

BIOPLIN, TEHNOLOGIJA IN OKOLJE

29 Novembra 2007, Rakičan

BIOGAS FOR FARMING, ENERGY CONVERSION AND ENVIRONMENT PROTECTION

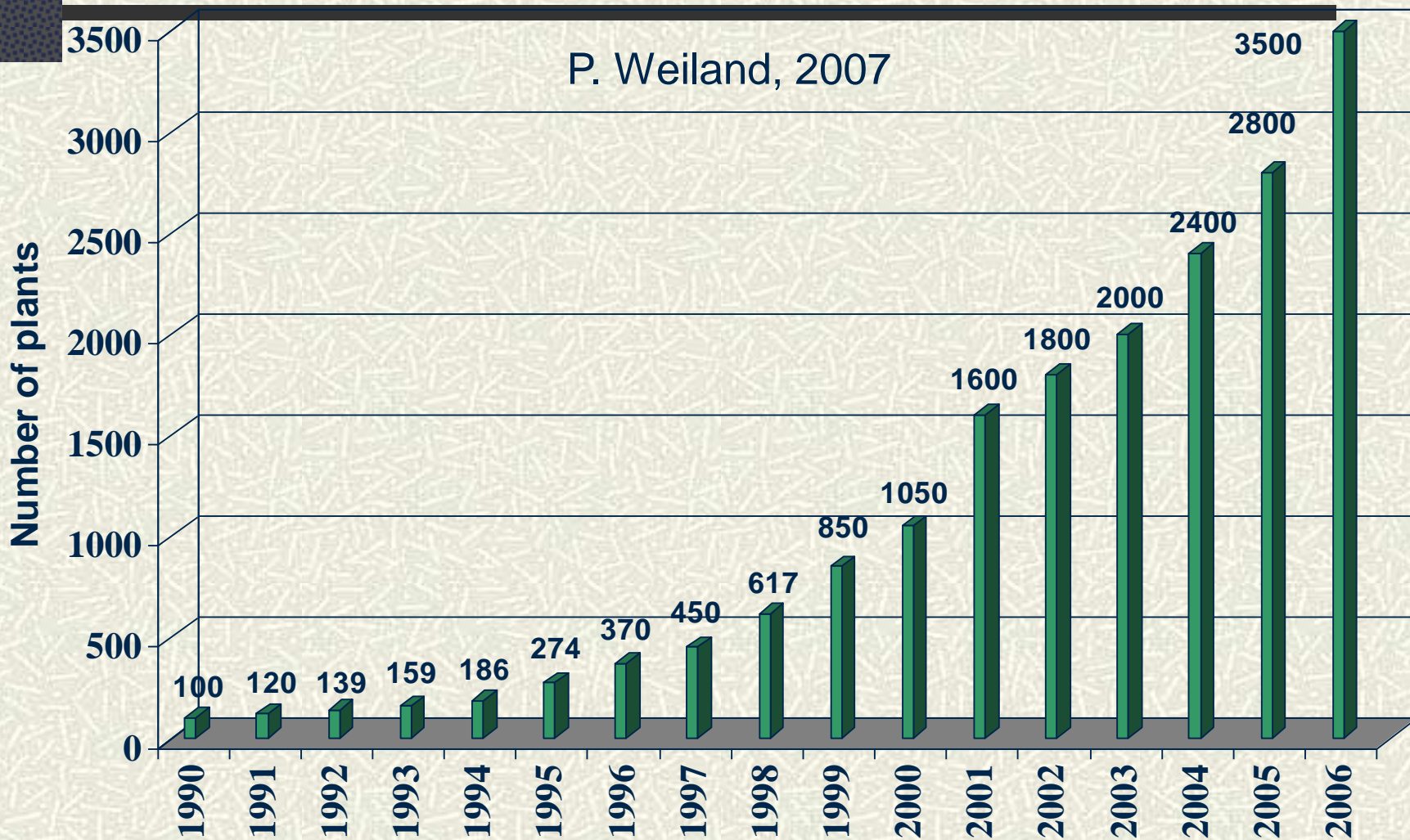
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INSPIRATIONS FOR BIOGAS

- # **Political** - *Kyoto protocol, EU and national legislations*
- # **Environmental** – *reduction of organic and biological pollution*
- # **Veterinary** – *treatment of animal by-products not intended for human consumption*
- # **Energy** – *replacement of fossils to local resources*
- # **Recovery** – *production of new products from wastes*
- # **Agricultural** – *waste treatment, fertilizers*
- # **Social** – *labor market and regional development*

Development of biogas industry in Germany



P. Weiland, 2007

Rakičan, 2007

Process design

Technology flows and elements

Substrate

collection and holding

pretreatment - *separation, cutting, mixing, sanitation*

loading and removal

digestate storage and utilization

Process

mixing

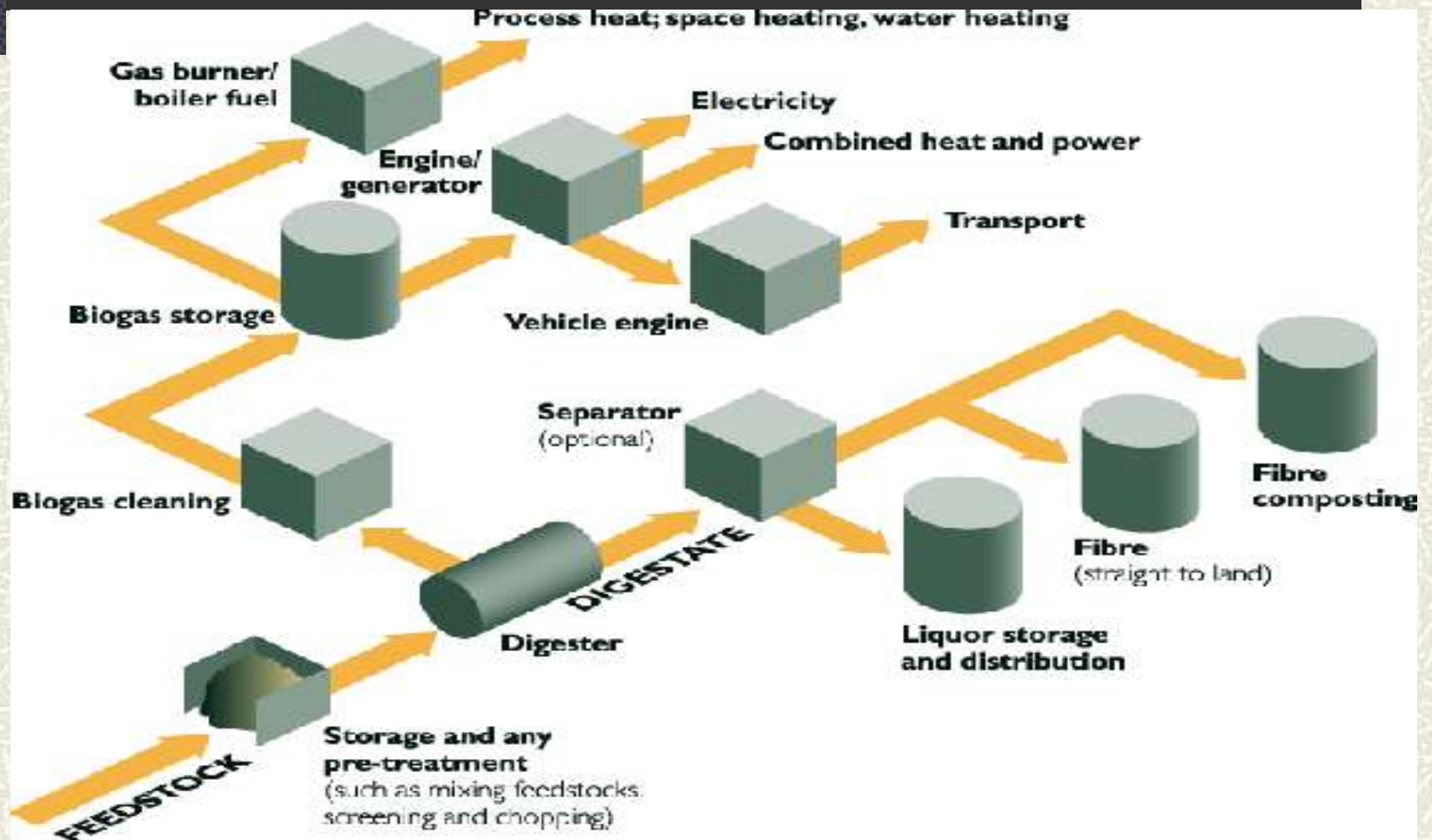
heating

Biogas

collection and holding

conversion

AD Process scheme



Process parameters

Temperature

- *Psychrophilic* (10°C - 25°C)
- *Mesophilic* (25°C - 45°C)
- *Thermophilic* (55°C - 60°C)

■ Hydraulic retention time *HRT*

(the average time the substrate remain in a digester)

- $HRT = V_1 / S_d$ (V_1 – liquid volume, S_d – daily flow)

Cattle manure - 12 – 18 days

Pig manure - 10 – 15 days

■ Organic loading rate *OLR*

(organic material fed daily per m³ of digester volume)

Cattle manure - 2.5 – 3.5 kg VS/ m³ day

Pig manure - 3.0 – 3.5 kg VS/ m³ day

Process indicators

SUBSTRATE

- *Composition (TS, VS, Proteins, Fats and Carbohydrates)*
- *pH level (about 7.0)*
- *Rate of C:N*
- *Biogas yield potential (m^3/kg substrate or m^3/kg TS)*

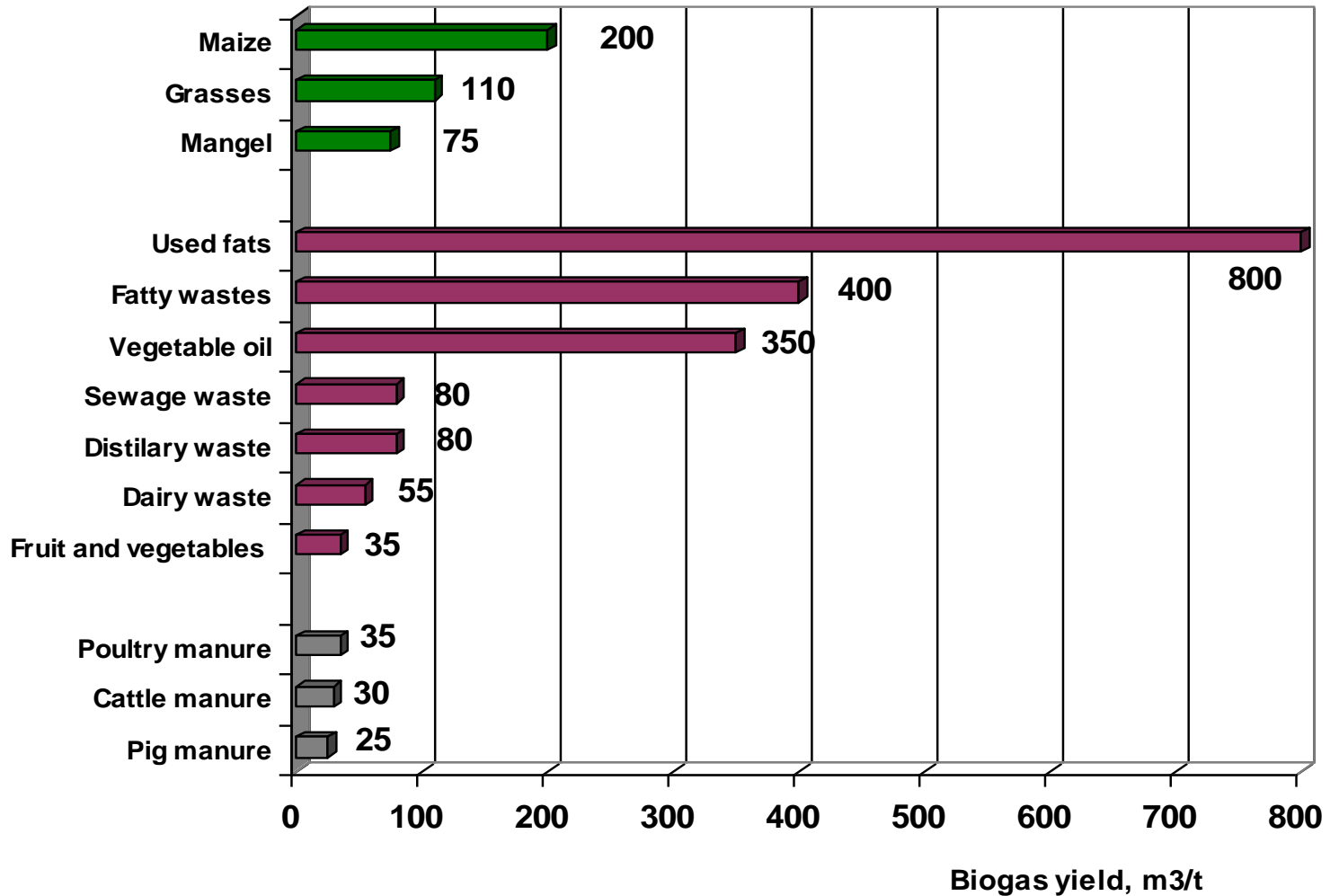
BIOGAS

- *Biogas rate (m^3/m^3 of digester volume per day)*
- *Biogas composition and energy potential*

OTHER

- *Energy efficiency or biogas utilization factors*
- *BOD and COD in feed and removal or VS in feed and removal*
- *Pay back*

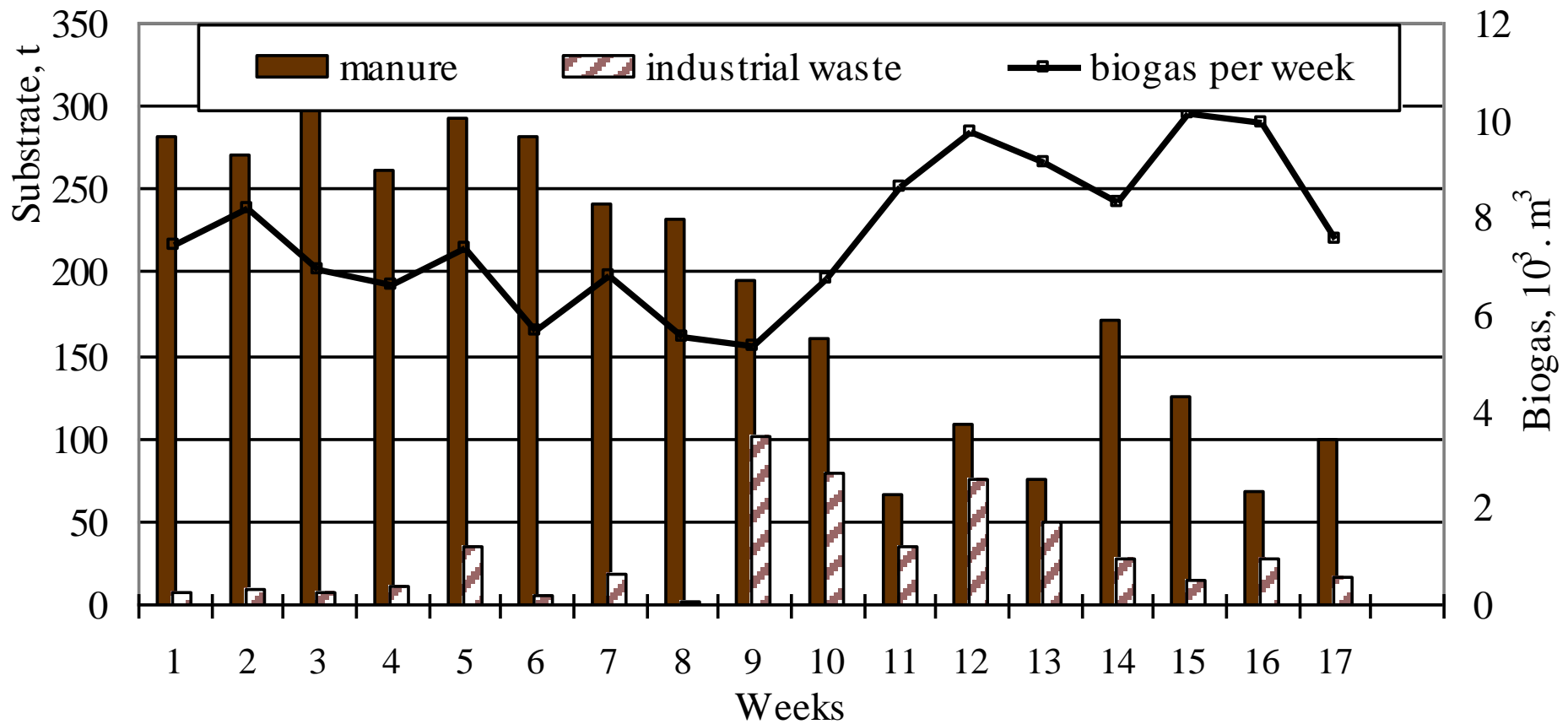
Biogas yields from different biomass



Biomass for biogas



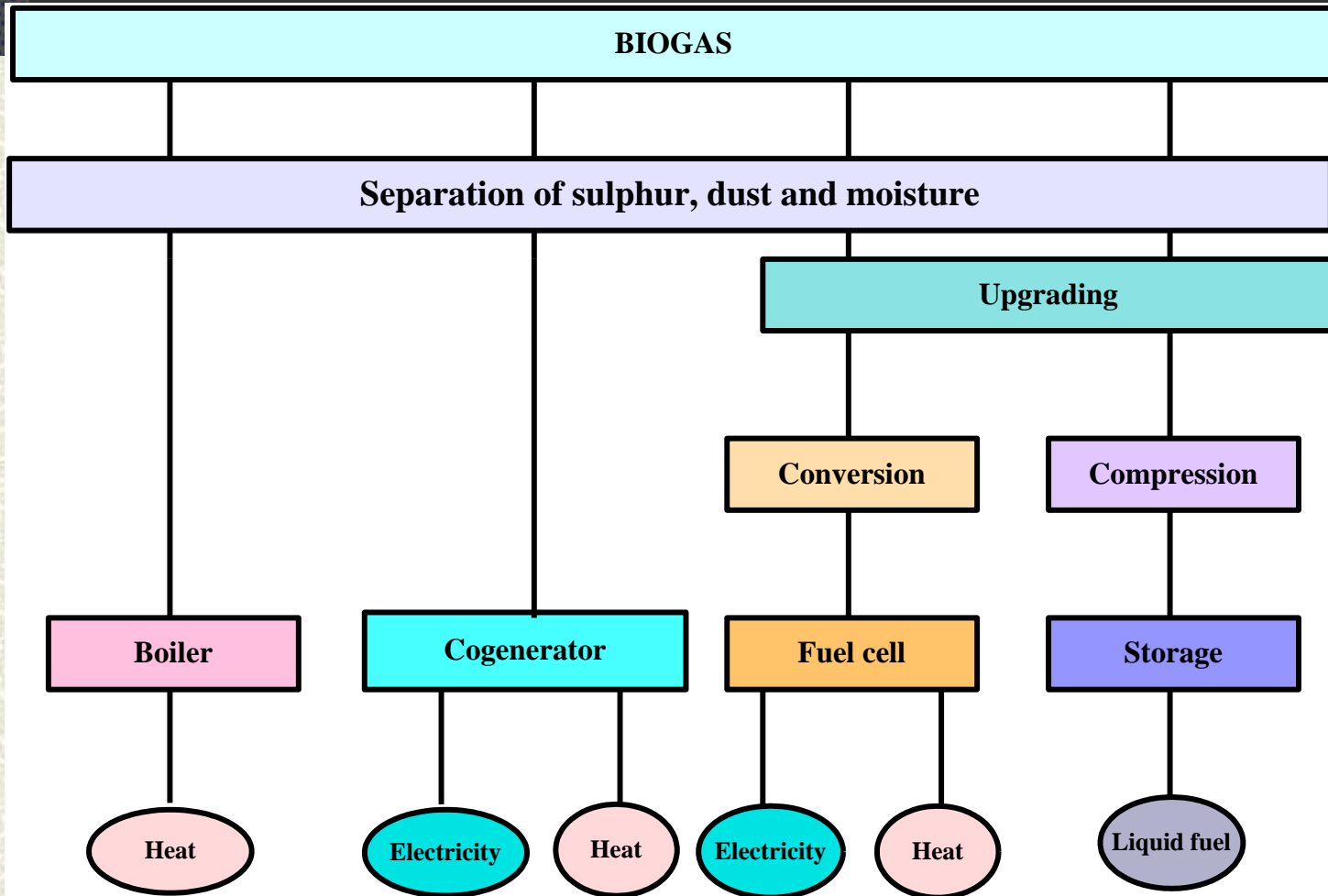
Influence on biogas production of the industrial substrate



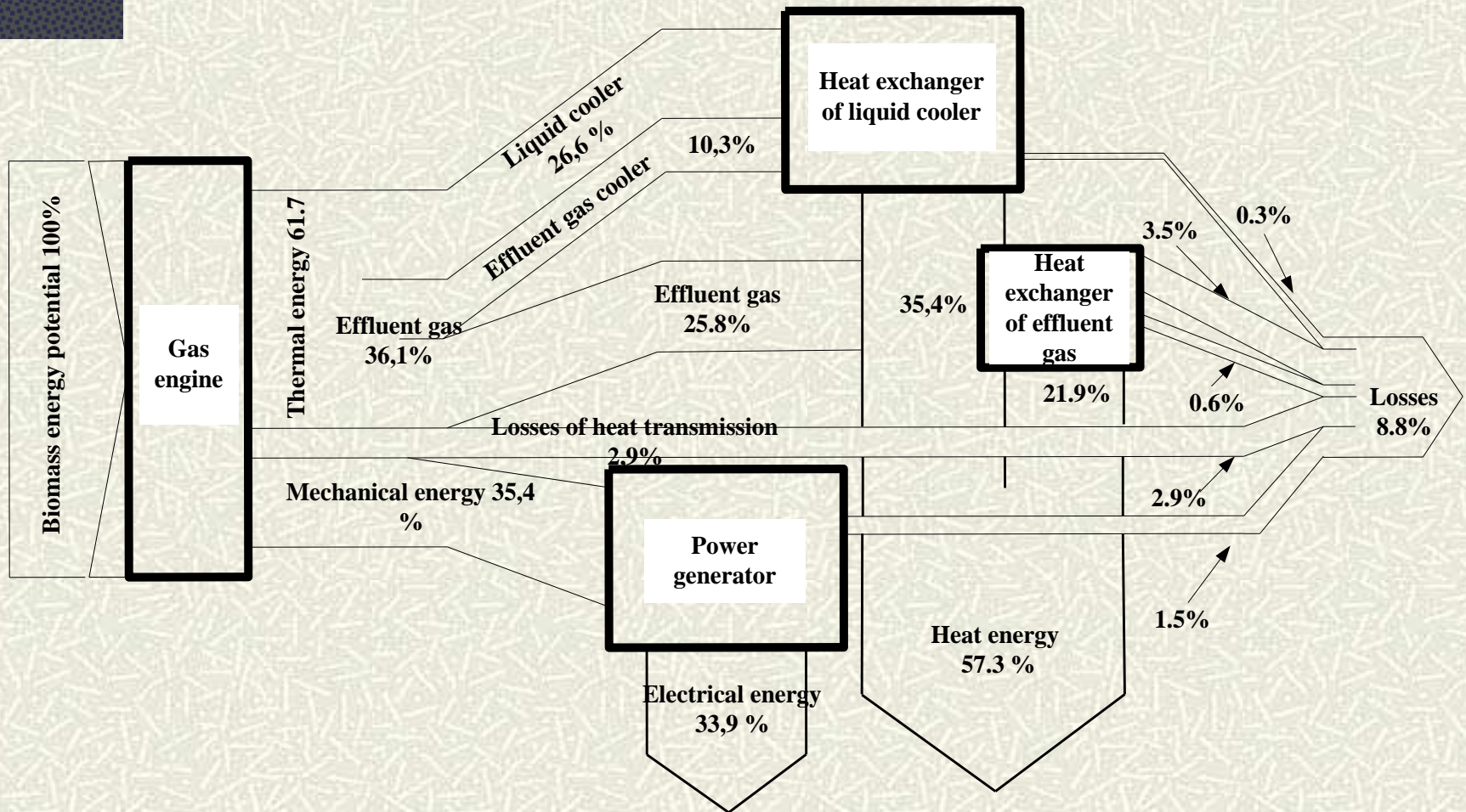
Composition of Biogas

Component	Dimension	Content
CH₄	%	55 - 80
CO₂	%	15 - 45
H₂S	mg/m³	0 - 5000
NH₃	mg/m³	0 - 450
Humidity	-	Saturated
Caloric value	MJ/m³	20 - 25
Caloric value	kWh/m³	5,5 – 8,0

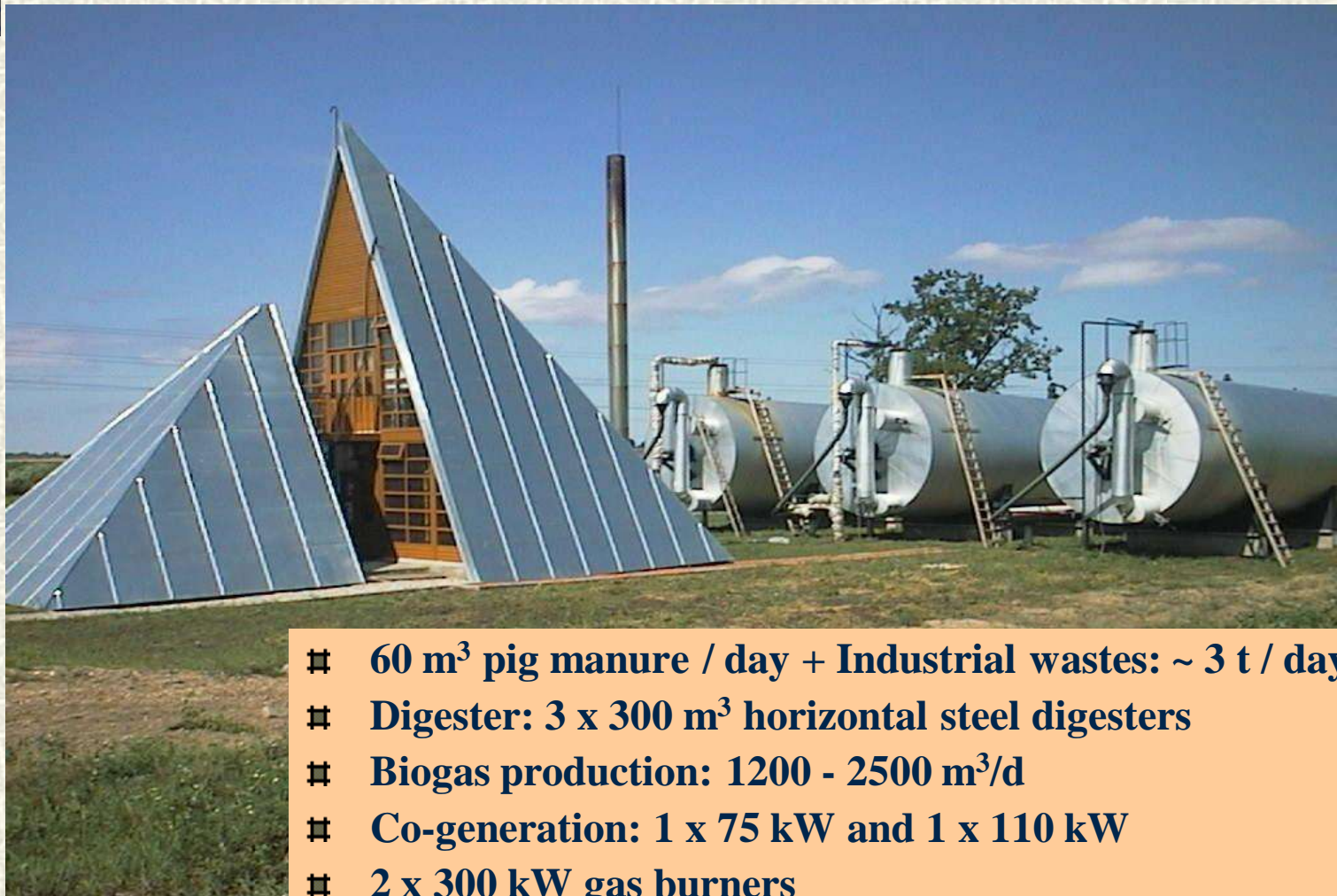
Biogas use



Cogeneration



Pig Farm Biogas Plant, Lithuania



- # **60 m³ pig manure / day + Industrial wastes: ~ 3 t / day**
- # **Digester: 3 x 300 m³ horizontal steel digesters**
- # **Biogas production: 1200 - 2500 m³/d**
- # **Co-generation: 1 x 75 kW and 1 x 110 kW**
- # **2 x 300 kW gas burners**

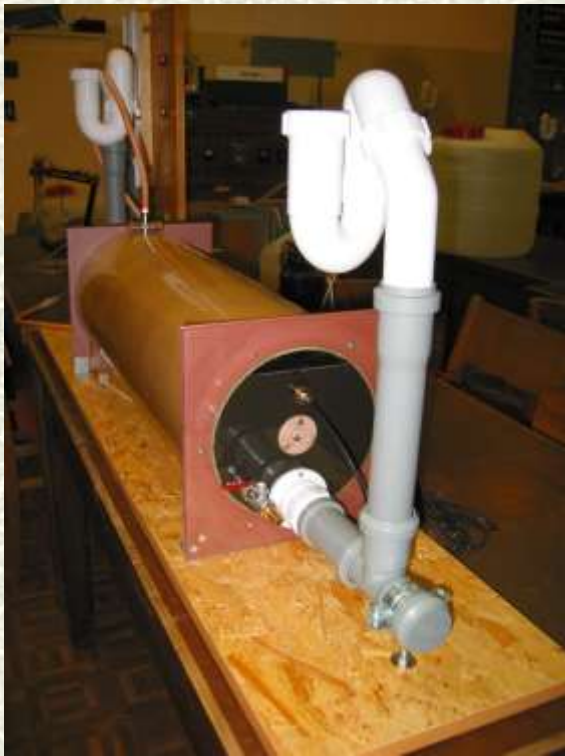
Pig Farm Biogas Plant, Lithuania 2



- # 90 m³ pig manure / day + Industrial wastes: ~ 10 t / day
- # 1 x 2000 m³ vertical steel digester
- # Biogas production: 3000 - 3500 m³/d
- # Co-generation: 4 x 150 kW_{e1}

Rakičan, 2007

Laboratory



Potential problems of anaerobic digestion

- # Waste management create traffic movements for waste collecting and digestate transporting to the land. Accidents of waste transporters can cause pollution of environment.
- # The potential noise can be given from deliveries, pumps, compressors, mixers etc.
- # There may also be some risk of fire and explosion, although no greater than with systems using natural gas
- # Employers of people working in biogas plants must assess the risk from exposure of the gases, pathogens in the feedstocks and to control that risk
- # Transportation of animal by-products creates some risks for health and risk of animal disease transmission between farms.

Benefits for environment

- # Mitigation atmospheric methane concentrations reduces impacts on global climate change
- # Treatment of wastes reduces water, air pollution, odors and destroys pathogens
- # Application of digestate fulfils the phosphorus requirements of the crops and completes the nitrogen requirements from mineral fertiliser.
- # Displacement of fossil fuels reduces CO_2 emissions

Farming benefits

- # Diversification of farming activities;
- # Reliable energy production and utilisation;
- # Additional earnings from waste treatment, production of energy and fertilisers, selling of green certificates;
- # Improvement of the mechanical and nutrition properties of manure;



Thank you for attention!

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