A novel biotechnological route for the power to gas concept

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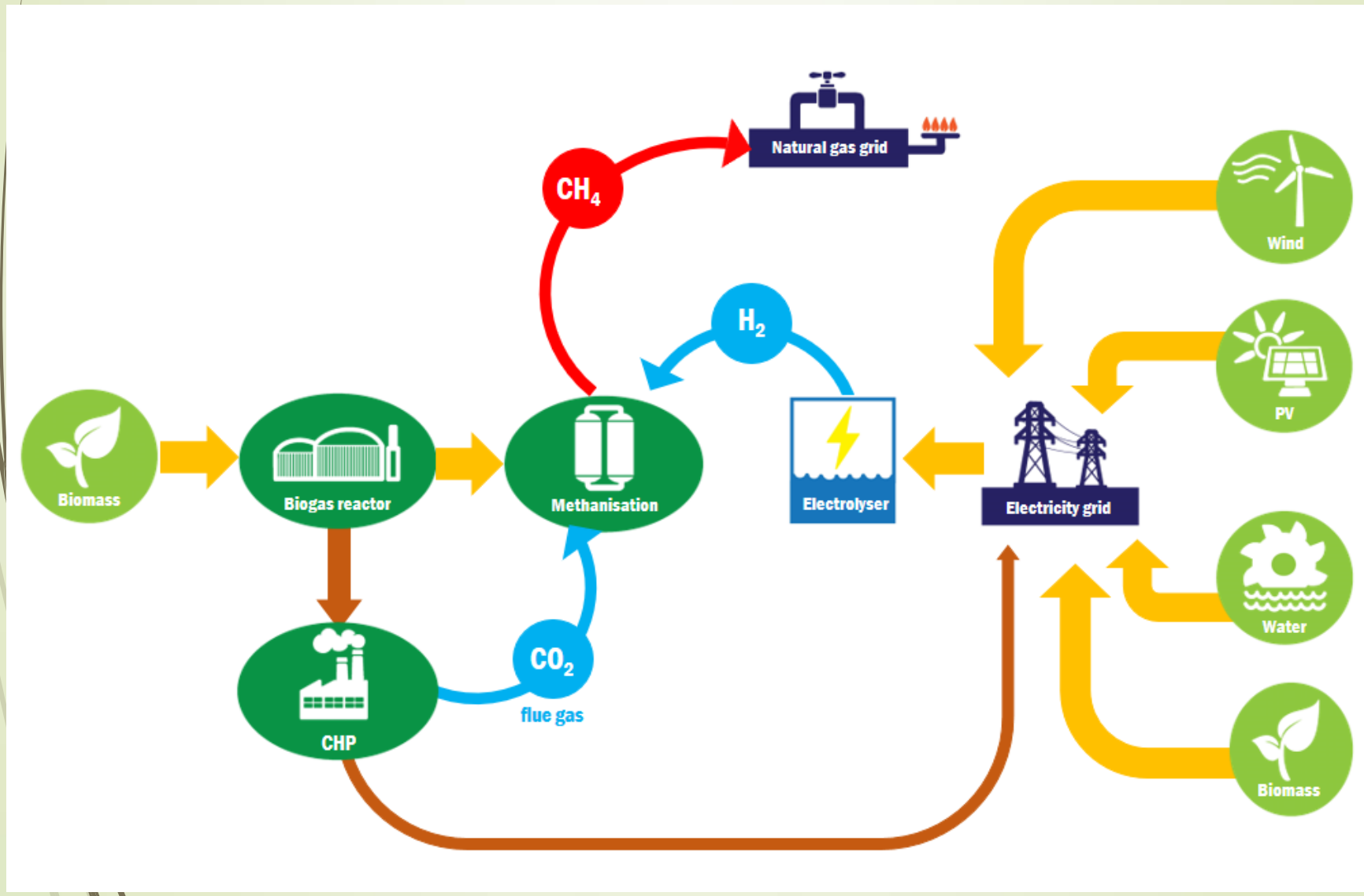
„Power-to-gas" concept



Previous observations and aims

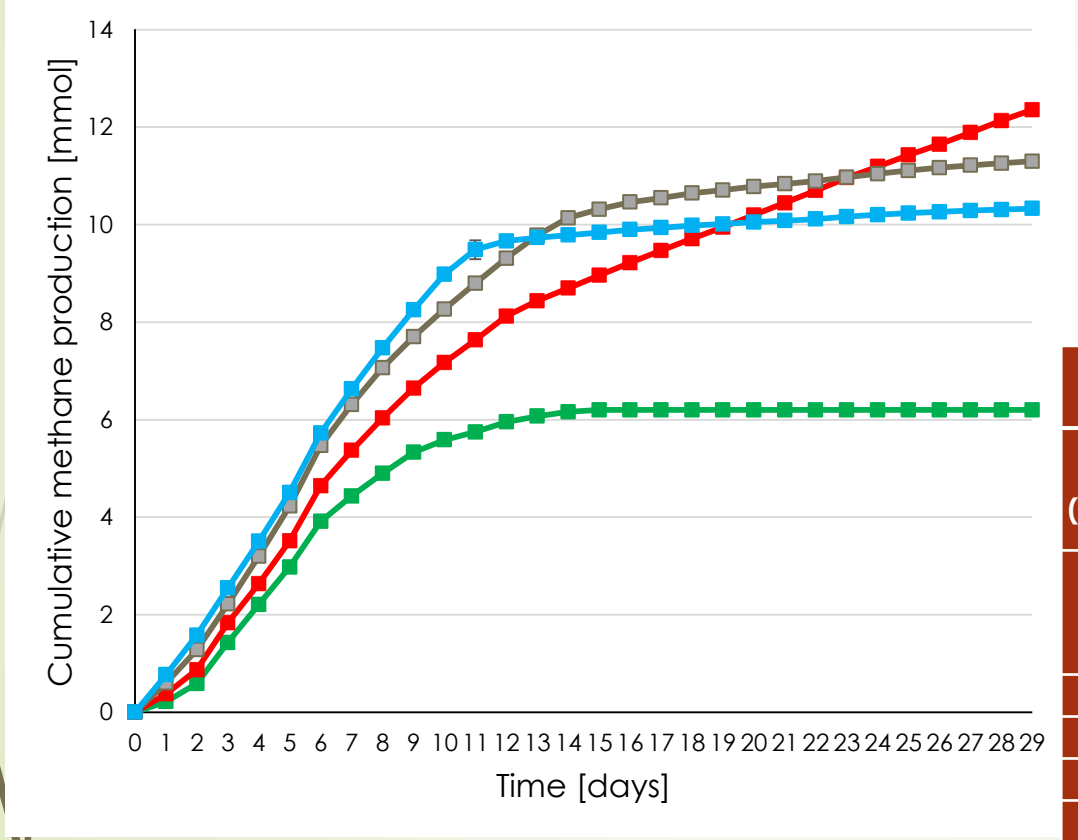
- H2 is a rate limiting bottleneck in methanogenesis
- Hydrogenotrophic methanogens are low in abundance but high in activity
- To what degree can they convert additional H2 to CH4?
- Does the community need substrate for the methane forming reaction?
- Concomitant pH changes and VFA accumulation?
- Is the AD effluent suitable to carry out power-to-gas efficiently?

Experimental setup

- Fed-batch fermentation
- Mesophilic inoculum
- Mesophilic temperature (37°C)
- Daily degassing and gas injection
- Gas composition analysis (GC)
- Volatile fatty acids analysis (HPLC)

		Series 1: a-cellulose at start				Series 2: a-cellulose weekly				Series 3: no a-cellulose			
H_2 (mmol)		0	0.81	1.43	1.86	0	0.81	1.43	1.86	0	0.81	1.43	1.86
	Substrate (g)												
	0.0					X	X				X		
	0.3	X	X	X	X	X	X						
	0.6					X	X						
CO_2 (mL)											5.0*		

Increasing daily H_2 load

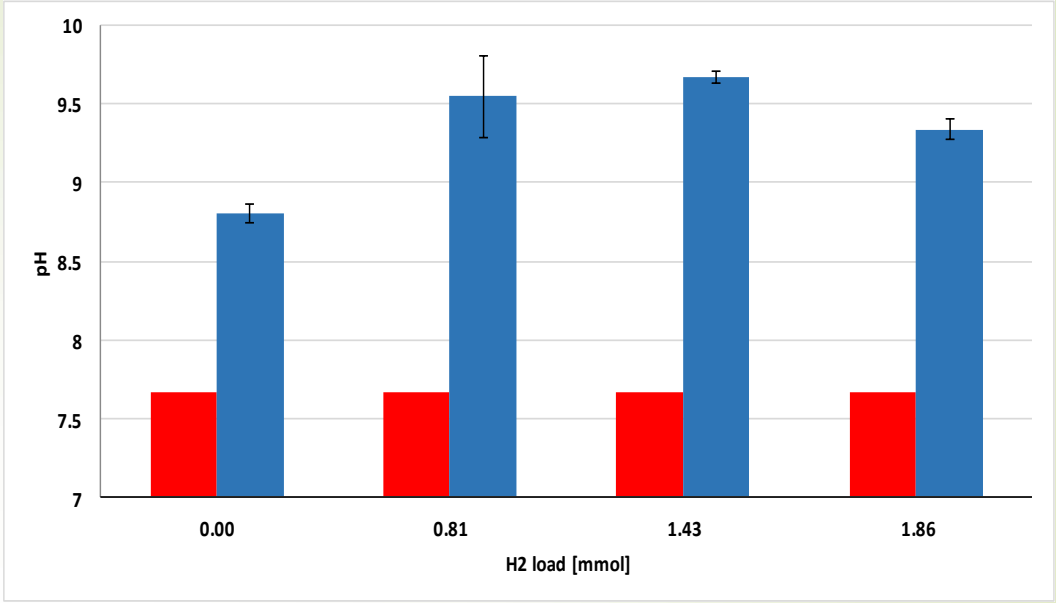


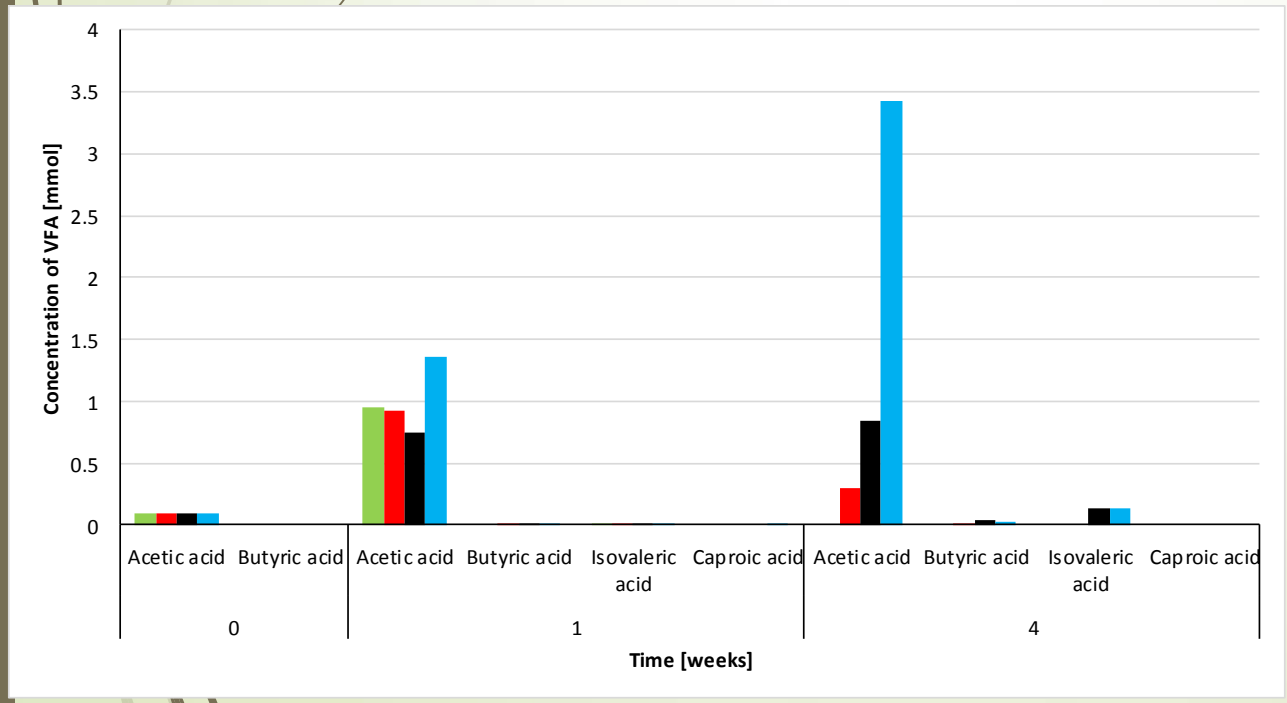
H_2 load [mmol]	Residual amount of H_2 [mmol]
0.00	0±0
0.81	0±0
1.43	18.06 ± 0.42
1.86	32.85 ± 1.17

		Series 1: a-cellulose at start			
H_2 (mmol)		0	0.81	1.43	1.86
	Substrate (g)				
	0.0				
	0.3	X	X	X	X
	0.6				
CO_2 (mL)					

H_2 is limiting, but the system can be overloaded

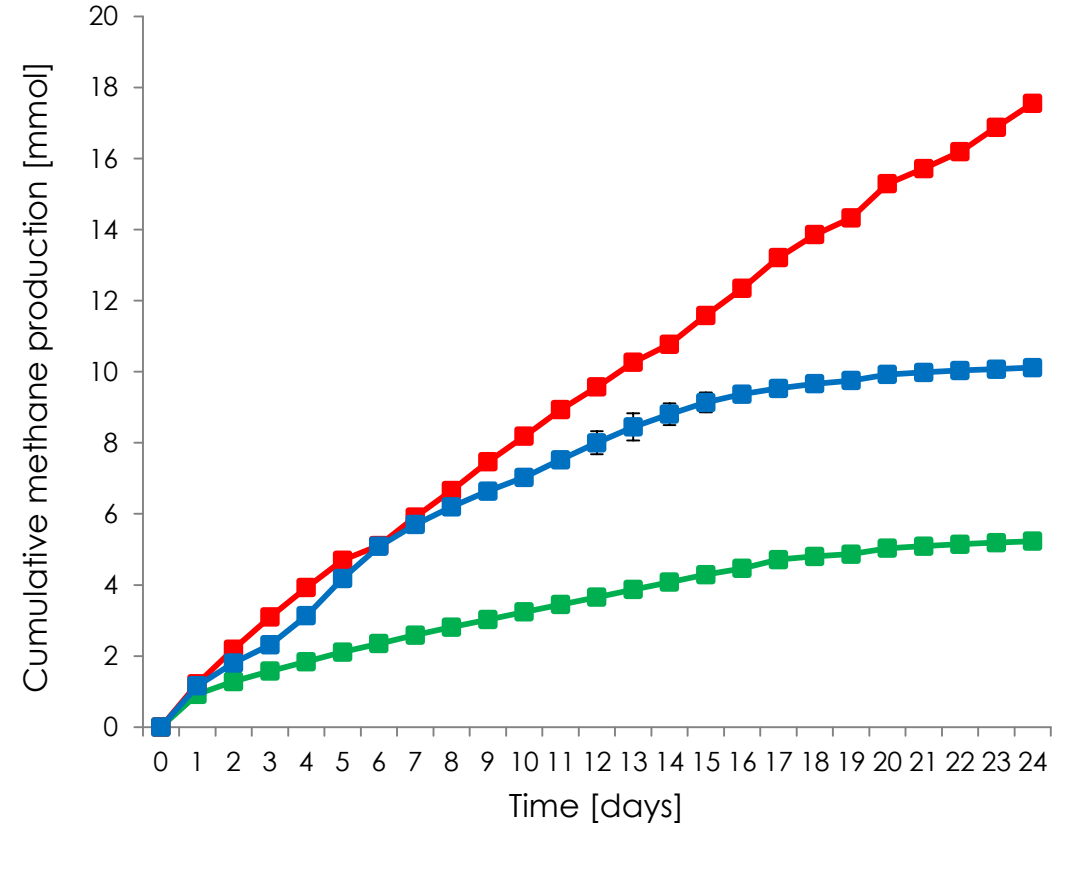
- pH at the start of the experiment
- pH at the end of the experiment





H_2 load of the reactors [mmol]
0
0.81
1.43
1.86

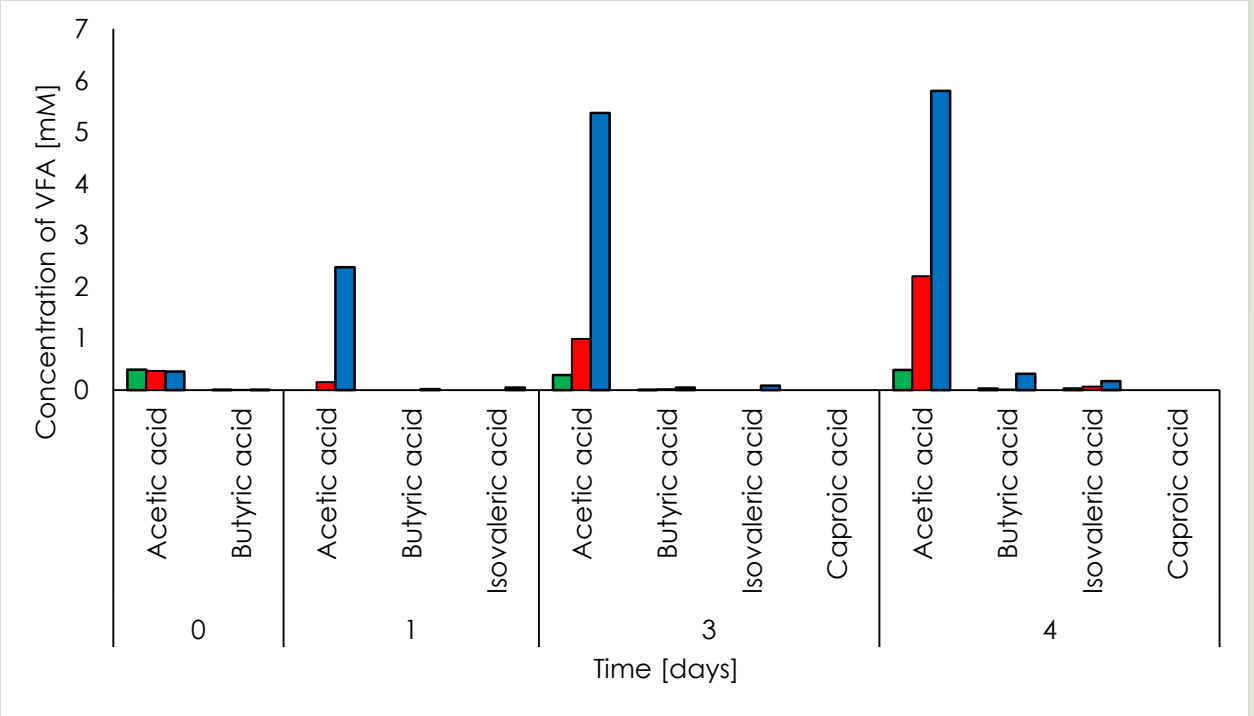
Weekly addition of a-cellulose

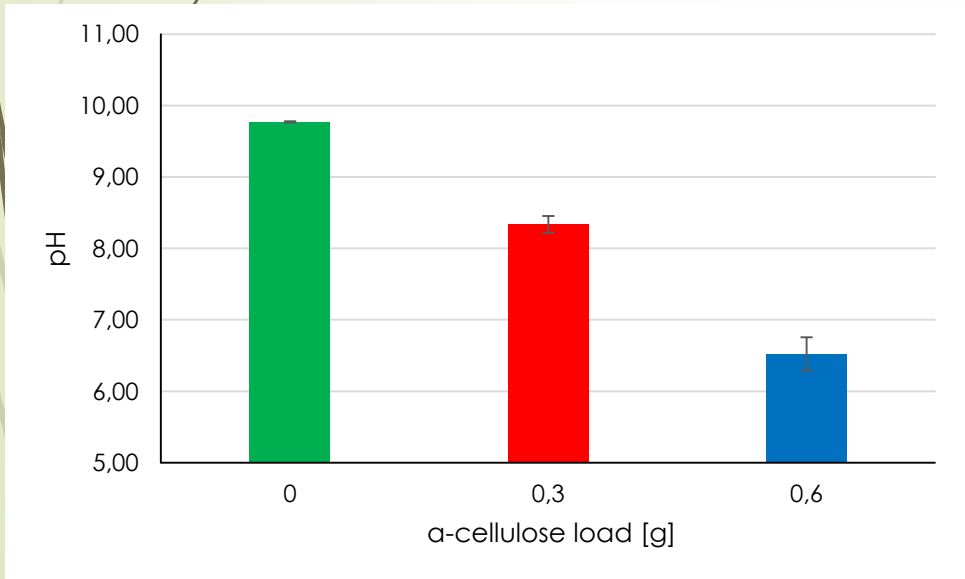


Amount of α-cellulose [g]	Residual amount of H_2 [ml]
0	2.54 ± 0.48
0.3	0.00 ± 0.0
0.6	3.08 ± 1.90

		Series 2: a-cellulose weekly			
H_2 (mmol)		0	0.81	1.43	1.86
	Substrate (g)				
	0.0	X	X		
	0.3	X	X		
	0.6	X	X		
CO_2 (mL)					

Additional substrate does not increase H_2 conversion

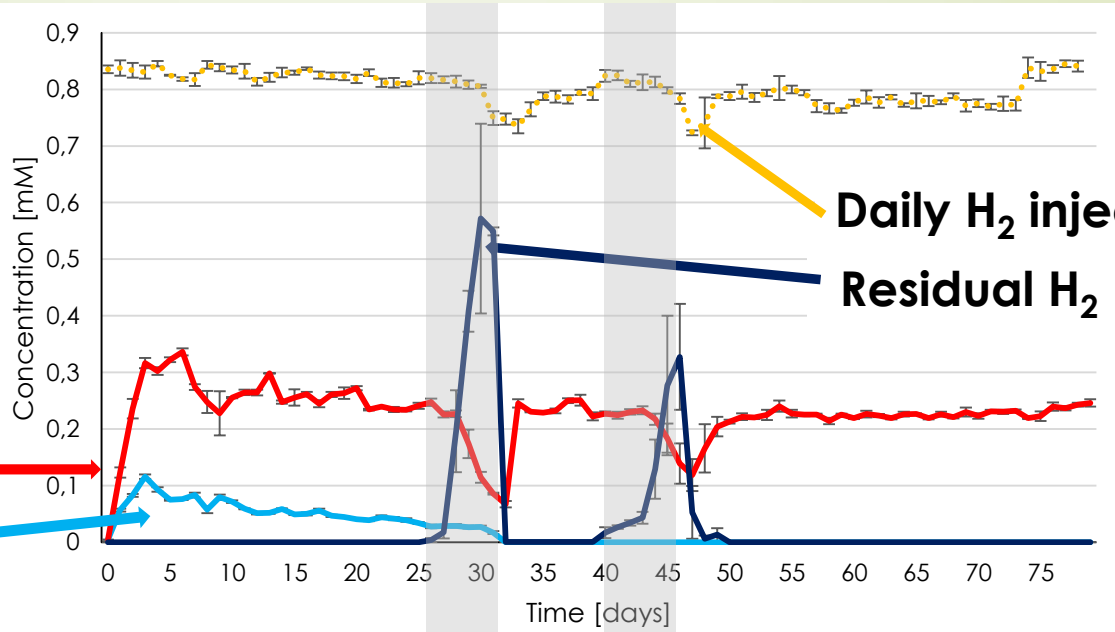


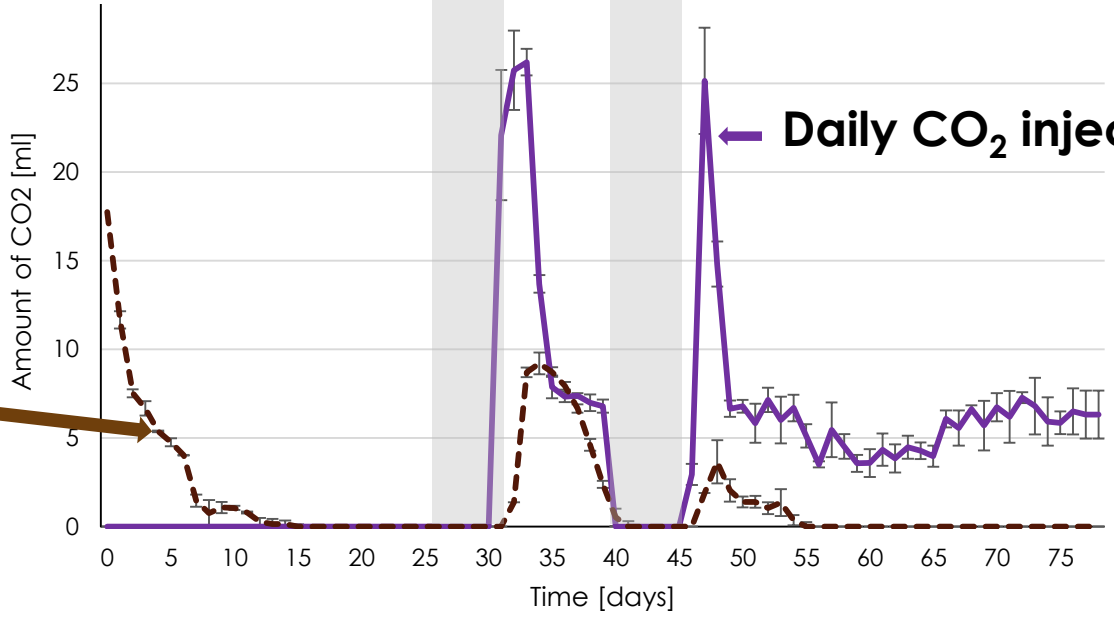


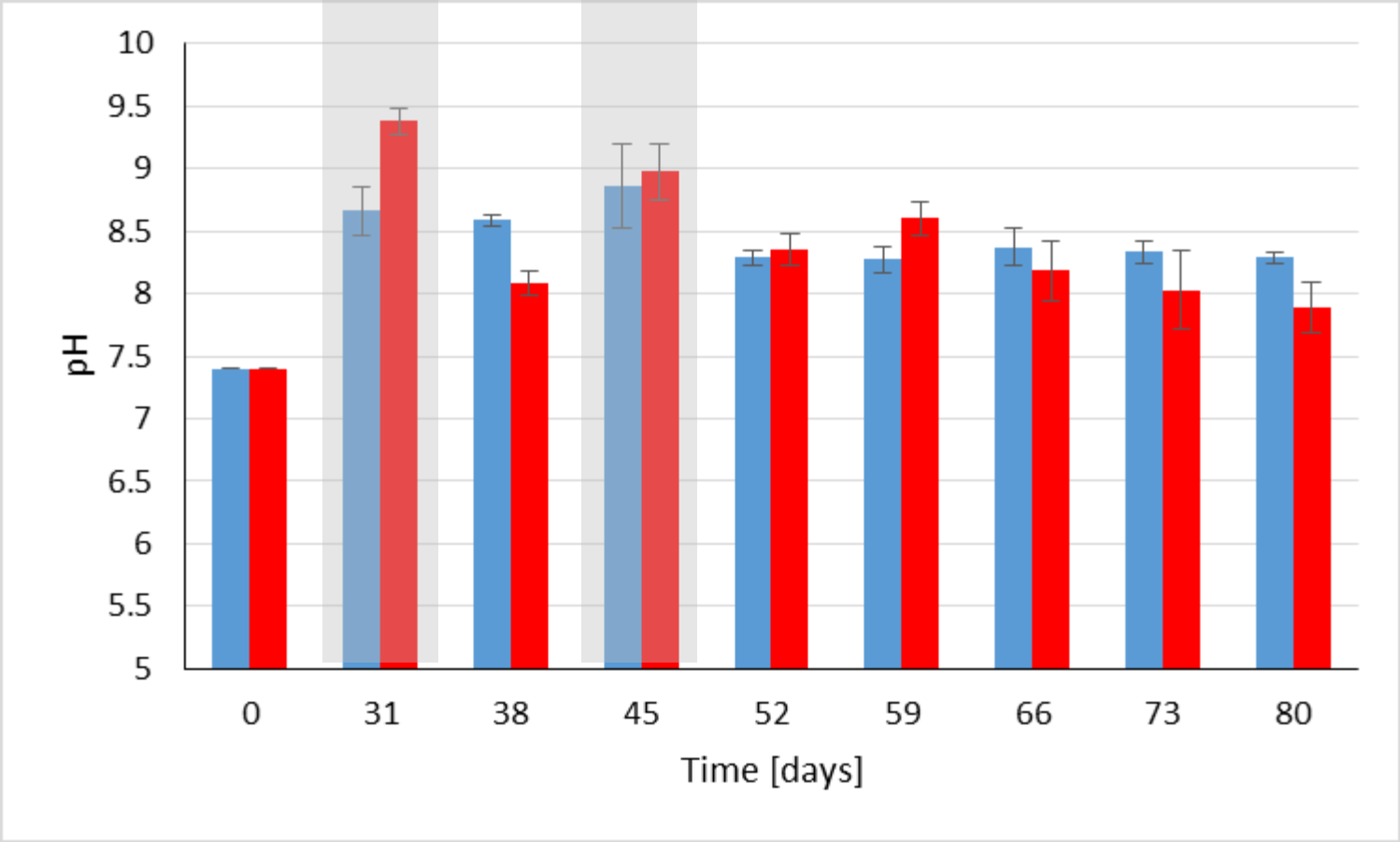
Amount of α-cellulose [g]	Residual amount of H_2 [mmol]
0	2.54 ± 0.48
0.3	0.00 ± 0.0
0.6	3.08 ± 1.90

		Series 3: no a-cellulose			
H_2 (mmol)		0	0.81	1.43	1.86
	Substrate (g)				
	0.0		X		
	0.3				
	0.6				
CO_2 (mL)			5.0*		

{ 1 }{ 2 }{ 3 }{ 4 }{ 5 }{ 6 }

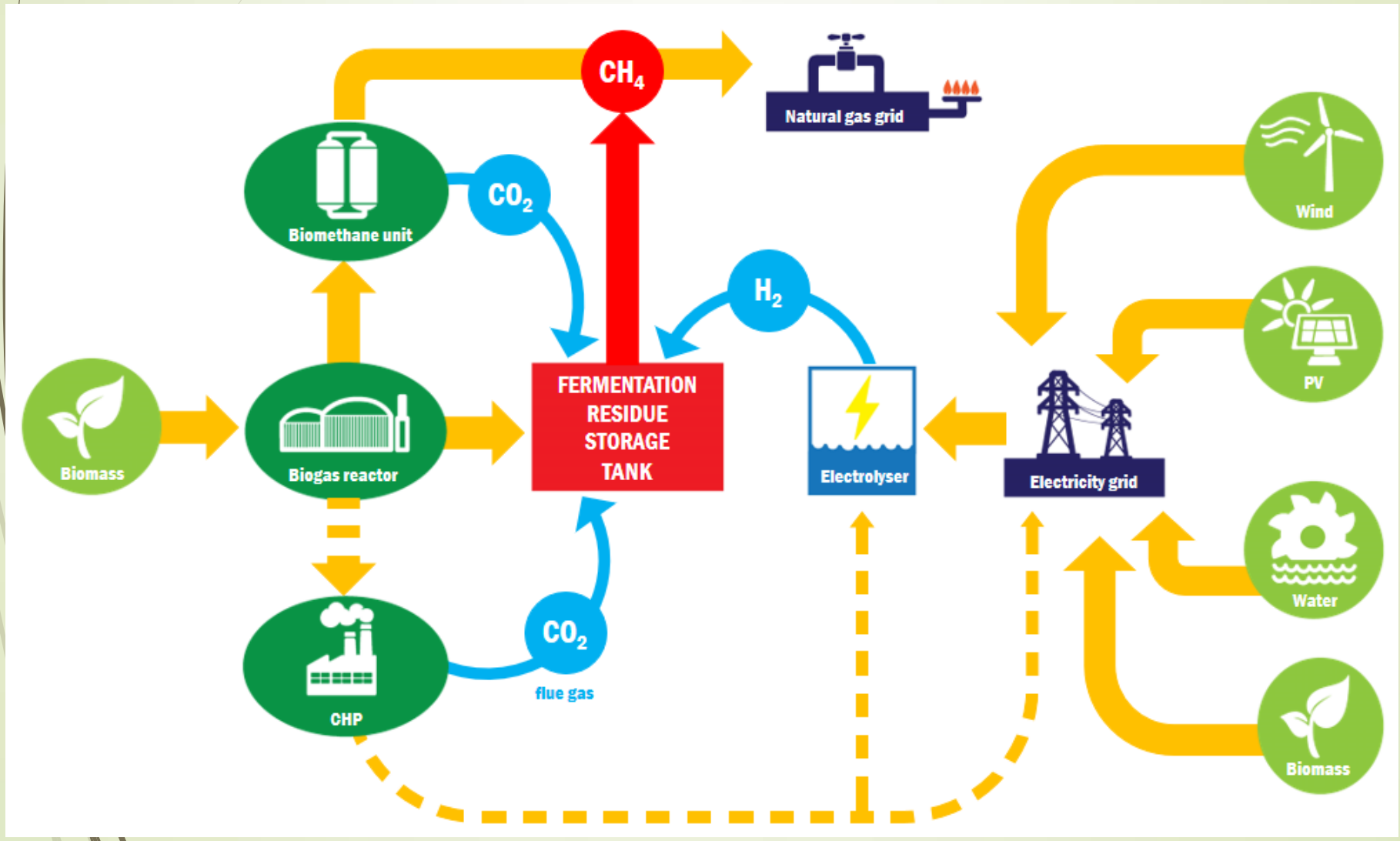






- pH in the control reactors
- pH in the H_2 fed reactors

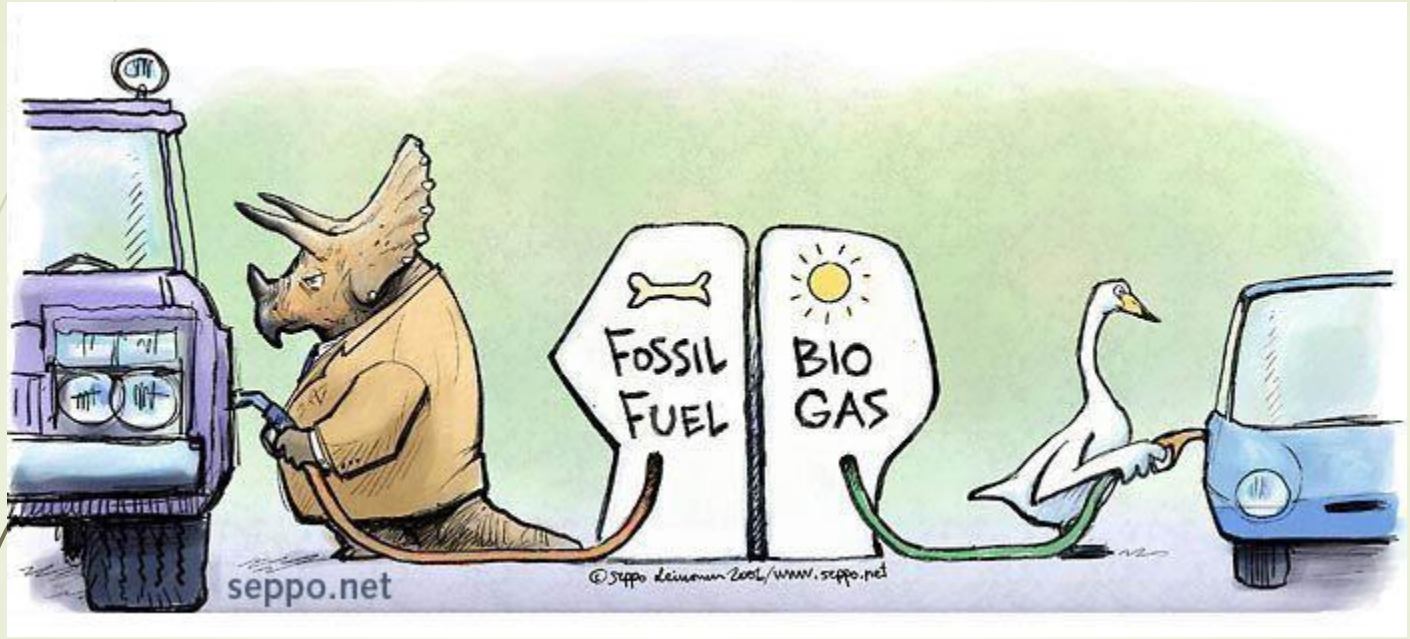
„Power-to-bioMethane" concept



Advantages of the system:

- the fermentation residue is an efficient, cheap, and continuously replenished catalyst for the reaction;
- the system tolerates "turn-on" and "turn-off" rapidly;
- with proper adjustment of the H_2/CO_2 ratio the biogas needs only purification from H_2S and H_2O;
- the excess CH_4 formed from renewable electricity is clean biomethane;
- the CO_2 emission is negative as the conversion reaction consumes CO_2

Thank you for your attention!



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