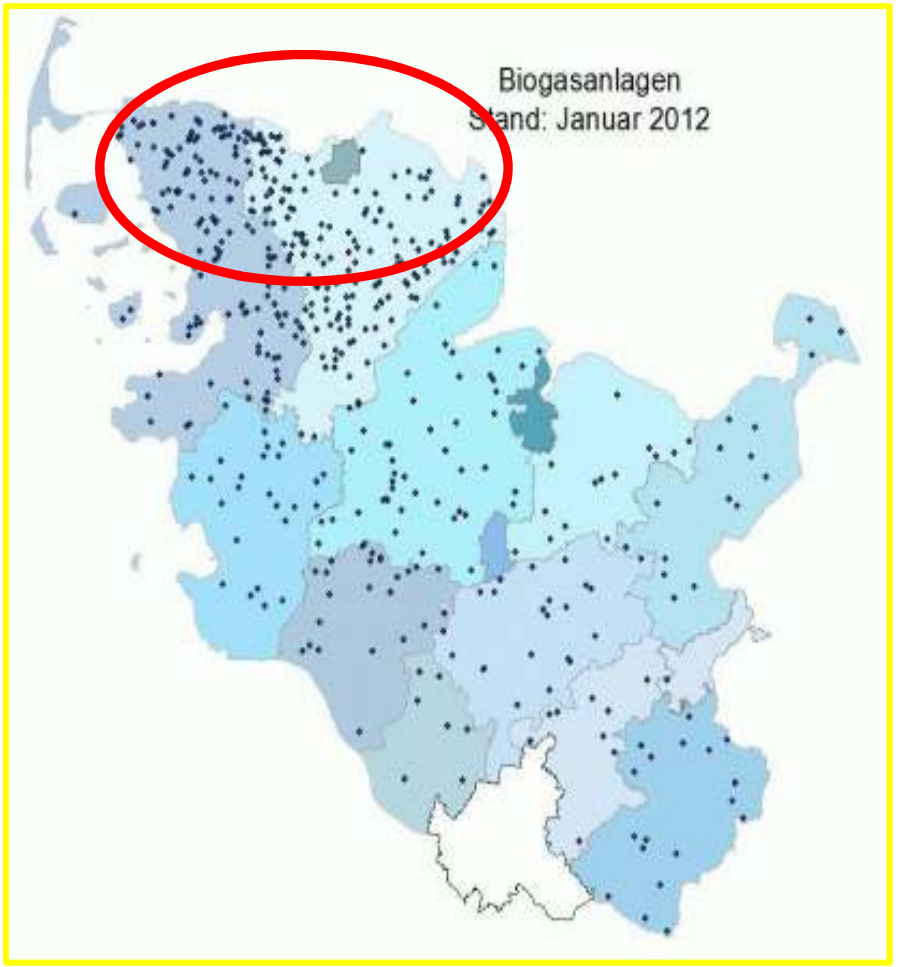
- *Own heat consumption*
- *Daily feeding protocols*
- *CHP heat content*

Own measurements at 6 plants:

- *Temperature (manure, corn silage, ambient …)*

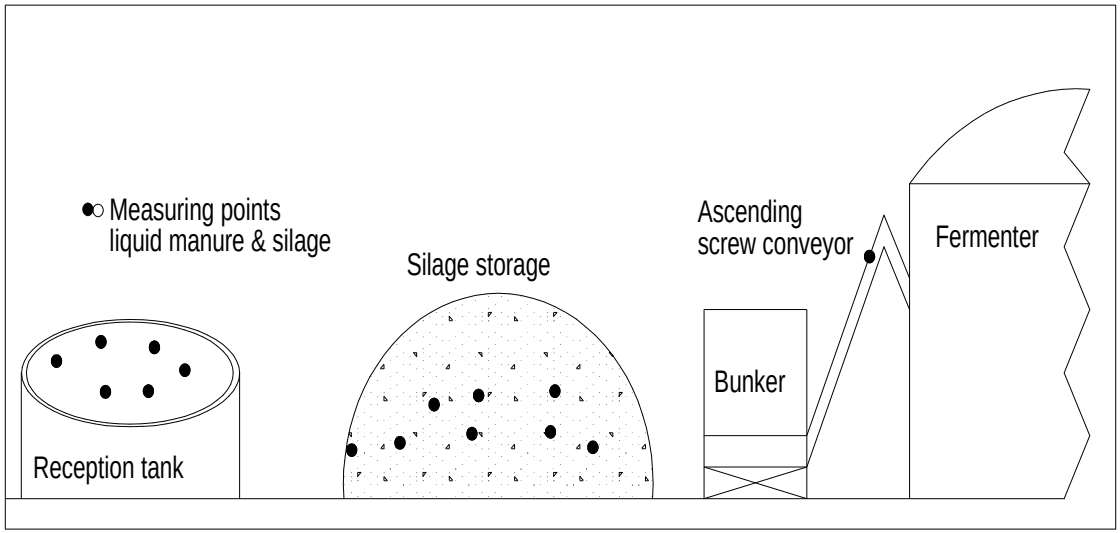
Own measurements at 8 CHP units:

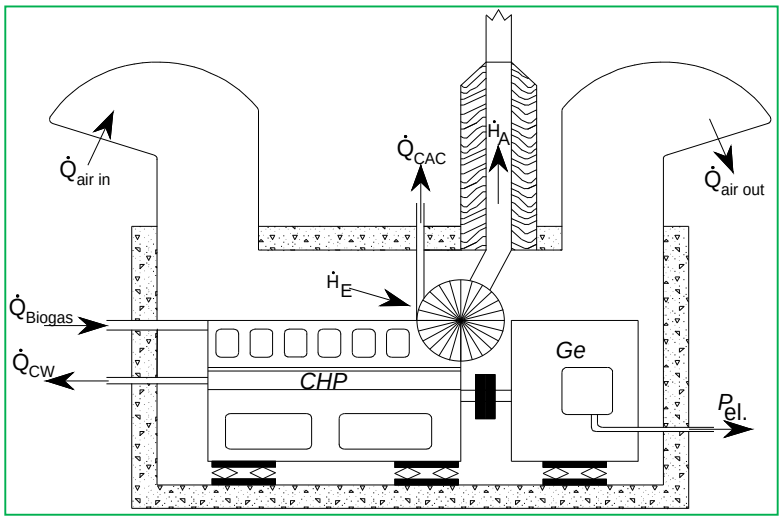
- *Cooling water heat, radiant heat, intercooled heat, residual heat (exhaust gas)*



# Data acquisition an measurement points

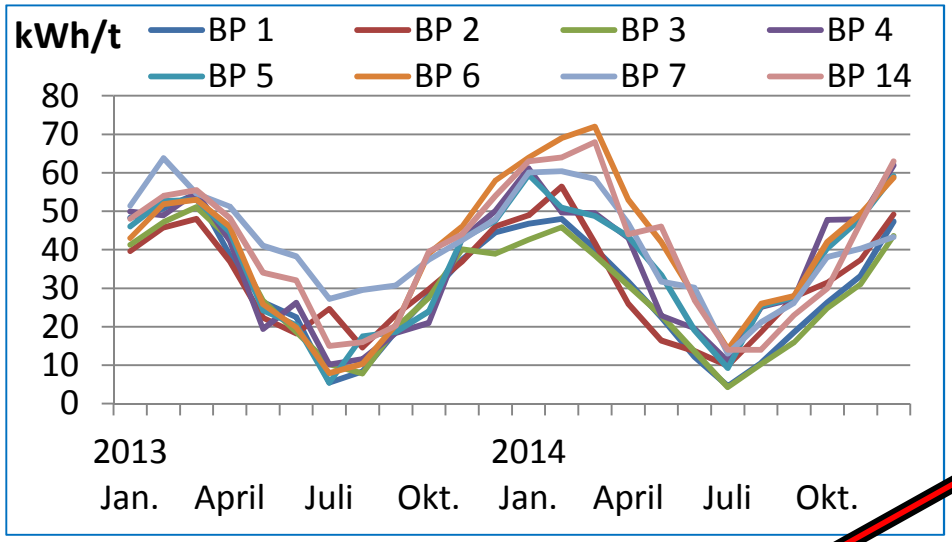
*Measuring points for liquid manure and corn silage. Once a week over 14 months of 5 biogas plants*



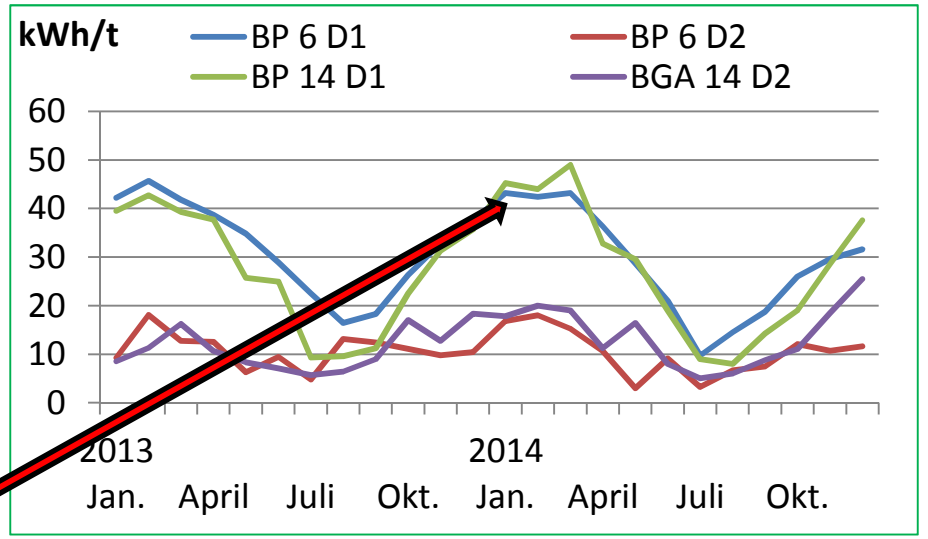




*Measuring points CHP unit 4 times over 1 year on 8 CHP units*

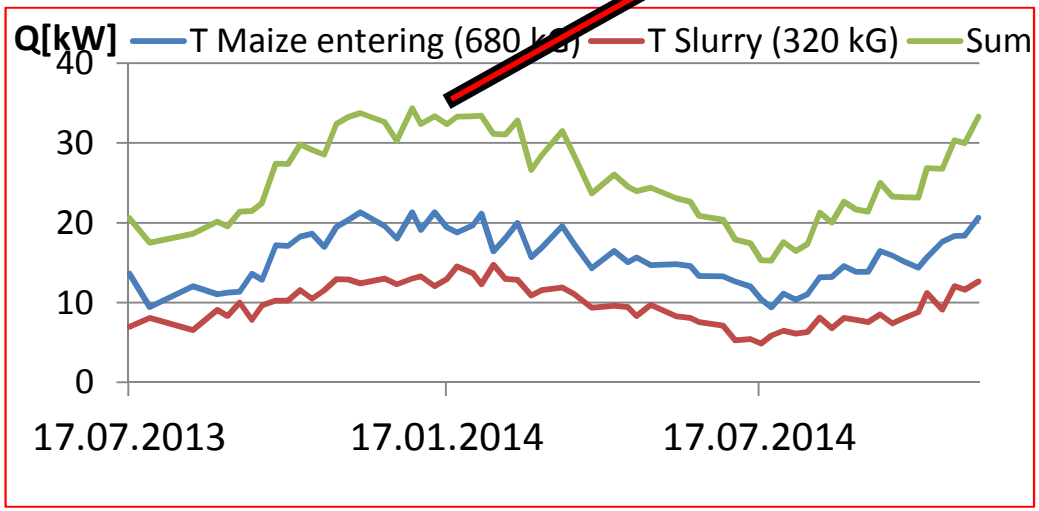
# Process heat demand




Heat consumption biogas plant



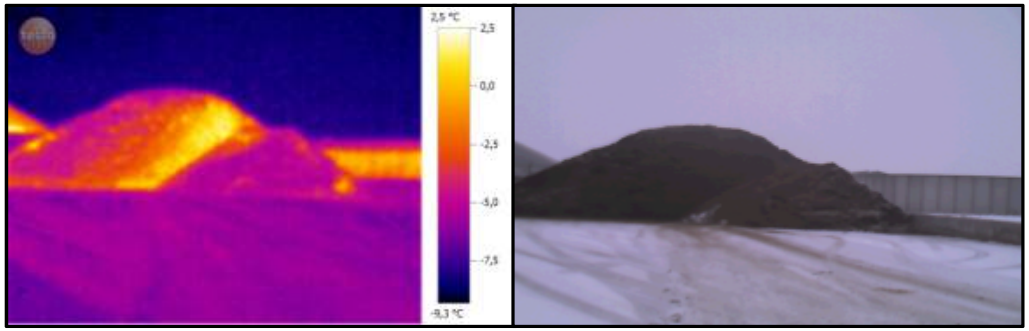

Heat consumption compared first and second digester



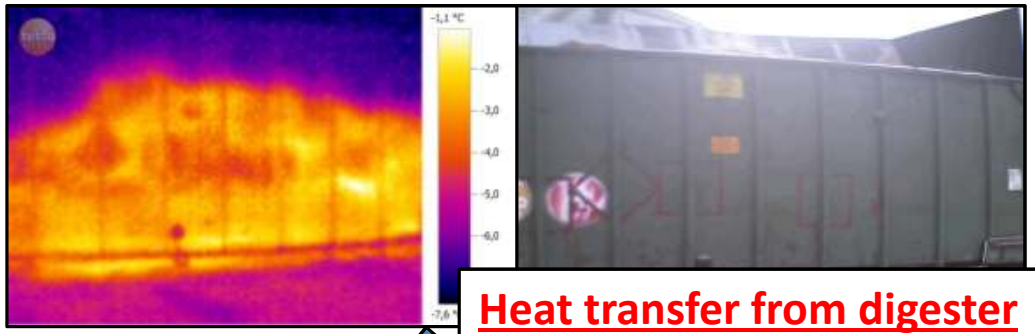

Heat demand for heating the substrate BP 6

# Cooling of corn silage

– Ambient temperature -7,4 °C **BP 7**

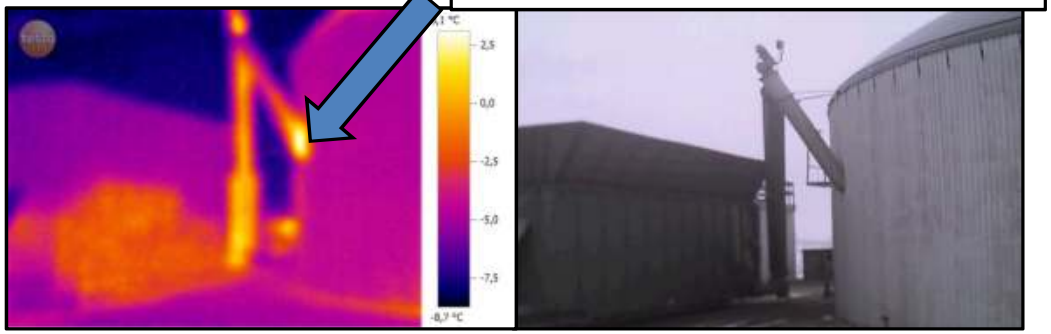


Silage storage 4 hours after feeding the biogas plant



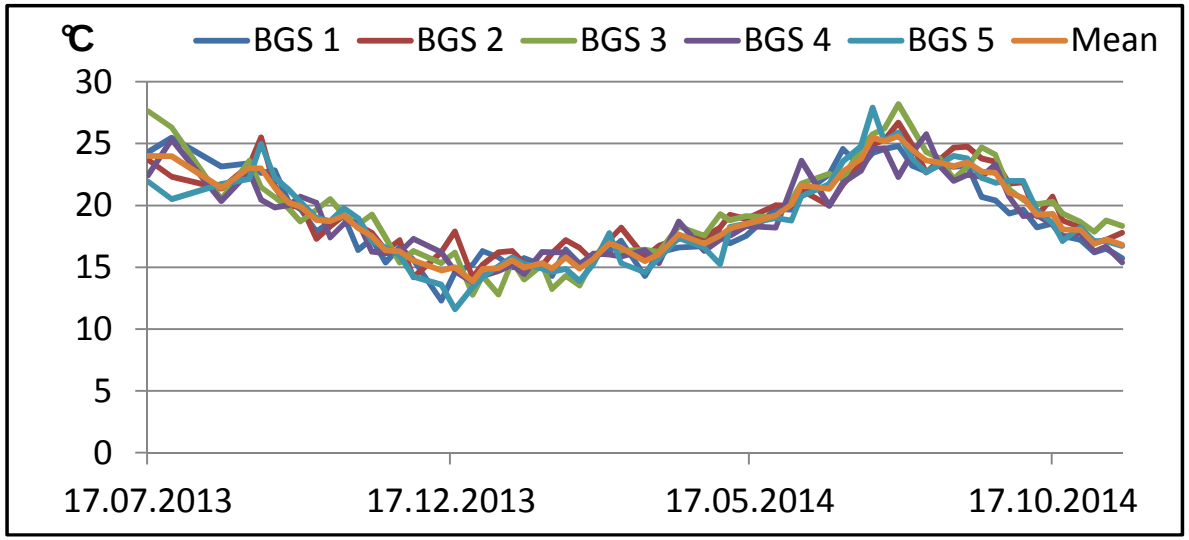
Thermal imaging from the silage bunker

**Heat transfer from digester**



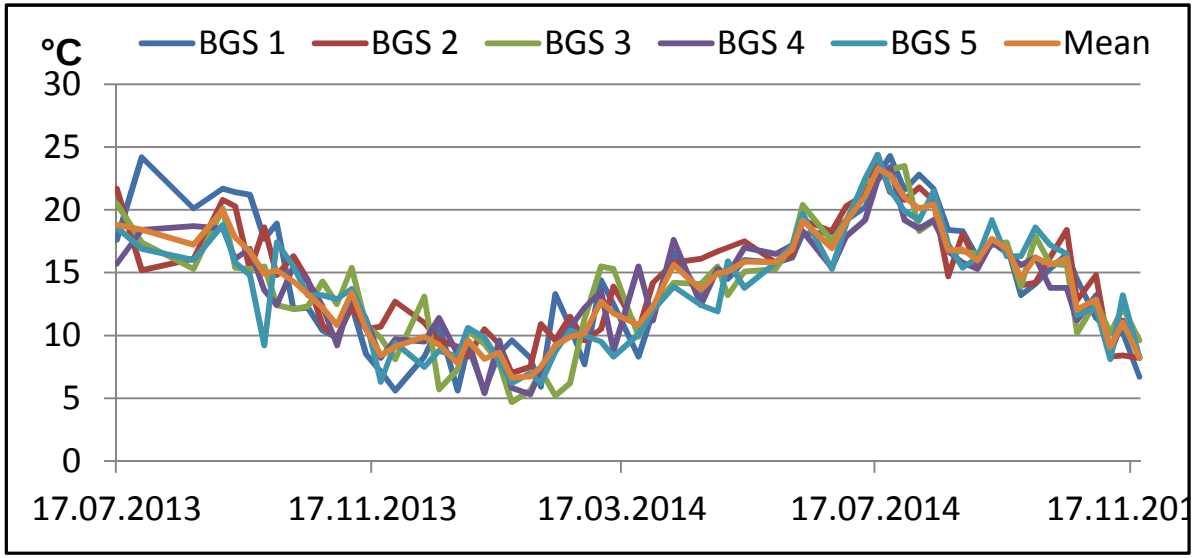
Thermal imaging of screw conveyors

# Temperature curves of the substrates

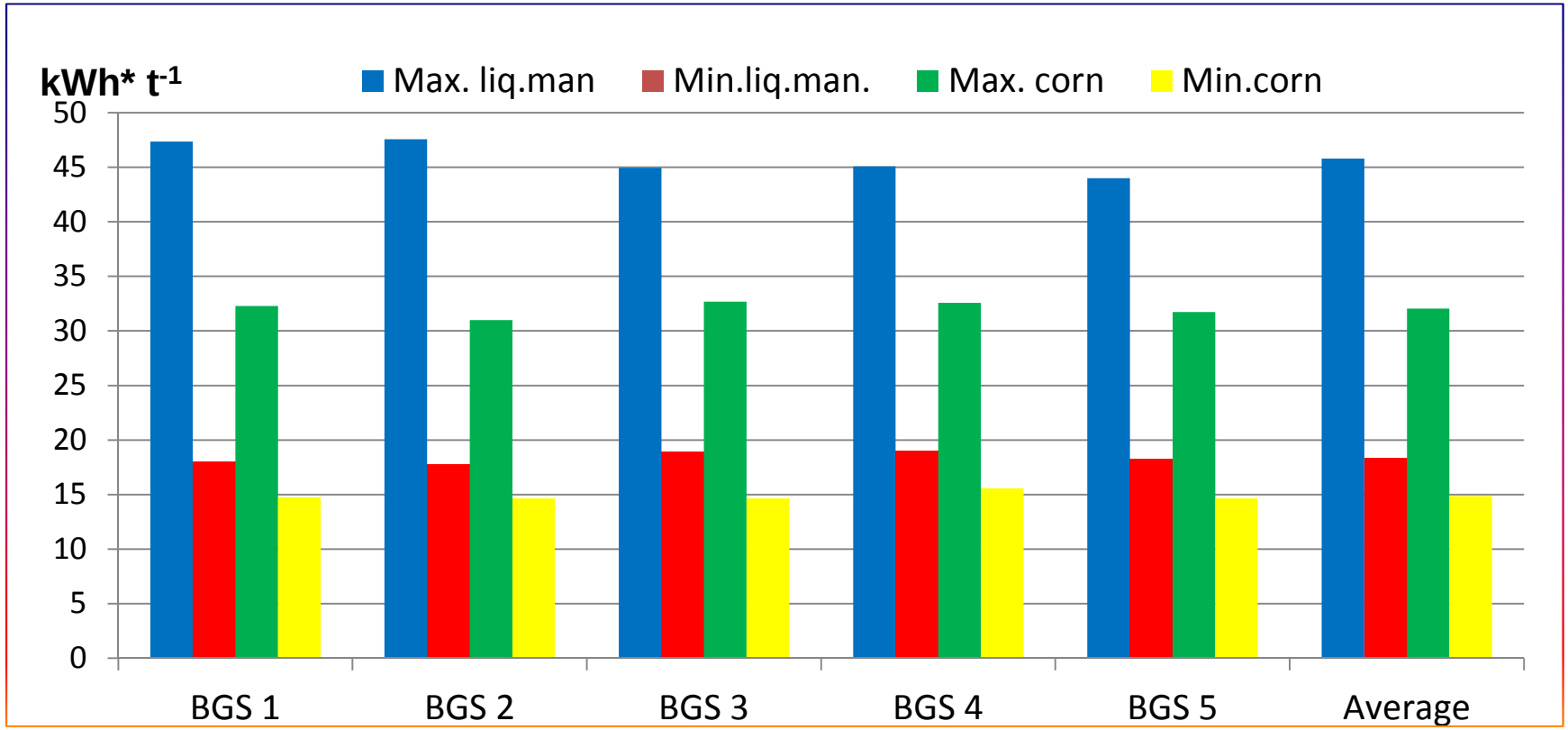



*Temperature curve of the corn silage in the silo of five biogas systems with average value*

*Temperatures of the corn silage in the course of the year before fermenter inlet*

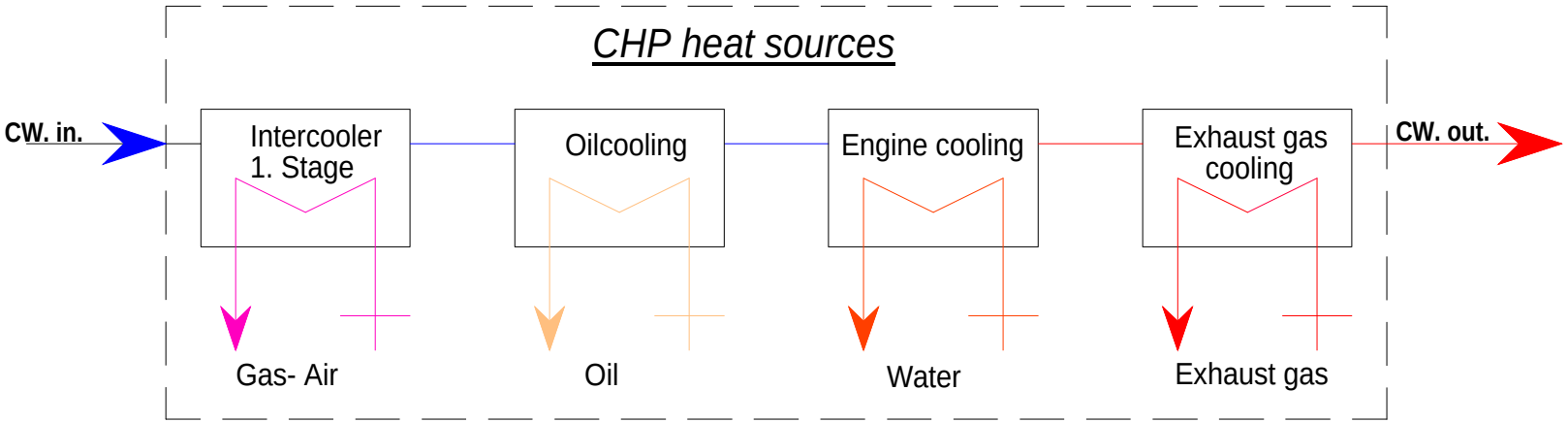


# Heat consumption




*Max. and min. heat requirement for liquid manure and corn silage*

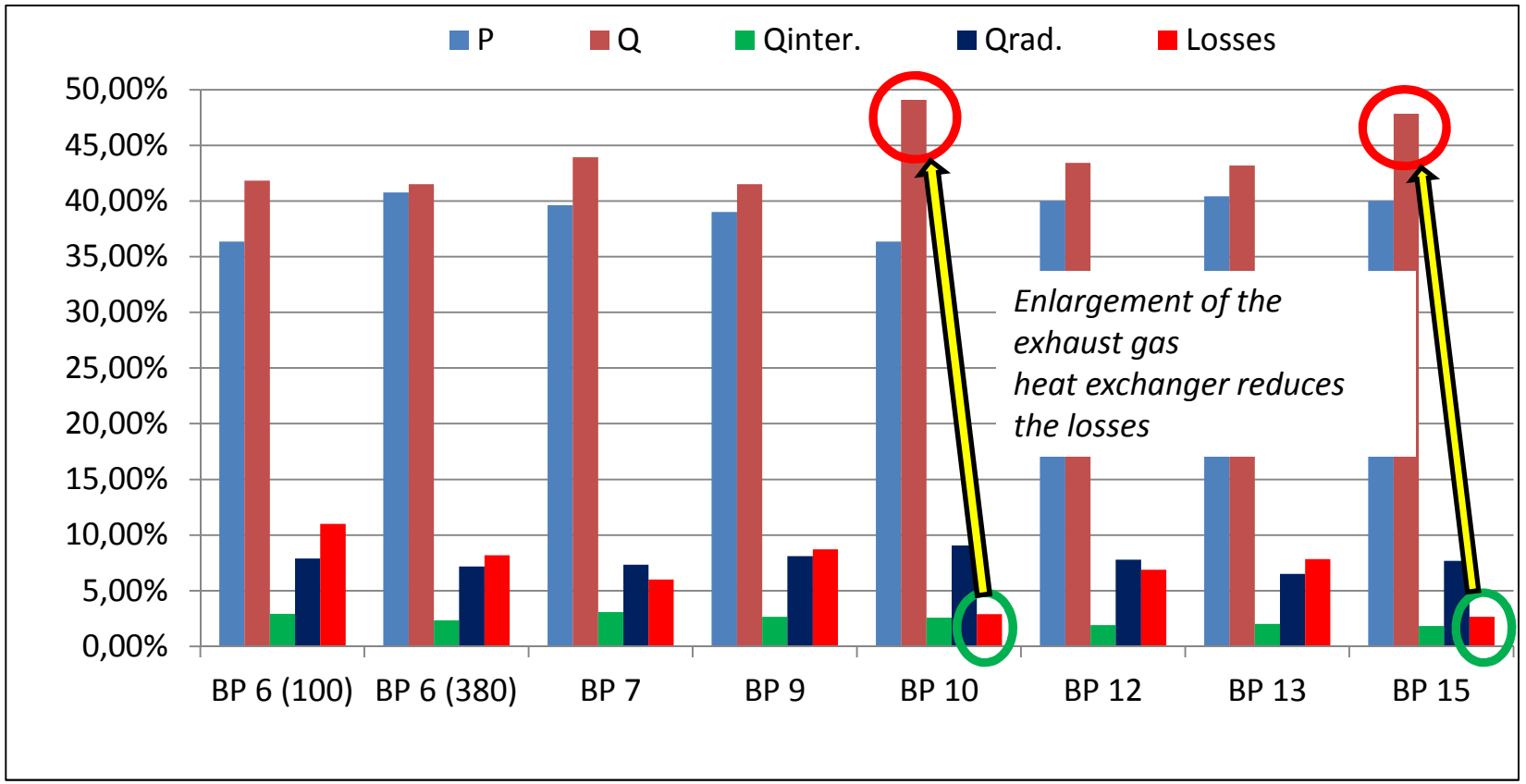
# CHP Heat sources




*Useful heat from the biogas CHP 90- 70°C or 95- 75°C*

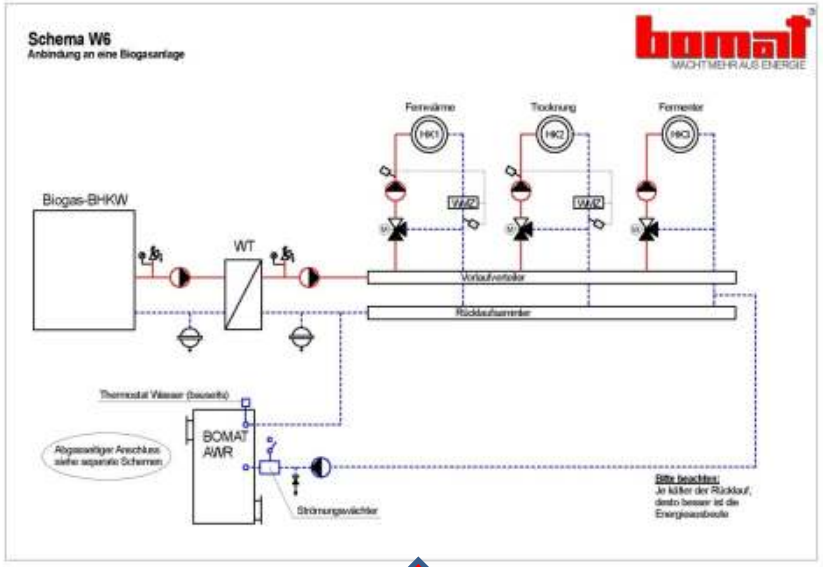
- ***Normally not use:***
- Exhaust gas under 180°C
- Intercooling 2. Stage
- Radiation heat

# CHP transformation




*Energy transformation of 100% Biogas in CHP unit*

# Exhaust gas exchanger




There are two different ways to get a higher efficiency from the exhaust:

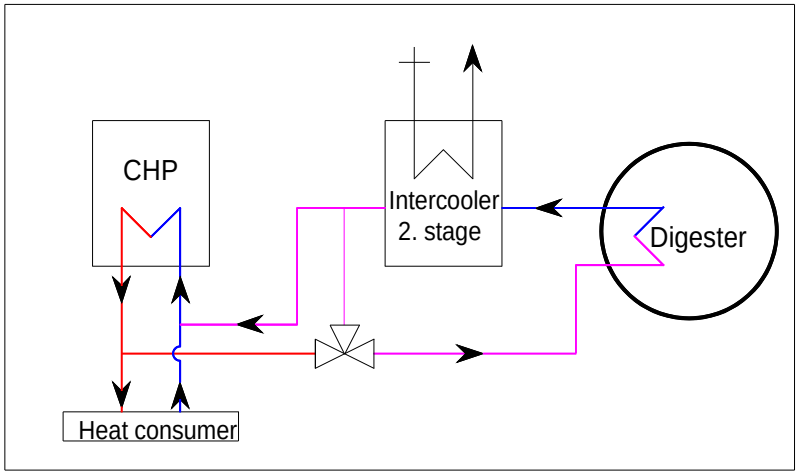
1) Sulfur content in the biogas should be close to 0 ppm,

2) The heat exchanger was made of corrosion – resistant material.

Example for an additional heat exchanger of corrosion –resistant material. Plants schematic and installation.

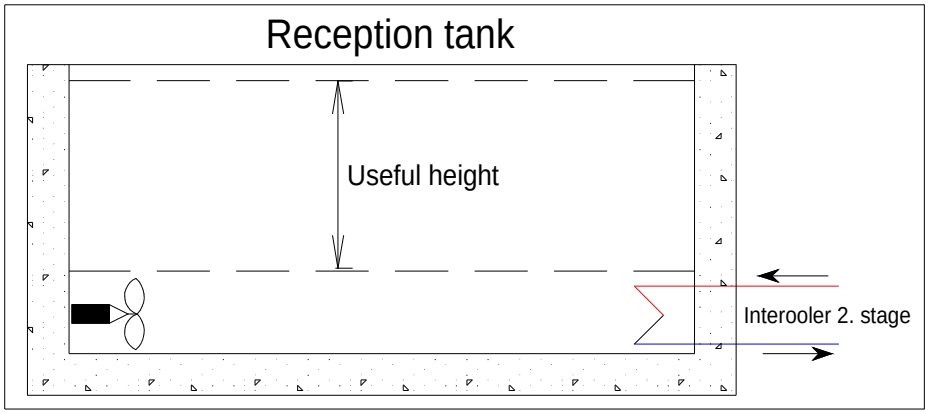
(bomat GmbH)

# Intercooler 2.stage




- The intercooling 2. stage heat can be used direct in heat system for the digester

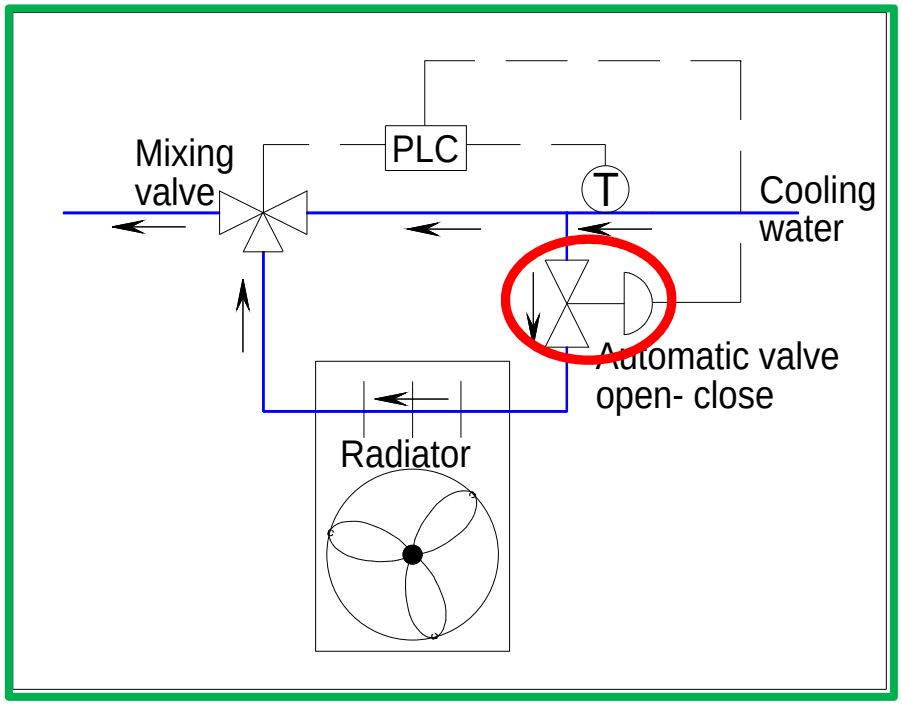
And it can be also used to preheat the slurry in the Reception tank




| | BP 6 | | BP 7 |
|---|---|---|---|
| $Q_{Proz.}$[GJ] | 3.159 | | 5.111 |
| $Q_{Inter.}$ [GJ] | 288 (100) | 911(380) | 1.440 |
| Proportion [%] | 23,46 | | 28,18 |

*Proportion of the intercooler heat to the process heat*

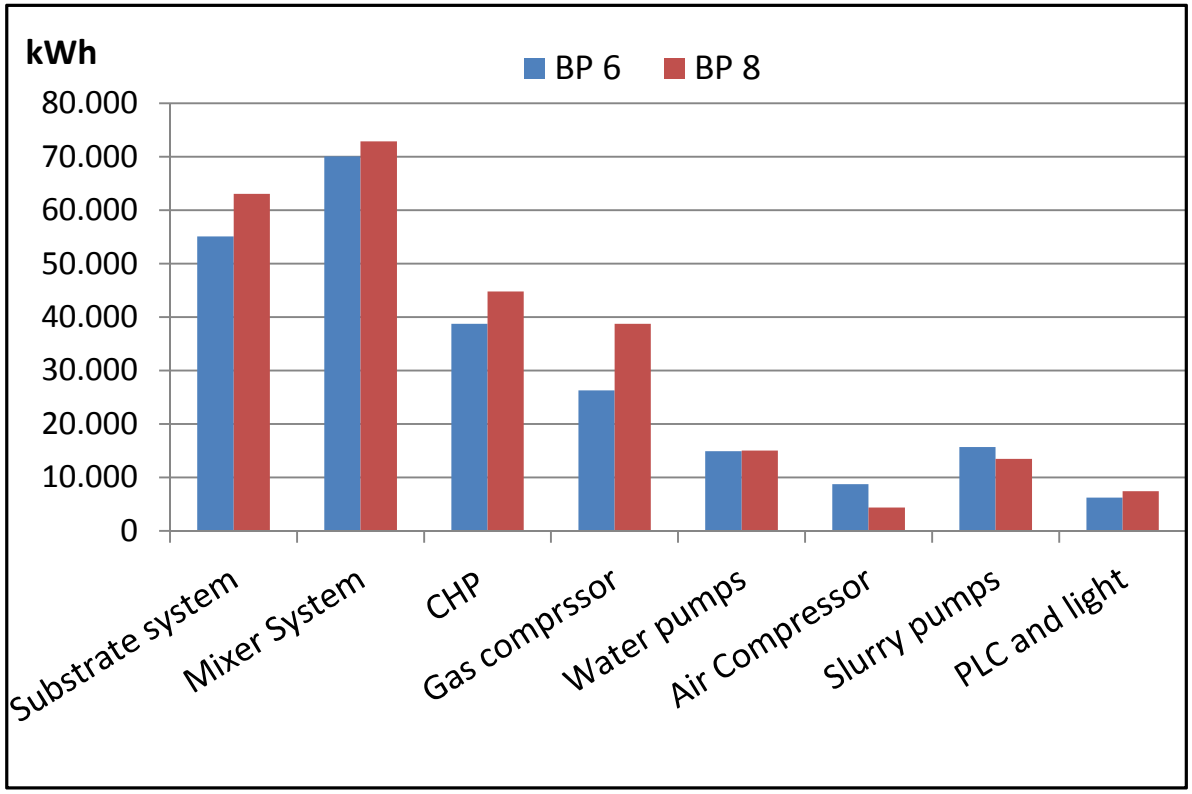
# Radiator losses




*Extended radiator system with automatic valve*

- Every biogas CHP unit is equipped with a radiator cooling system.
- The control works over a three way mixing valve.
- The min. flow volume to the radiator is 2- 3% of the whole cooling water energy.
- An additional automatic valve in the cooling water pipe can reduce this heat losses up 95%.

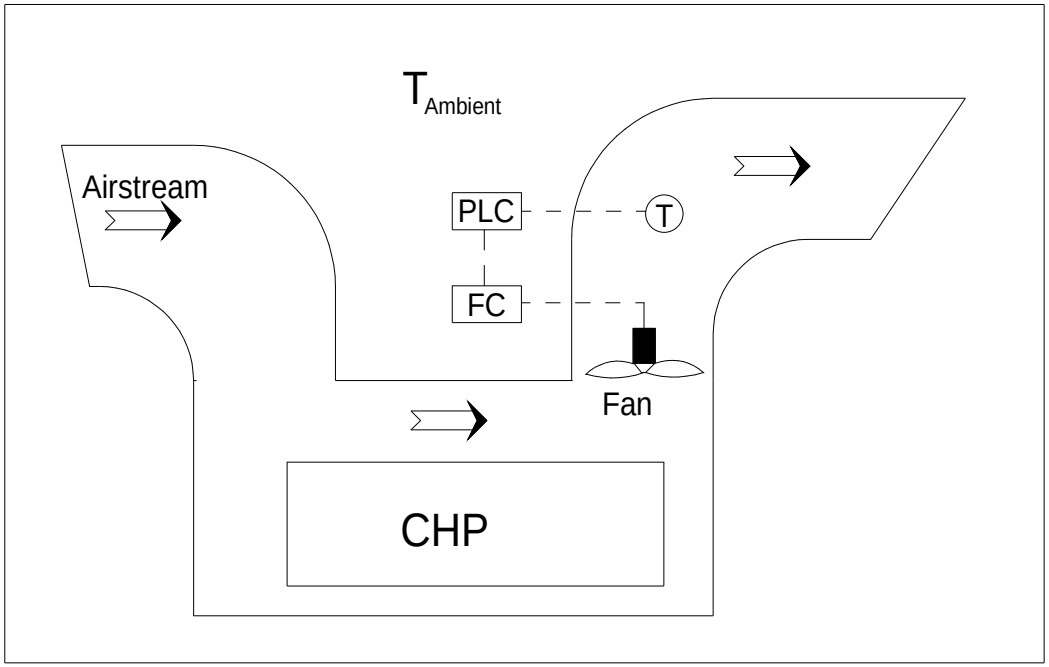
# ***Electrical own consumption***




- Comparison of the electric own consumption on two biogas plants 2014.
- Main consumers substrate – Mixer system and CHP

# ***Control over frequency converter***

- Over 95% of the electrical consumption are used for motors.
- Some of these drivers do not need the full power over the year.
- Pumps and fans for example with a controlled temperature can save much energy over the year




*Fan controlled with frequency converter*

# ***Summary***

- The optimization of own consumption on biogas plants shows several possibilities.
- On the thermal side, the process heat for the biogas plant can be reduce and the heat output of the CHP can be increased.
- On the electrical side can the own consumption reduced with a higher expenses of control technology.

***Analysis an optimization of energy flows in existing biogas plants for improved economic performance***

- **Thank you for your attention!**

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