

SEASONAL VS. APROS MODEL COMPARISON AND ROLE IN NCE MODELLING

5th researchers' seminar

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ENERGY

TRUST IN RENEWABLE.



- MODELLING PROCEDURE
- SEASONAL MODEL VALIDATION
- ANALYSIS

Apros model

- Accurate, subsecond time scale
- Not so fast for long (>month) simulations



Seasonal model

- Not so accurate, one hour time step
- Solves mass conservation, not continuity
- Fast for long simulation periods
- Can be validated with Apros model
 - reasonable accuracy

Optimization

Seasonal model

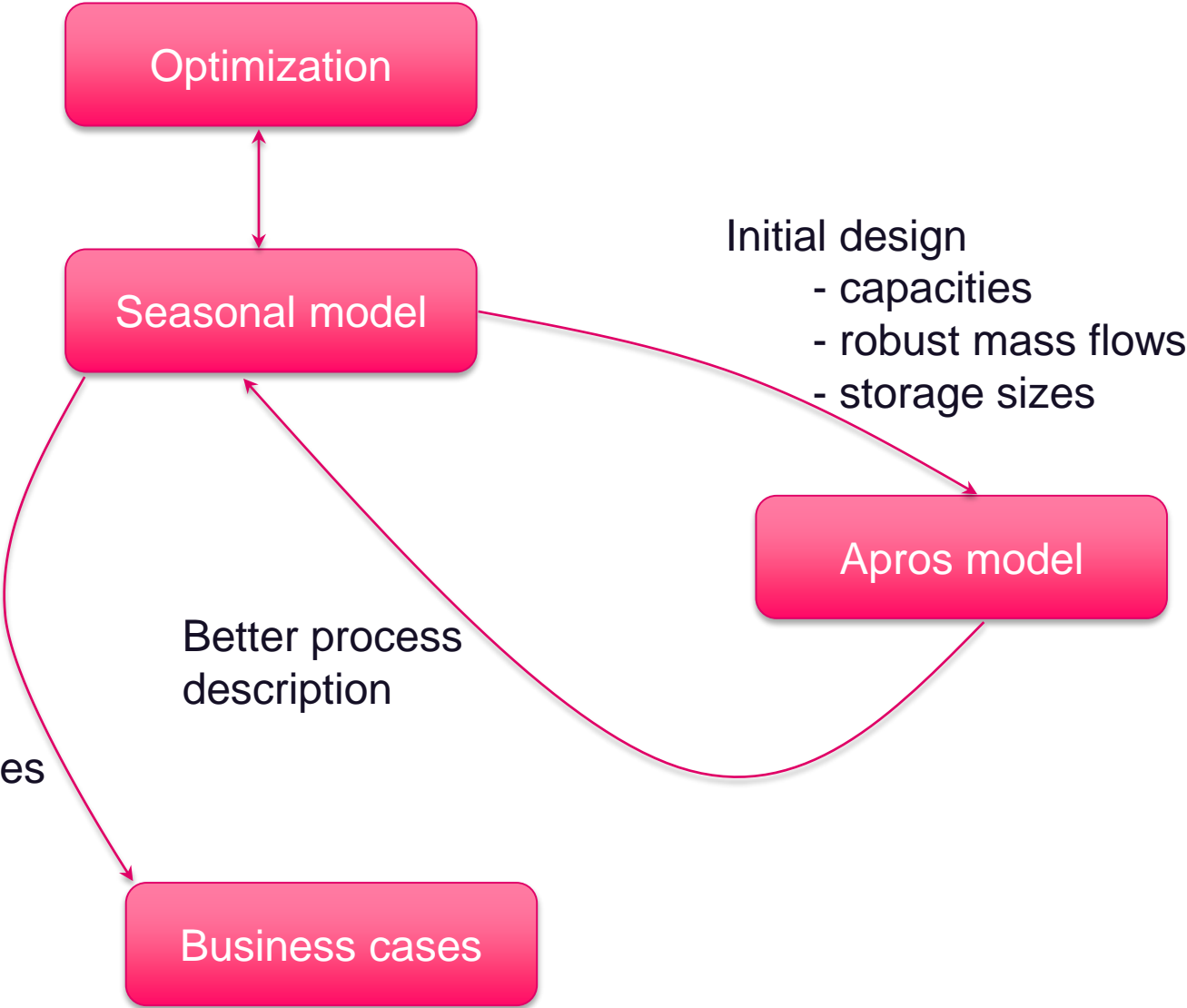
Apros model

Business cases

Initial design
- capacities
- robust mass flows
- storage sizes

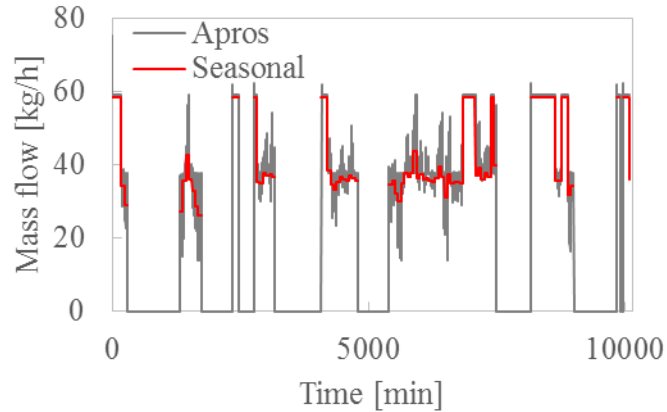
Better process
description

Average values
- CAPEX
- OPEX

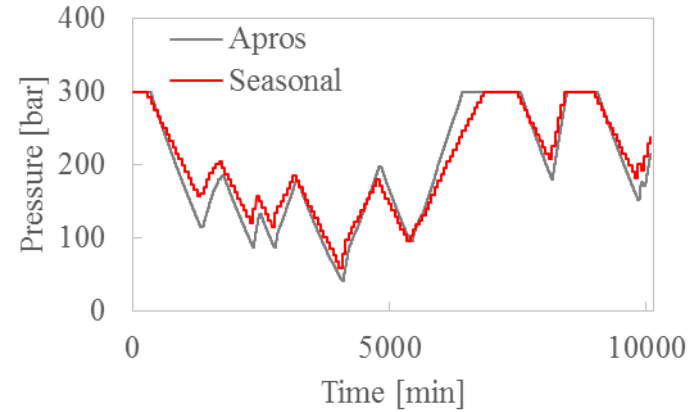


Validation - One week

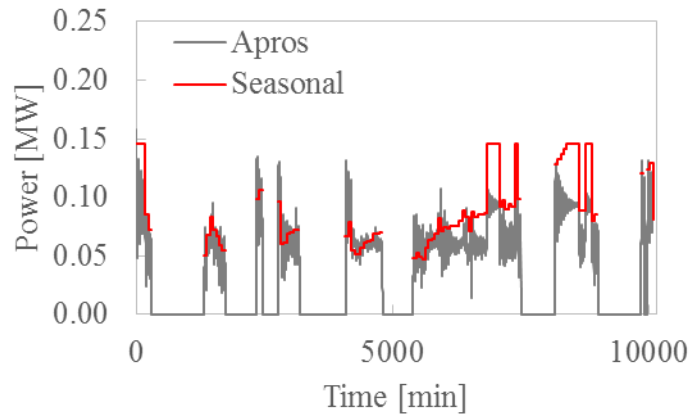
H₂ production



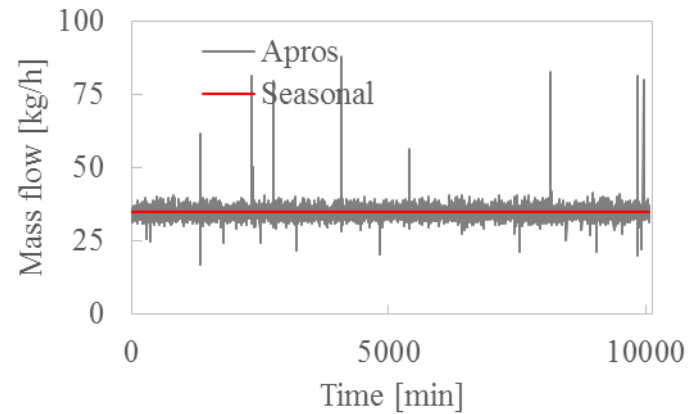
Pressure of H₂ storage



H₂ compression power

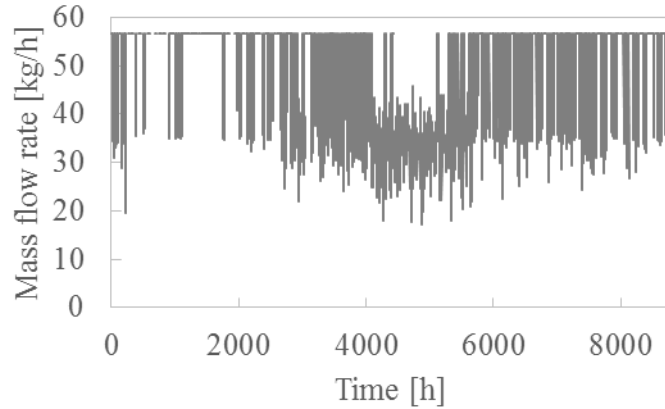


CH₄ production

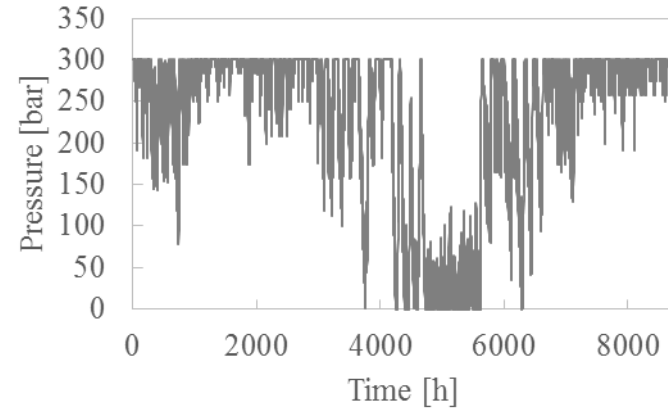


One year simulation period

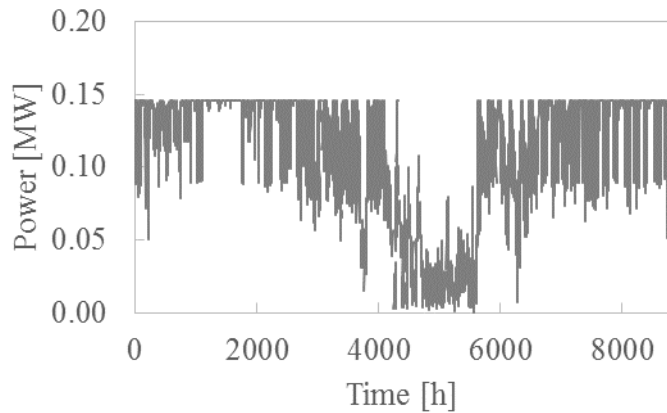
H₂ production



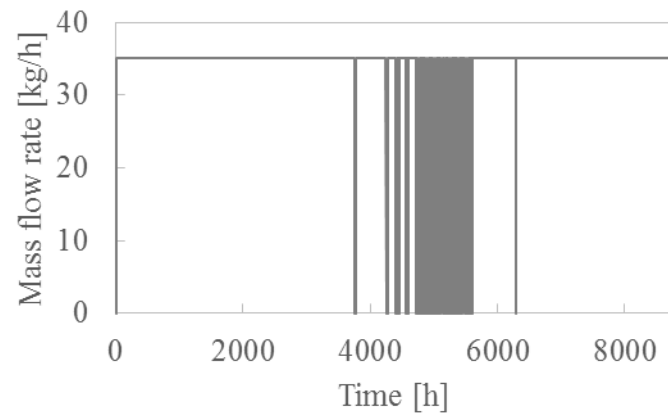
Pressure of H₂ storage



H₂ compression power



CH₄ production

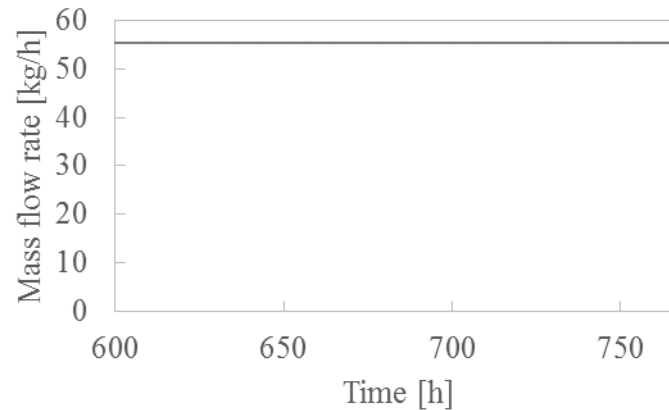


ANALYSIS

- Operational dynamics
- Methanation capacity
- Buffer storages

Operation dynamics

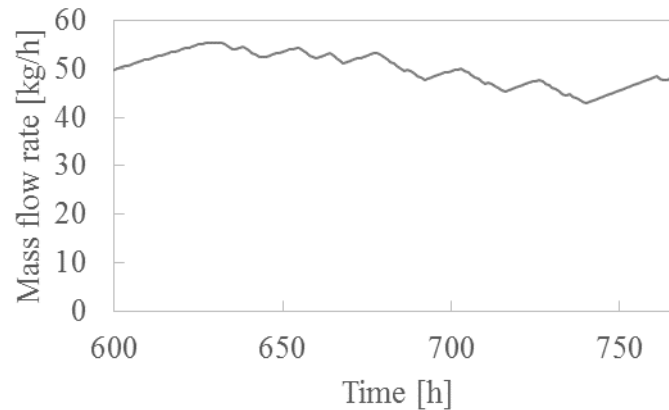
- Three operation modes for methanation:
 1. Constant, no part load possibility



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Operation dynamics

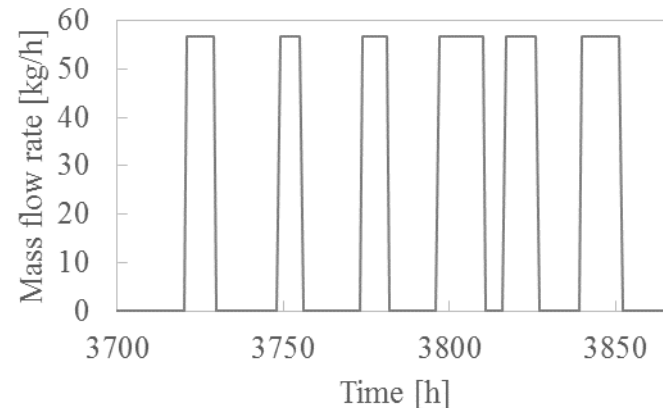
- Three operation modes for methanation:
 1. Constant, no part load possibility
 2. Constant, 50 % part load possibility



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Operation dynamics

- Three operation modes for methanation:
 1. Constant, no part load possibility
 2. Constant, 50 % part load possibility
 3. Cyclic, no part load possibility, min. 6 h uptime



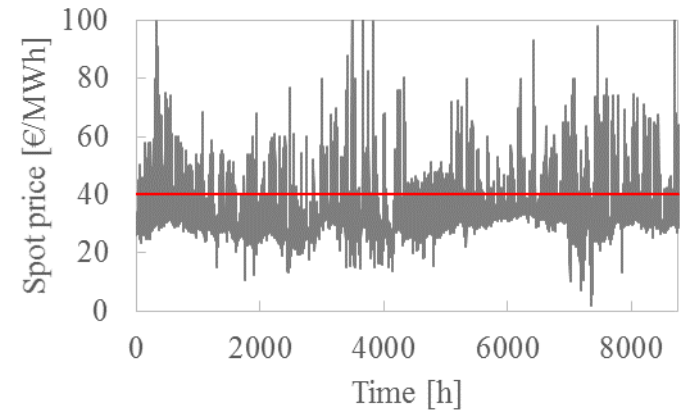
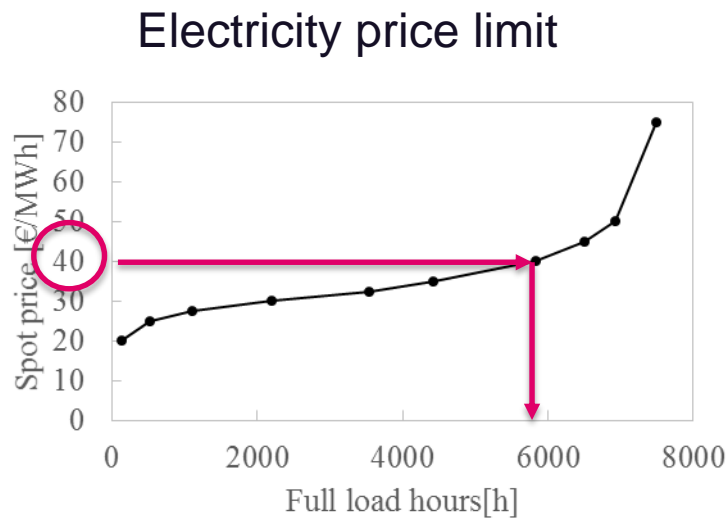
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Defining methanation capacity

- Example: 3 MW electrolyser produces hydrogen 56 kg/h
- Feed flow to methanation 56 kg/h
→ methanation capacity is 100 % of electrolyser capacity
- Feed flow to methanation 28 kg/h
→ methanation capacity is 50 % of electrolyser capacity

Defining methanation capacity

- Constant H₂ flow to methanation for whole year

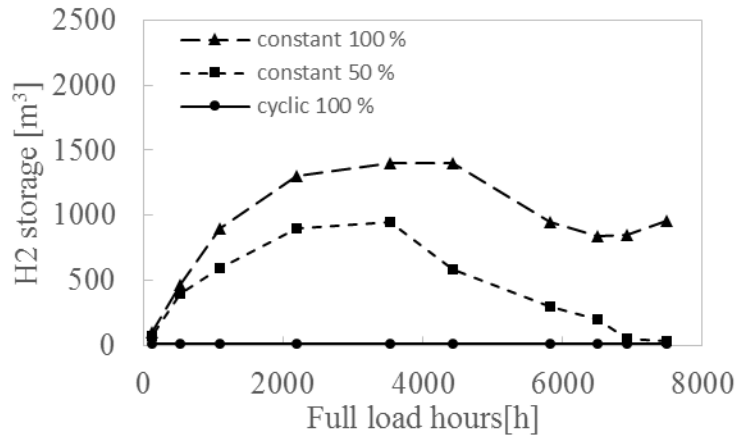


Full load hours for electrolyser: 5900 h

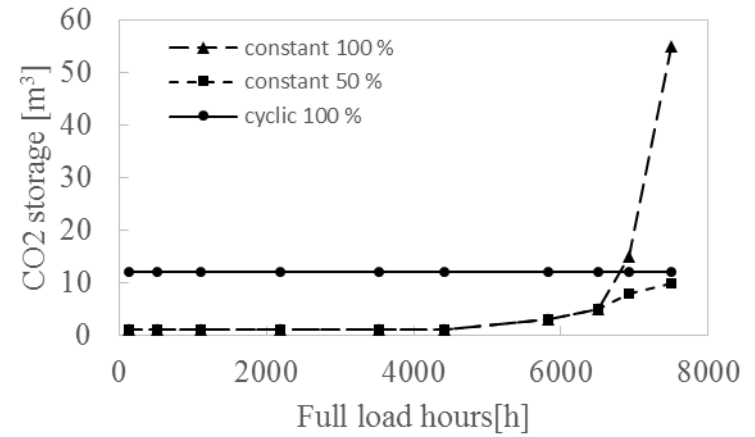
Methanation capacity:
 $5900 / 8760 = 0.67 = \underline{67\%}$

Storages

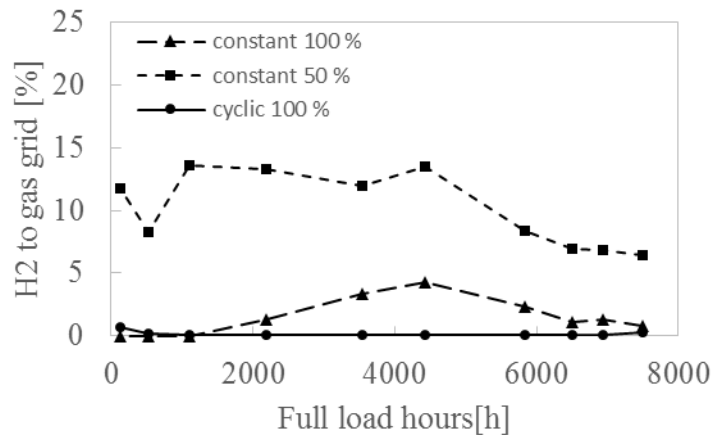
H₂ storage



CO₂ storage

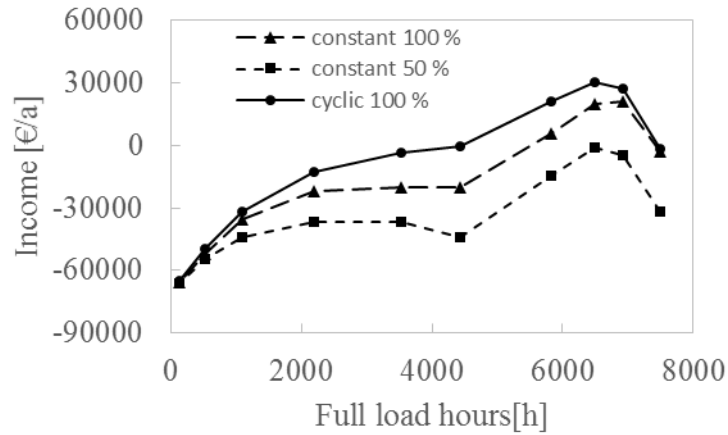


Full storage → H₂ directly to gas grid

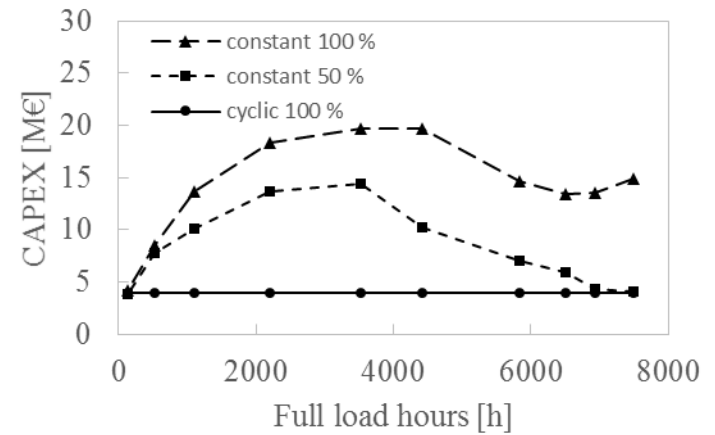


Economics

Net yearly income

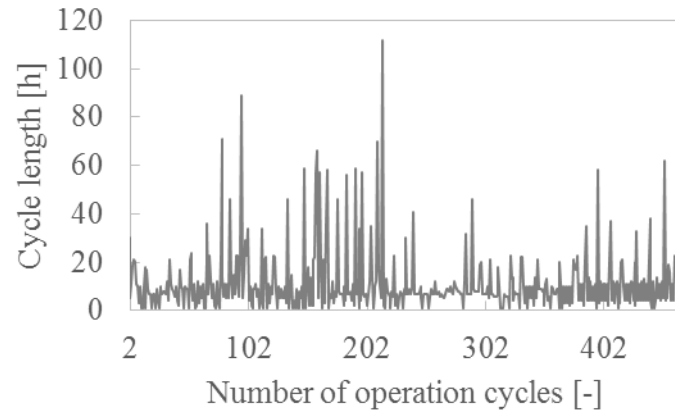


Capital cost

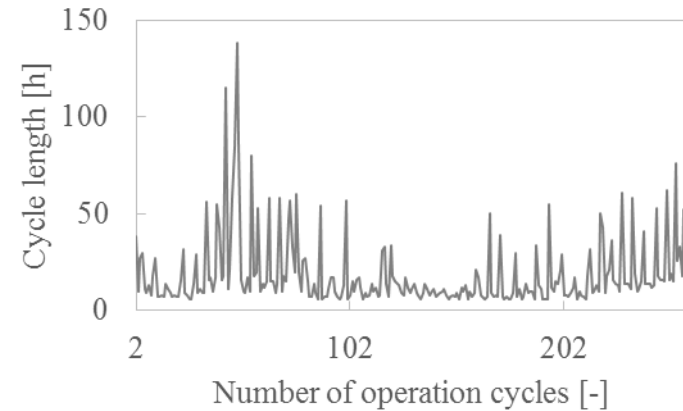


Length & number of cycles

Electrolyser



Methanation



Heat saved by integration

