Investigation of a Novel Hybrid Heat Pump Concept

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Preface

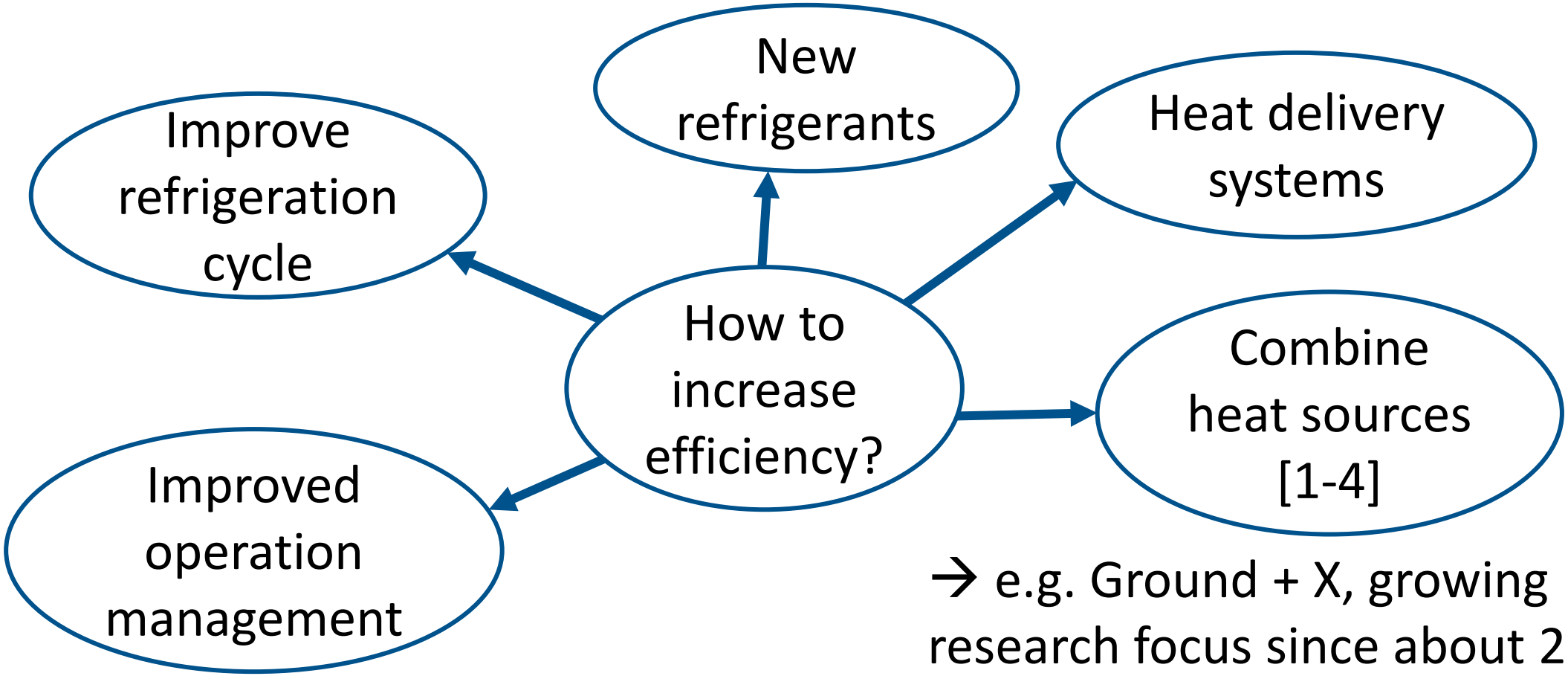
Hybrid Heat Pump usually refers to a system consisting of a heat pump plus gas boiler.

In this talk, I will use it for a **specific dual source heat pump** system to stay consistent to the research project's name ("Hybrid Heat Pump+").

Agenda

1. Introduction
2. Scientific question
3. Methodology
4. Results
5. Outlook

1. Introduction



→ e.g. Ground + X, growing research focus since about 2018 [1]

1. Introduction

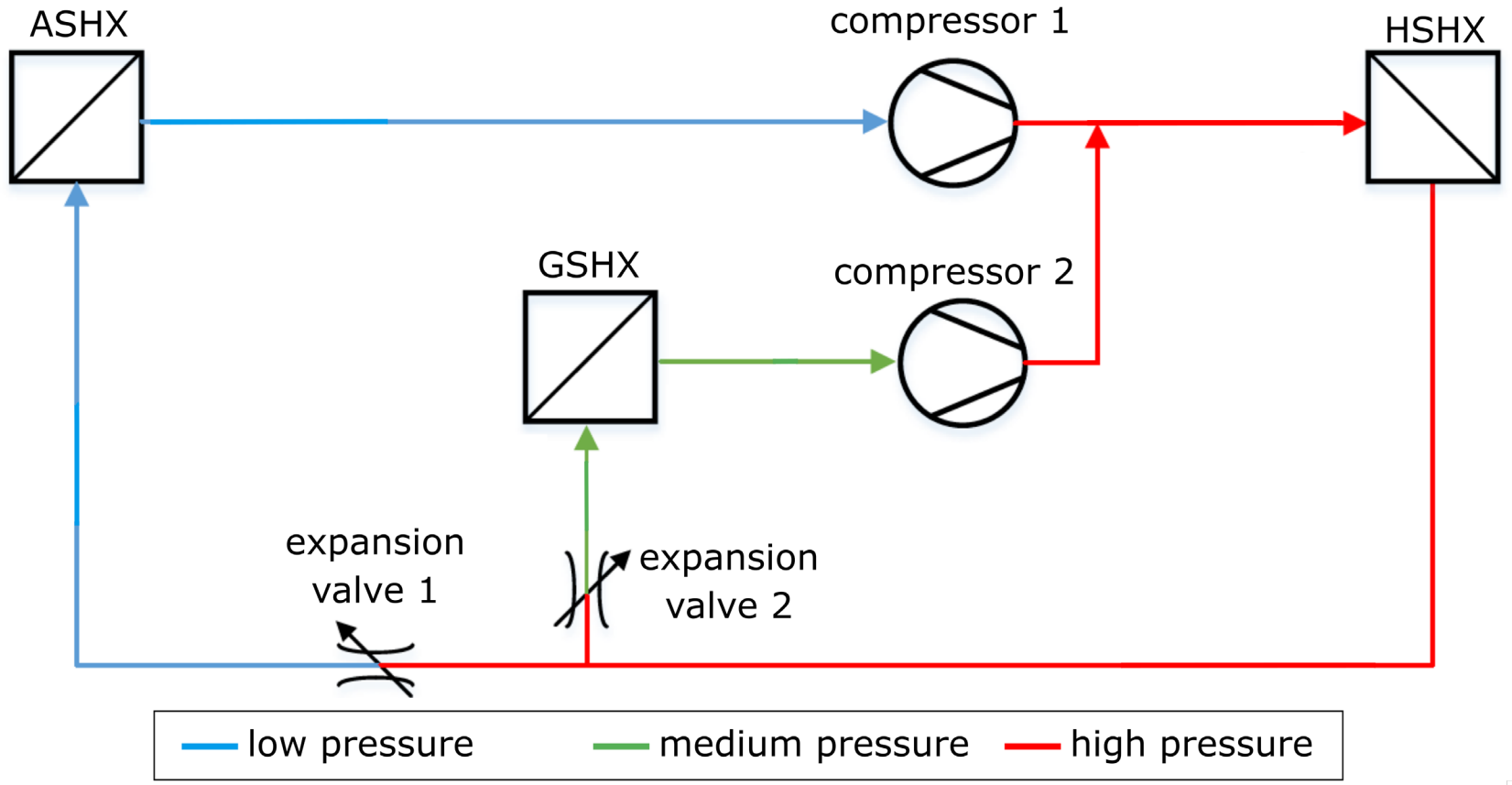
Decreasing dimensions of GSHX is an upcoming criterium [3, 4]:

- Mostly in the form of reduced energy extracted by switching back and forth between the heat sources
- Supposed to open up markets of more densely populated areas (e.g. urban areas)

1. Introduction

Is it possible to reduce required power of the GSHX?

→ Parallel operation of both heat sources (e.g. [5])



ASHX: air source heat exchanger; GSHX: ground source heat exchanger; HSHX: heat sink heat exchanger [6]

2. Research question

How does (efficient) parallel operation affect:

a) Efficiency of the Hybrid Heat Pump?

b) Dimensioning of the GSHX (both energy and power)?

3. Methodology

Experimental results [6]

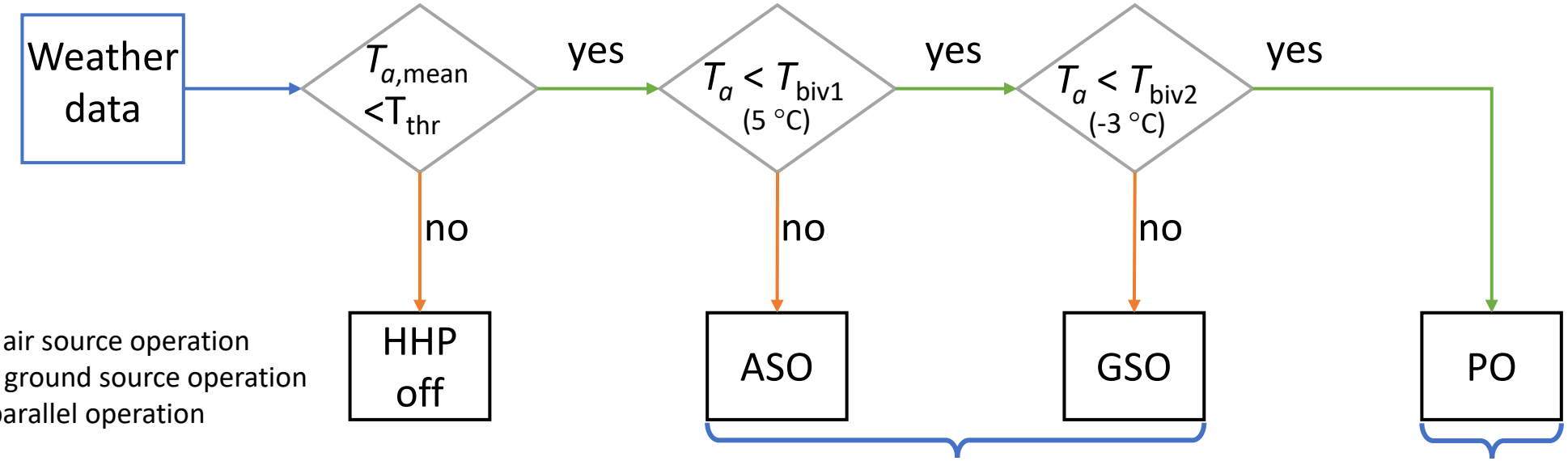
Hybrid Heat Pump model

Annual simulation

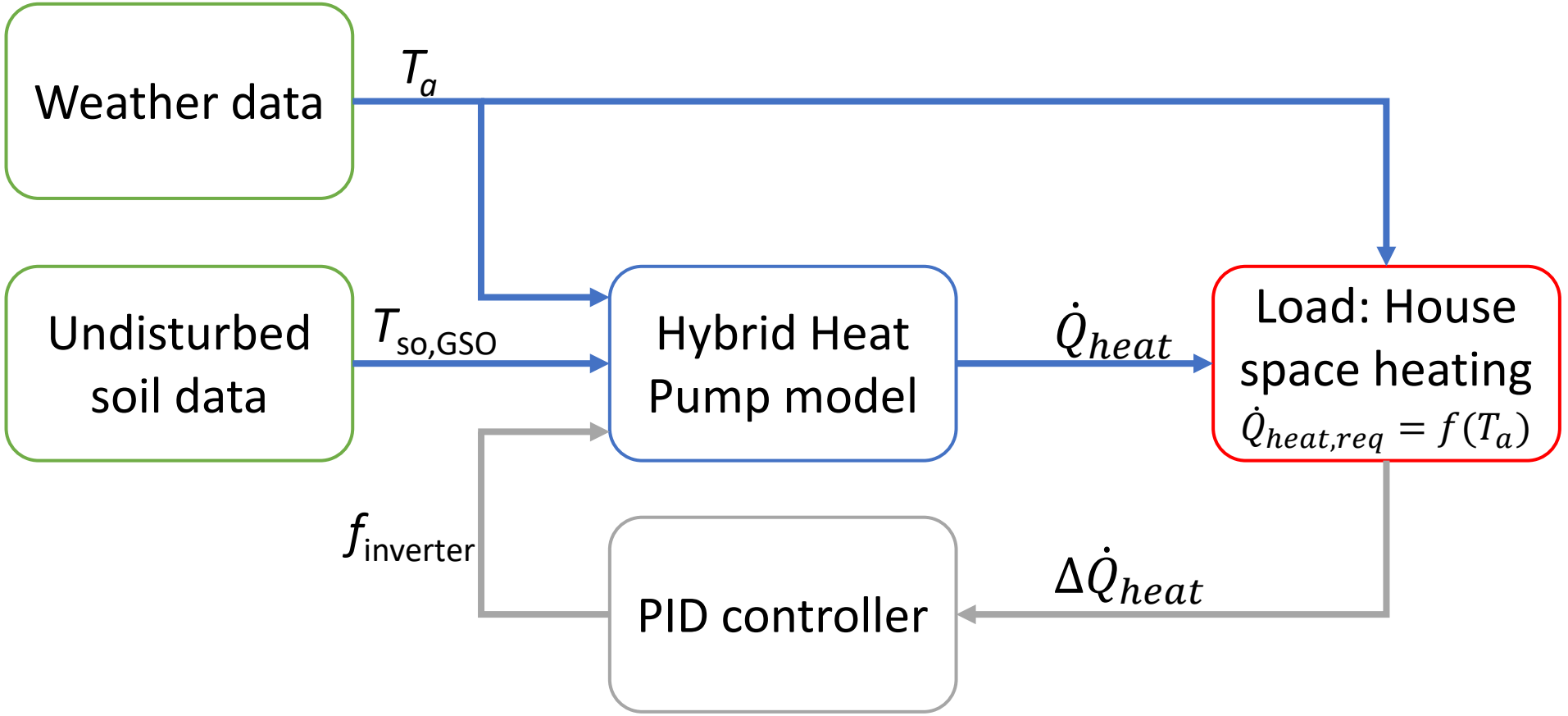
Comparison with conventional GSHP

3. Methodology

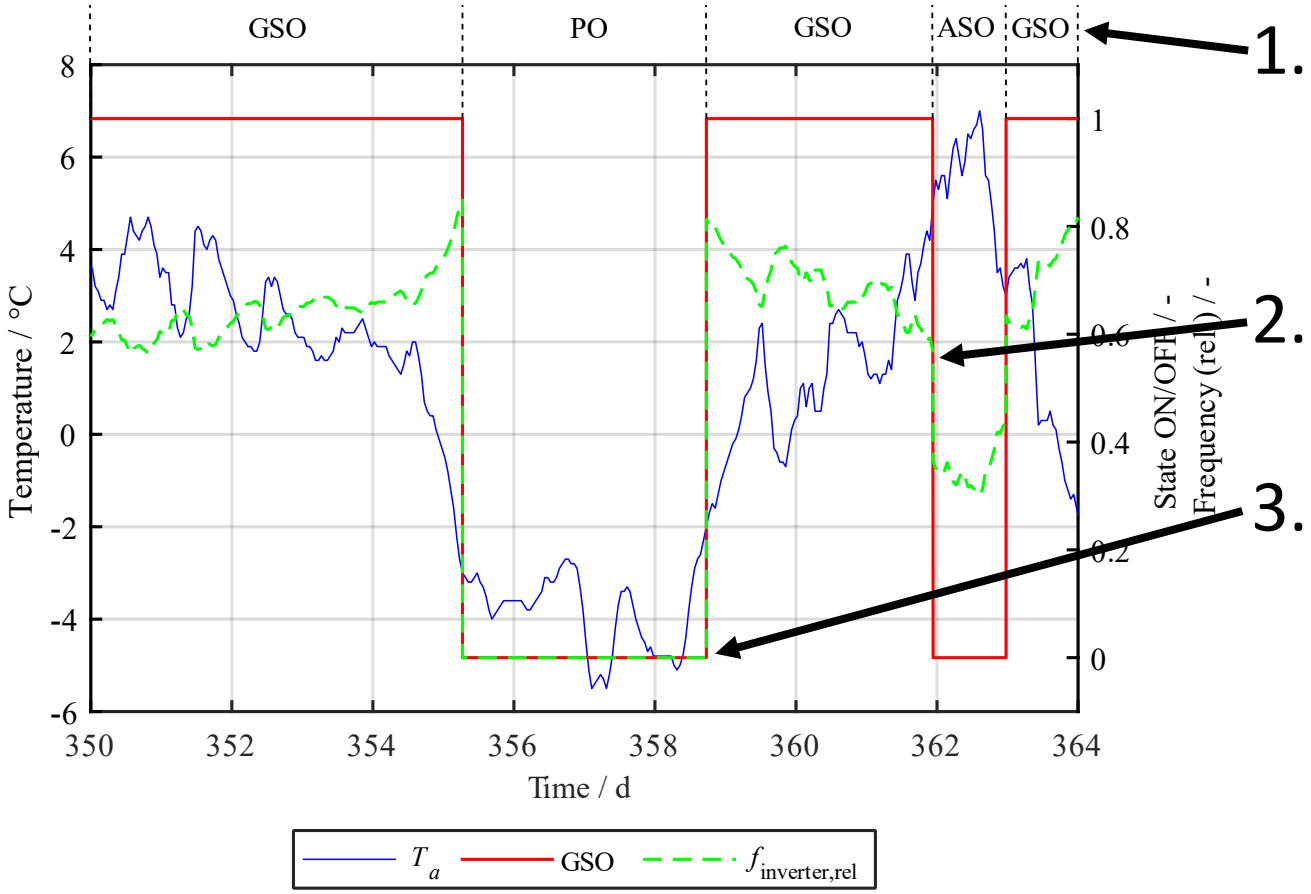
Hybrid Heat Pump model: Choose operation mode according to T_a and bivalence points T_{biv}:



3. Methodology

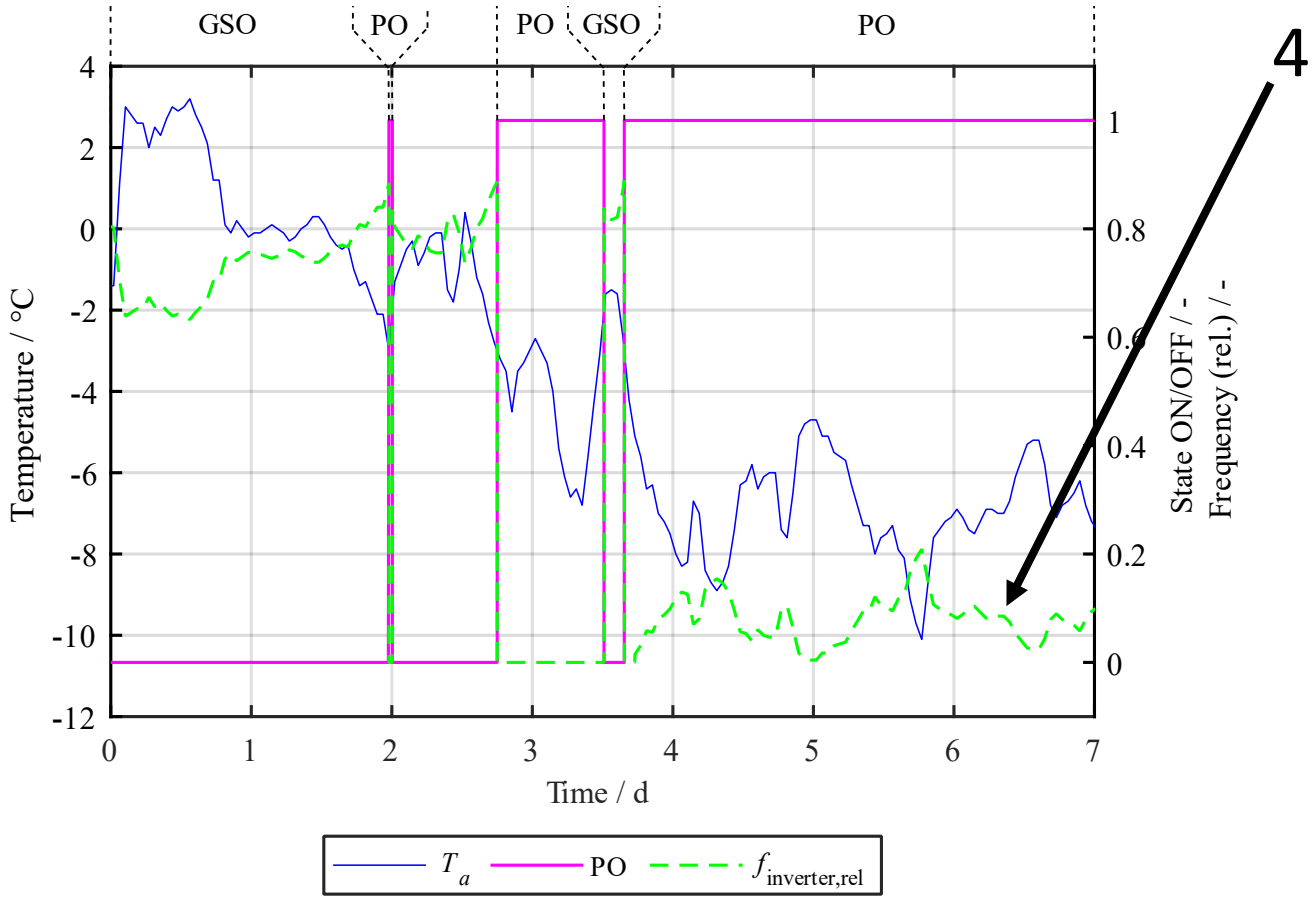


4. Results



1. Switching between the operation modes worked according to T_a
2. Inverter control operated quickly and stable
3. PO activated at too high T_a: inverter reduces air source operation to naught → examine bivalence point 2

4. Results



4. PO activated properly at T_a: inverter controlled air source operation → examine bivalence point 2 **according to ground source temperature/ time of the year**

4. Results

Value	Unit	HHP	GSHP
Heating energy	MWh	18.9	
Seasonal Performance Factor	-	4.37	4.27
Energy extracted from the GSHX	MWh	8.9	14.4
Cooling power on GSHX	kW	4.5	5.6

- SPF increases slightly by about 2 %
- Energy extracted from GSHX reduced to about 62 %
- Cooling power on the GSHX reduced to about 80 %

5. Outlook

- Efficiency increased, but more realistic comparison necessary (electric heating)
- Energy and power on GSHX limited by Hybrid Heat Pump (with 2 compressors) → smaller sizing possible, but: periphery was simplified and must be expanded upon (especially DHW and ground source model)
- Hybrid Heat Pump model requirements:
  - Analyze bivalence point adaptation
  - Improve parallel operation modelling
  - Improve inverter control
- In general: economic evaluation necessary

References

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Thank you for the attention!

Any questions?

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