



# Biogas plant – rural energy source

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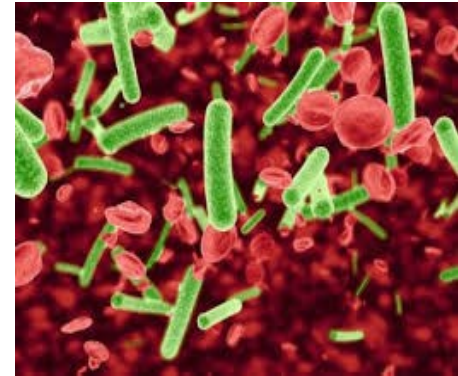
Bioeconomy course, University of South Bohemia  
May 25, 2017

# Sun - ultimate source of energy on Earth and powers all other renewable energy sources

- **Energy from Sun - free of charge energy**
- **Fotovoltaics** - direct utilization of sun's energy
- **Wind** - uneven heating of the atmosphere from the sun create low and high-pressure areas, which cause air to move
- **Hydropower energy** - Sun drivers the water cycle
- **Biomass** - plants convert the sun's energy into biomass through photosynthesis



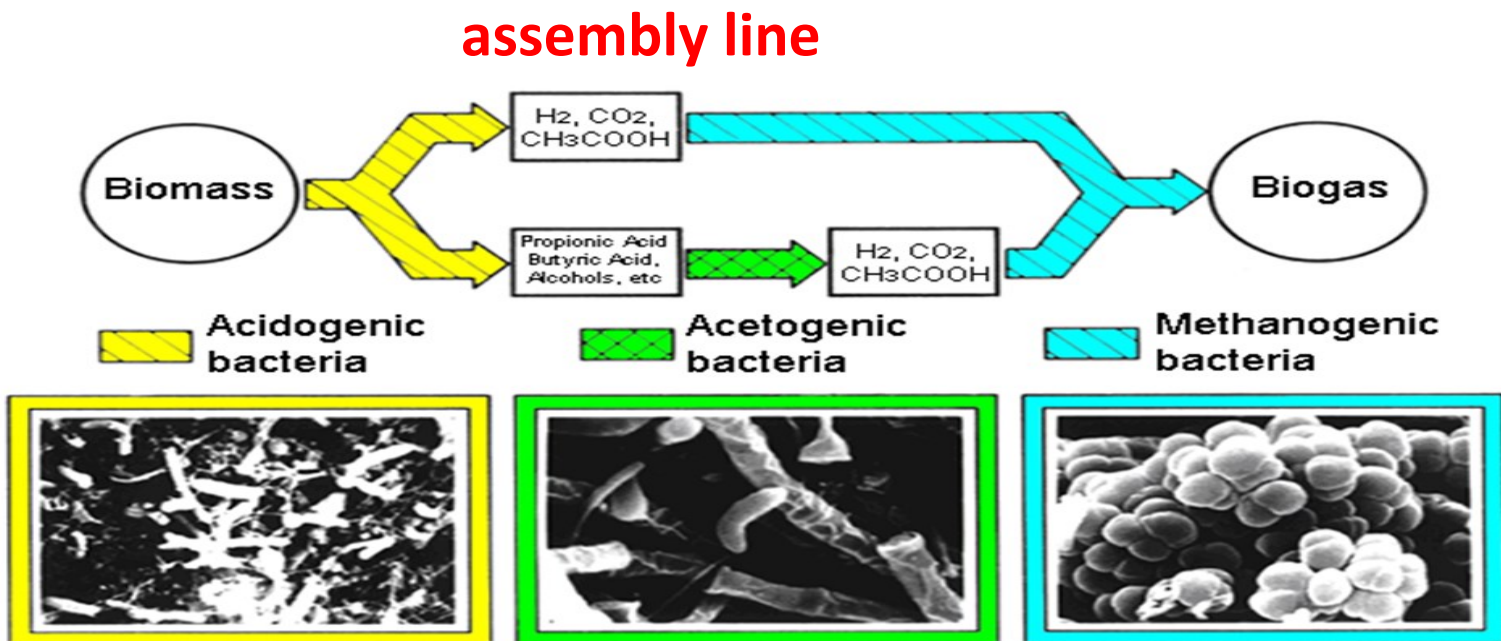
# Microorganisms



- „gratis“ workers - no salary, no holidays, no labor union – work only for food and suitable accommodation (conditions)
- Food = substrates (organic materials)
- Suitable work conditions = temperature, pH, etc.

# Anaerobic digestion – biogas production

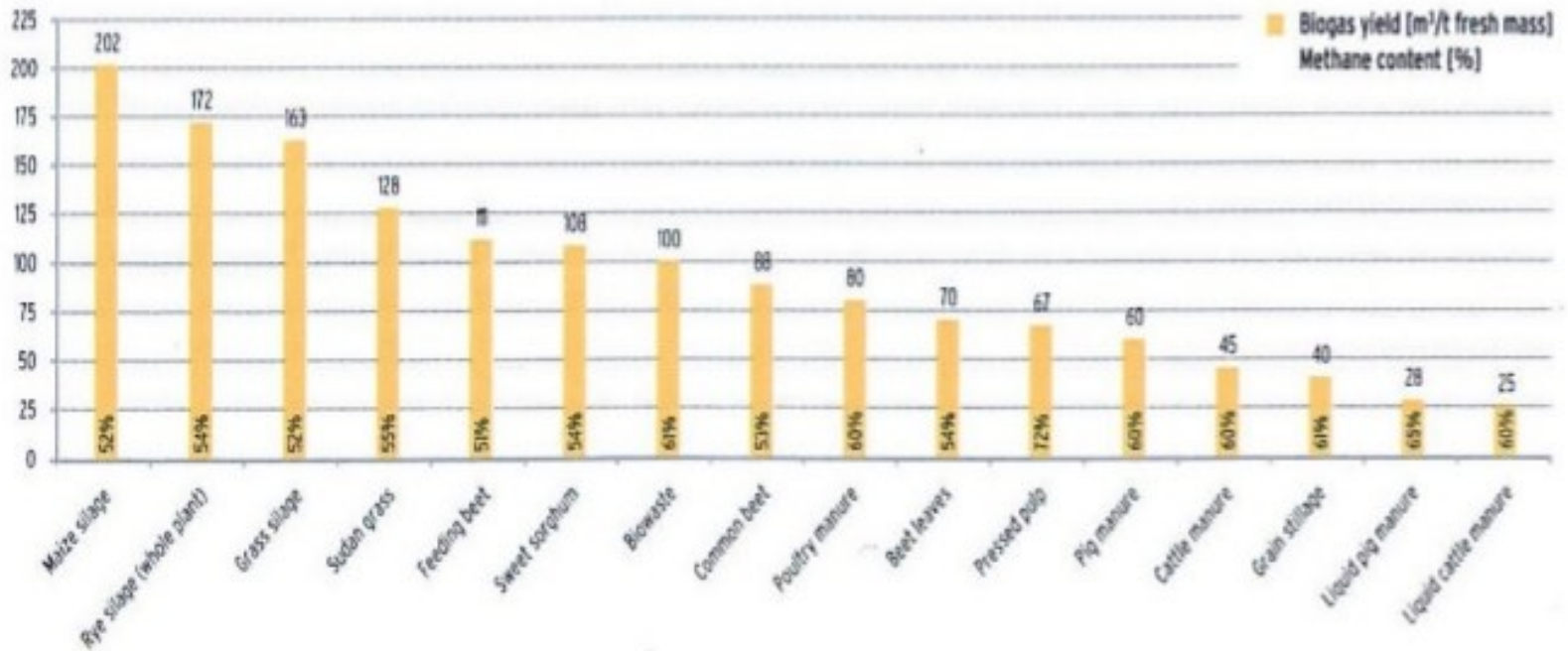
- Process in which microorganisms step by step break down biodegradable material.
- The final products of this are **biogas** (*a mixture of carbon dioxide and methane*) and **digestate** (*a nitrogen-rich fertiliser*).



# Substrates for AD – biogas yield

Organic input substrates can vary greatly and result in different gas qualities and quantities. Substrates have an important influence on plant technology selected for anaerobic digestion systems.

Biogas yields<sup>4</sup>



Source: AEBIOM Roadmap to Biogas

2010

10

# Composition of Biogas

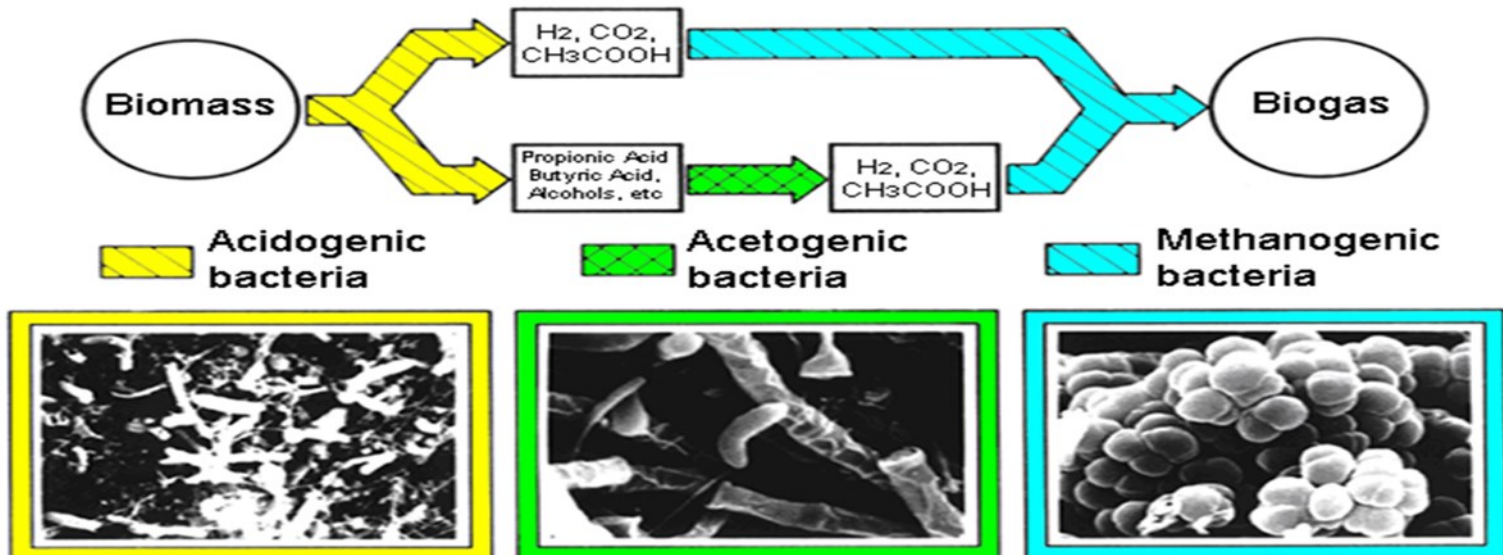
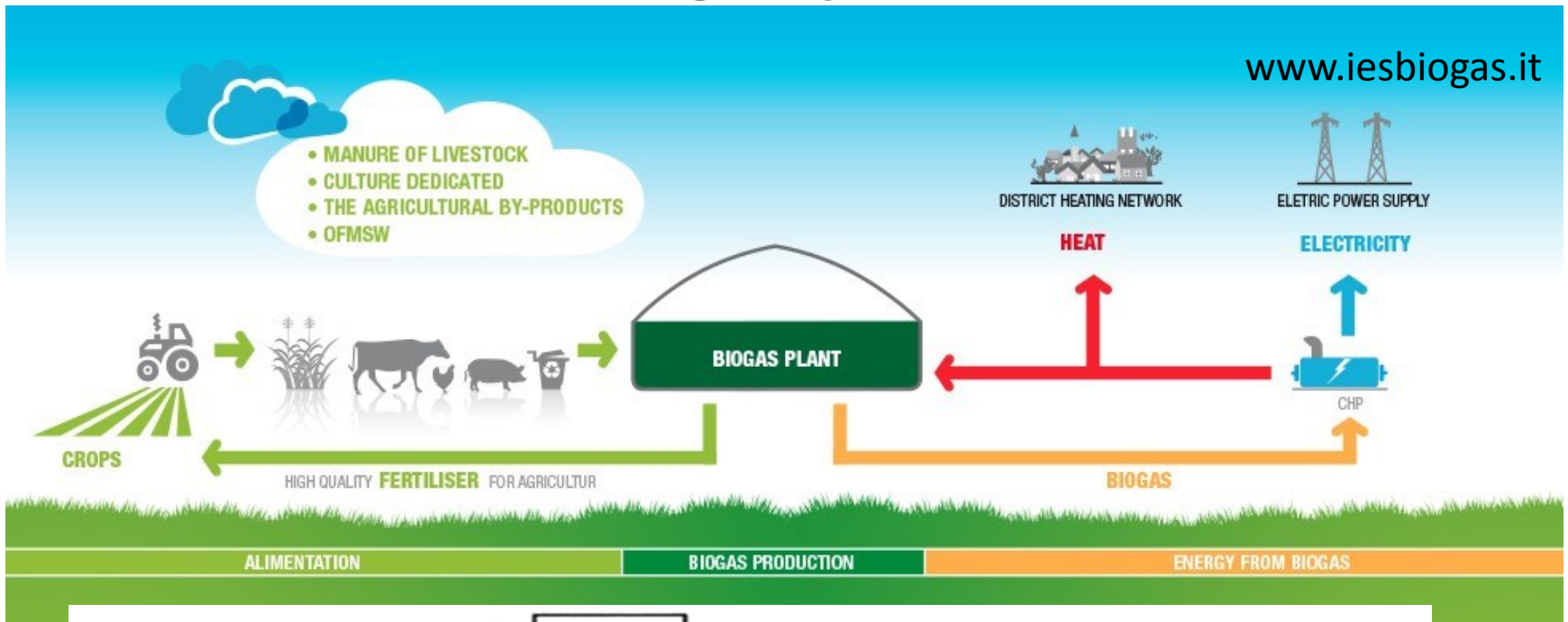
- Depends on substrates and fermentation condition

Compound	Biogas	Natural gas
<u>Methane</u> (CH <sub>4</sub> )	50 - 75 %	80 - 90 %
Carbon Dioxide (CO <sub>2</sub> )	25 - 50 %	0,5 – 2,5
Hydrogen (H <sub>2</sub> )	5 to 10 %	traces
<u>Nitrogen</u> (N <sub>2</sub> )	1 to 2 %	1 – 5 %
Hydrogen sulphide (H <sub>2</sub> S)	traces	0 – 5 %
C <sub>2</sub> – C <sub>5</sub>	traces	0,5 – 5 %

**Utilization for heat, electricity, biomethane**

# Biogas plant

[www.iesbiogas.it](http://www.iesbiogas.it)







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# Distribution of population by size of population centre in the Czech Republic

Size of popul. centre	Number of popul. centres	Total population (mil)		
<b>&lt; 1 000</b>	<b>5 000</b>	<b>1,7</b>	<b>Lower salaries</b>	<b>Higher investment cost for infrastructure</b>
<b>1 000 – 10 000</b>	<b>1 100</b>	<b>4,5</b>		
<b>10 000 – 100 000</b>	<b>130</b>	<b>2</b>		
<b>&gt; 100 000</b>	<b>5</b>	<b>2</b>		

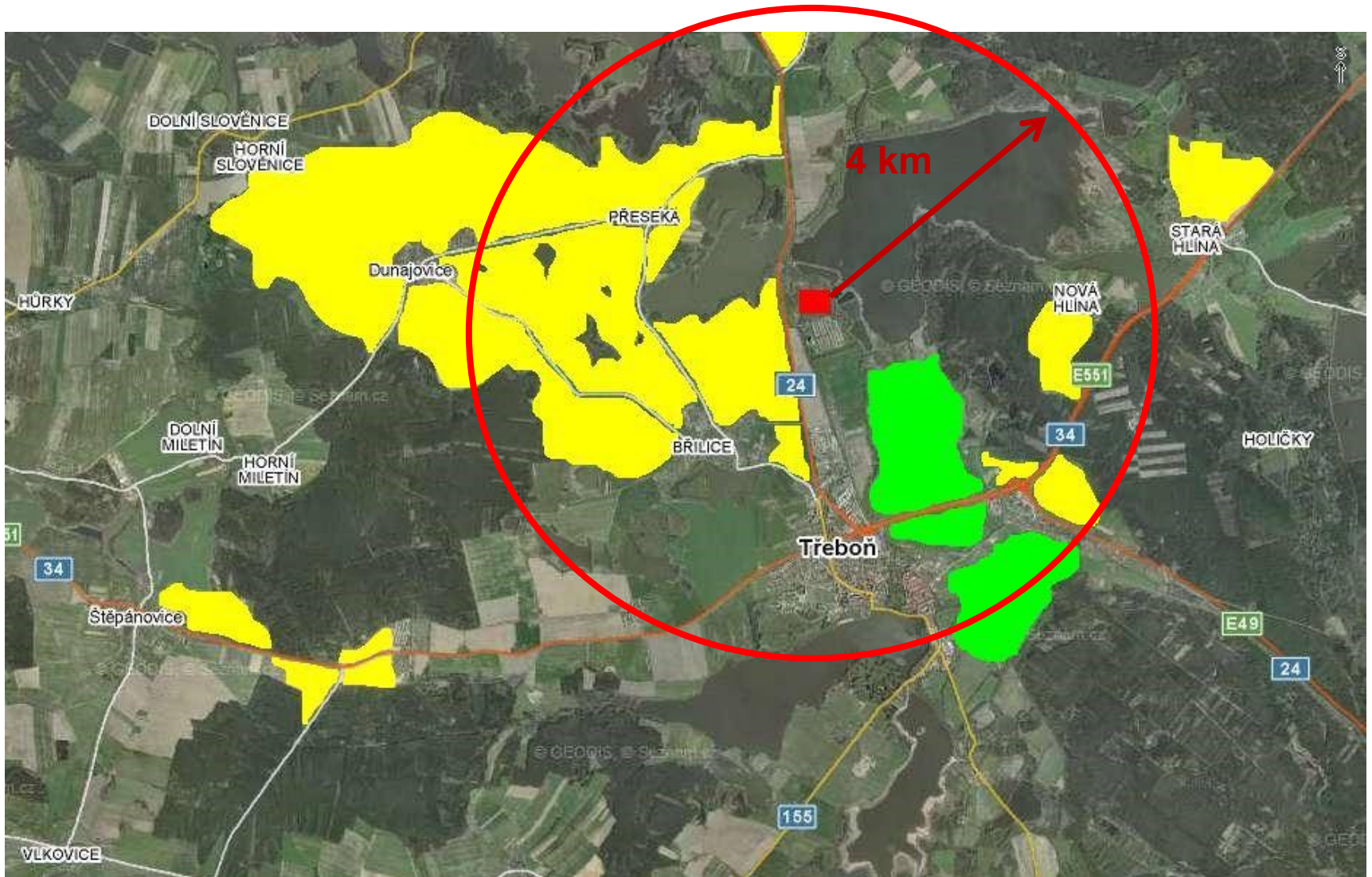
Annual consumption in CZ	
<b>Electricity</b>	<b>1,5 MWh/p/y</b>
<b>Heat</b>	<b>3,0 MWh/p/y</b>

# Biogas plant can be an excellent decentralized source of energy for human settlements (villages, towns) in rural districts

Radius	Area	20 % of area for biogas	Biomass production ( 30 t/ha)	Biogas production (170 m <sup>3</sup> /t)	Electricity	Heat	Electricity 1,5 MWh/ p./year	Heat 3 MWh/ p./year
km	ha	ha	FM tons	mil. m <sup>3</sup> /y	MWh/y	MWh/y	people	people
1	314	63	1890	0,3	643	643	426	107
3	2 826	565	16 956	2,9	5 044	5 044	3 400	1 681
<b>4</b>	<b>5 024</b>	<b>1005</b>	<b>30 144</b>	<b>5,1</b>	<b>8 968</b>	<b>8 968</b>	<b>6 000</b>	<b>3 000</b>



# Substrates from region can cover demand of BGP





# Biogas projects in Třeboň

Two different biogas plants  
in the same area



**BGP #2**

**BGP #1**



# BGP #1

- In operation 1974 – 2011 !!!
- Processing pig's manure 130 m<sup>3</sup>/day + sludge 40m<sup>3</sup>/day
- Reasons of construction:
  1. *odour elimination of manure during storage and application*
  2. *production of **heat** and electricity*



# BGP #1

- Biogas production 2 400 m<sup>3</sup>/day
- Cogeneration 175 kW el. + boiler 400 kW
- **Priorities of biogas utilization**
- *Maintain of anaerobic digestion = heating of fermentors*
- *Heating of pigs barn and other agricultural facilities*
- *Electricity production for farm, biogas plant, WWTP, workrooms etc.*

# Experienes BGP #1

- Process of anaerobic fermentation is stable when is well managed – 37 years without interruption.
- Biogas plant can fully cover energy demand of the animal farm.
- The simple – robust technology can be preferable than sophisticated one (failure, repair cost etc.).



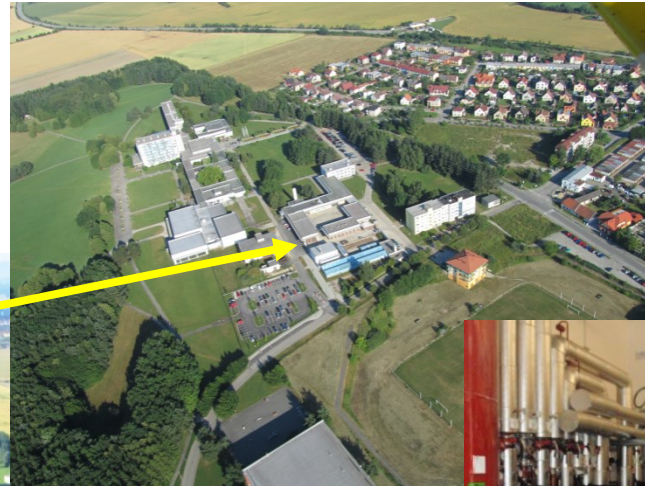
# BGP #2

- In operation from 2009
- **Reason of construction:**
  1. production of electricity and **heat**
  2. to stabilize agricultural activities in region, because:
    - *dramatic decline in cattle and pigs production after accession to the EU*
    - *relatively low prices of plant products*
    - *decline in milk production (cash flow)*
  3. processing of grass from floodplains



# BGP #2

4.3 km of the biogas pipeline to the heat consumption point  
(Municipal Spa)





# BGP #2

- Substrates: maize, grass, GPS
- Installed el. power 1 015 kW
- Heat utilization – spa, block of flats

**175 kW el./ 210 kW heat**



**840 kW el./ 840 kW heat**



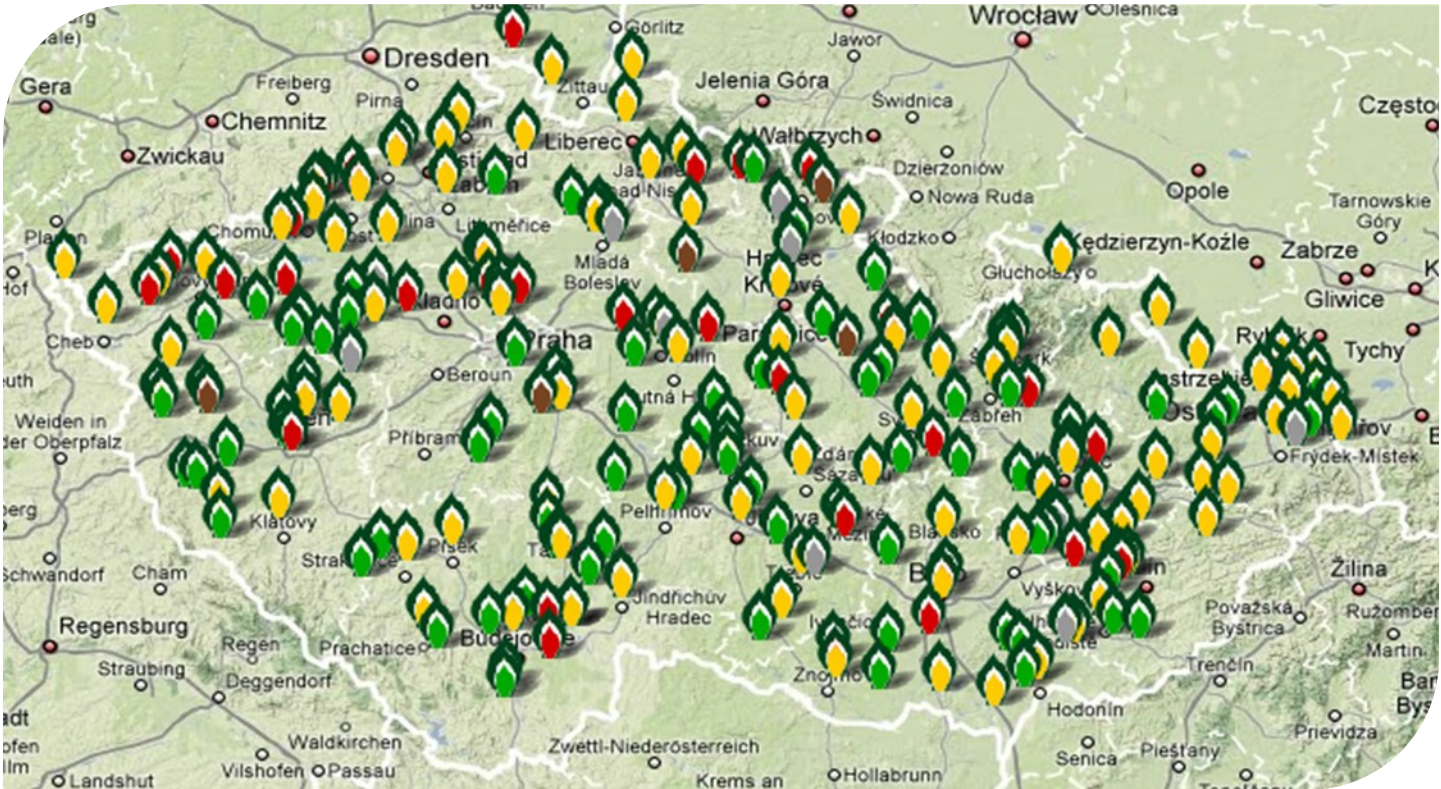
# Energy consumption in Třeboň

## 7000 inhabitants

	<b>Natural gas</b> <i>MWh/year</i>	<b>Electricity</b> <i>MWh/year</i>
<b>Household</b>	25 000	7 000
<b>Other</b>	30 000	13 000
<b>Total</b>	<b>55 000</b>	<b>20 000</b>
<b>BGP #2 production</b>	6 000 Heat equivalent	8 000
<b>Share</b>	11 %	40 %

# Biogas plants in the Czech republic

[www.czba.cz](http://www.czba.cz)





**GBA**  
Czech Biogas Association

***Biogas: The all-rounder  
good for the environment  
and good for people in rural areas***

**Thank you  
for your attention!**

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