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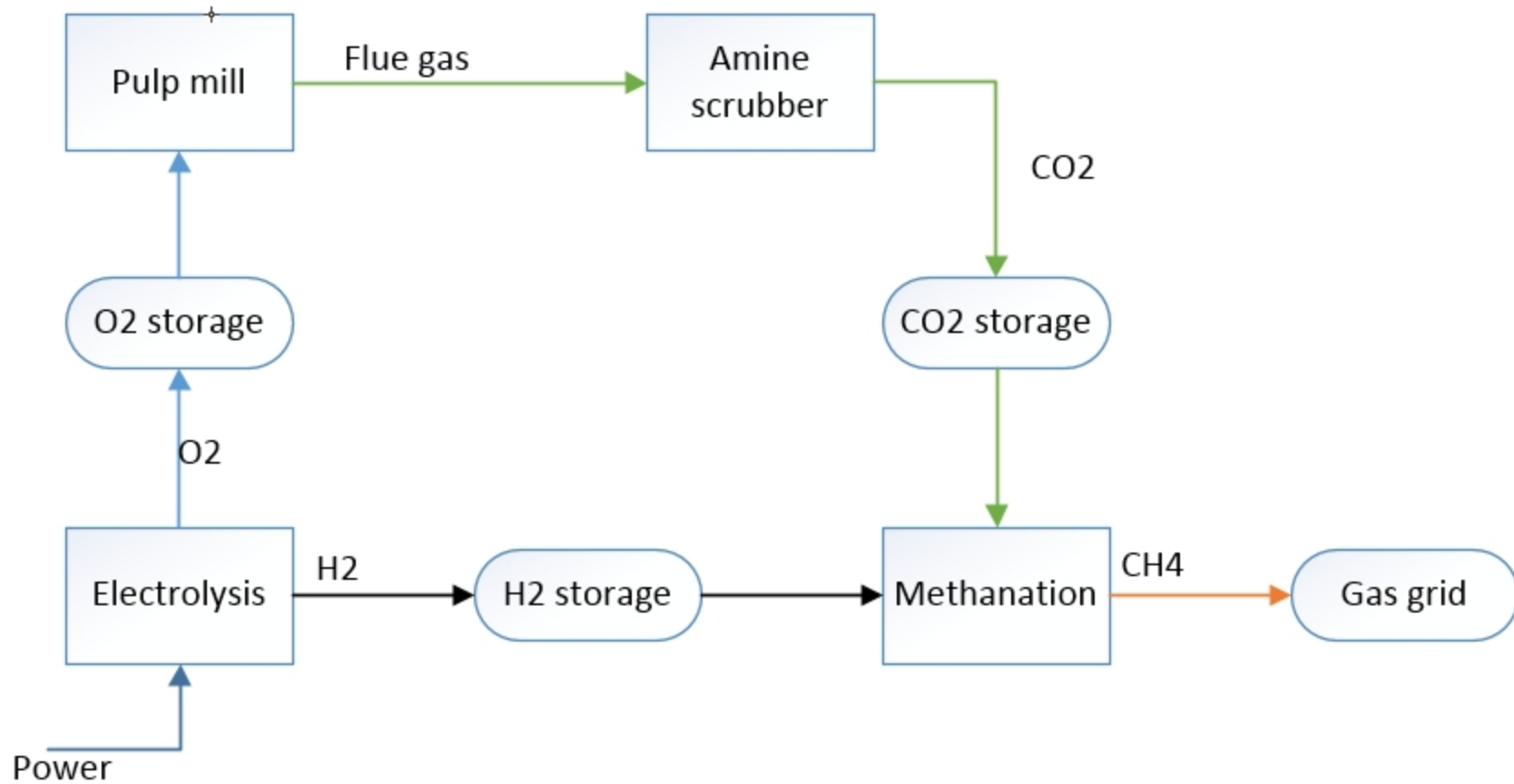
Neo-Carbon WP4

Excel tool for 0D mass and energy balances in
power-to-gas –system

Eero Inkeri
16.12.2014



System

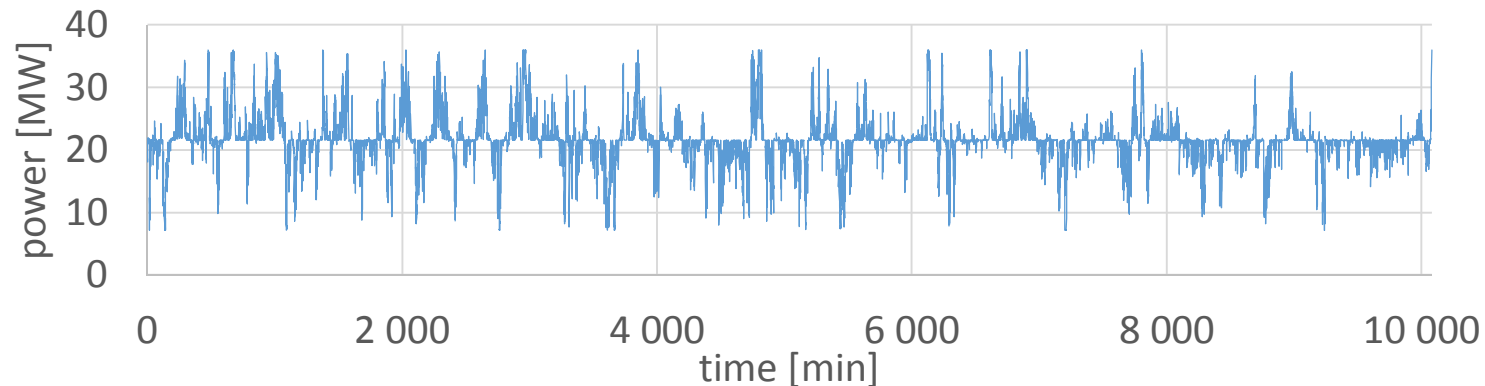


Main inputs and outputs

- Inputs:
 - Grid balancing demand as electrolyser power, 40 - 100 % of maximum power with 1 min time step
 - Pulp mill oxygen demand, 1 hour time step
- Outputs: (1 hour time step)
 - O₂, H₂ and CO₂ production rate, consumption rate and storage levels
 - Required storage sizes
 - CH₄ production rate
 - Required power and electricity cost for electrolyser, compression (O₂, H₂, CO₂) and CO₂ capture
 - Hourly income from O₂, CH₄ and grid balancing services

Electrolyser

- Type: alkaline
- Power input: time serie for 30 days by V. Tikka & P. Peltoniemi (0,1 s time step), averaged to 1 min time step.
- Production: O₂ and H₂ production based on LHV efficiency (70 %)
- Heat flux: no cooling
- Pressure: 1 bar
- Temperature: 40 °C
- Cost: electricity cost



H₂, O₂ and CO₂ storages

- Phase: gas
- Time step: 1 h
- Size: free or specified target size
- Pressure: multistage compressor, specified outlet pressure (8 bar), intercooling (40 °C), polytropic efficiency (0,8)
- Temperature: 40 °C
- Cost: electricity cost for compressors

Methanation

- Output: $\text{CH}_4_{\text{out}}/\text{H}_2_{\text{in}}$ mass ratio is constant 2,0
- Heat out: Reaction heat (10,3 MJ/kg_{CH4}) and specified heat loss [%]
- Input: H2 storage
CO2/H2 mass ratio is constant 5,5
Enough CO2 is assumed to be available
- Income: 0,56 €/kg_{CH4}
- Cost: no cost

CO₂ capture

- Type: amine scrubber
 - Heat flux: heat demand 0,97 kW/kg_{CO₂}/h (3,5 MJ/kg_{CO₂})
 - Electricity: electricity demand 0,19 kW/kg_{CO₂}/h
 - Cost: electricity cost
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- Heat from methanation is enough

O2 utilization

- O2 to pulp process -> assumed income is 0,05 €/kg_{O2}
 - Real O2 demand (kg/h) in a finnish pulp mill is available



Electricity prices

- Nord Pool hourly price for electricity
- Hourly price for grid balancing

