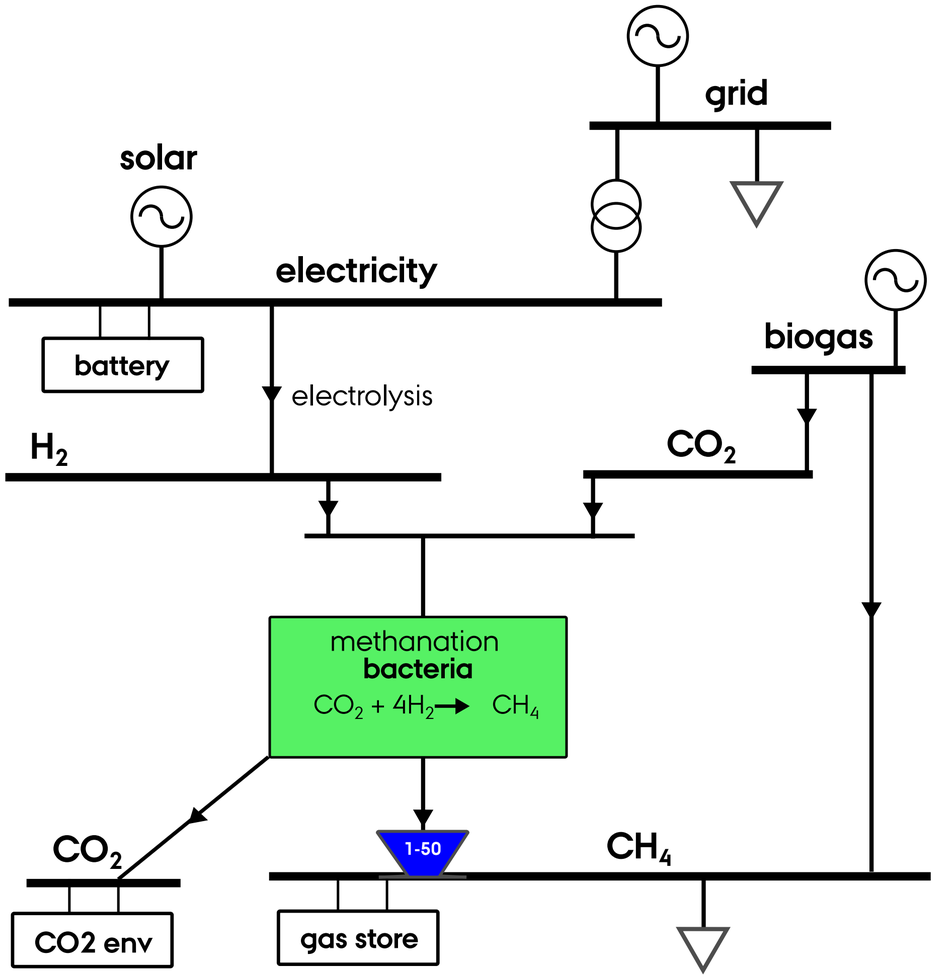
APPLAUSE project meeting

4 November

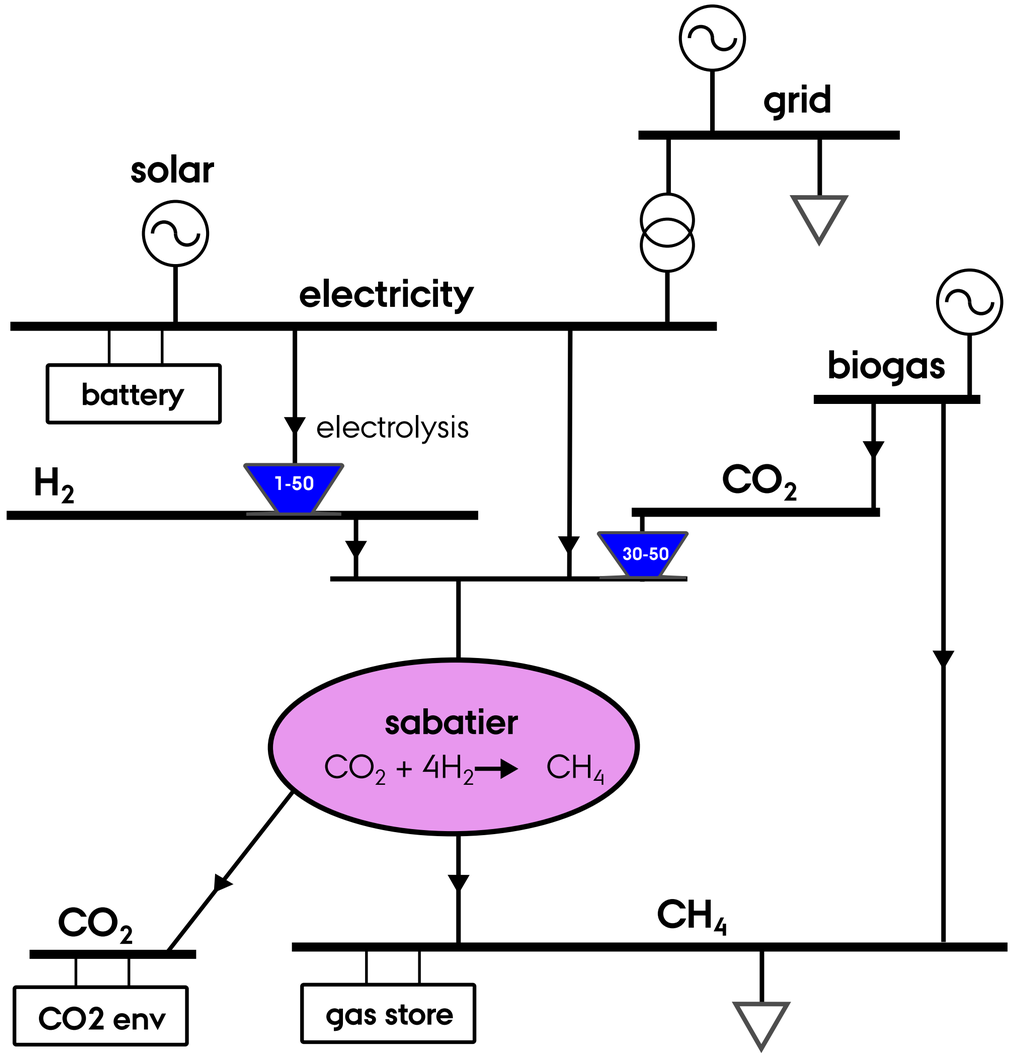
Model

Methanogens



Model

Sabatier



- Transformer serves as bidirectional, lossless link
- Massive load, massive generator
- Battery extendable, solar extendable
- 10GW Grid supply available, 10MW demand

Cost assumptions

S1. Cost assumptions

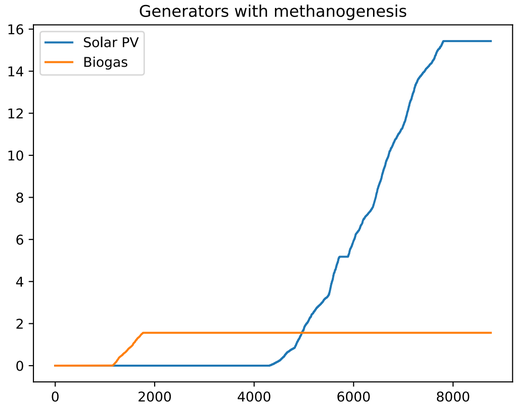
Table S1: Efficiency, lifetime and FOM cost per technology (values shown corresponds to 2020).

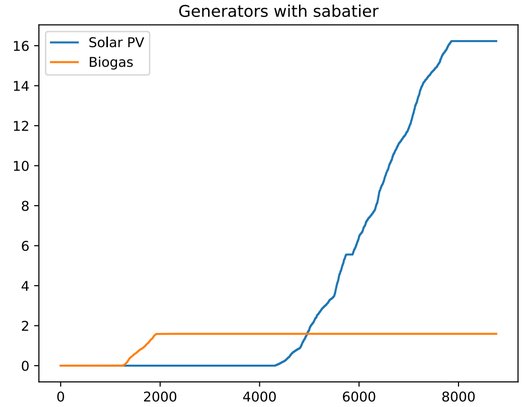
Technology	Unit	2025 Cost	FOM[a]	Lifetime	Efficiency	Source
	[%/a]	[a]				
Solar PV (utility-scale)	€/kW	452	1.6	35		[1]
Battery storage	€/kWh	187		20		[1]
Battery inverter	€/kW	215	0.2	10	0.95	[1]
Electrolysis	€/kW$_{el}$	550	2.0	25	0.66	[1]
Methanation	€/kW$_{CH4}$	278	4.0	30	0.8	[2]
methanogens	€/kW$_{CH4}$	834	4.0	30	0.8	
biogas generator	€/kW$_{CH4}$	0			0.9	
CO2 storage	€/kWh	0				
gas storage	€/kWh	0				

generator dcurves

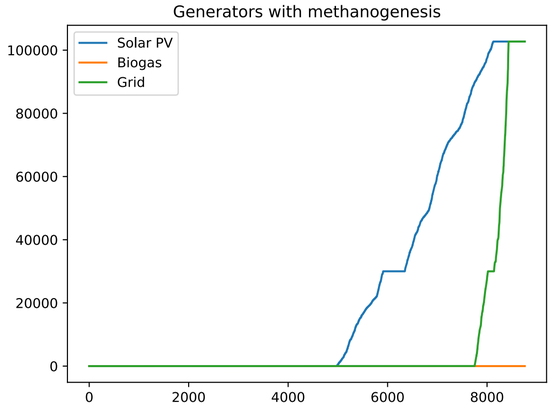
Results

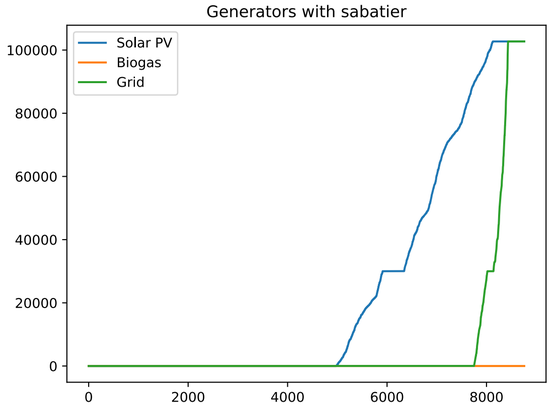
no grid





grid





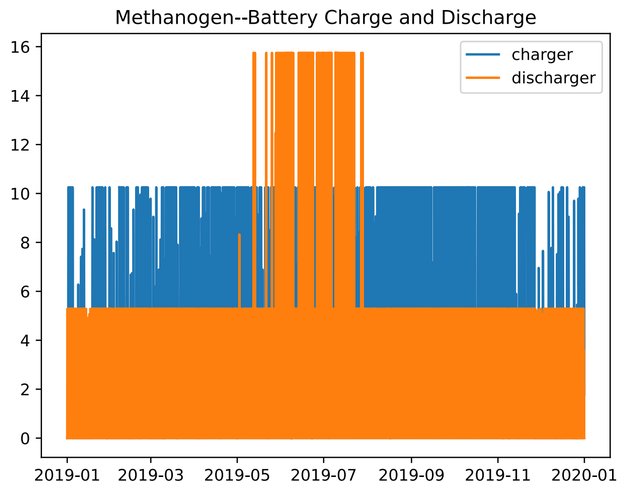
methanogen

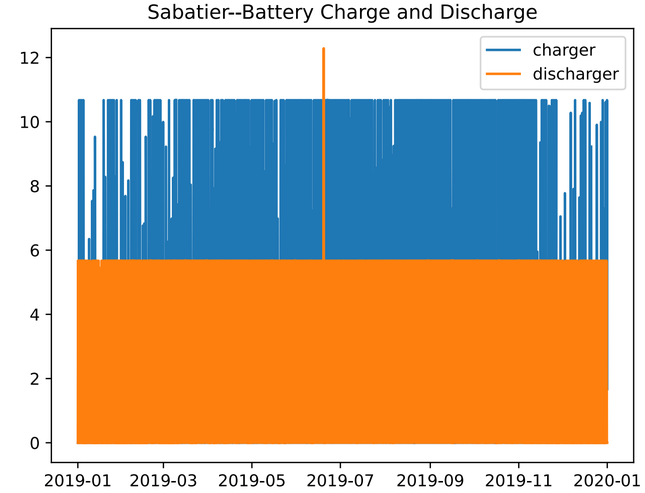
sabatier

Results

battery inverters

no grid





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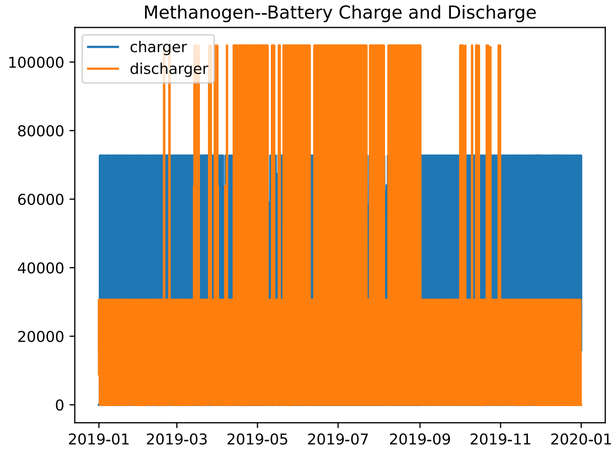
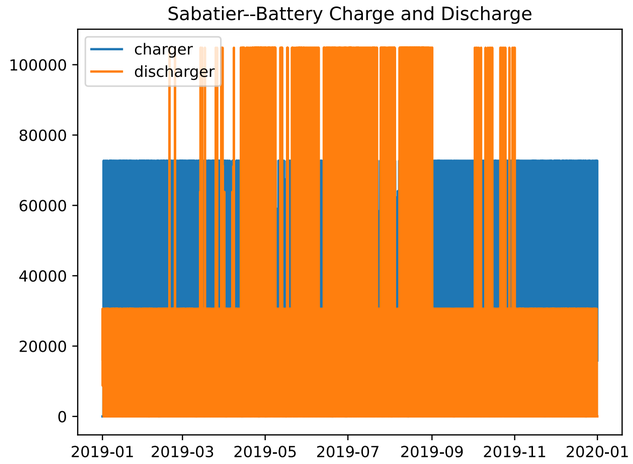




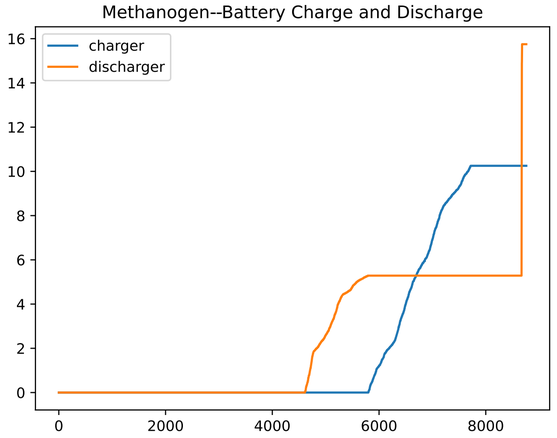
methanogen

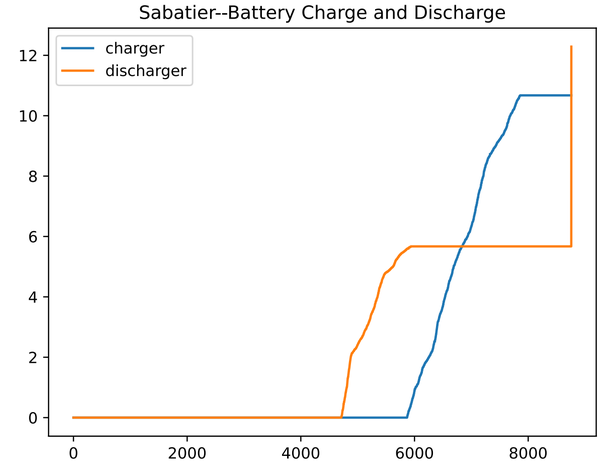
sabatier

battery inverter dcurve

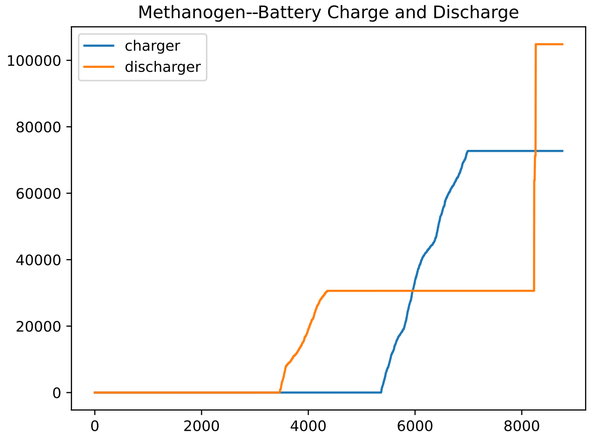
Results

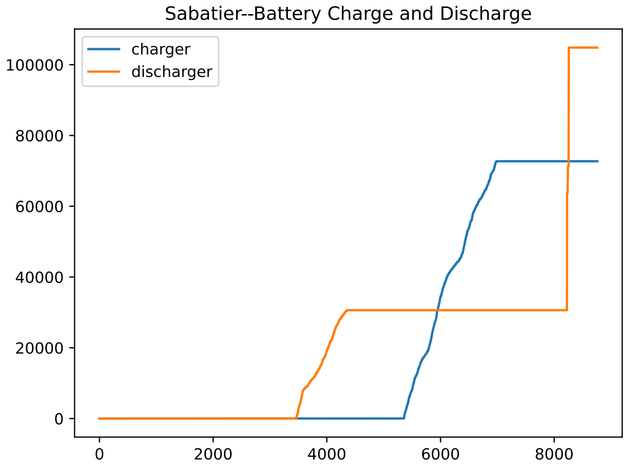
no grid





grid





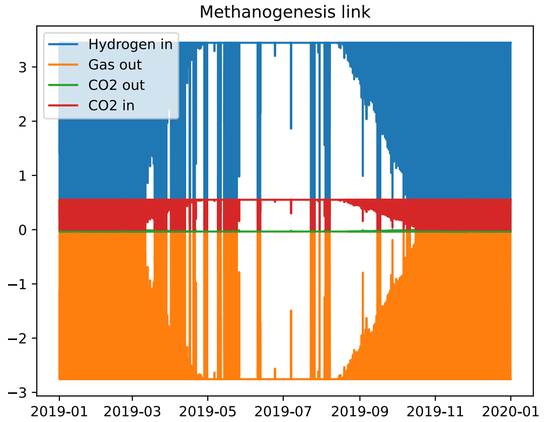
methanogen

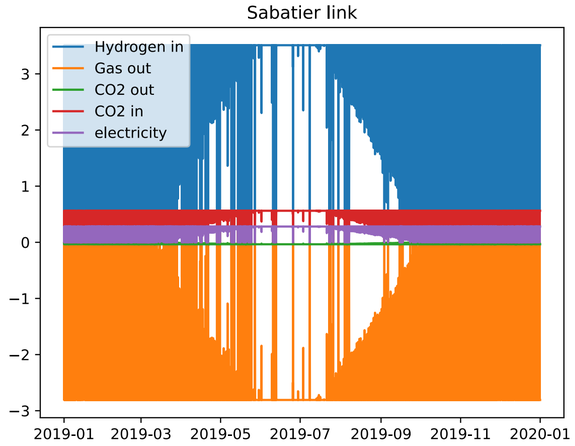
sabatier

methanation

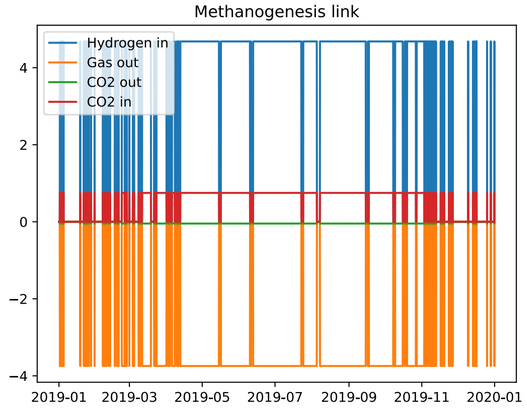
Results

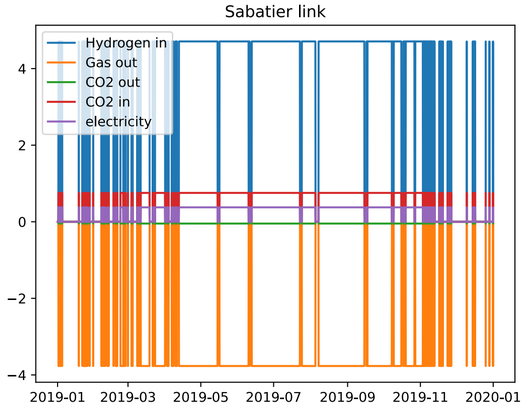
no grid





grid



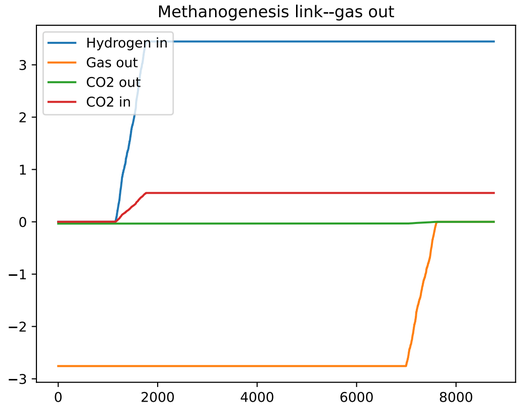


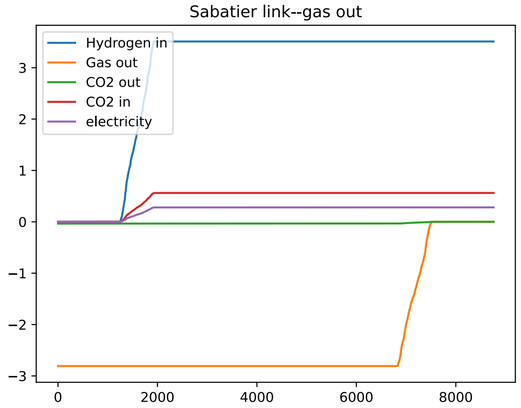
methanogen

sabatier

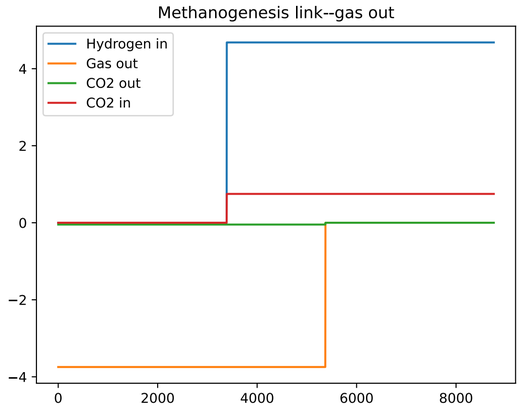
Results

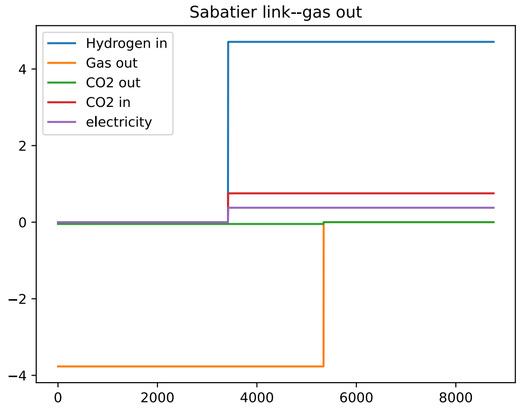
no grid





grid





methanogen

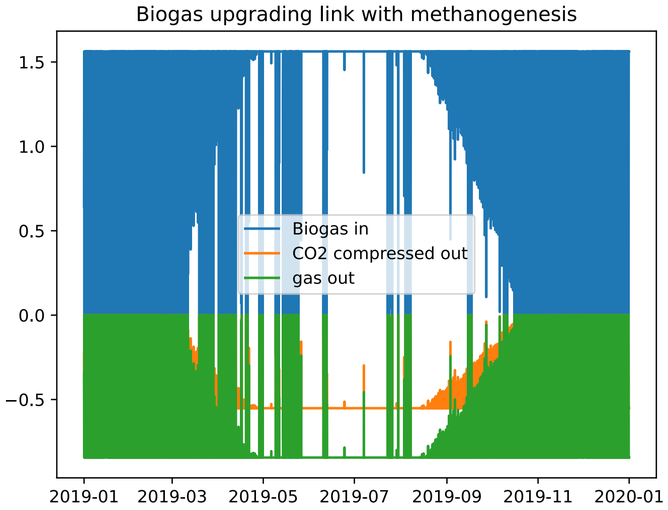
sabatier

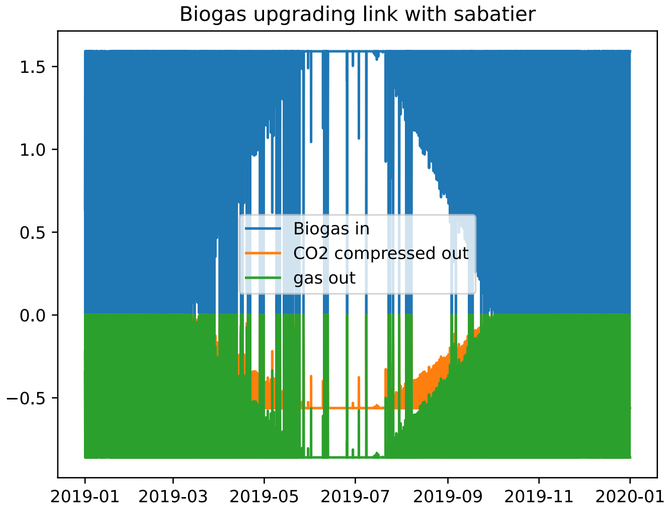
Results

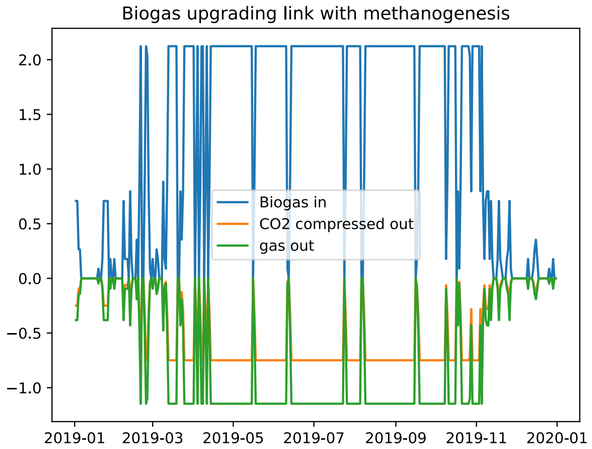
biogas

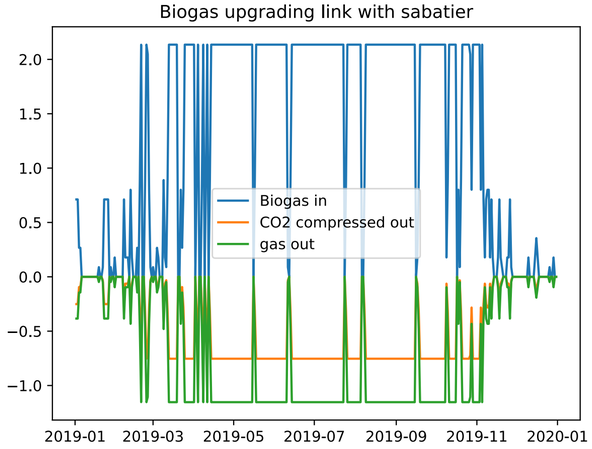
no grid

grid









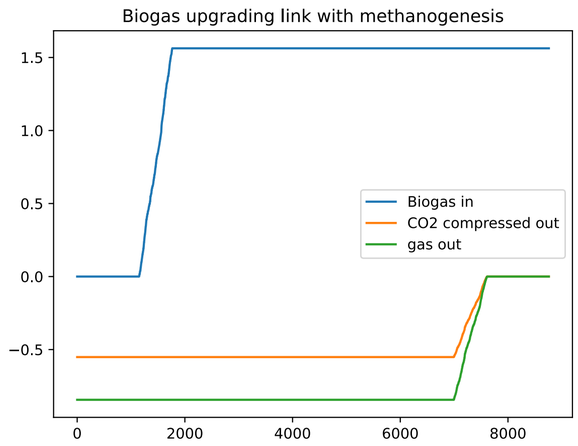
methanogen

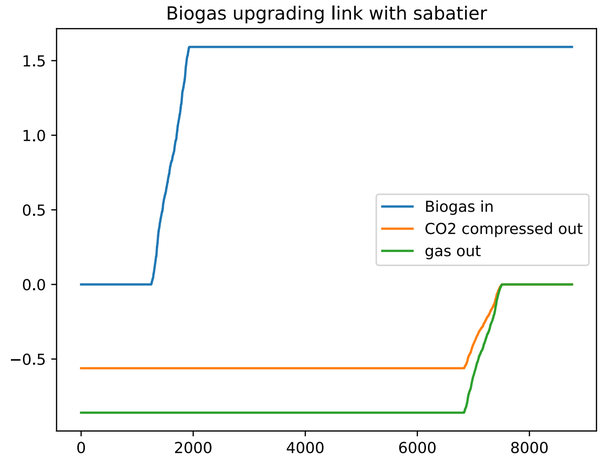
sabatier

biogas dcurve

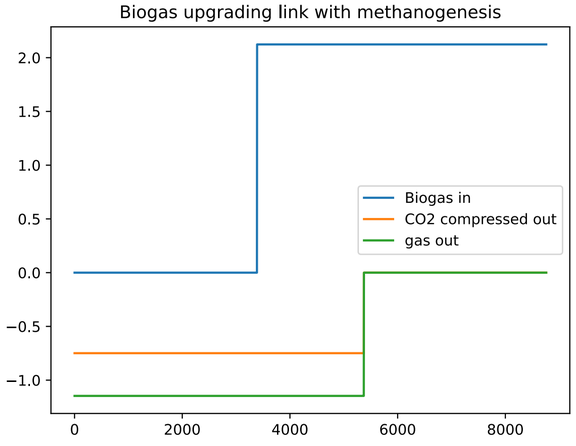
Results

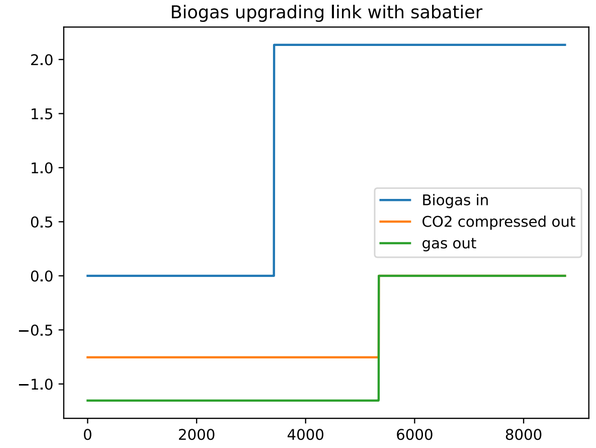
no grid





grid





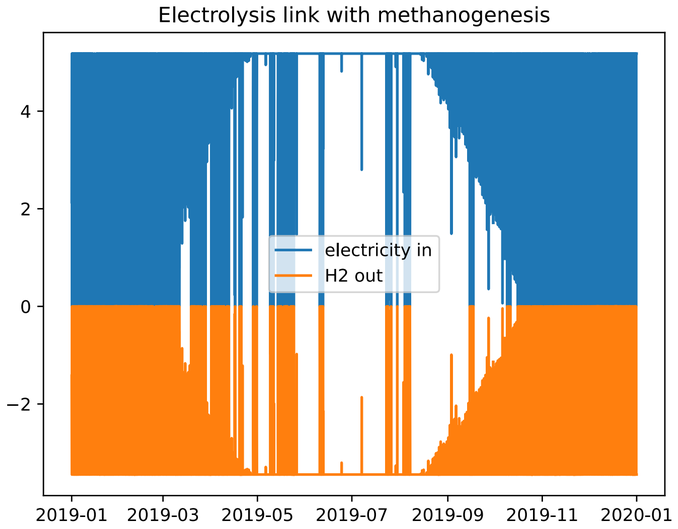
methanogen

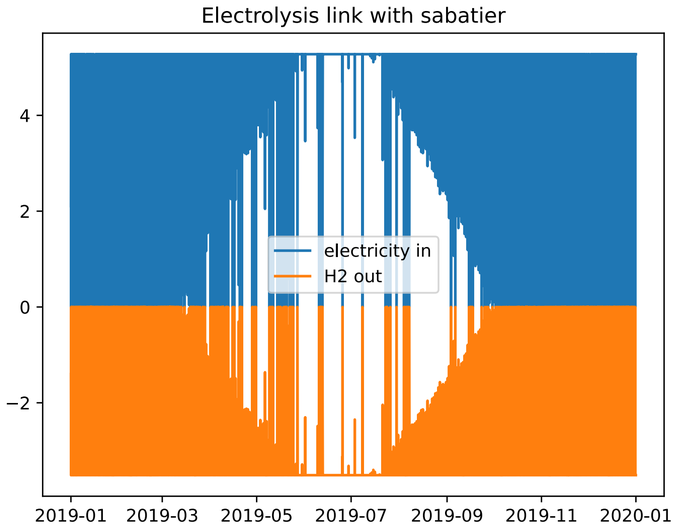
sabatier

Results

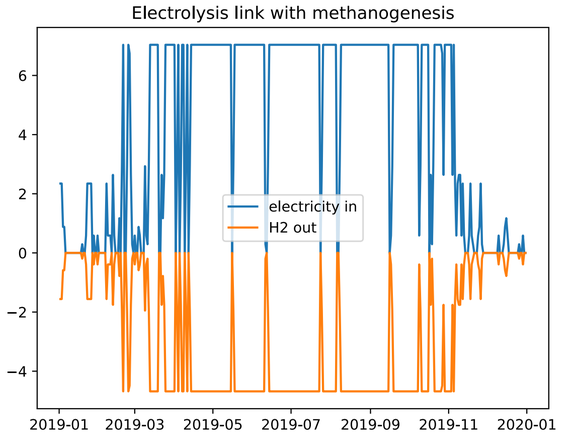
electrolysis

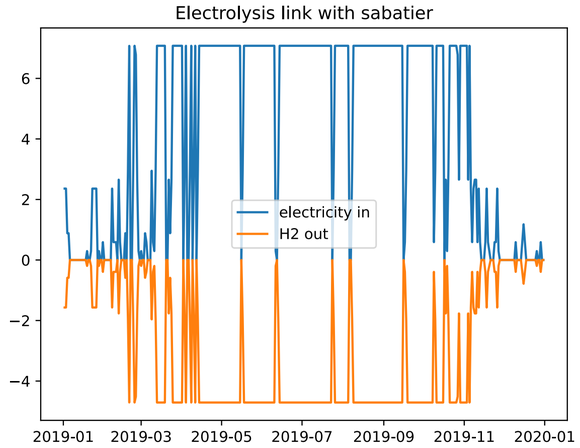
no grid





grid





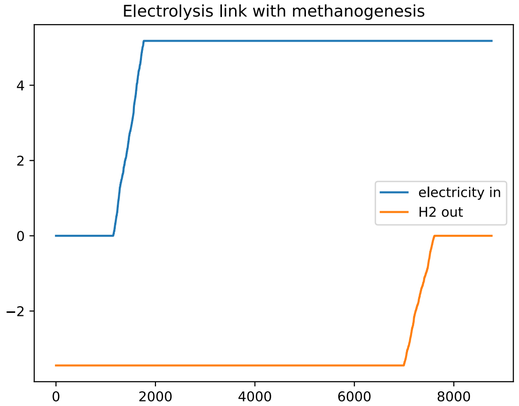
methanogen

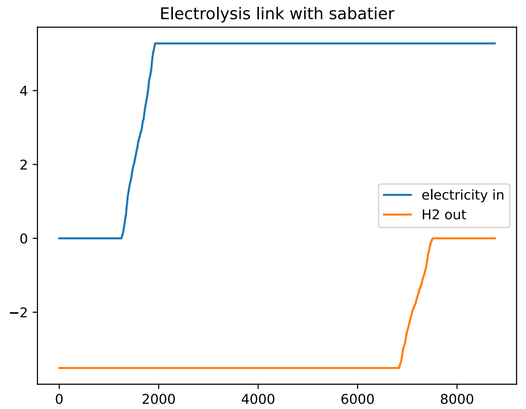
sabatier

electrolysis dcurve

Results

no grid





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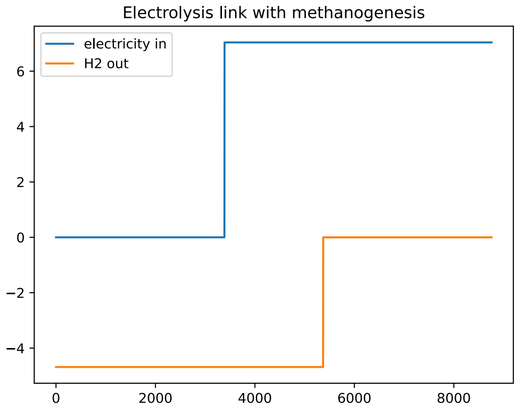
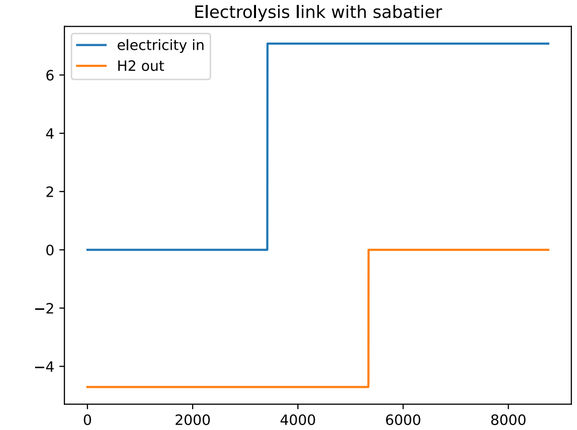




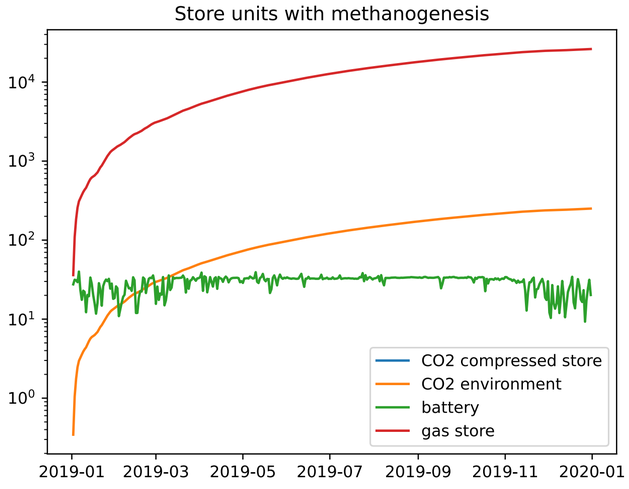
methanogen

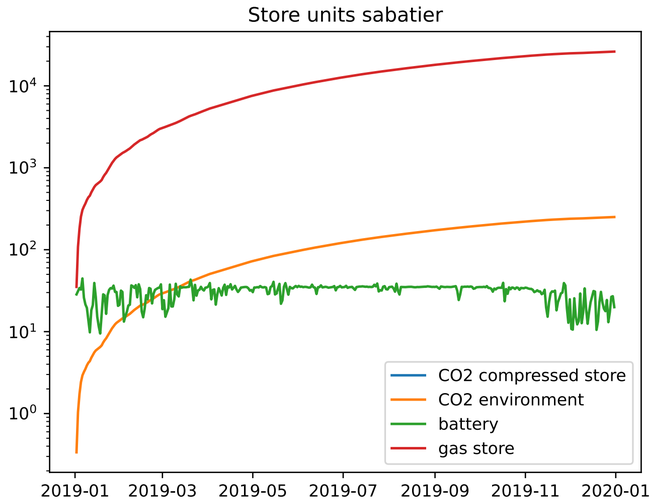
sabatier

Results

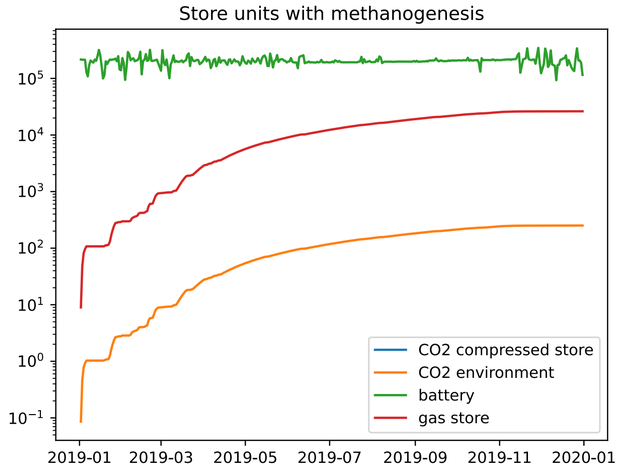
stores

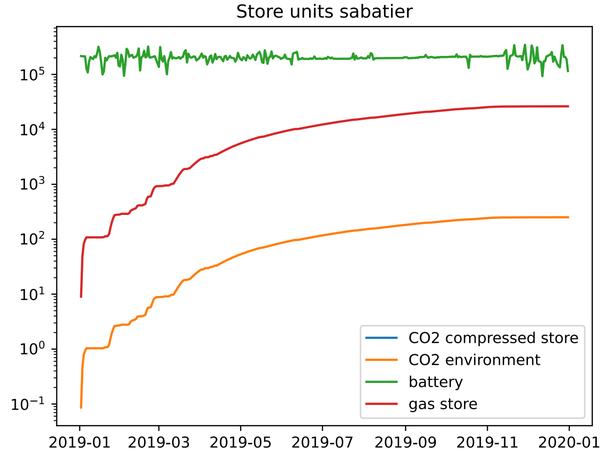
no grid





grid





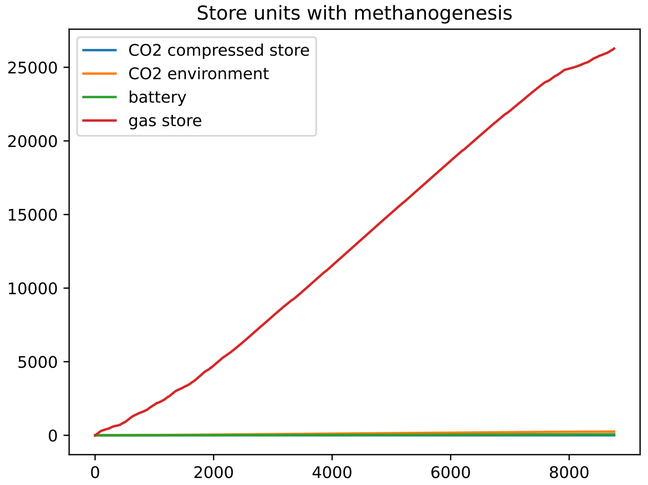
methanogen

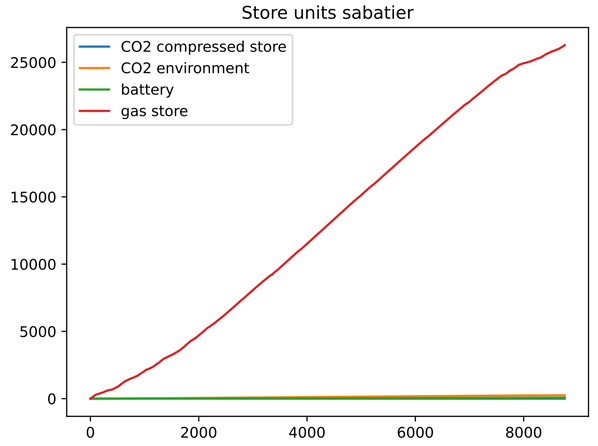
sabatier

Results

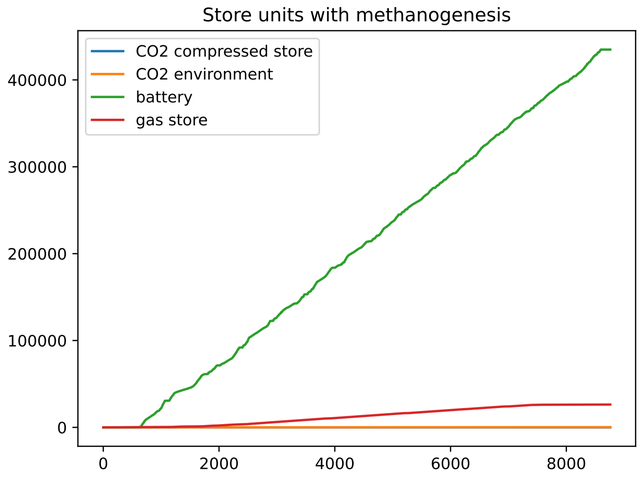
stores

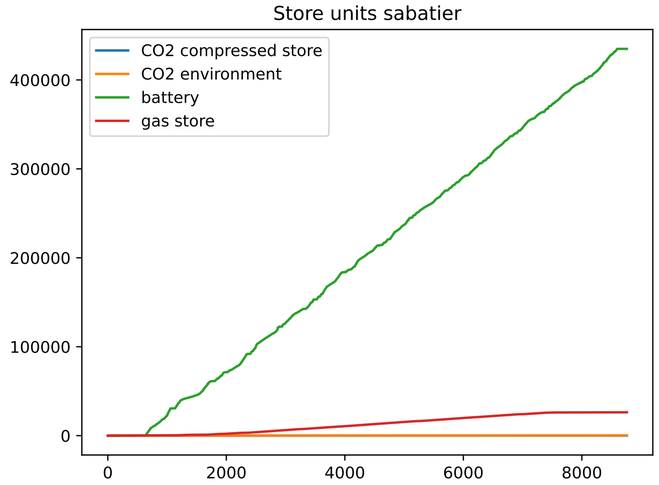
no grid





grid





methanogen

sabatier

Issues

- Size of battery and solar generator is primarily determined by the size of the grid load
- Solar and battery are infinitely extendable
- I set p_max_pu = 10000000
- The grid was therefore not used at all

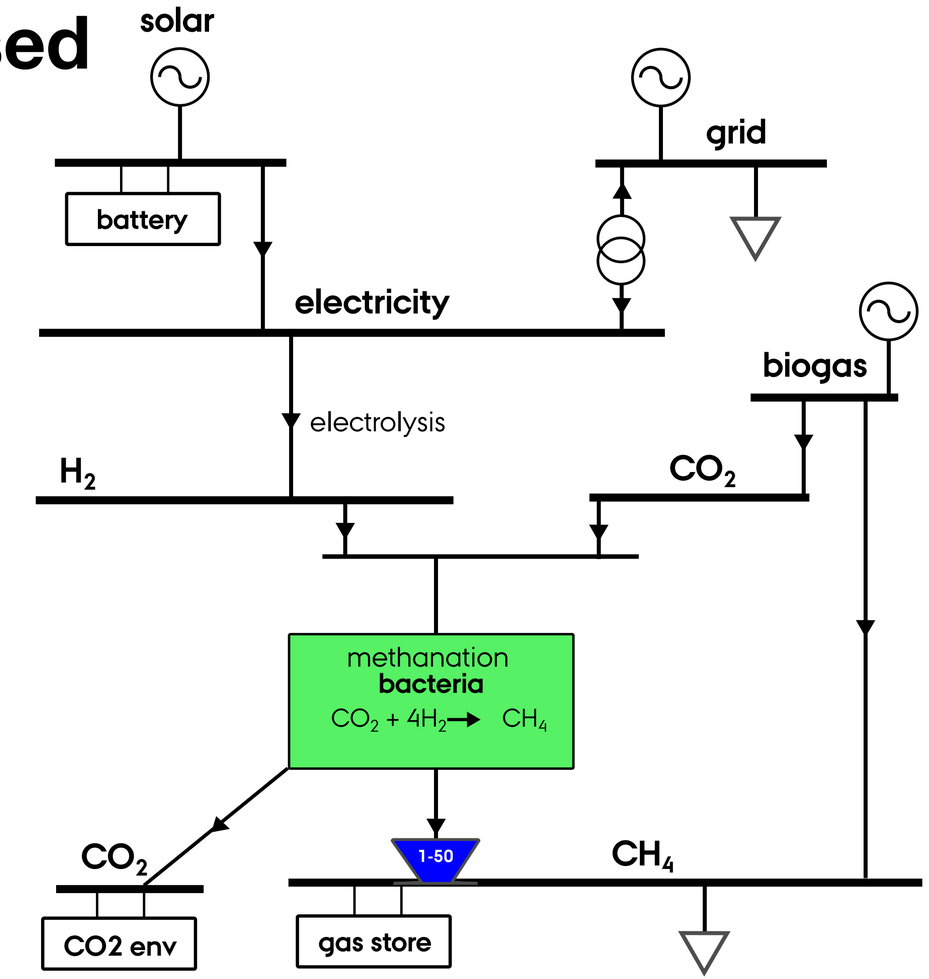
Research Question

- Limit size of solar to 130 MW, battery to 240 MWh
- Is there a difference when the grid is not allowed to use the battery? Should the grid be allowed to use the battery?

https://www.apple.com/newsroom/2021/03/apple-powers-ahead-in-new-renewable-energy-solutions-with-over-110-suppliers/#:~:text=Energy%20Storage%20and%202030%20Progress,7%2C000%20homes%20for%20one%20day

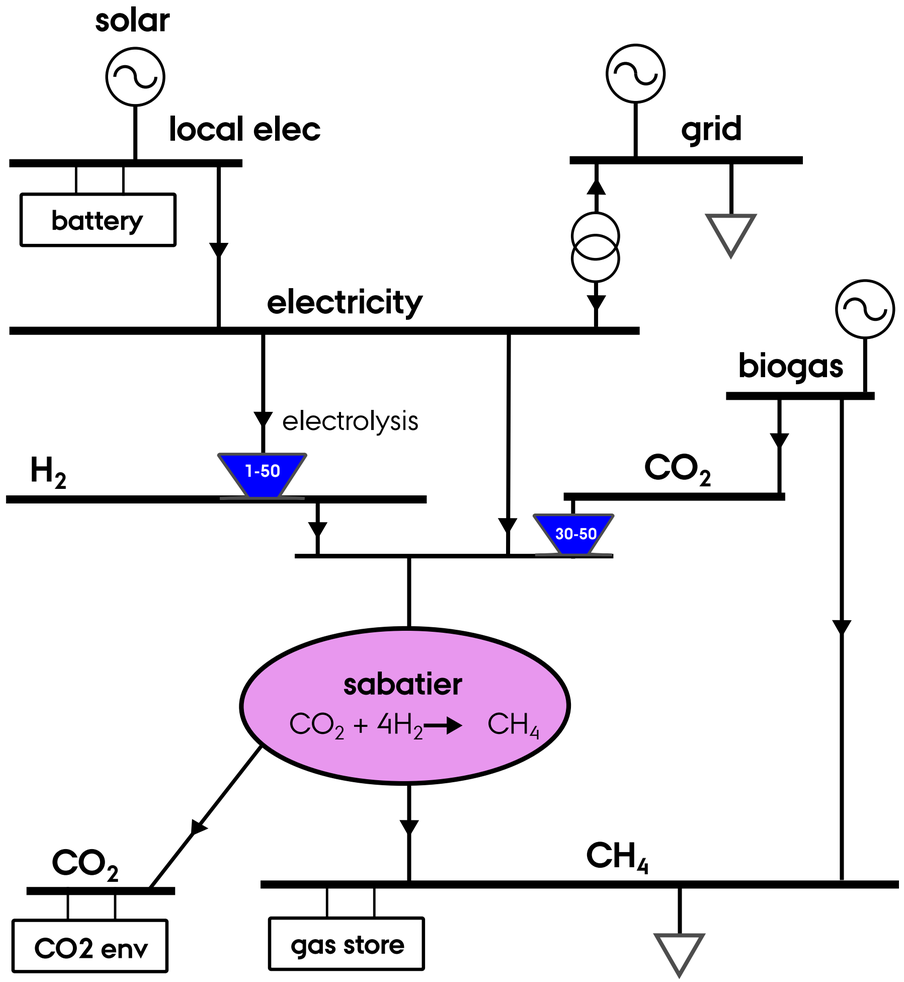
Model

Methanogens—proposed



Model

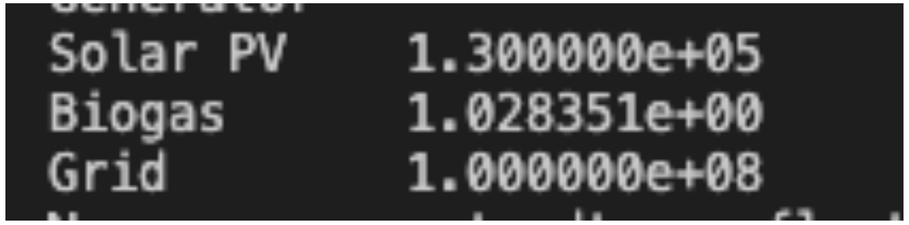
Sabatier—proposed



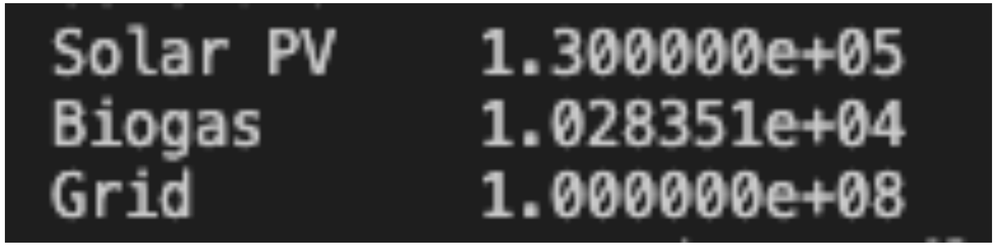
Experiment

- 1 kW vs 10 MW demand of gas

Results



1 kW



10 MW

Results

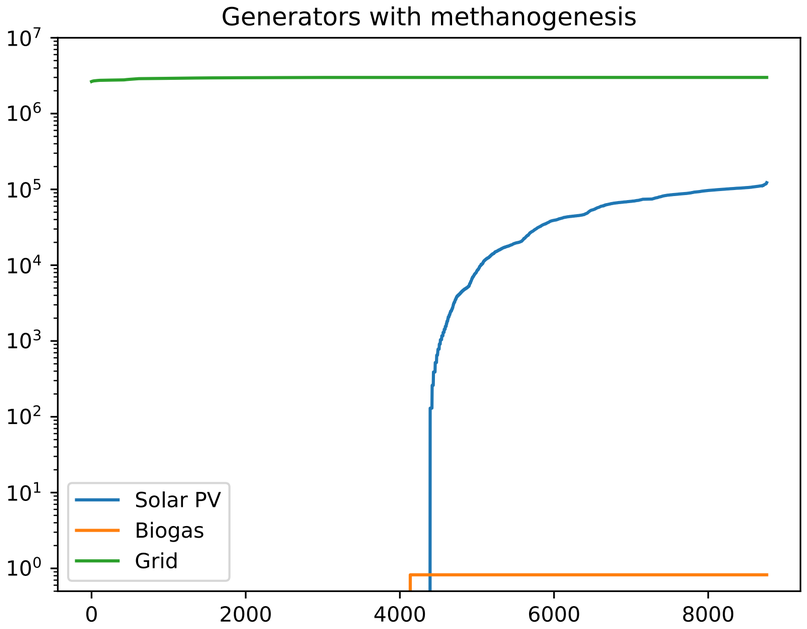
battery	240000.000000
gas store	8758.106765
CO2 environment	85.647243

1 kW

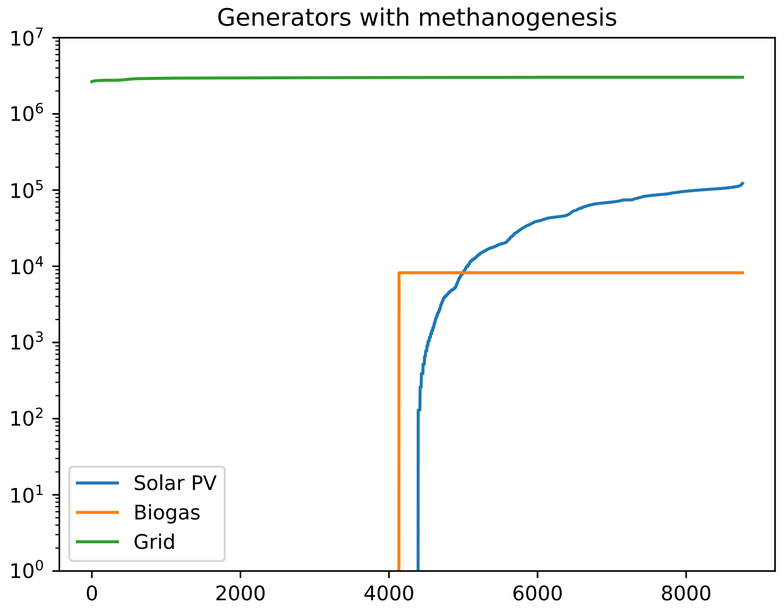
battery	2.400000e+05
gas store	8.758107e+07
CO2 environment	8.564724e+05

10 MW

Results

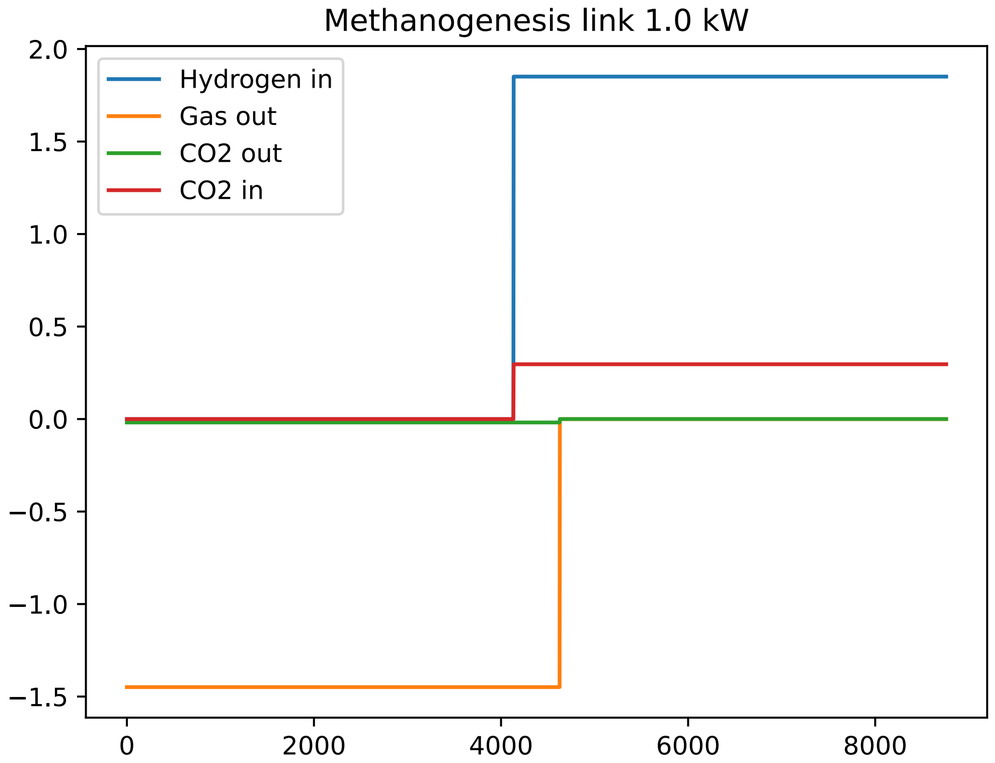


1 kW

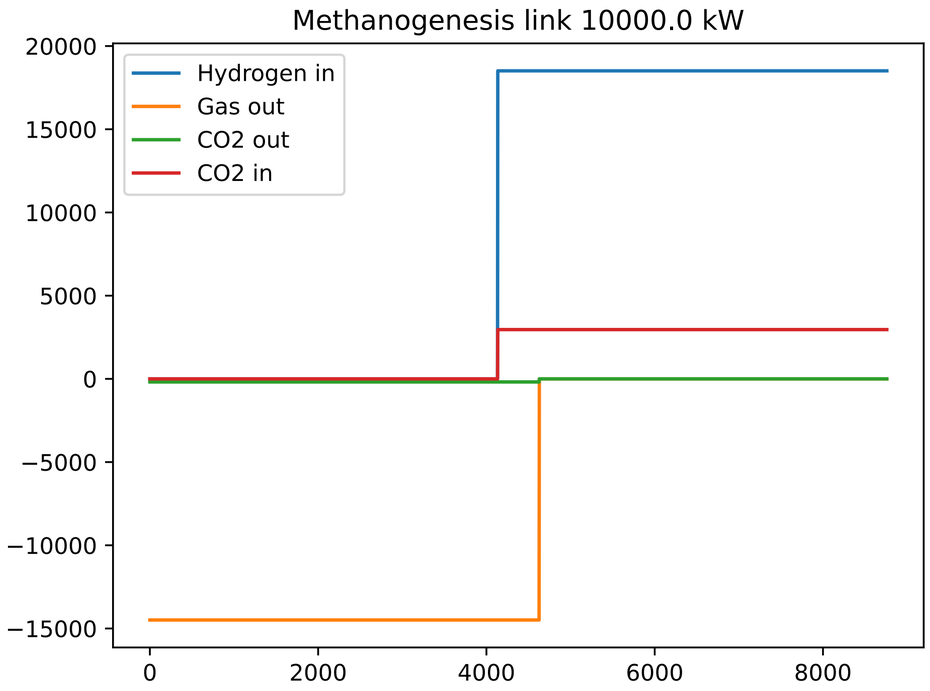


10 MW

Results

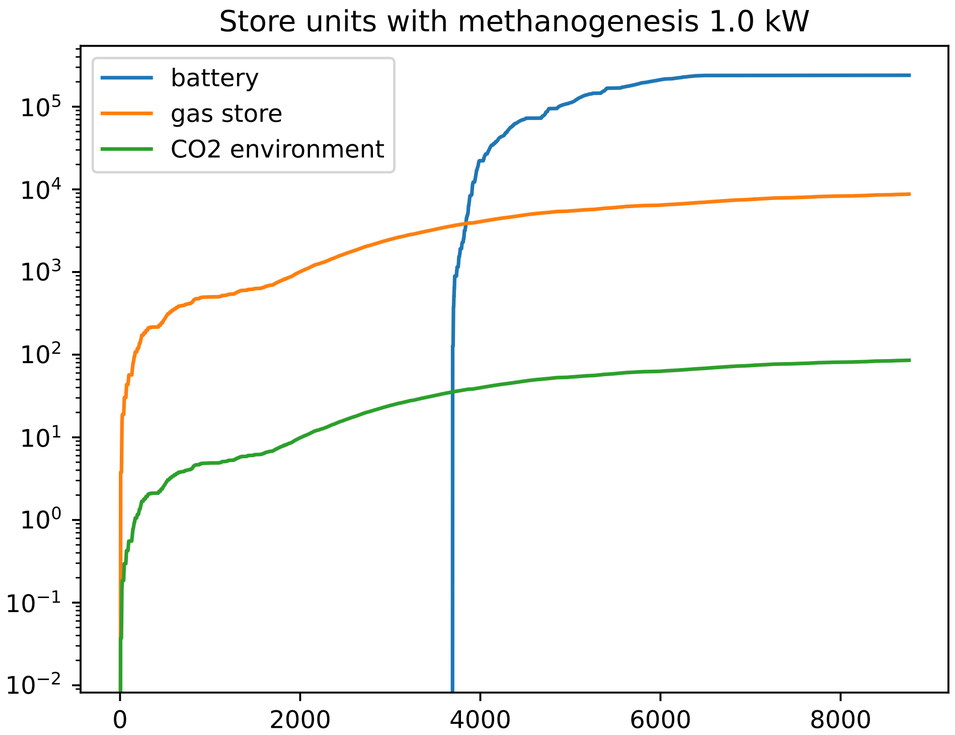


1 kW

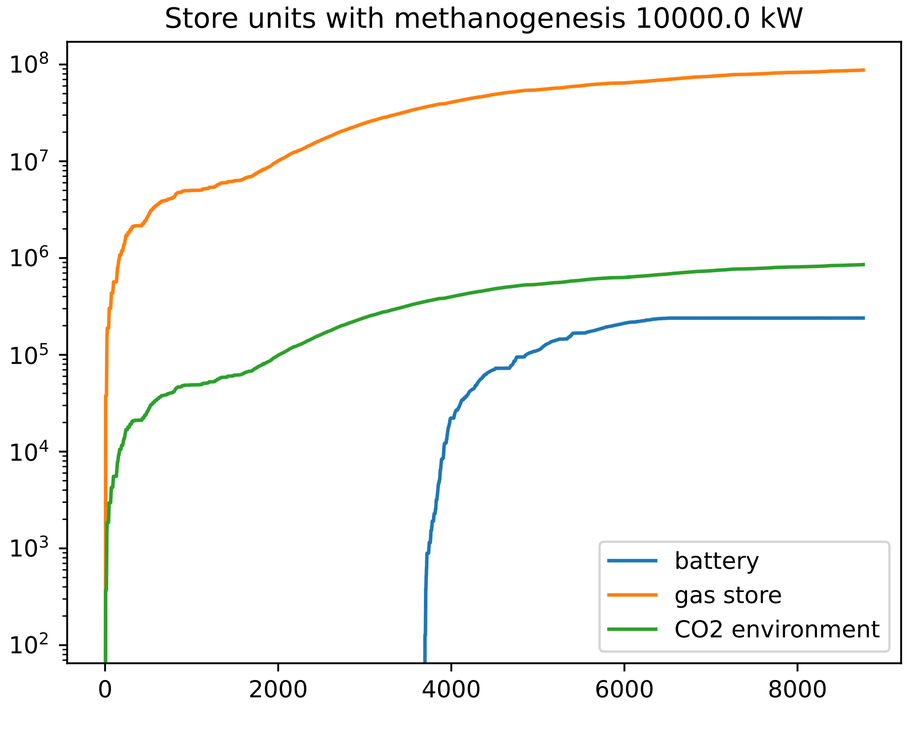


10 MW

Results



1 kW



10 MW

Next steps

- Fix up model for inverter/converter and costs
- Make a figure where sweep demand and calculate levelized cost of fuel
- Next meeting with Michael and co? What should we present?
- Next experiments?
- YEEES?