SOLAR HEAT SUPPORTED HIGH TEMPERATURE ELECTROLYSIS PROCESS

Techno economic assessment of a concentrated solar heat supported high temperature electrolysis process using a thermal energy storage

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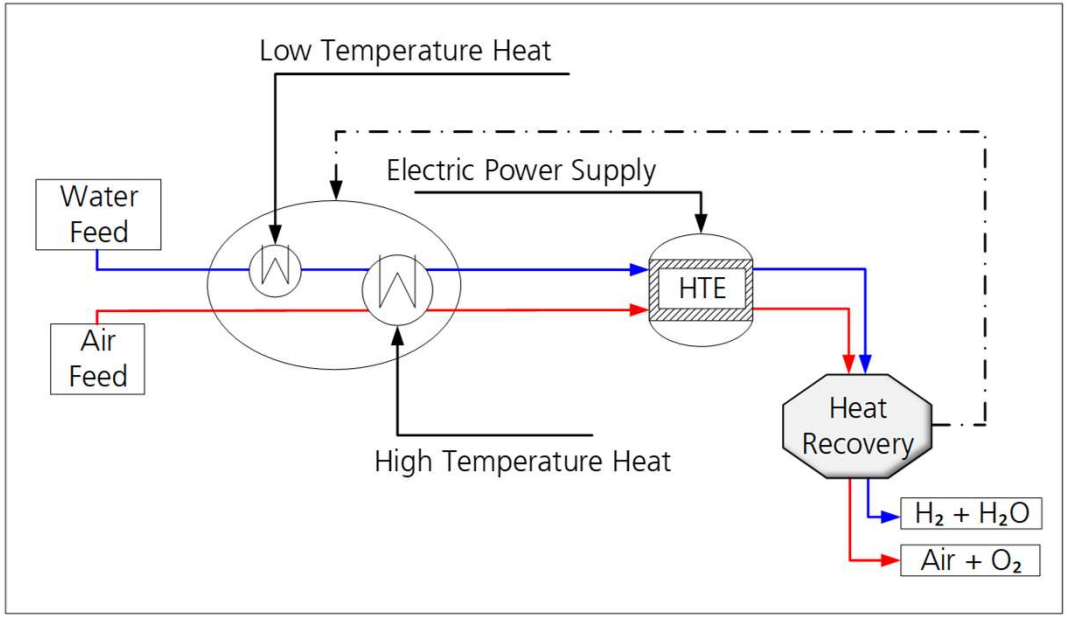
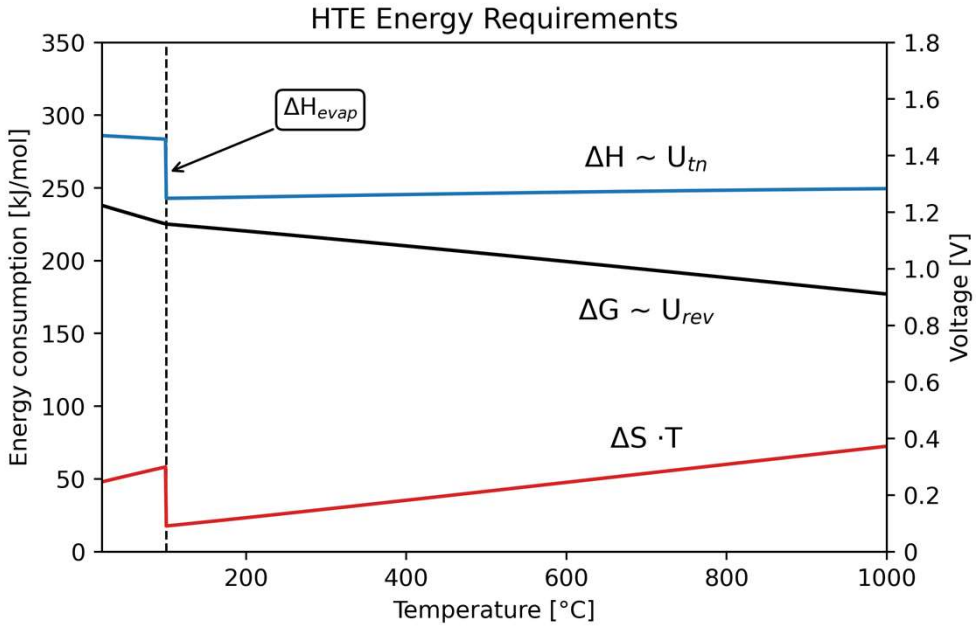
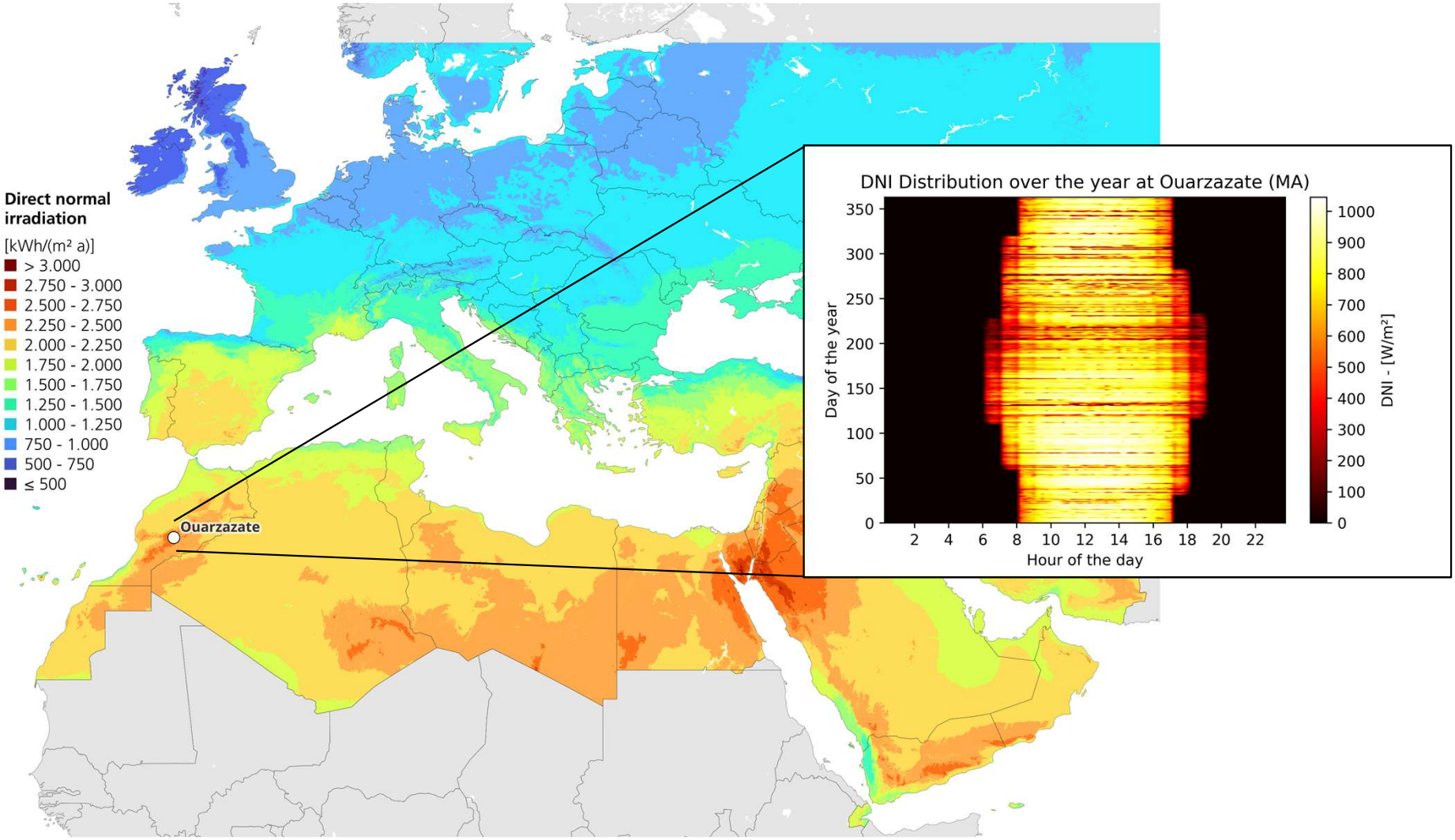
HTE System needs Thermal Energy supply!





Concentrated Solar Energy Potential



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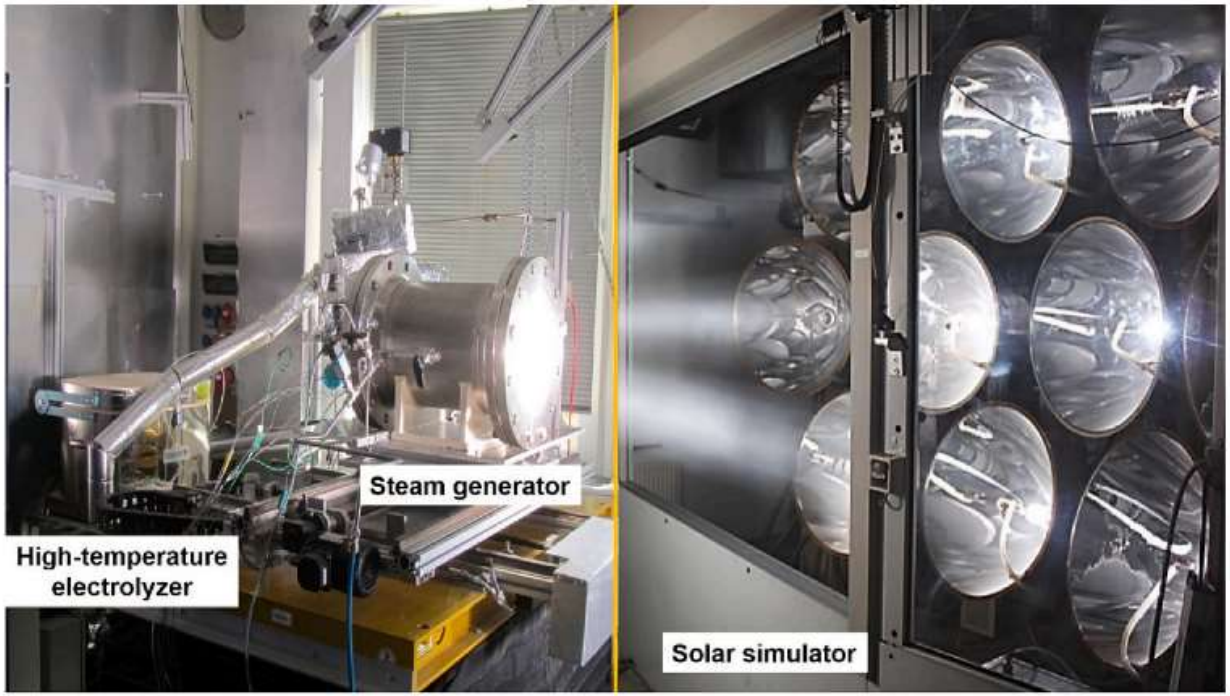
Hydrogen Production using Concentrated Solar Heat

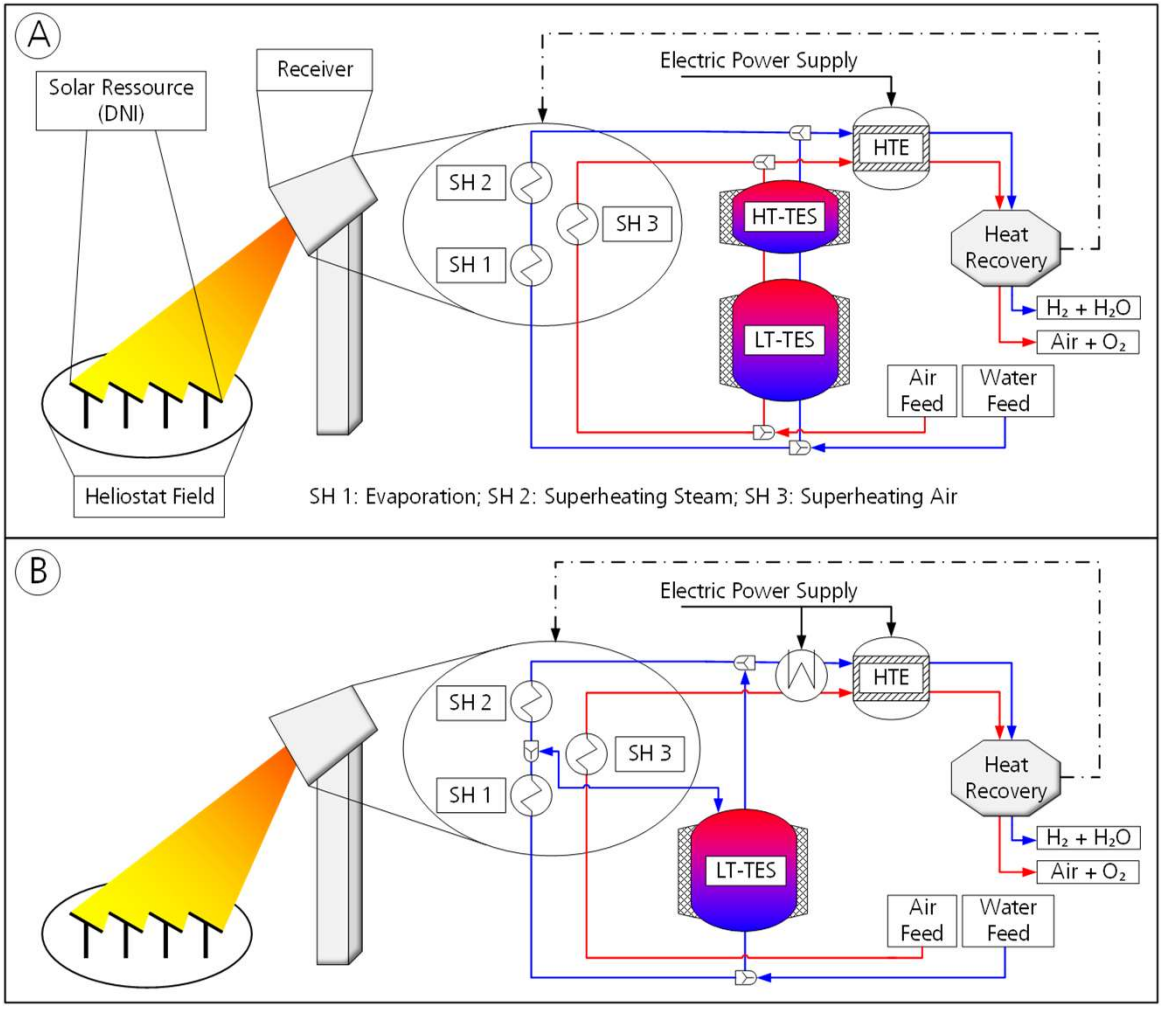
- DLR Project – Future Fuels



- Successful solar Hydrogen production at 820°C
- Feed Stream temperature at over 700°C needed
- Storage of steam and high temperature energy

[Schiller et al. **2020**]
[Kadohiro et al. **2023**]

Concentrated Solar Thermal Heat supported HTE Process

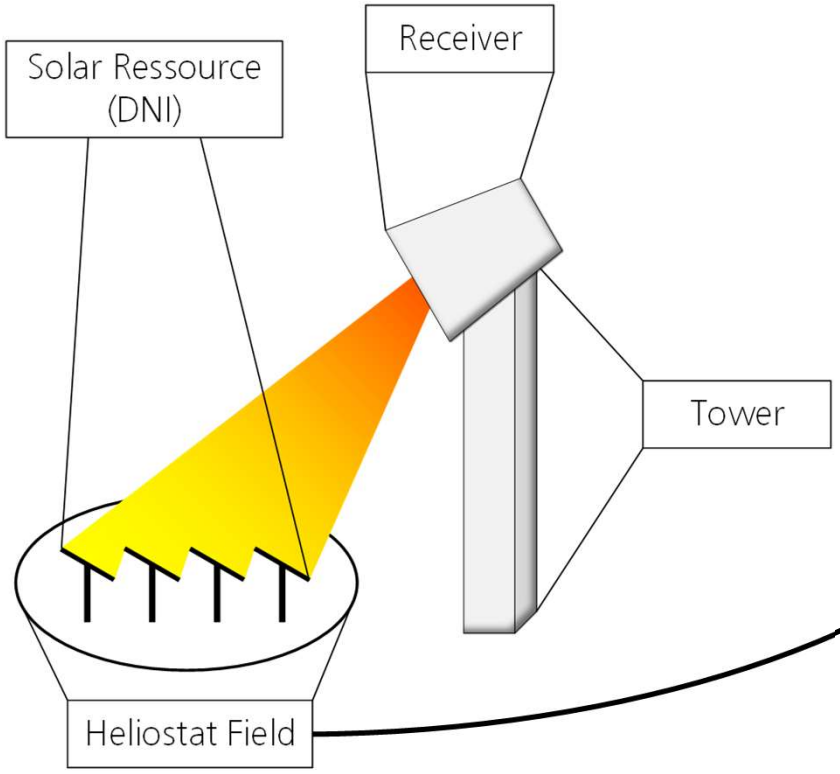


- Supply of high temperature heat during day and night

- Supply of high temperature heat during day
- Low temperature steam during night

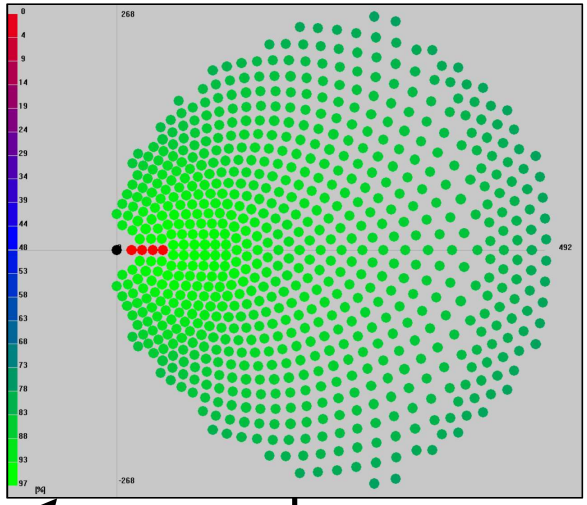
Solar System Cost Calculation

Major Solar Components



HFLCAL

$$A_{HF} = f(h_{Tower}, \dot{Q}_{Receiver}, Location)$$

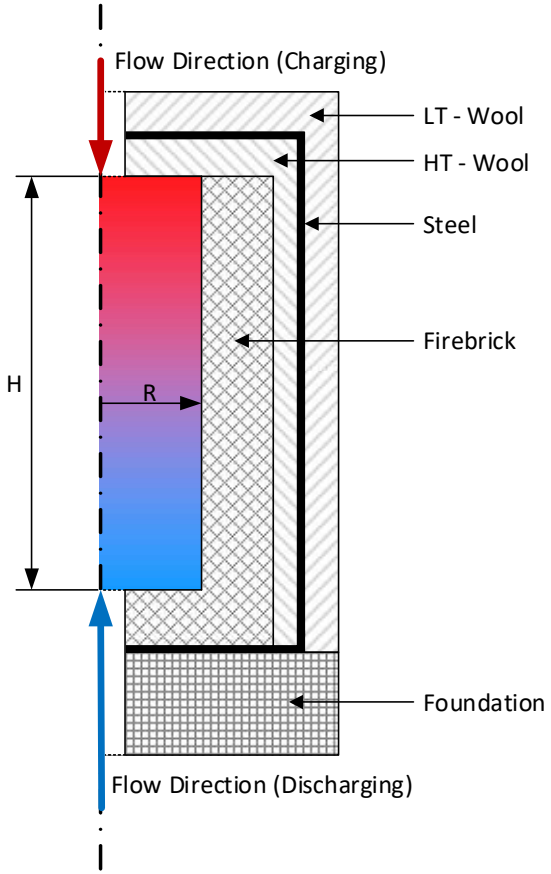


$$A_{HF}, h_{Tower}, \dot{Q}_{Receiver}, \eta_{HF}$$

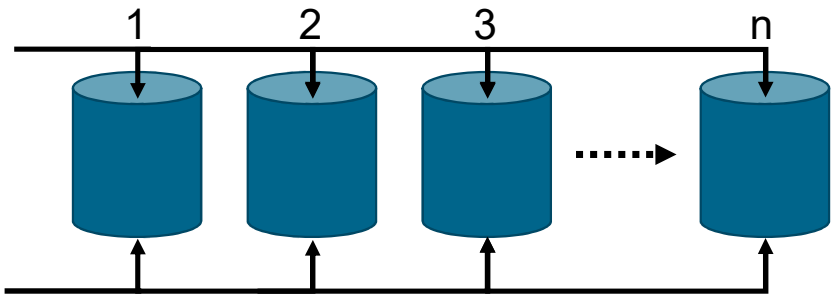
[Schwarzbözl et al. **2009**]
[Dersch et al. **2020**]

Thermal Energy Storage Cost Calculation

TES Unit Cost Calculation



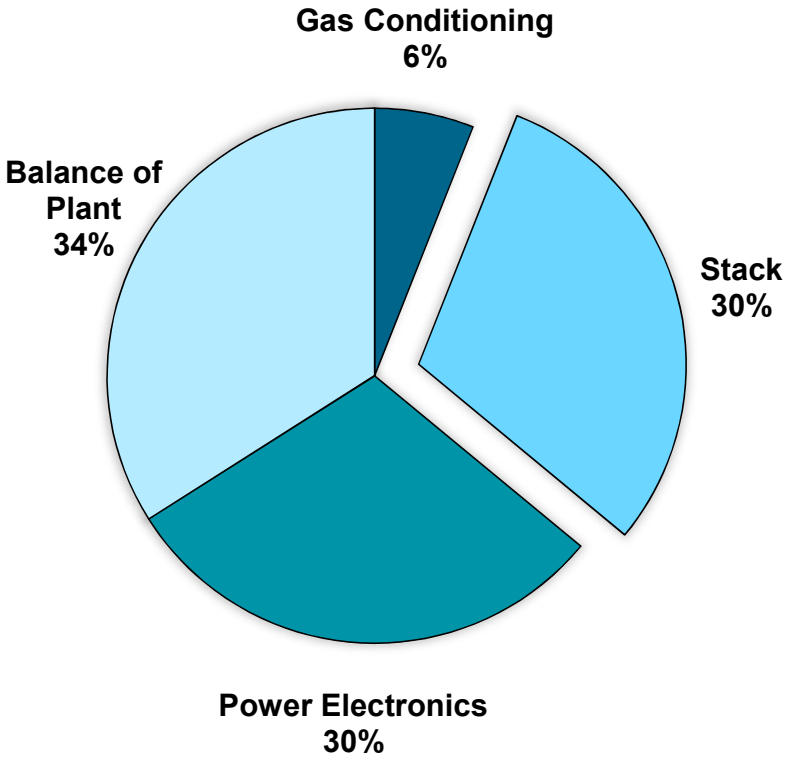
Interconnection of the TES units



$$EC_{TES} = (1 + f_{const}) \cdot ((1 + f_{TES,Pipe}) \cdot \sum EC_{TES,i})$$

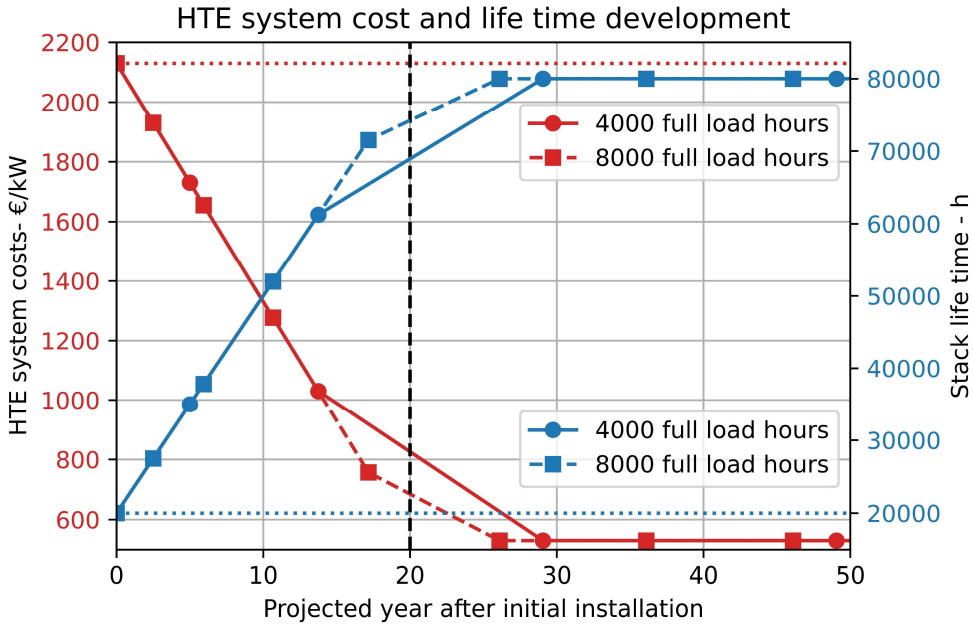
High Temperature Electrolyser Cost Calculation

HTE System Cost Breakdown



[Böhm et al. **2019**]

Stack Replacement Prediction

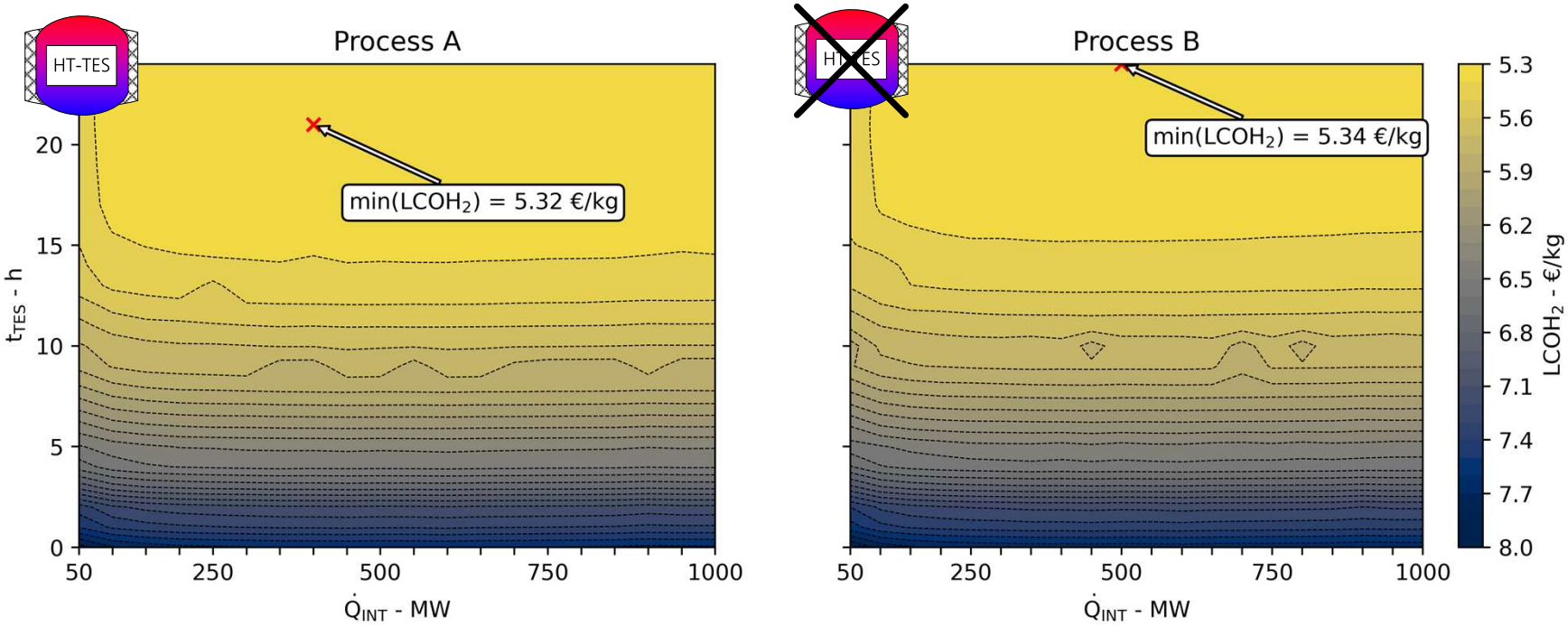


[European Commission **2022**]

RESULTS

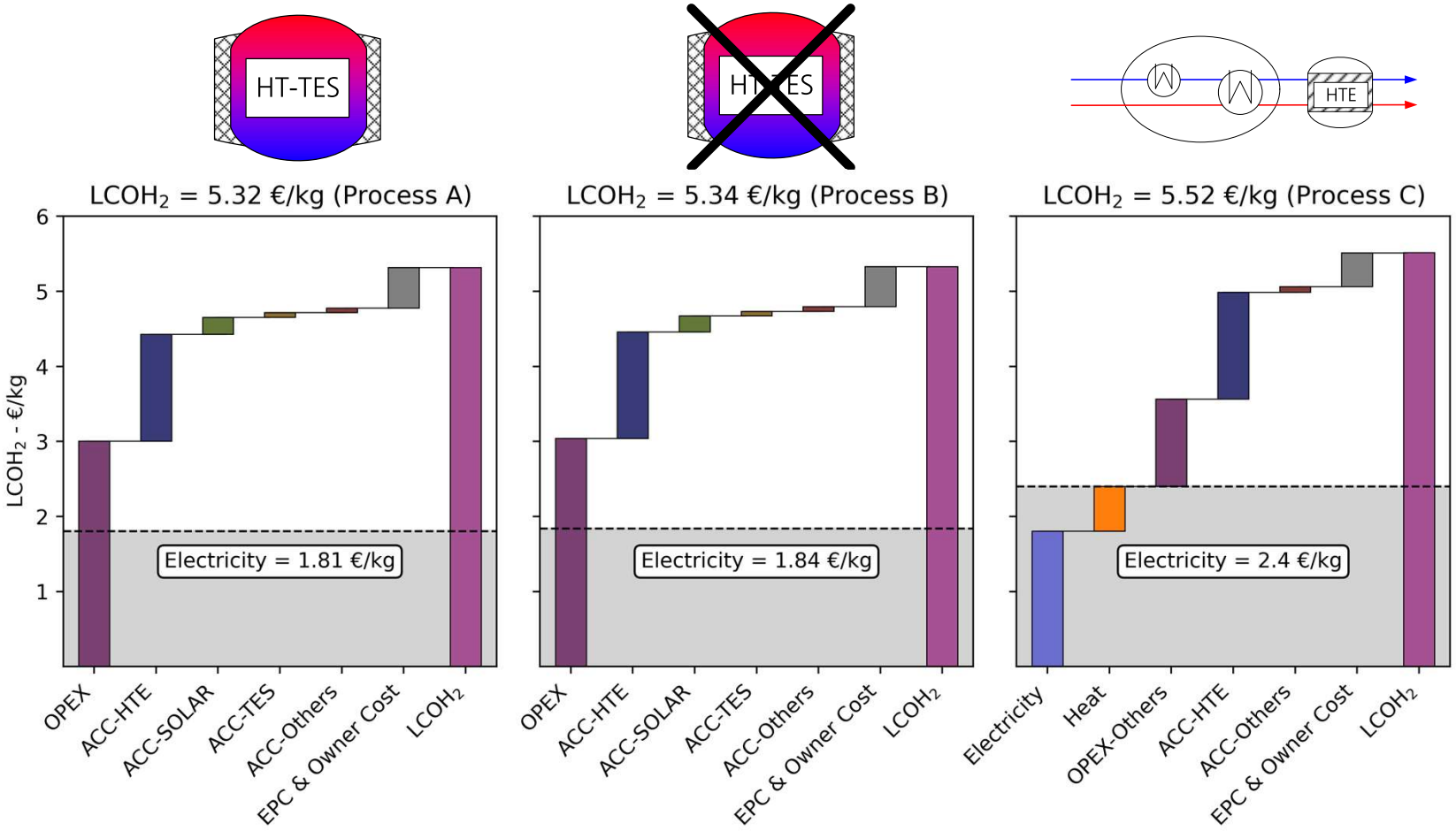
Transient Process Simulation & Techno-Economic Assessment

Comparison – LCOH

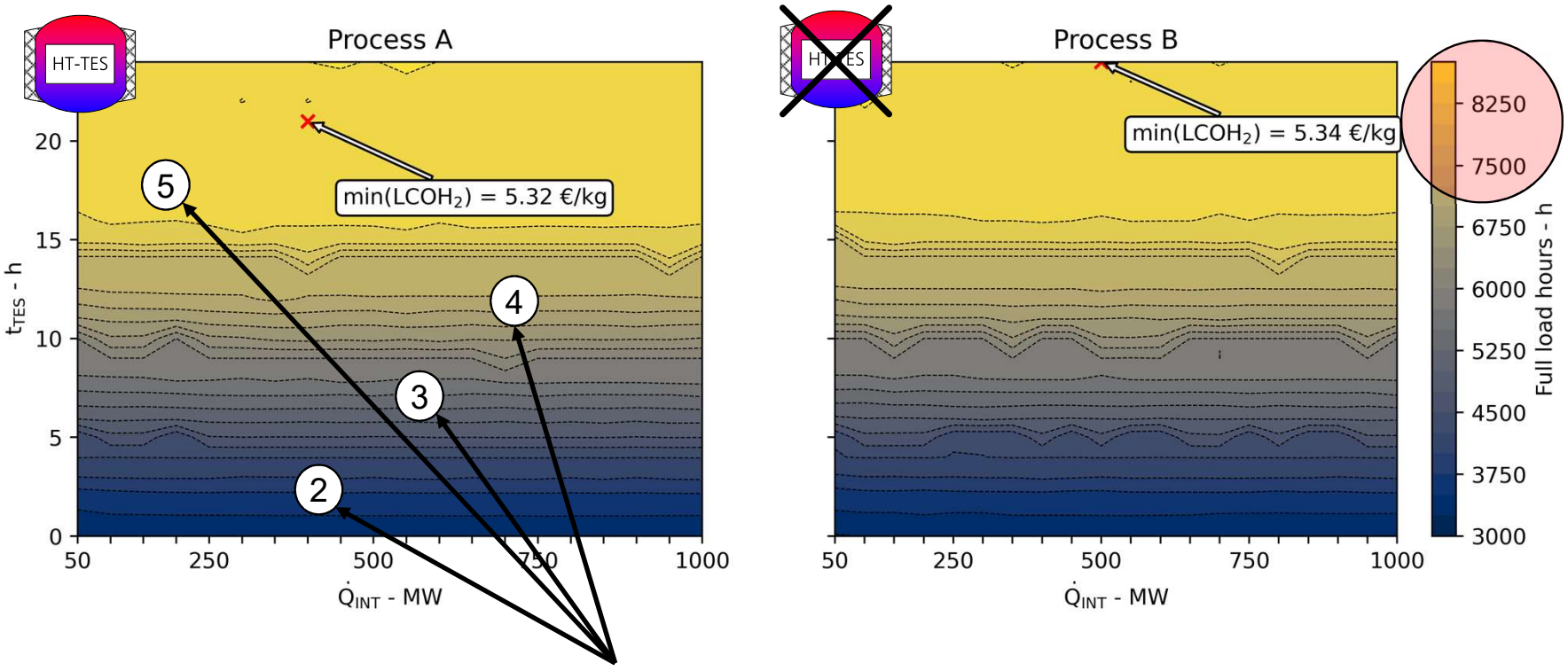


*Electricity price of 50 €/MWh

Impact on the $LCOH_2$

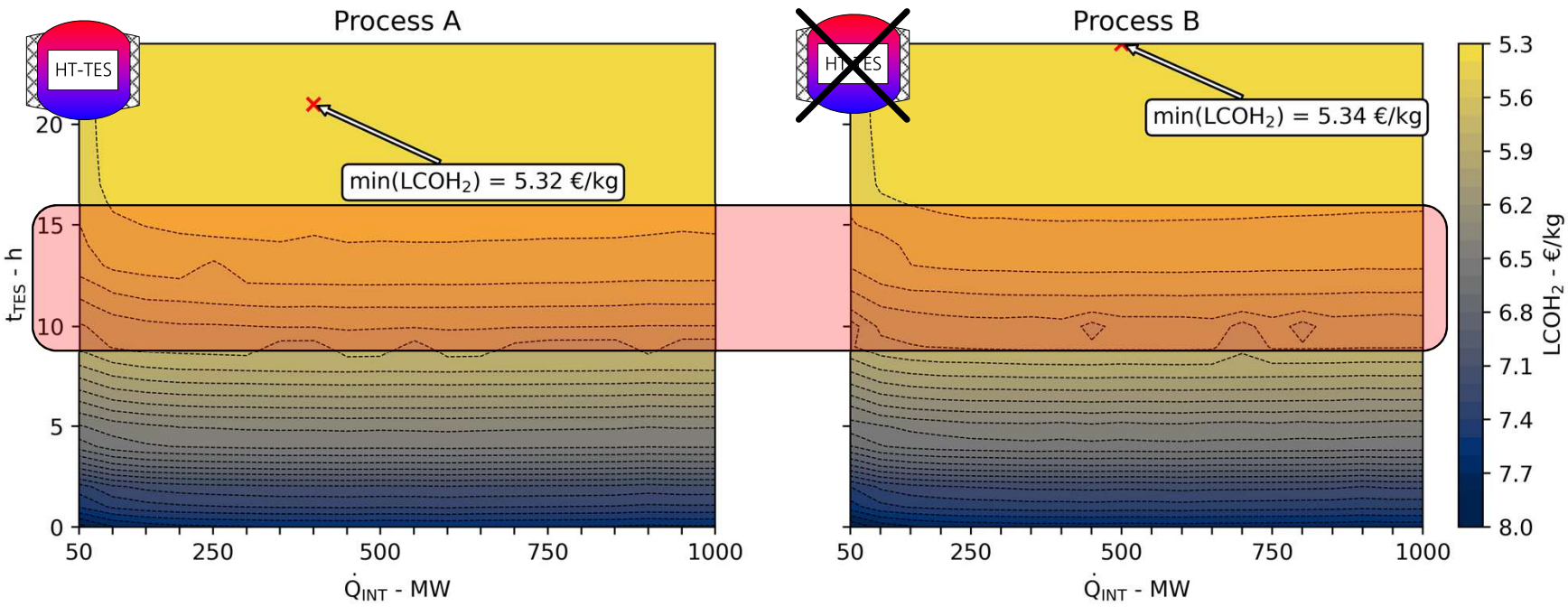


Comparison - Full Load hours



Number of HTE – Stack replacements

Comparison – LCOH

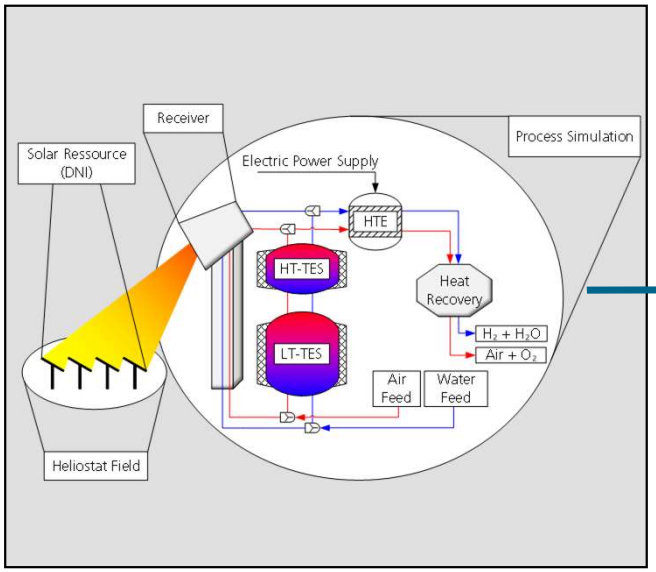


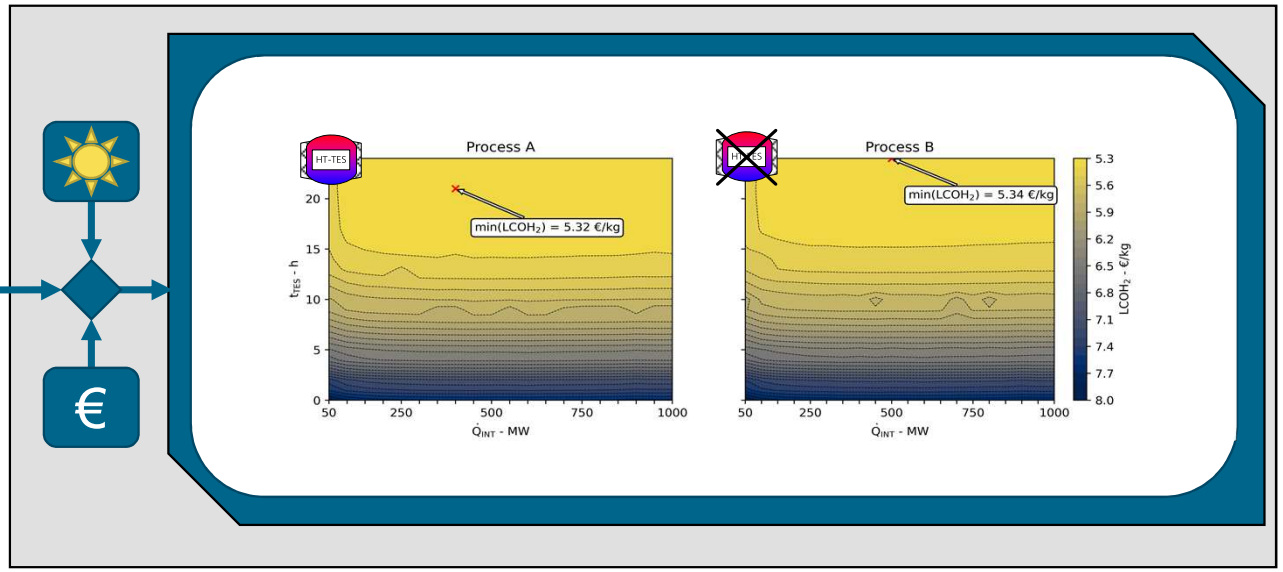
$t_{TES} = 10h, \sim 6300\ \mathrm{FL-h}$	Process A	Process B
$LCOH_2$	$\approx 5{,}71\ €/kg$	$\approx 5{,}77\ €/kg$
$t_{TES} = 15h, \sim 8100\ \mathrm{FL-h}$	Process A	Process B
$LCOH_2$	$\approx 5{,}38\ €/kg$	$\approx 5{,}42\ €/kg$

Summary

Techno-Economic Process Analysis

Steady State Process Simulation	Transient Process Optimization





THANK YOU FOR YOUR ATTENTION!

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Literature

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