IBBA
INTER BALTIC BIOGAS ARENA

Poznań University of Life Sciences

Biogas perspective in Poland

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Presentation thesis:

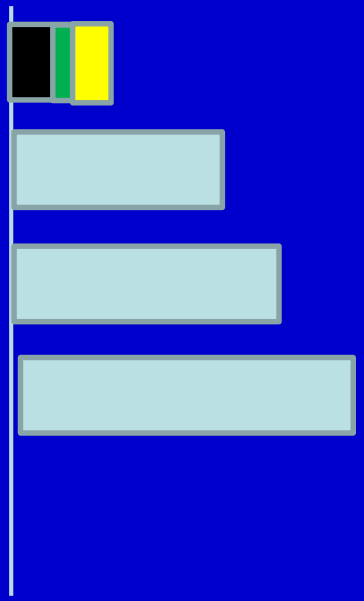
- During 2012-16 Poland was a market with very low subsidies for RES.
- In consequences most of biogas plants past or almost reach the state of bancrupcy.
- Biogas plants generate multiple possibilities to take additional money.
- Issue: Poland has one of the most innovative biogas market in the world.
- Potential of Polish agricultural biogas sector: 3.5* - 6 GW of electric power.

**without maize silage used as substrate*

Specific situation of Poland

- Over 300 biogas plants (94 agricultural)
- Very low price for energy from RES;

Comparison of the price for electric energy produced by biogas plants (*June 2016*).



Poland	43-51 euro/MWh
Czech Republic	138 euro/MWh
Romania	182 euro/MWh
Germany	200-270 euro/MWh

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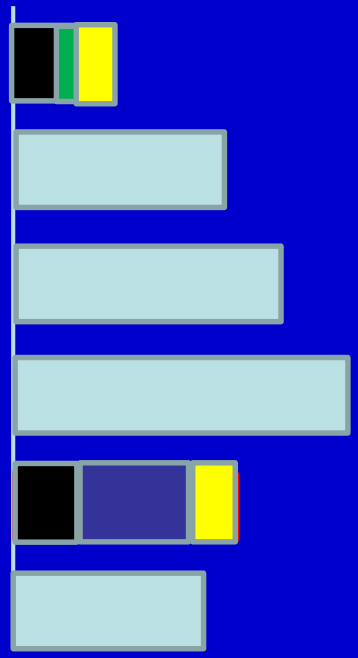


Poland	43-51 euro/MWh **08/2017*
Czech Republic	138 euro/MWh
Romania	182 euro/MWh
Germany	200-270 euro/MWh
PL - old system	*118-147 euro/MWh
PL - new system	*128 euro/MWh (<500 kW) ??? - auctions (>500 kW)

How do the Polish biogas plants improve profits?

- Heat from co-generation usage (subsidies: 29 euro/MWh).
- Production of fertilisers based on digestates (up to 240 euro/Mg).
- Use of biowaste as substrates (15-250 euro/Mg)
- Use of CO_2 from exhausted gases for greenhouses or cold rooms.
- Specific production related to biogas plants:
  * fish
  * schrimps
  * worms

Heat used from combusted biogas for worms production and drying for animal feeding (1000 m^2 = 250 t livestock/month = 80 t of dryied worms)

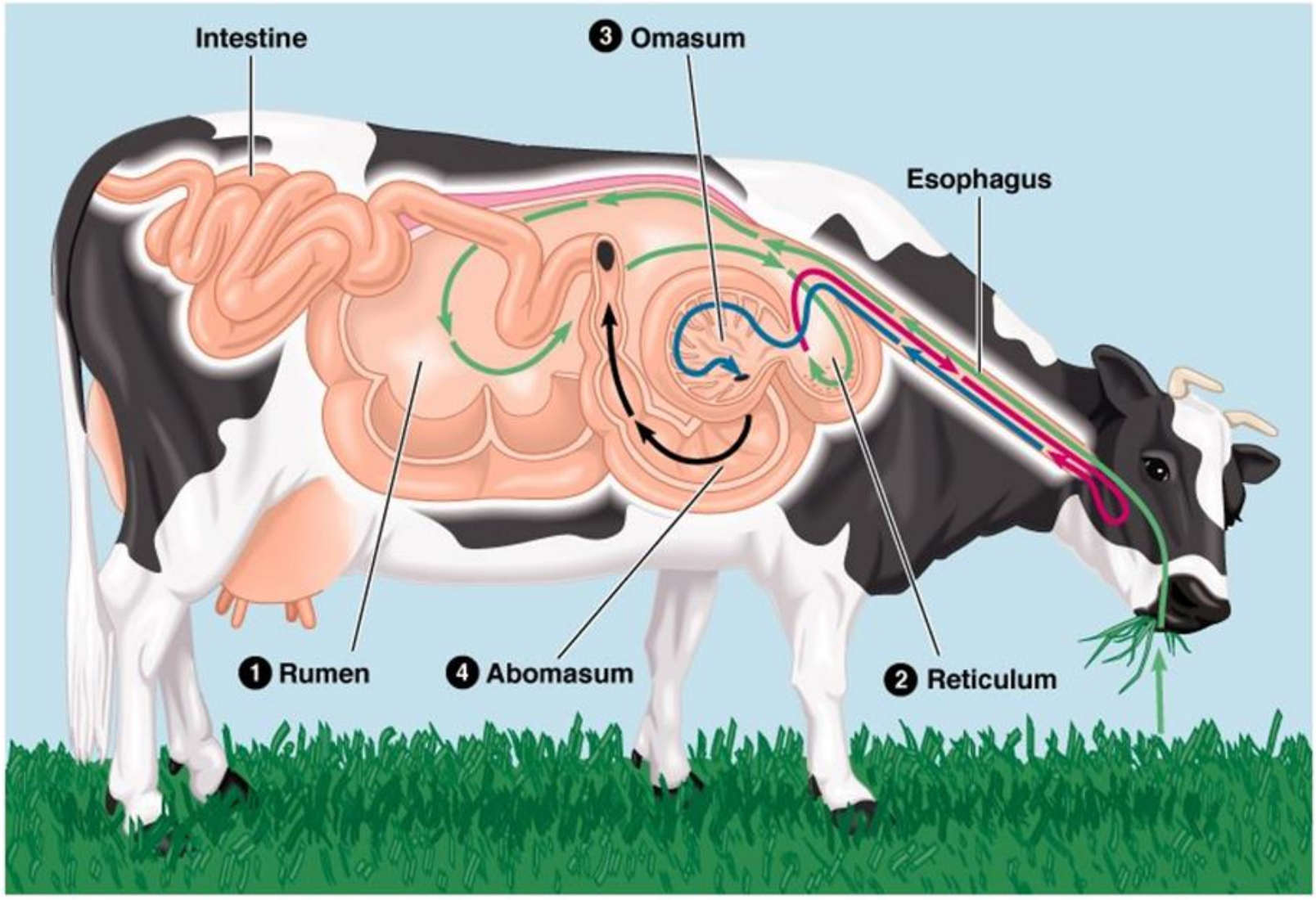
Trends in Polish biogas technologies:

1. Modular installations from steel (unification and repetability, 1 MW_e=10 containers, montage=6300 workinghours).
2. Deep digestion (no solid fraction in digestate = up to 27% higher CH_4 yield).
3. Low energy self-consumption.
4. Extremely large spectrum of substrates used (including bio waste).

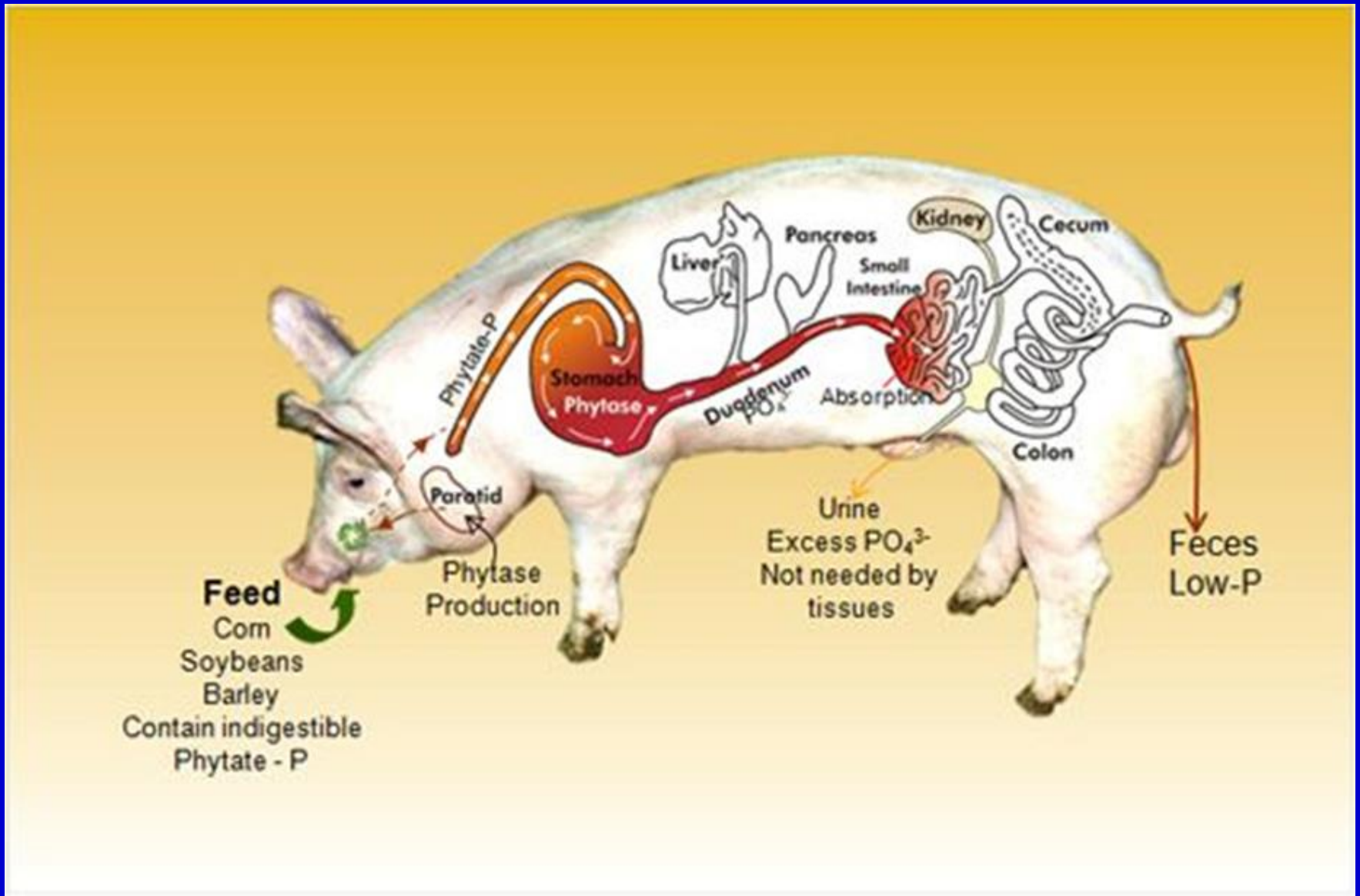
Promissing scenario: waste-to-energy systems

Dominating European technology (NaWaRo) uses mainly silages. Typical biogas plant is called „the conreet cow”.

Stable feeding, limited changes, narrow spectrum of substrates.



Swine – scheme of digestion system in typical biowaste installation.



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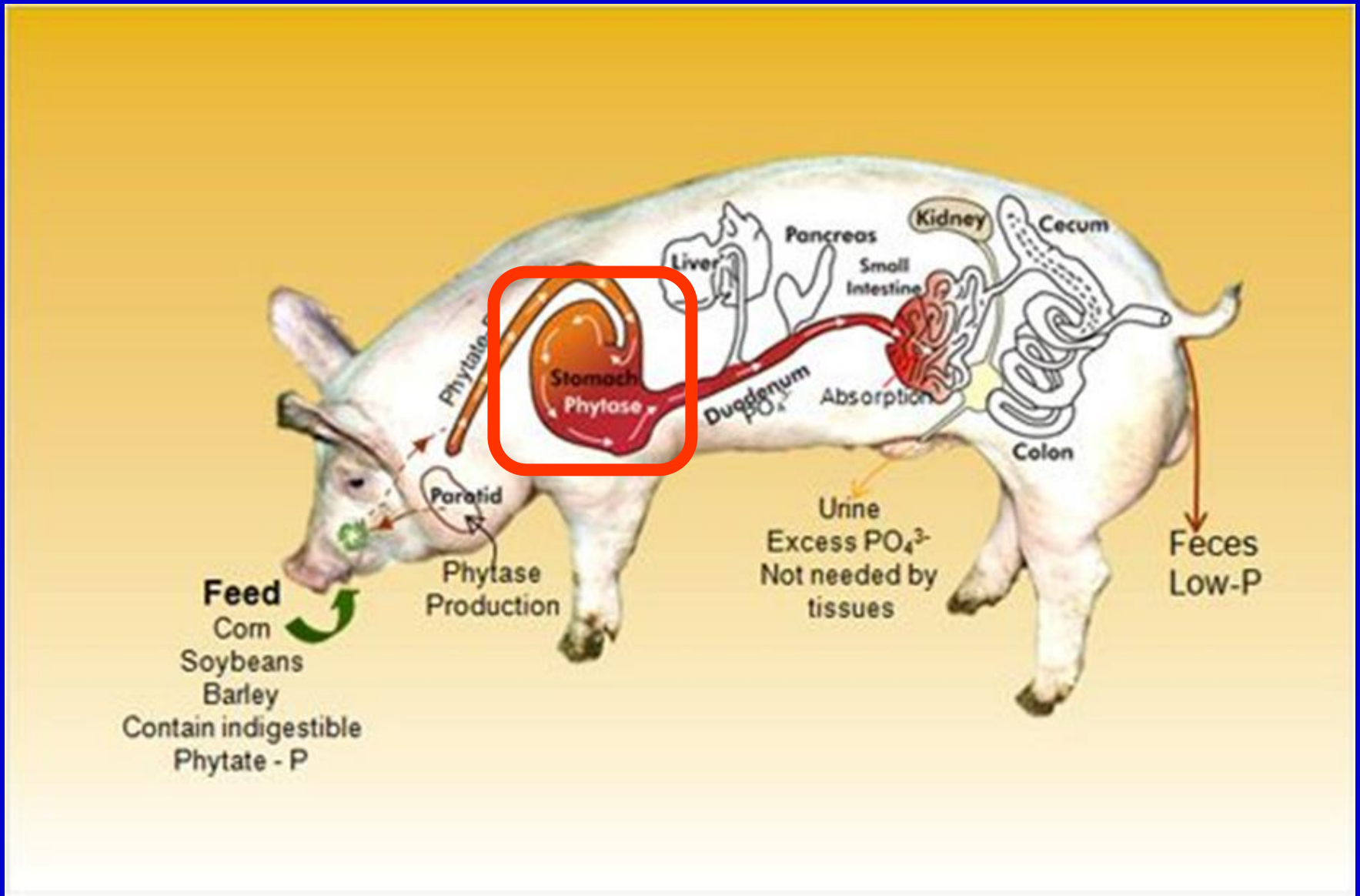


Biochemical Processes Accelerator® (BPA) is an innovative system used to accelerate and augment the distribution of a wide range of substrates during methane fermentation process

NaWaRo

Dynamic Biogas

VS.

pH 7.2 – 7.8

Hydrolysis
Acidogenesis
Acetogenesis
Methanogenesis

pH 3.2 – 4.8

Hydrolysis
Acidogenesis
Acetogenesis

~~**Methanogenesis**~~

pH 7.2 – 7.8

Methanogenesis
Hydrolysis
Acidogenesis
Acetogenesis

Hydrolysis+acidogenesis+acetogenesis = 12-36 h
CH_3COOH concentration = up to 20000 mg/L

Test made on 2 biogas plants:

- Kloster Lehnin (2015)

- Dolgelin (2015/16)

Study case – Dynamic Biogas technology: agricultural biogas plant with steel fermenters and vertical mixing (999 kWe + 1050 kWt)

6 steel fermenters (1000 m^3, with vertical mixers)
Results for 2016: 8499 MWh (over 97% of theoretical efficiency)

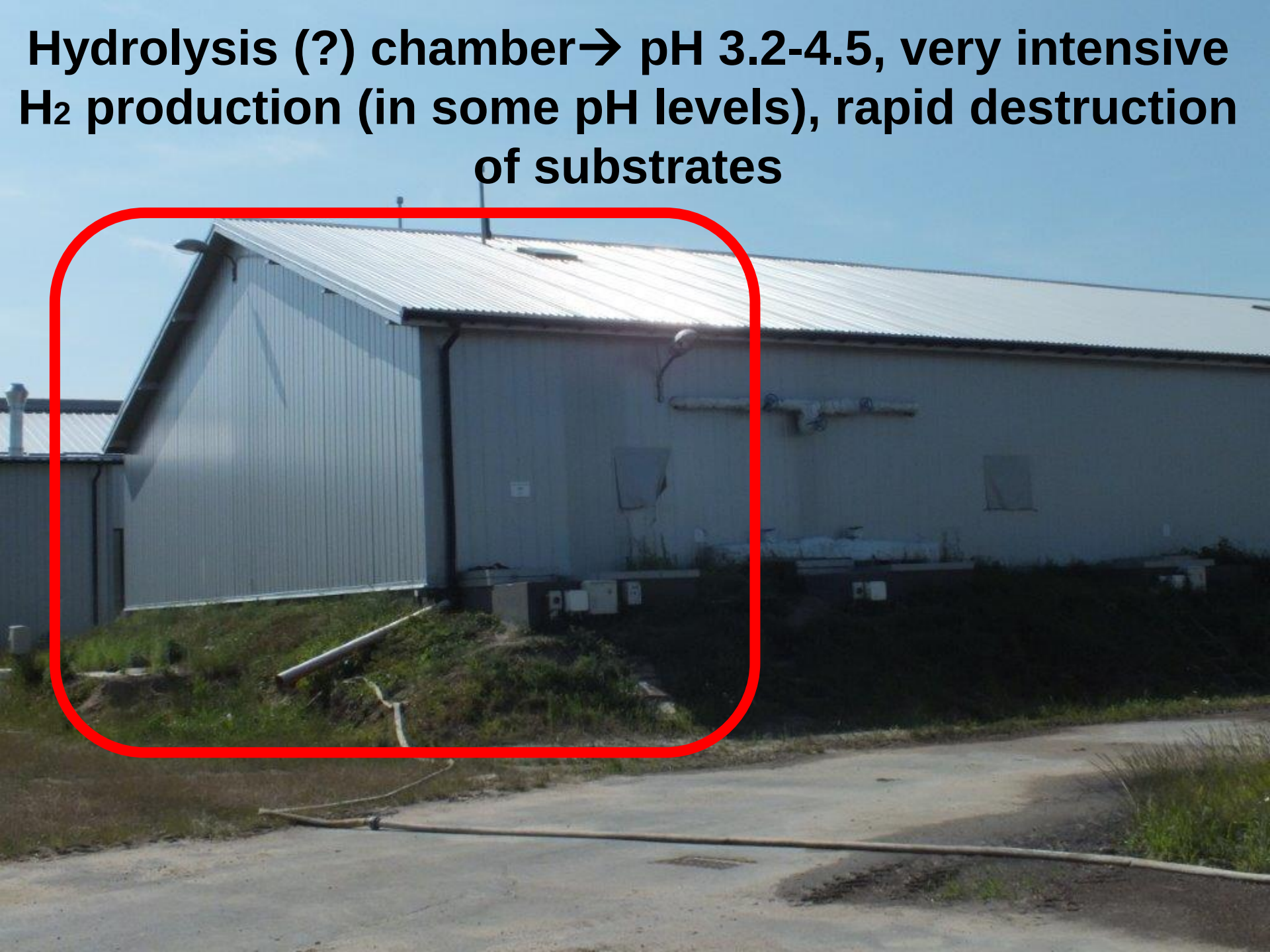
1 fermenter (920 m^3) feeds app. 250 kW_e

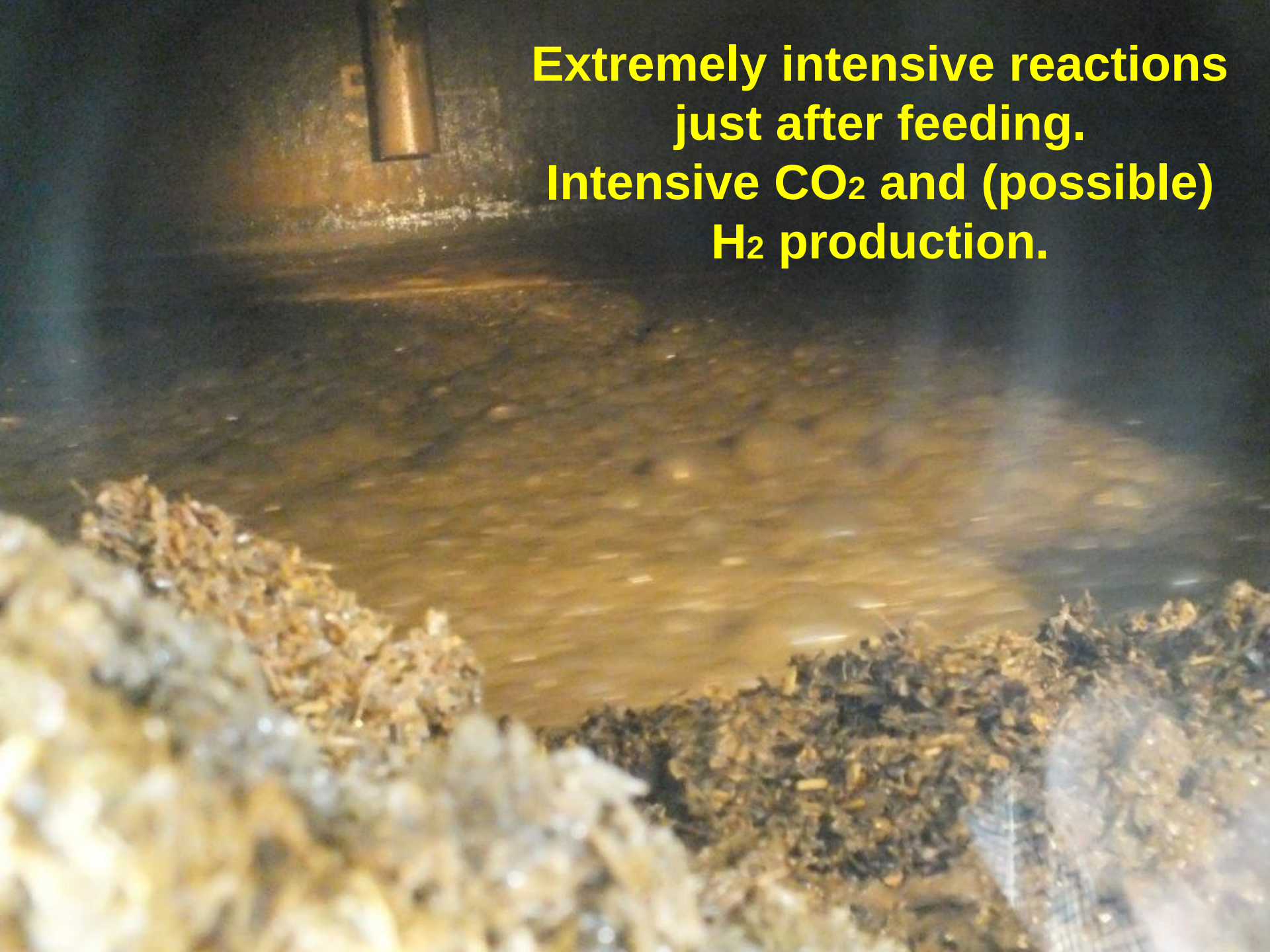
Extremely efficient mixing system (5 kW) → very homogeneous pulp, no upper layer presence (even in case of maize silage with 44% D.M.)

Study case – ProBioGas technology: agricultural-biowaste biogas plant in Miedzyrzec working with separated hydrolysis and long, narrow fermenters

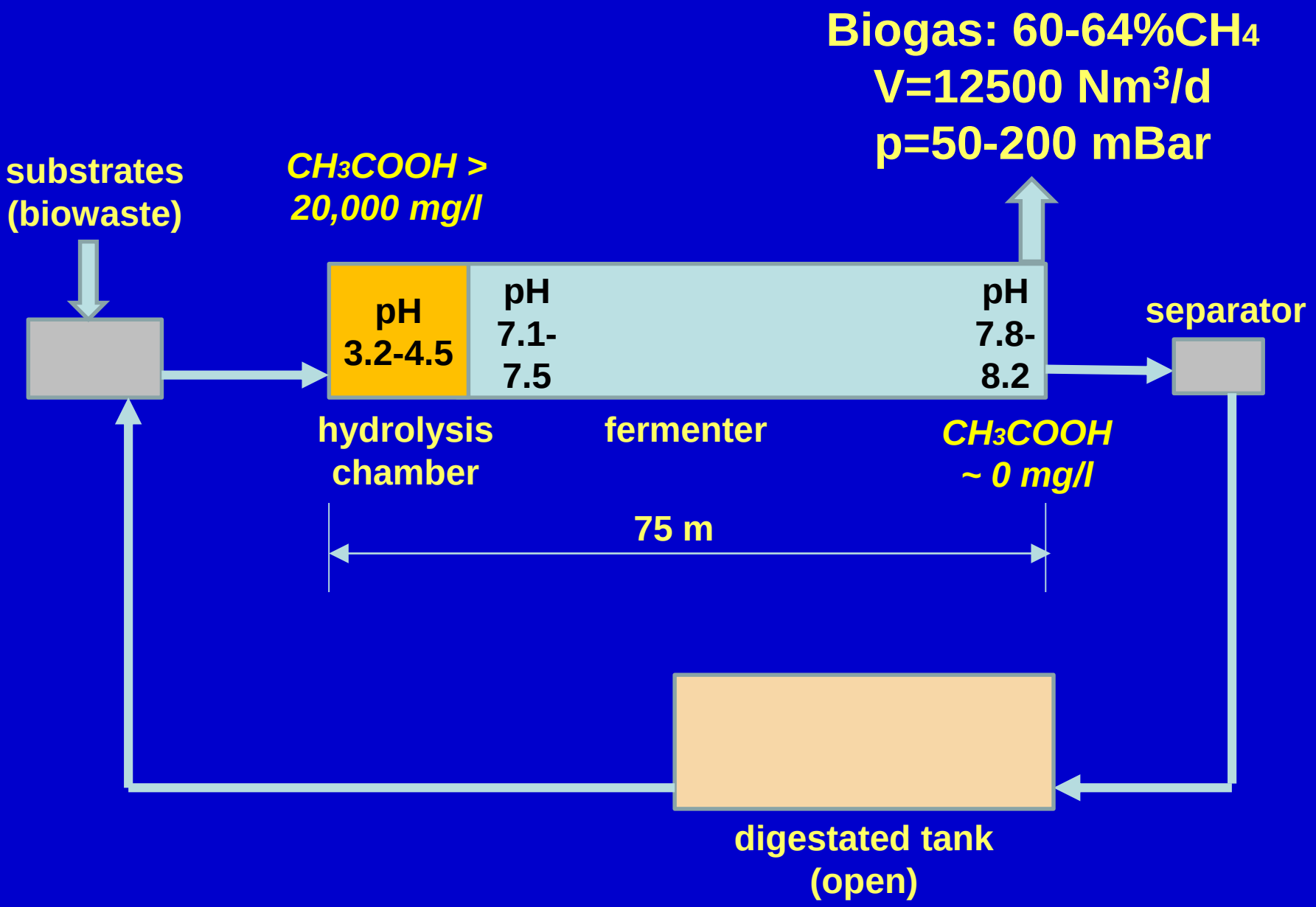

Agricultural-biowaste biogas plant (1200 kWe + 1300 kWt); 2 hydrolisys chambers (300 m3 each), 2 fermenters (3300 m3 each)

Hydrolysis (?) chamber→ pH 3.2-4.5, very intensive H_2 production (in some pH levels), rapid destruction of substrates

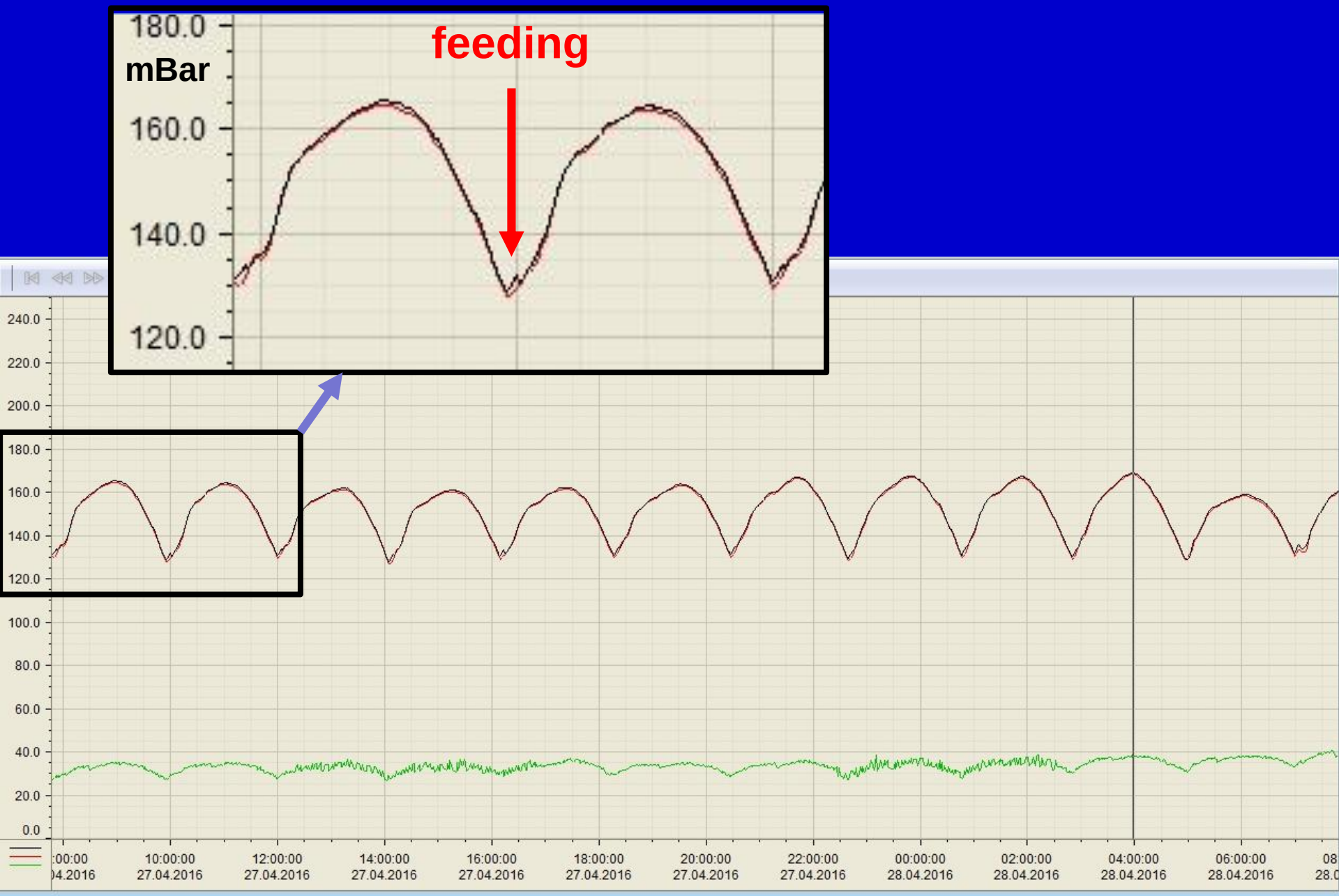



Extremely intensive reactions
just after feeding.
Intensive CO_2 and (possible)
H_2 production.

Biogas production scenario:



Pressure changes during hydrolyser feeding



Separation of digestates: very small amount of solid fraction.
More than 90% of solid fraction is digested in hydroliser and processed directly into increasing of biogas production.

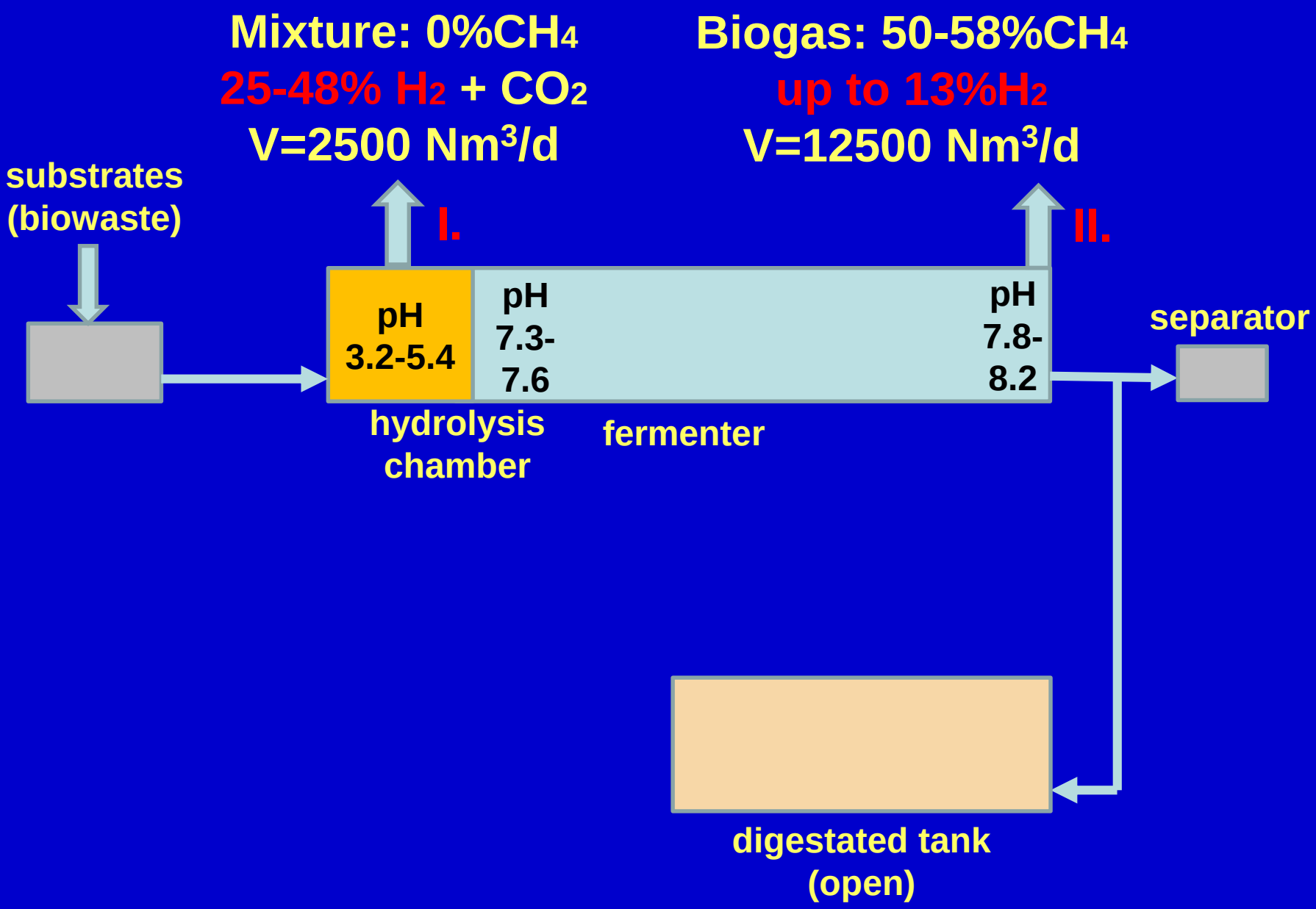
Typical technology working with maize silage: effect – big amount of solid fraction

Typical results:

Daily rates	t F.M.	% D.M.	t D.M.
Apple pomace	22	26	5,72
Potato pulp	6	15	0,9
Distillery stillage	100	7	7
Other biowaste	20	7	1,4
		D.M. in total	15,02

Result: 545 m^3 CH_4 / t D.M.

Hydrogen production scenario:



Required further research:

- Black box (how exactly is hydrogen produced?) Laboratory tests still do not follow real-scale efficiency).

- Energetic balance (more H_2 = less CH_4).

- Economic balance: which kind of production (CH_4 / H_2) is more profitable???.

- Hydrogen separation methods.

Conclusions

- Best practice: biowaste usage let to obtain green energy and clean environment.

- There is still huge potential for efficiency growth in existing installations.

- Polish biogas potential:
  - can cover whole natural gas import or
  - can replace 2 (planned) nuclear plants.

- Look for possibilities of usage of other products than energy: CO_2, H_2 and digested pulp.

Thank you for your attention

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