



Biogas plant – rural energy source

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Bioeconomy course, University of South Bohemia
Day 4 (May 26, 2016)

Bioeconomy is... (wikipedia)

- The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to produce food, materials and energy.
- In practice[edit]
- The biobased economy uses first-generation biomass (crops), second-generation biomass (crop residue), and third-generation biomass (seaweed, algae). Several methods of processing are then used to gather the most out of the biomass. This includes techniques such as

- **Anaerobic digestion**
- **Pyrolysis**
- **Torrefaction**
- **Fermentation**
- **Biorefinery**

Anaerobic digestion is generally used to produce ethanol, pyrolysis is used to produce pyrolysis-oil (which is solidified biogas), and torrefaction is used to create biomass-coal. Biomass-coal and biogas is then burnt for energy production, ethanol can be used as a (vehicle)-fuel, as well as for other purposes, such as skincare products.

Bioenergy, bioeconomy

solar energy

- **Solar energy - free of charge energy**
- **Sun - ultimate source of energy on Earth and powers all other renewable energy sources**
- **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



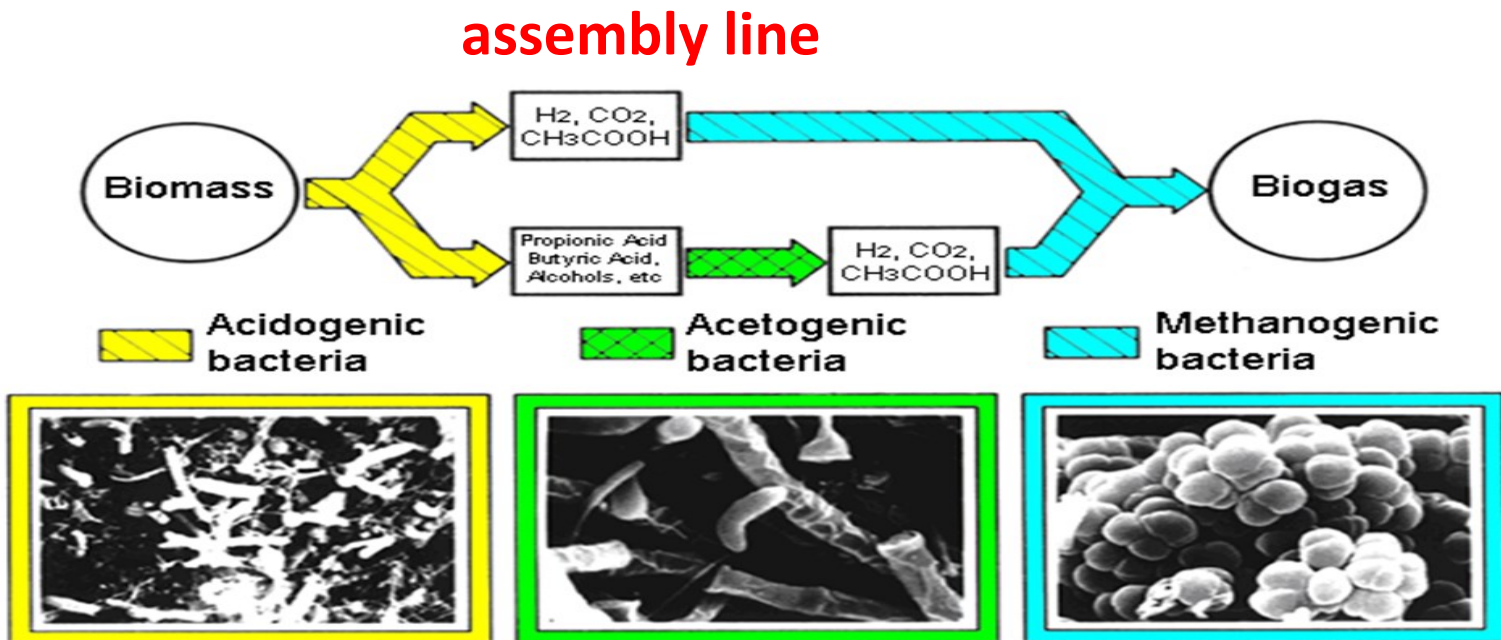
Bioenergy, bioeconomy microorganisms



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

Anaerobic digestion – biogas production

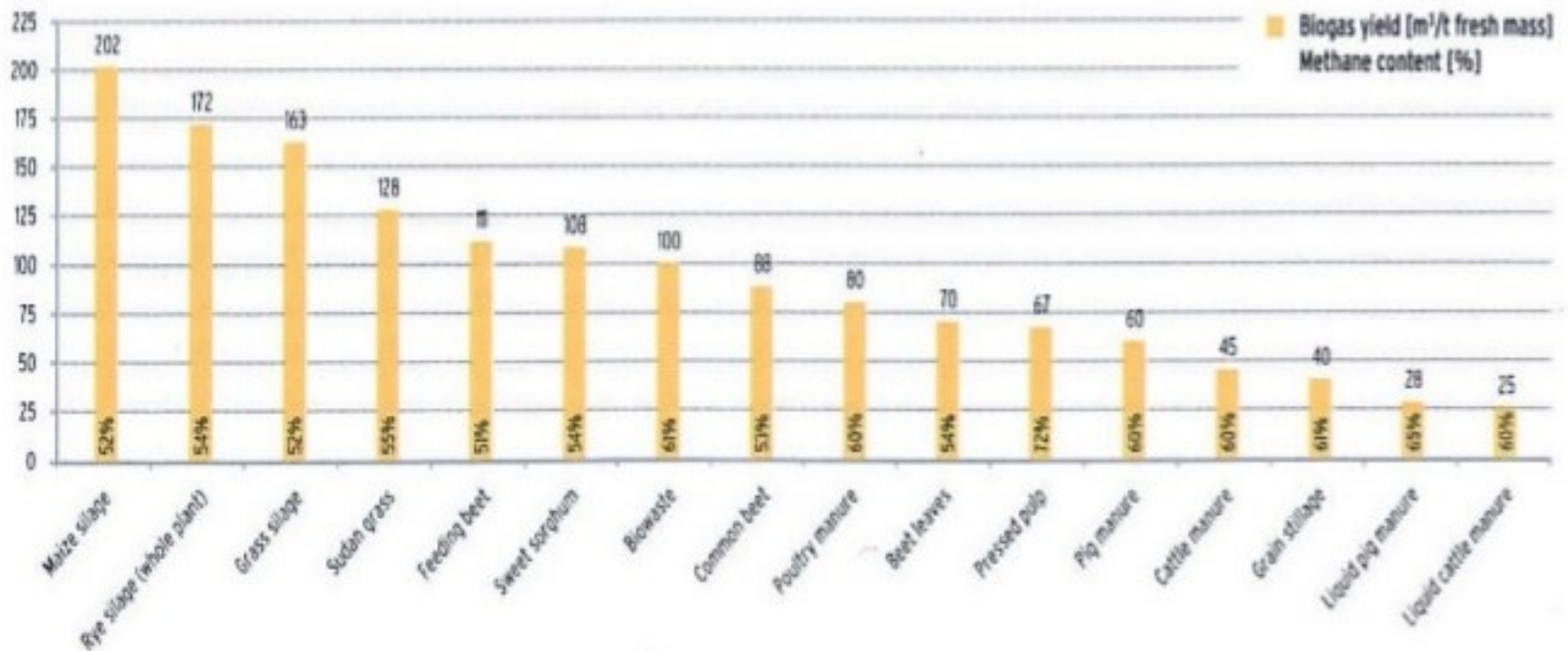
- Process in which microorganisms step by step break down biodegradable material in the absence of oxygen.
- The final products of this are **biogas** (*a mixture of carbon dioxide and methane*) and **digestate** (*a nitrogen-rich fertiliser*).



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 yields⁴



Source: AEBIOM Roadmap to Biogas

2010

10

Composition of Biogas

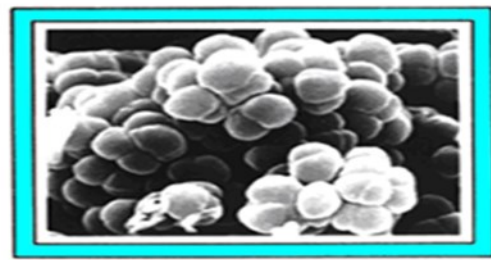
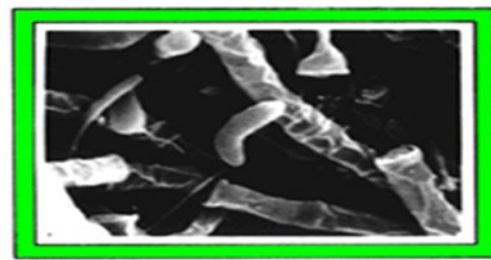
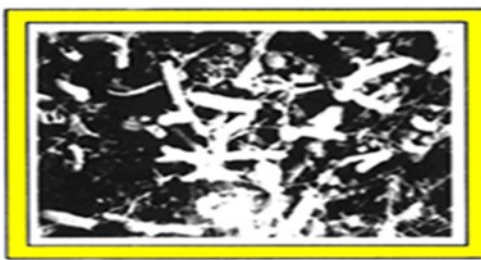
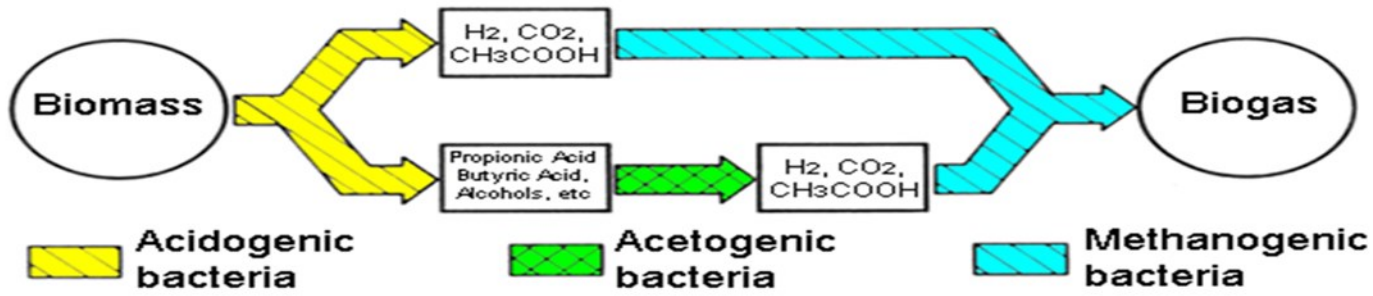
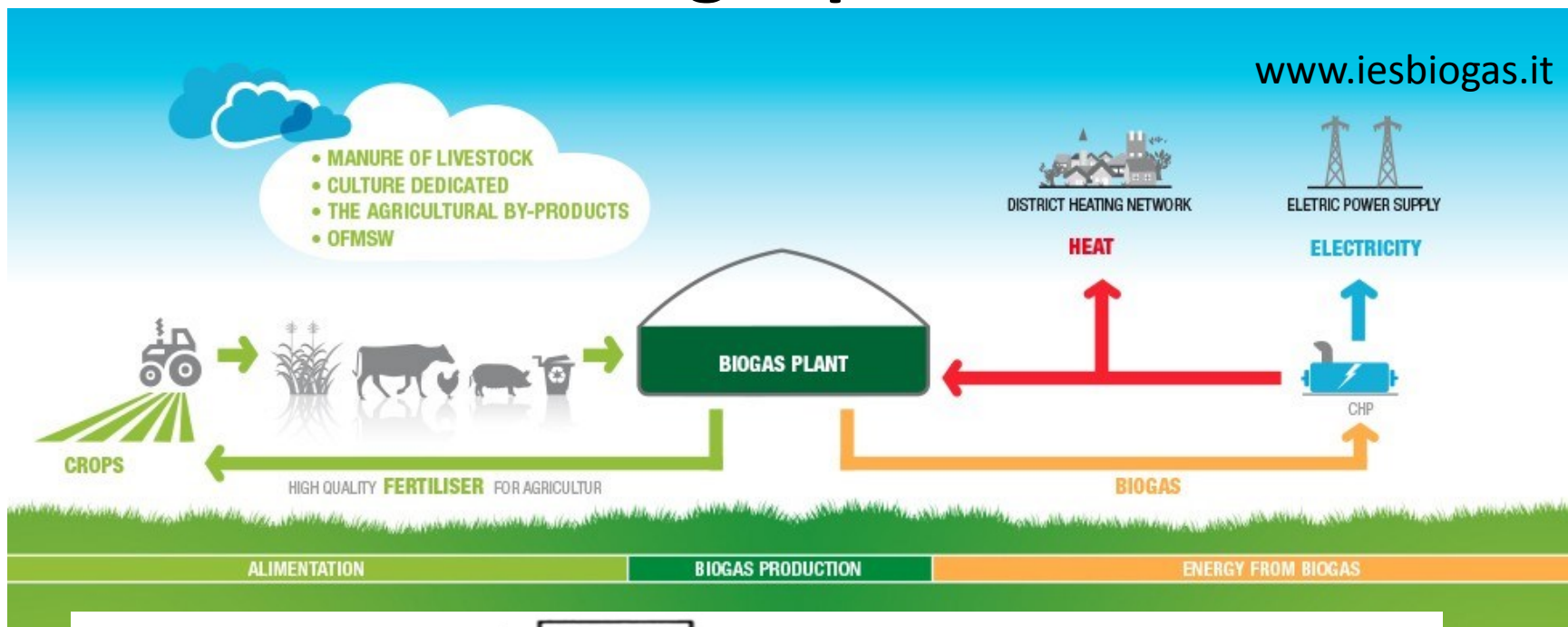
- Depends on substrates and fermentation condition

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

Utilization for heat, electricity, biomethane

Biogas plant

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)		
< 1 000	5 000	1,7	Lower salaries	Higher investment cost for infrastructure
1 000 – 10 000	1 100	4,5		
10 000 – 100 000	130	2		
> 100 000	5	2		
Median 382				

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

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 ³ /t)	Electricity	Heat	Electricity 1,5 MWh/ p./year	Heat 3 MWh/ p./year
km	ha	ha	FM tons	mil. m ³ /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
4	5 024	1005	30 144	5,1	8 968	8 968	6 000	3 000



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 m³/day + sludge 40m³/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 m³/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.).

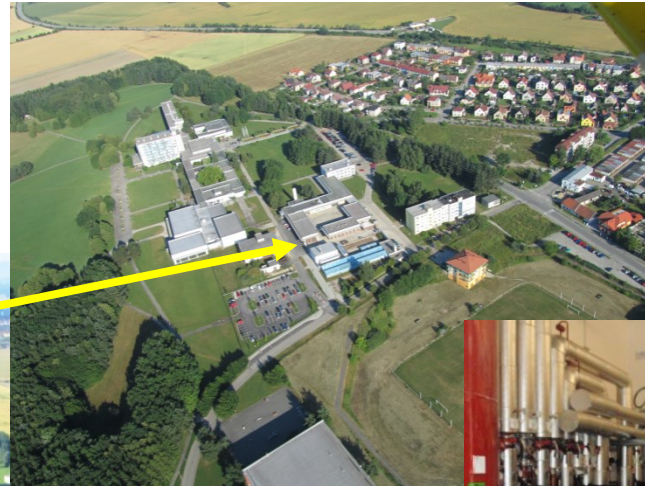
BGP #2

- 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

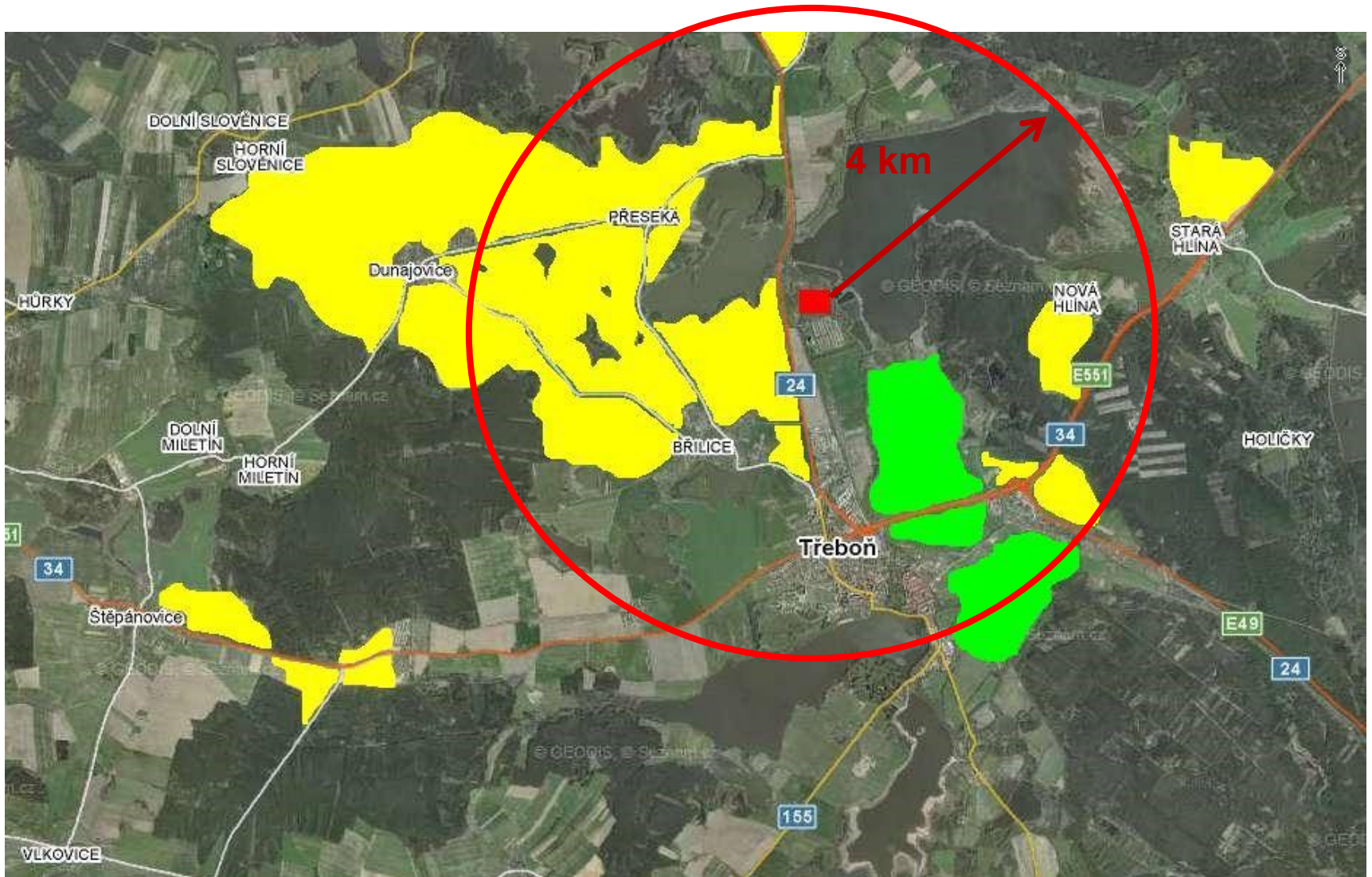


Energy consumption in Třeboň

7000 inhabitants

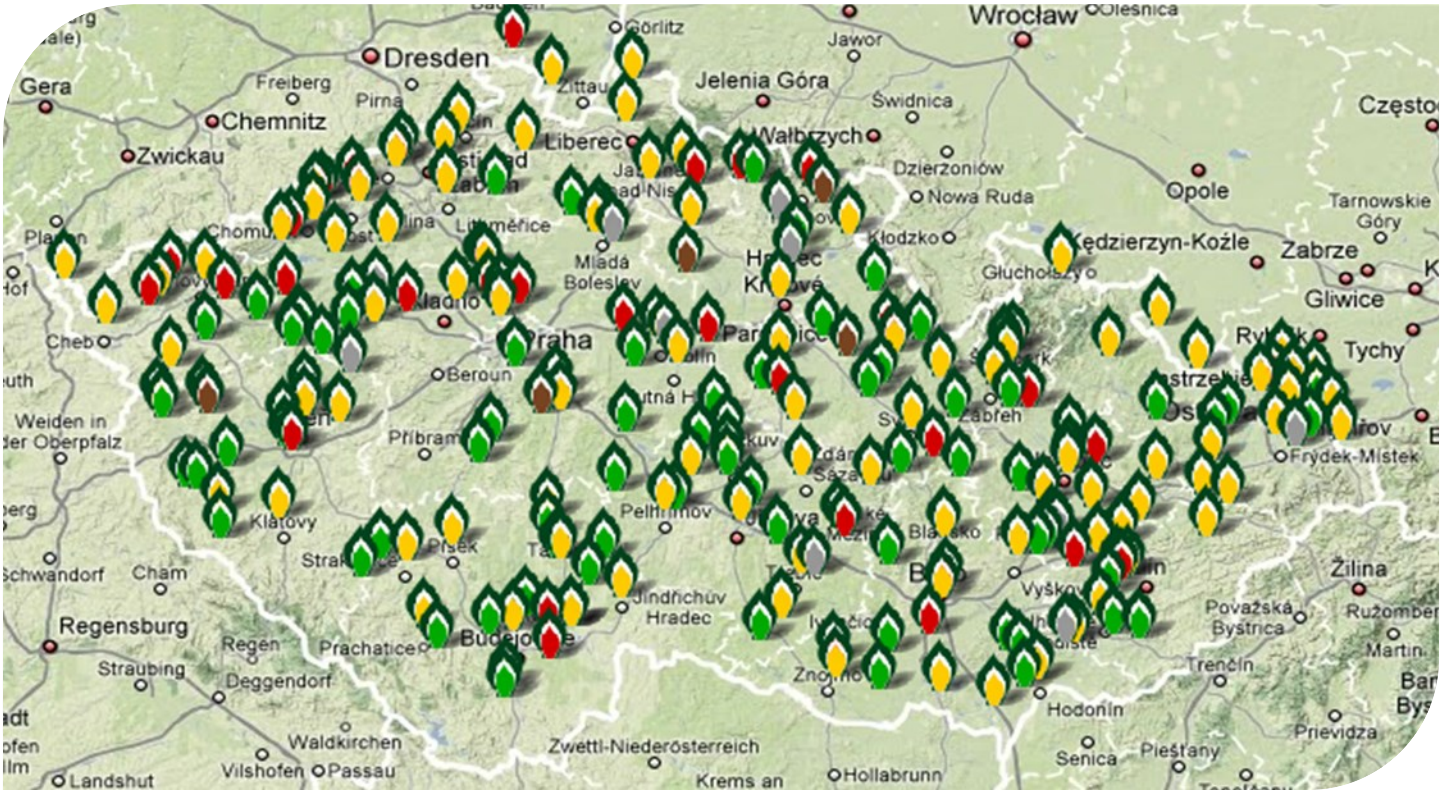
	Natural gas <i>MWh/year</i>	Electricity <i>MWh/year</i>
Household	25 000	7 000
Other	30 000	13 000
Total	55 000	20 000
BGP #2 production	6 000 Heat equivalent	8 000
Share	11 %	40 %

Substrates from region can cover demand of BGP

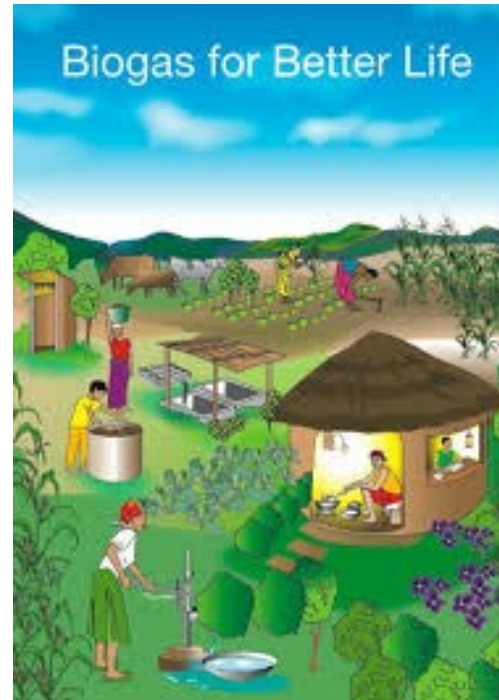


Biogas plants in the Czech republic

www.czba.cz



Biogas in developing rural areas



What are the advantages of using biogas as fuel for cooking?



- Biogas burns very cleanly, and produces less pollutants during cooking than any other fuel except electricity
- Depending on the type of gas stove used, the handling of biogas for cooking is easy and allows for strong heat as well as for small simmering heat
- It can decrease the workload of women as it is often they who are responsible for collecting firewood for cooking
- Deforestation, land degrade and greenhouse gases
- The using of firewood for energy needs has a severe impact on the worlds forests (*it accounts for 54% of the worlds deforestation in developing countries*).



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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