

Multi-source heat pumps: the IDEAS project experience

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www.horizon2020ideas.eu



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Novel building **I**ntegration **D**esign for increased **E**fficiencies
in **A**dvanced climatic tunable renewable energy **S**ystems

two test cases at the University of Ferrara

small scale prototype
at TekneHub **Laboratory**



large scale prototype at the Department of Biomedical
and Specialties Surgical Sciences **snackbar**



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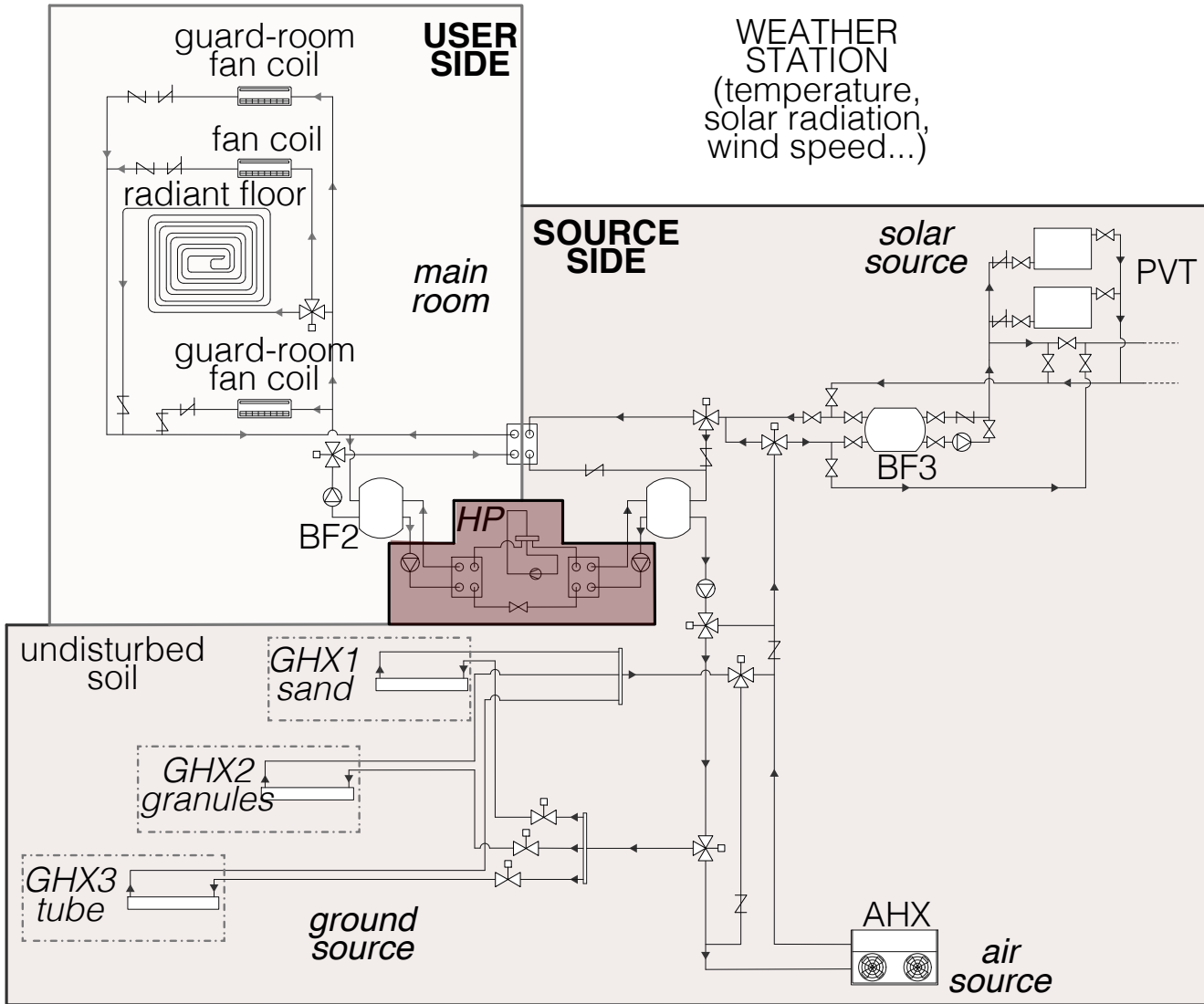


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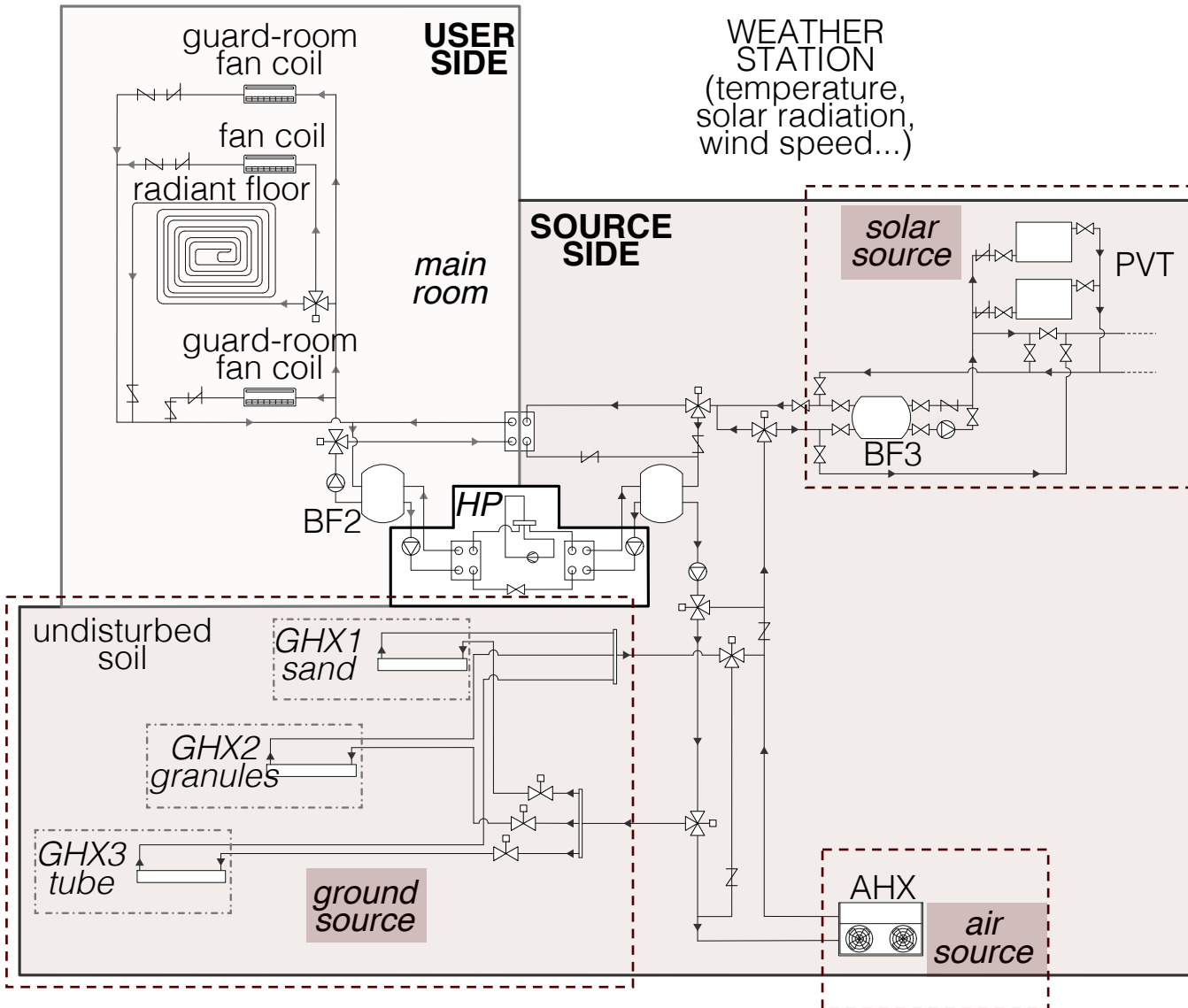


Multi-source heat pumps: the IDEAS project experience

5 kW invertible water-to-water HP



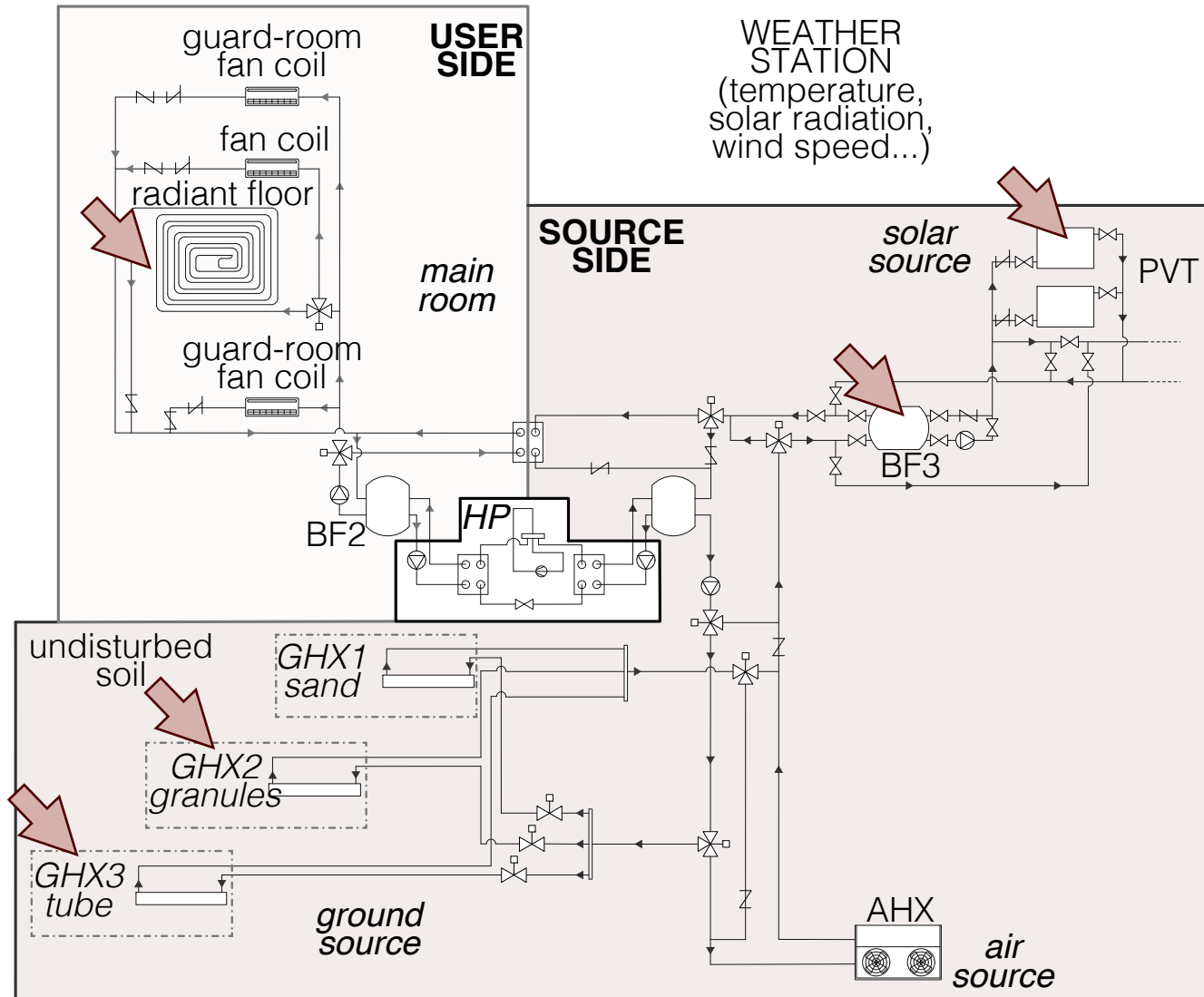
SMALL SCALE LAYOUT



5 kW invertible water-to-water HP

- three thermal sources:
- ground (**GHX**)
 - air (**AHX**)
 - sun (**PVT**)
- that can work both in series and in parallel

SMALL SCALE LAYOUT



5 kW invertible water-to-water HP

three thermal sources:

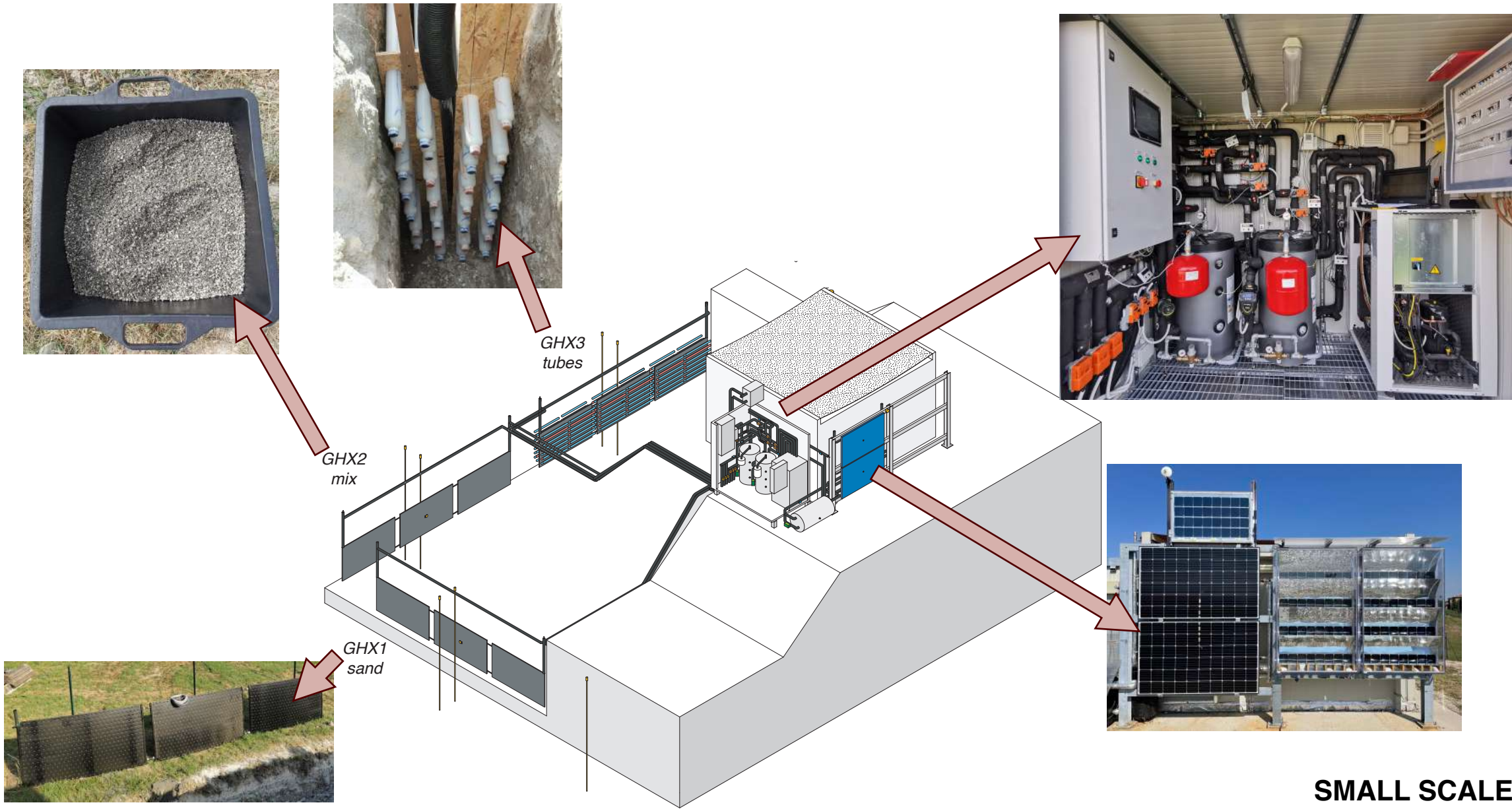
- ground (**GHX**)
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that can work both in series and in parallel

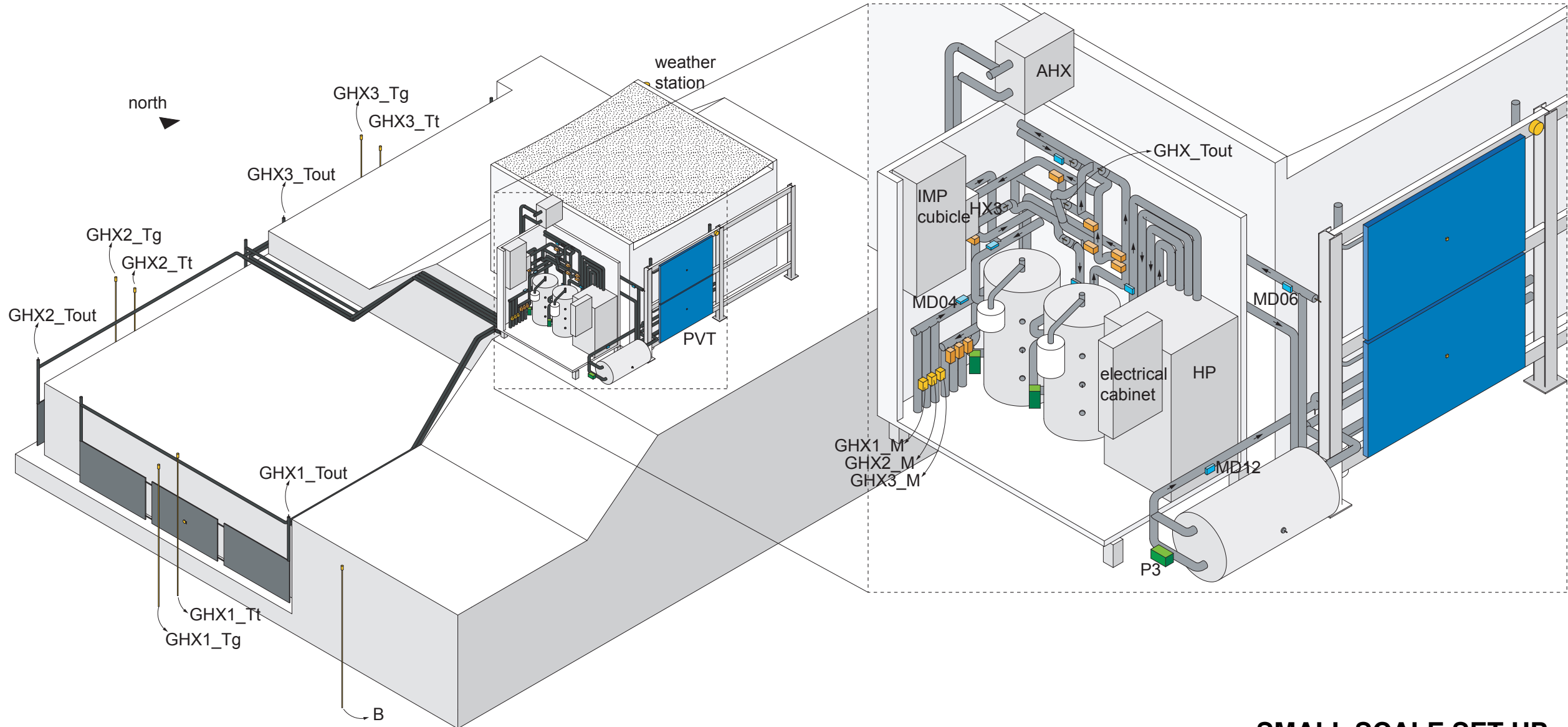
PCM integrated:

- as backfilling of **GHX** panels
- coupled with prototype **PVT** panels
- stored in a buffer tank (**BF3**)
- in the radiant floor (**RF**)

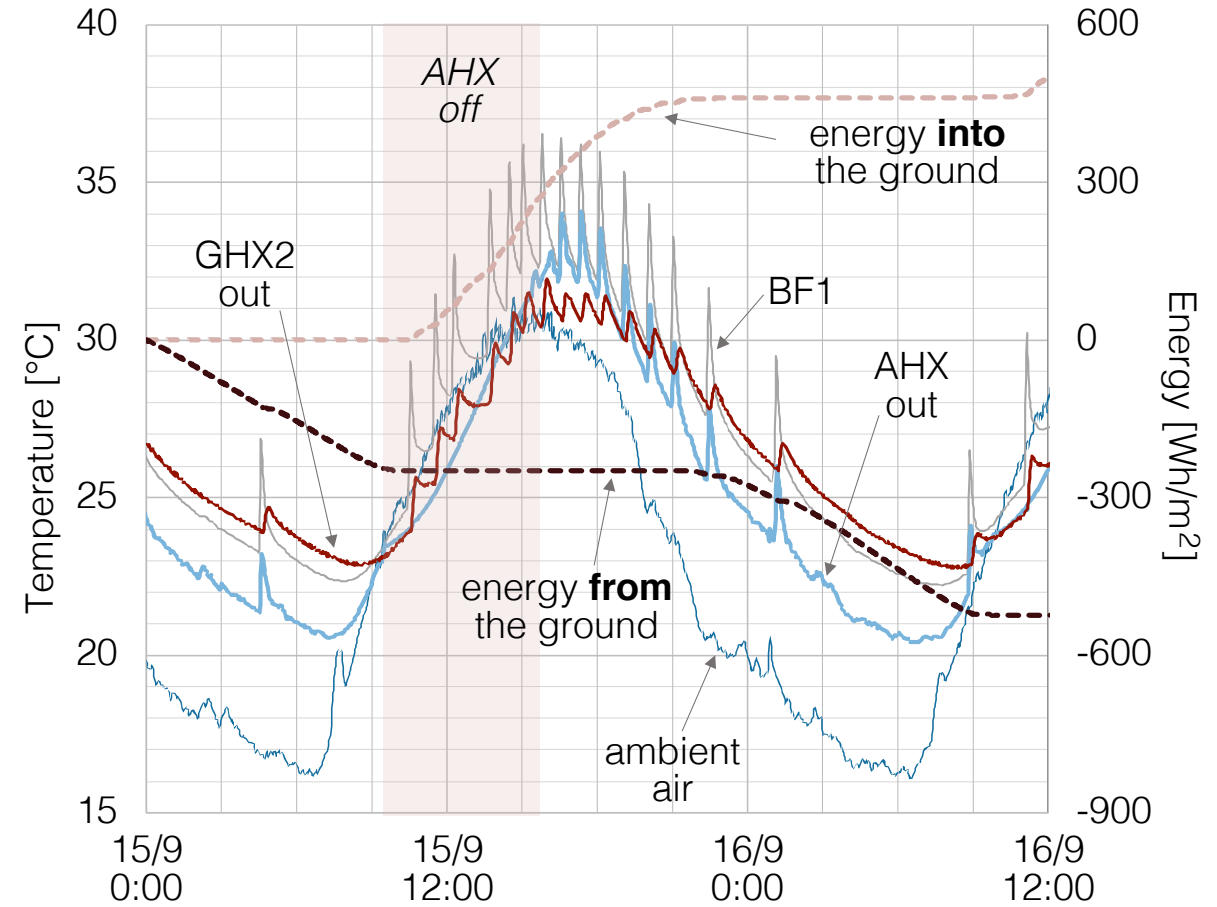
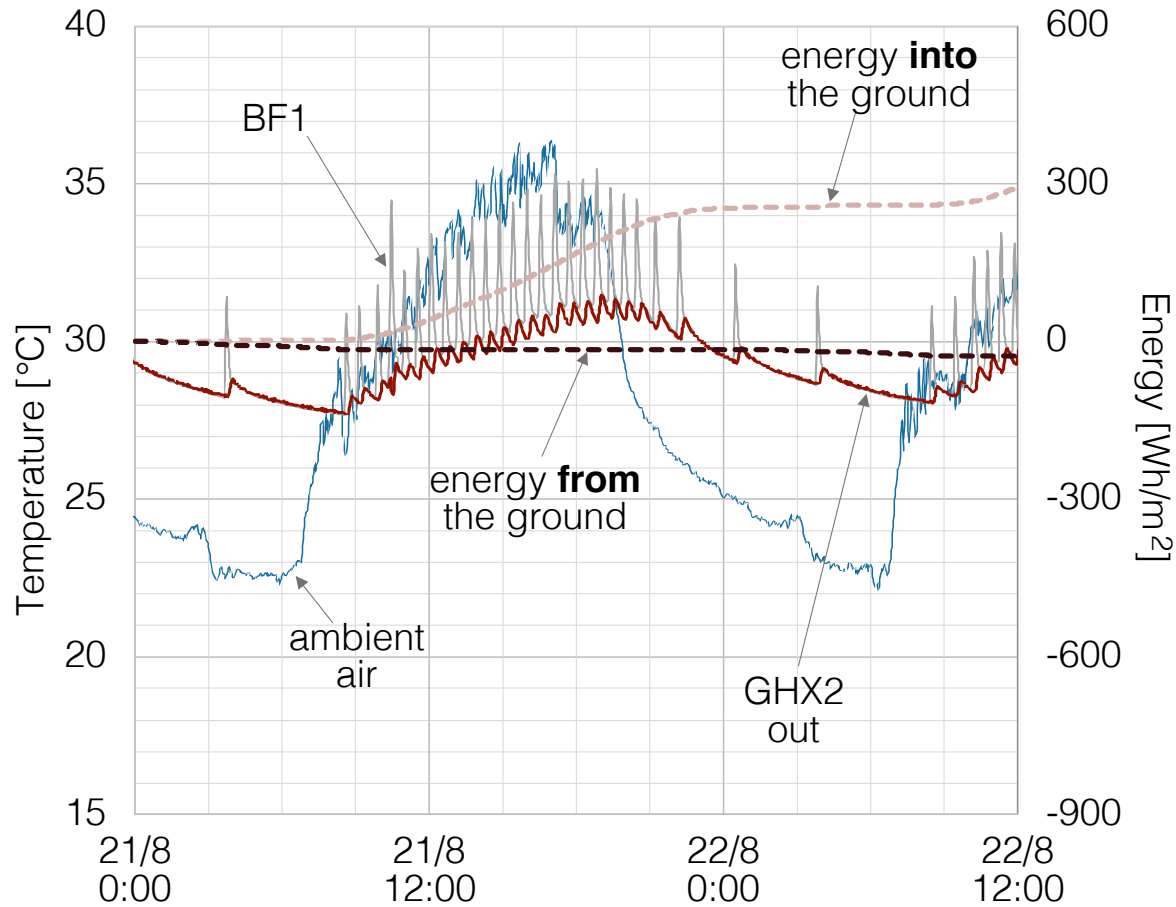
SMALL SCALE LAYOUT



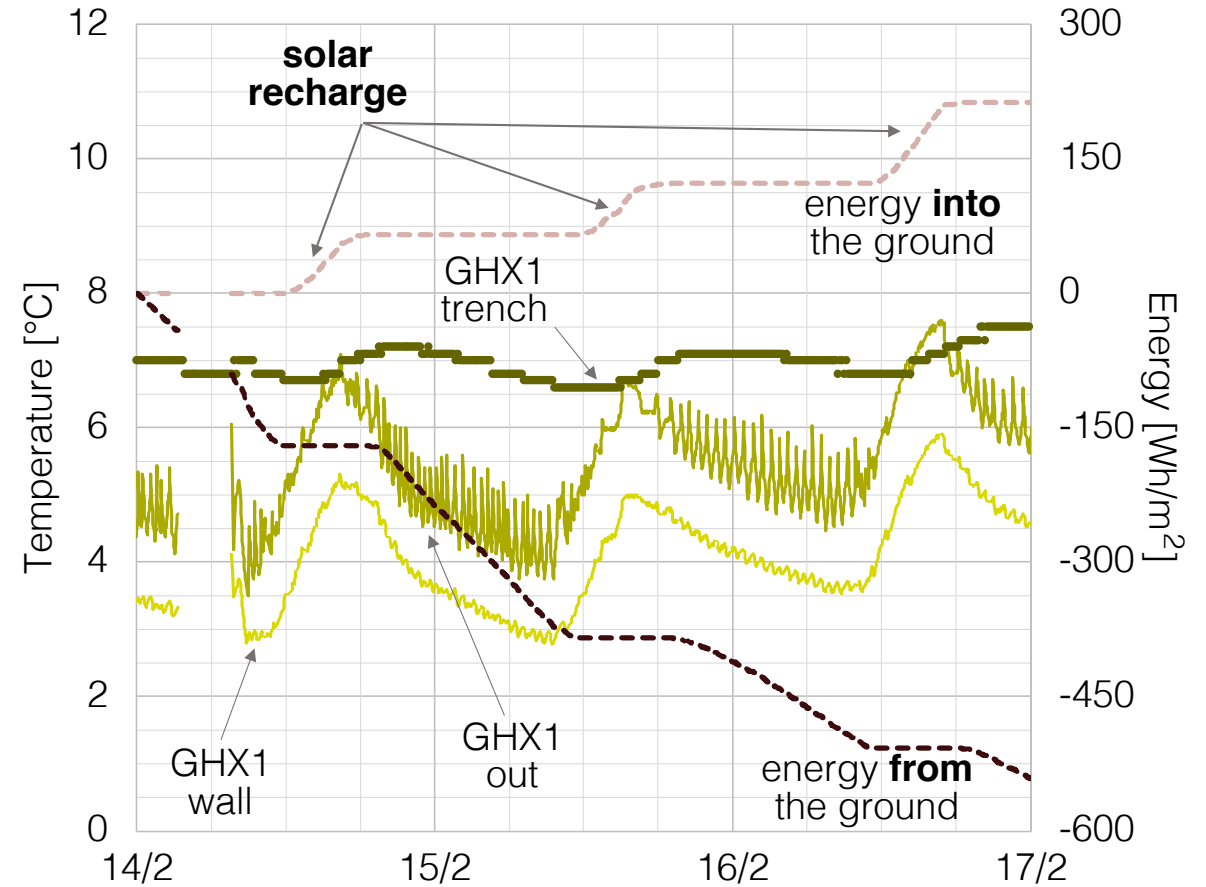
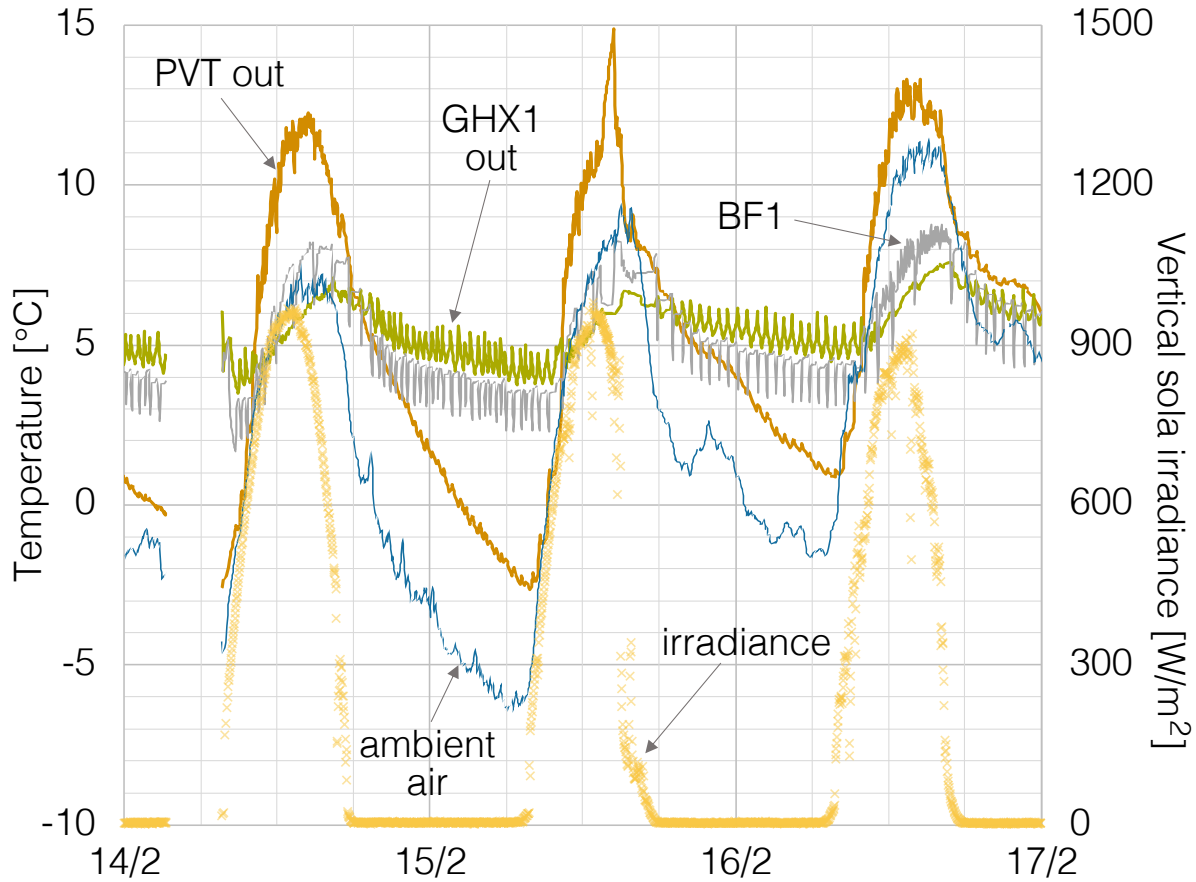
SMALL SCALE SET UP



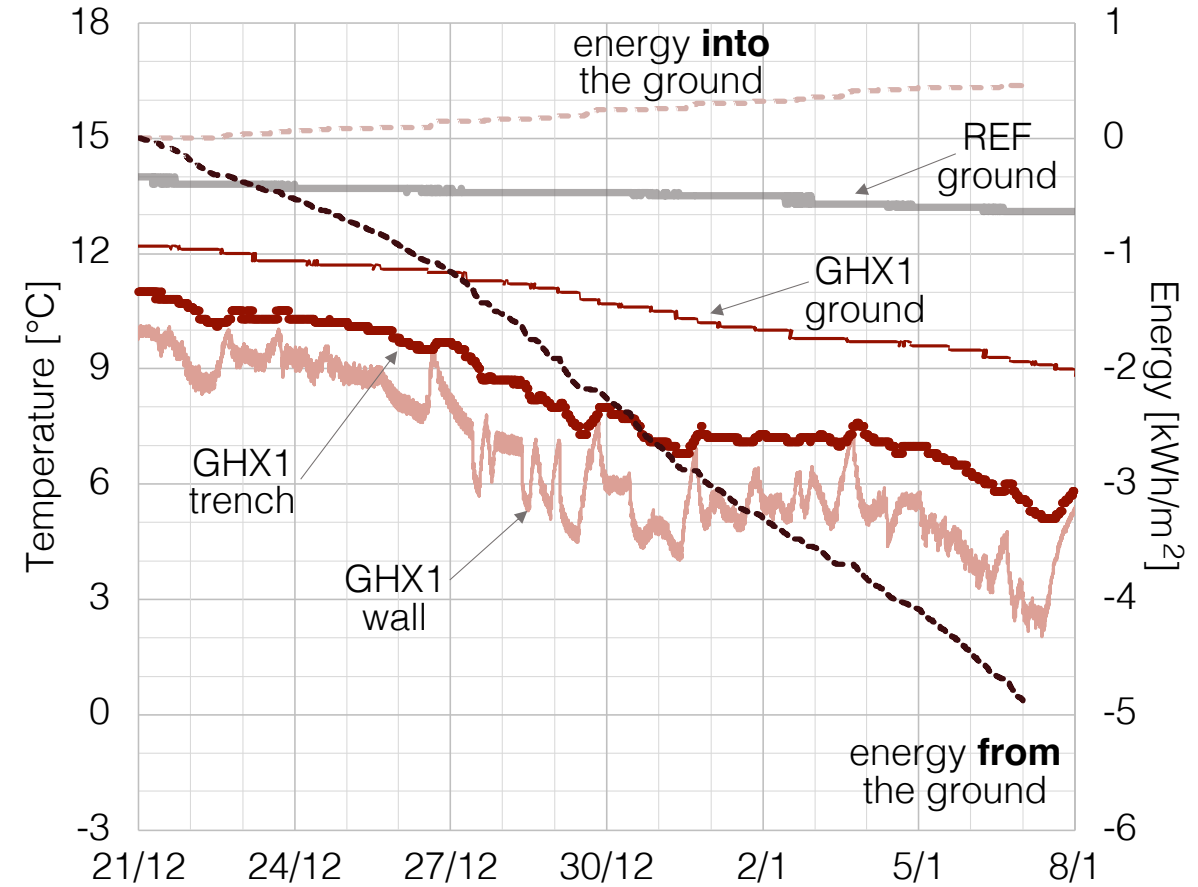
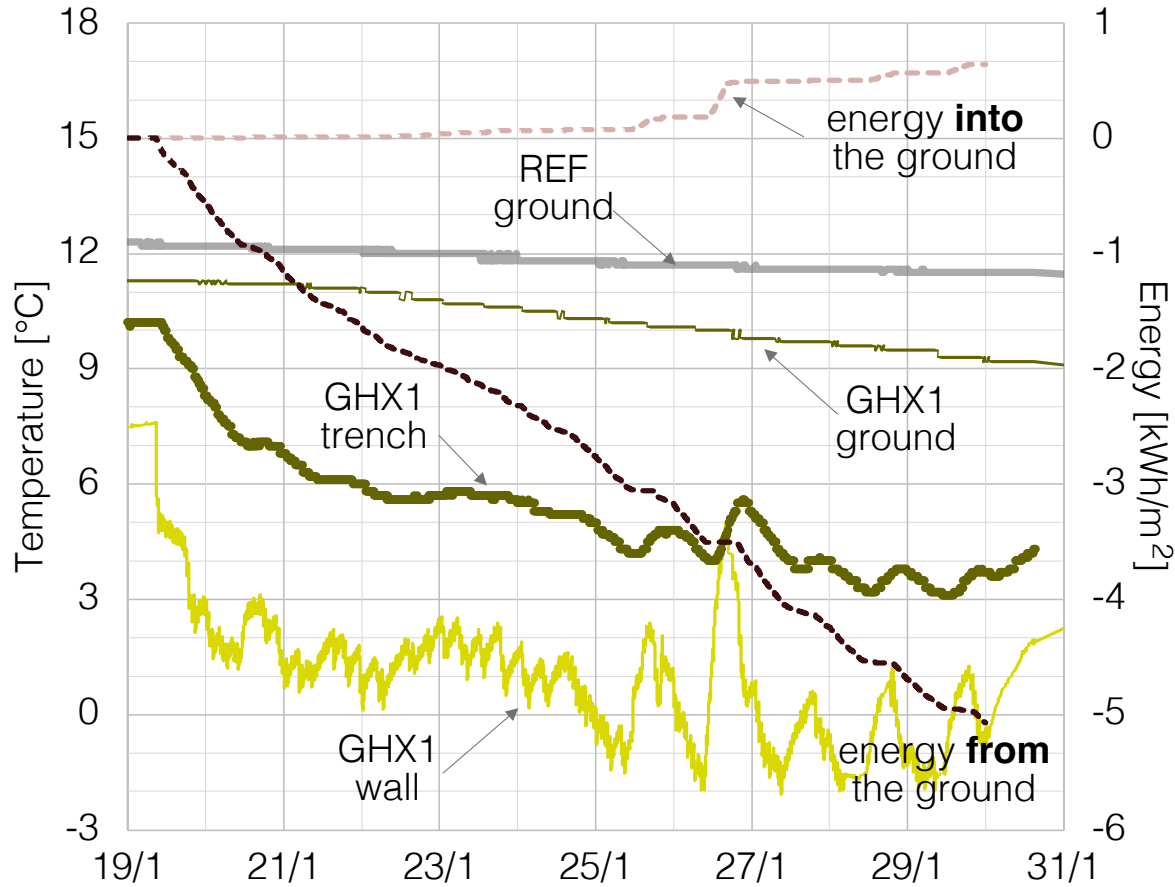
SMALL SCALE SET UP



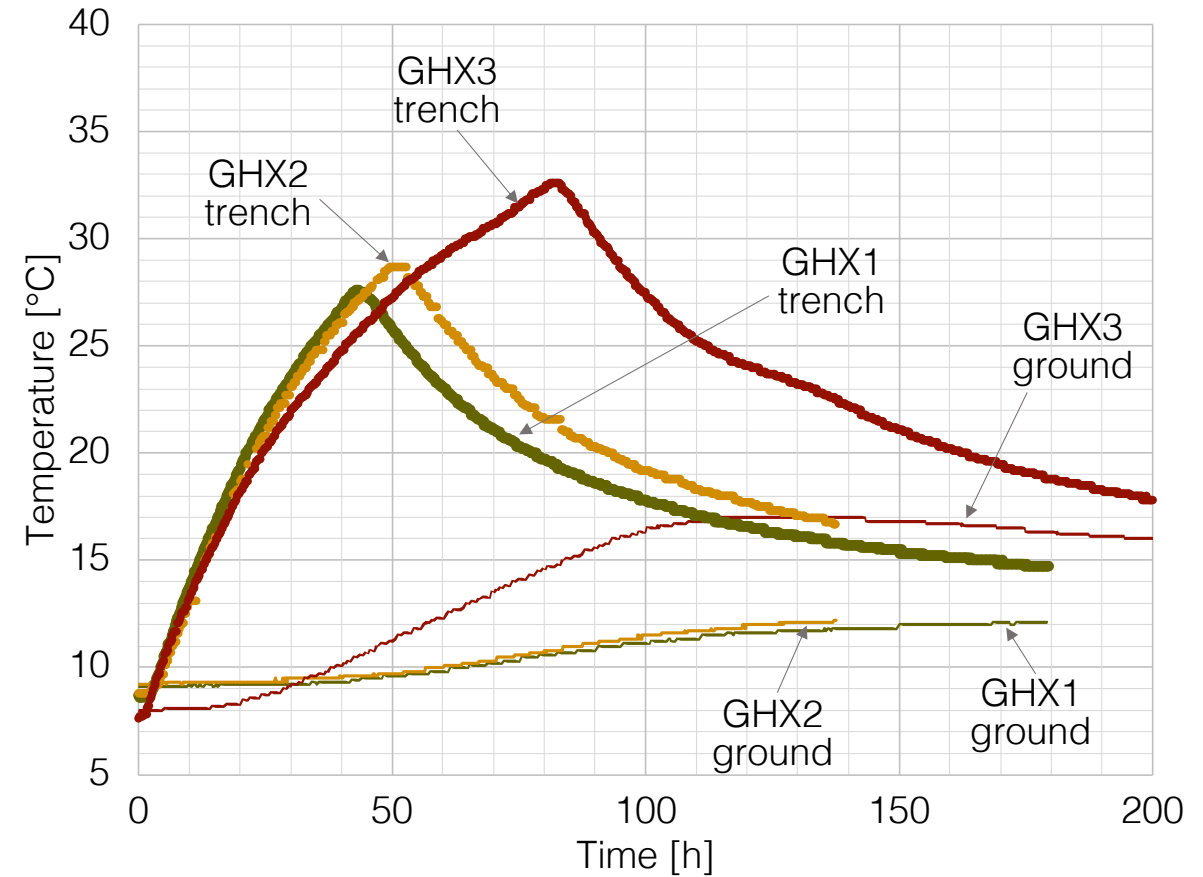
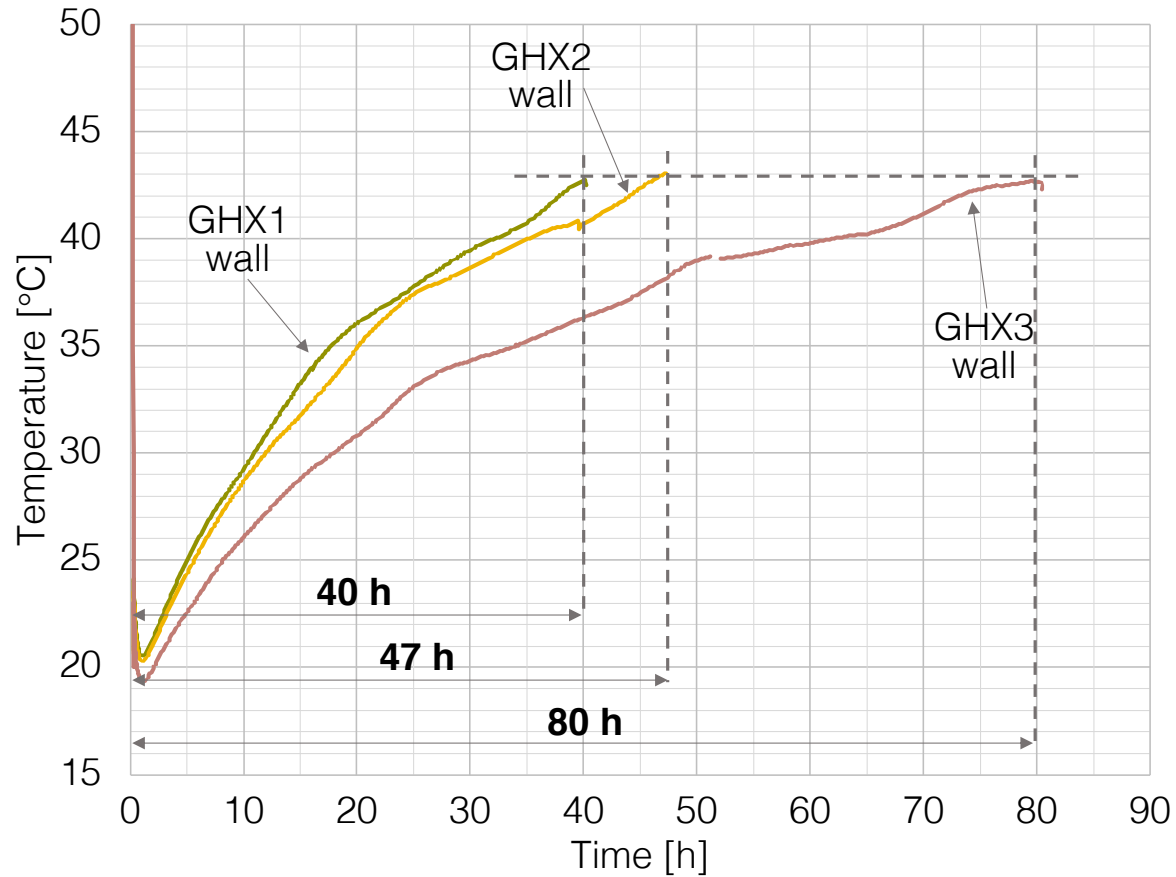
GHX THERMAL DISCHARGE THROUGH AHX



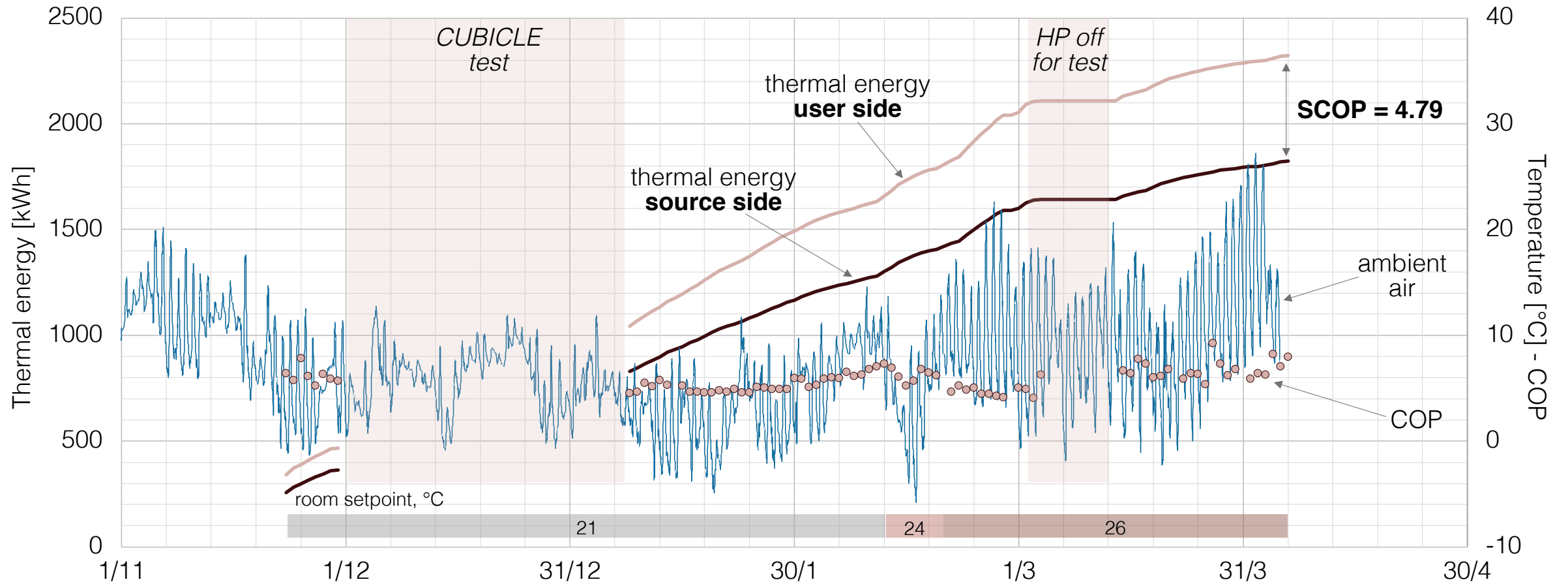
GHX THERMAL CHARGE THROUGH PVT



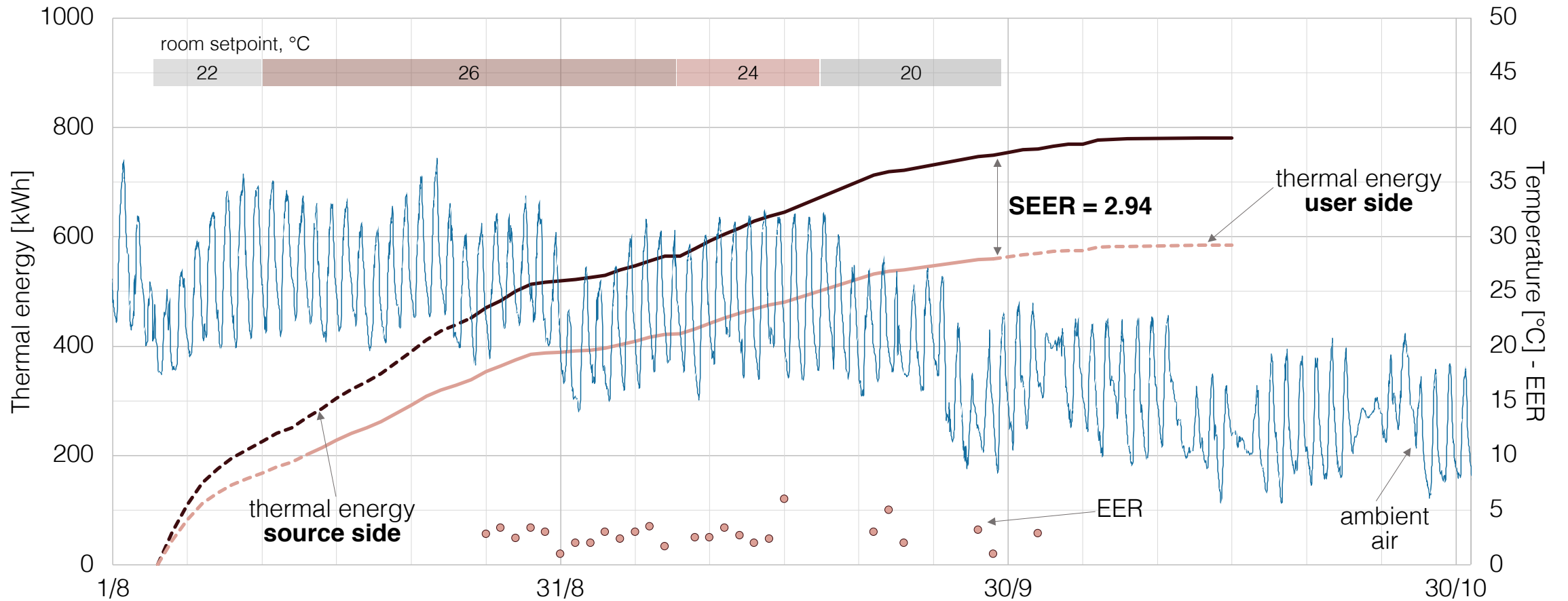
EFFECT OF PCM AS GHX BACKFILLING – “winter” PCM



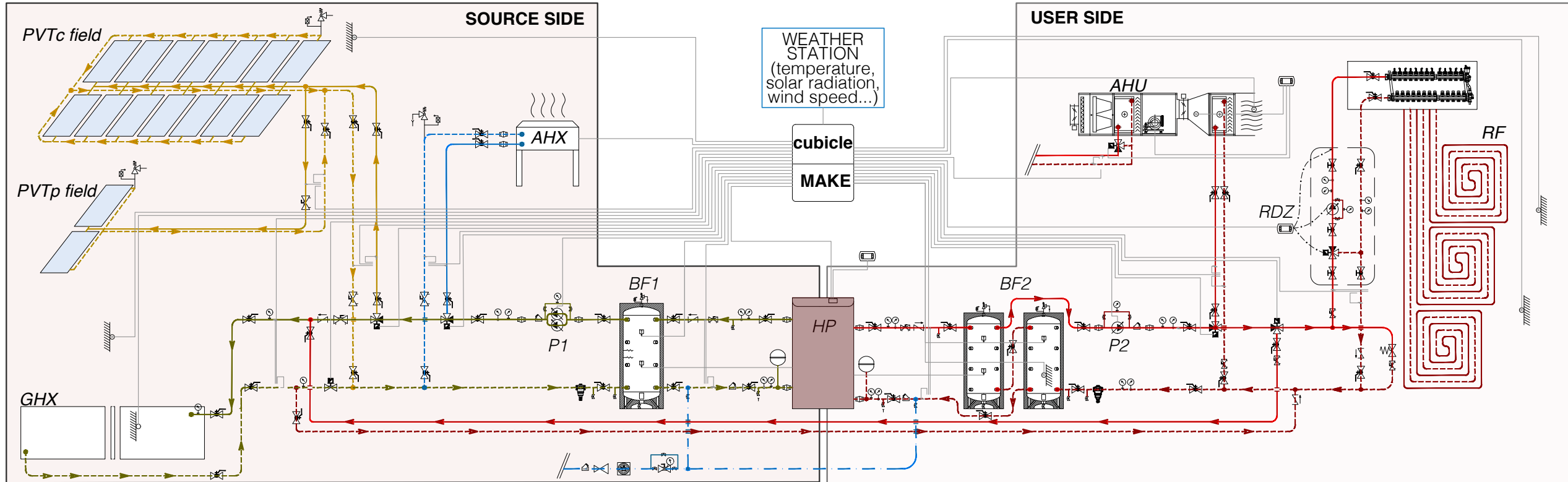
EFFECT OF PCM AS GHX BACKFILLING – “summer” PCM



WINTER PERFORMANCE

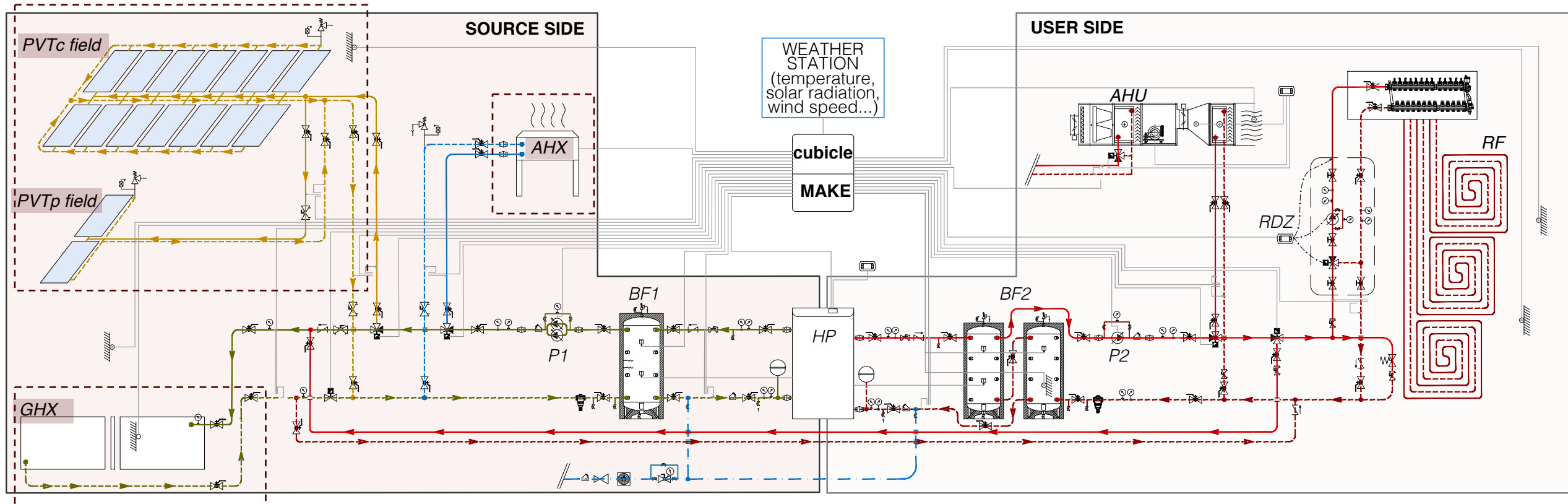


SUMMER PERFORMANCE



25 kW invertible
water-to-water HP

LARGE SCALE SET UP



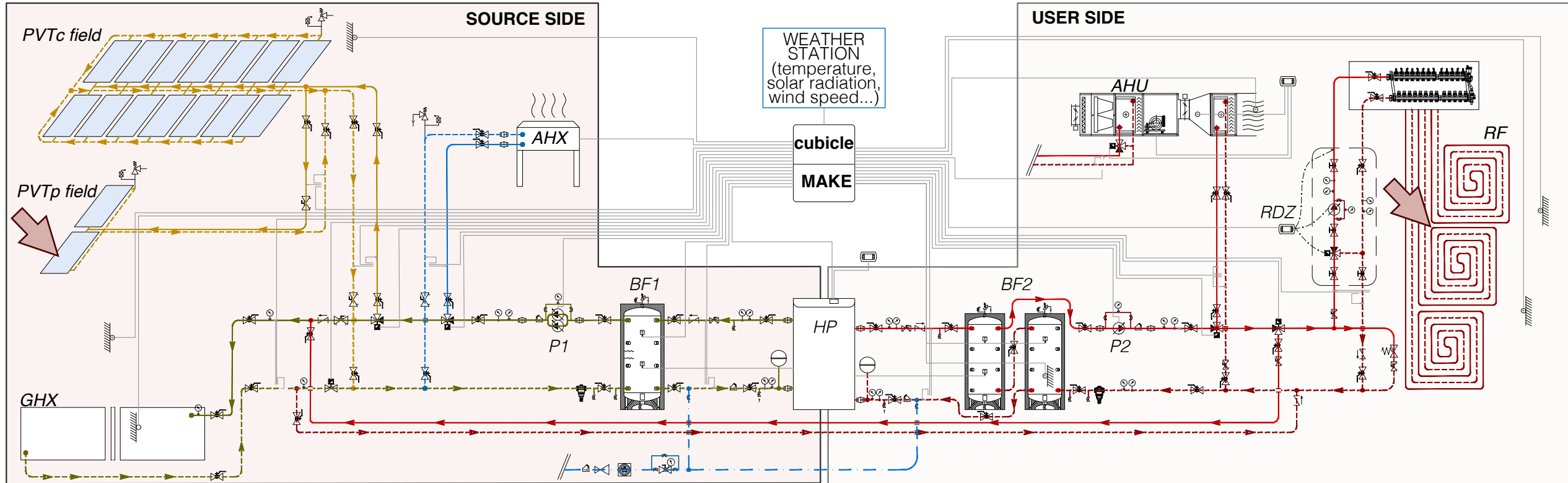
25 kW invertible
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three thermal sources:

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- sun (**PVT**)

that work in series

LARGE SCALE SET UP



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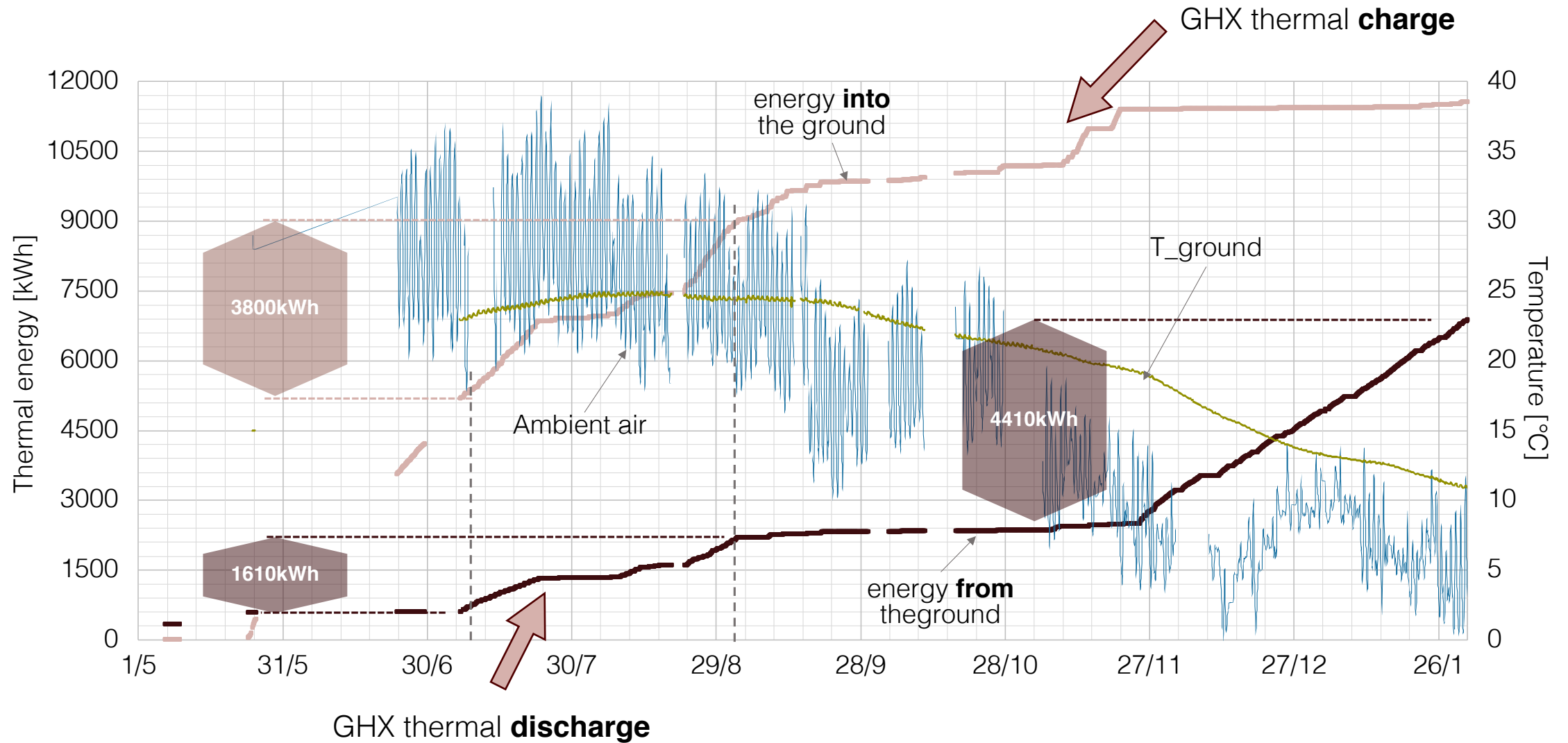
- ground (**GHX**)
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that work in series

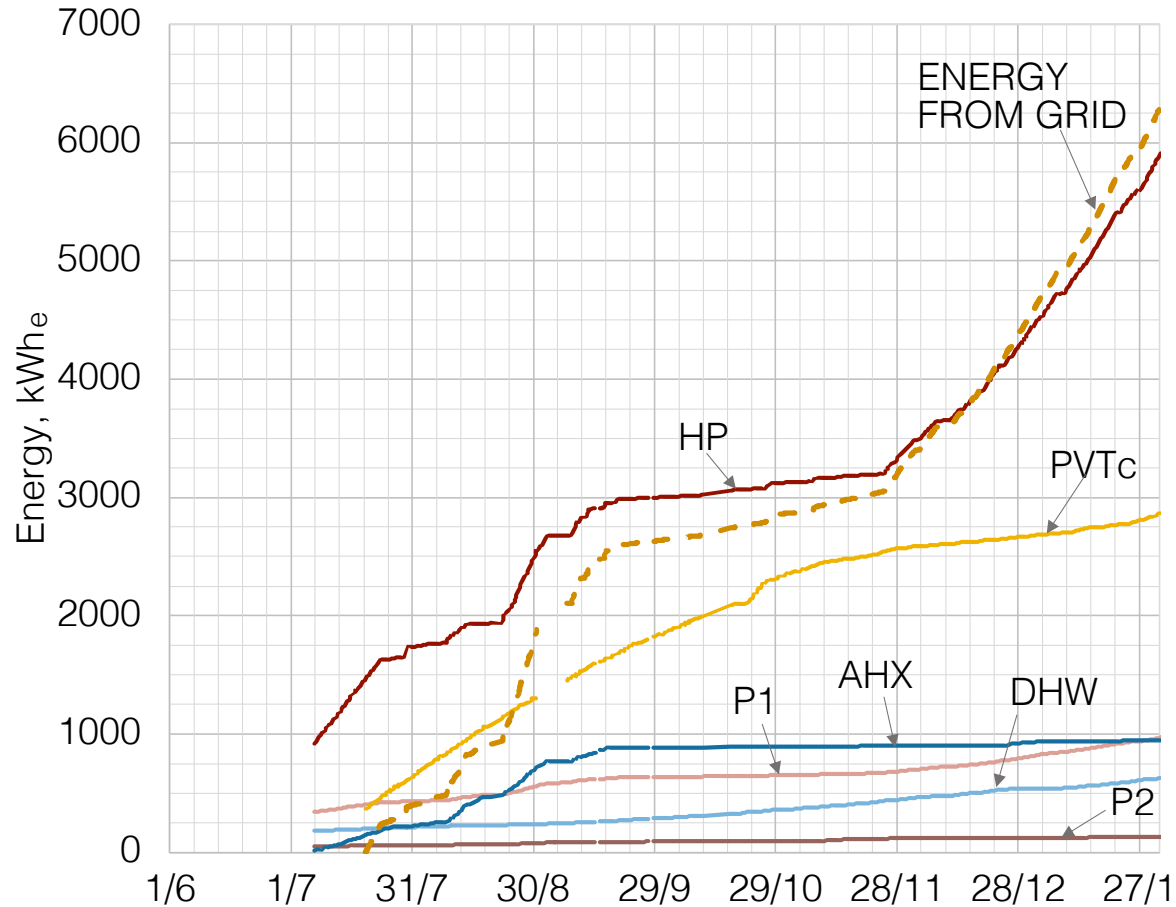
PCM integrated:

- coupled with prototype **PVT** panels
- in the radiant floor (**RF**)

LARGE SCALE SET UP



GHX BEHAVIOUR



- **declared** in the datasheet
- obtained after **monitoring**
- **obtainable***

improvement

*improving internal circulators and with PVT electrical production

	EER	COP
- declared in the datasheet	3.26	3.69
- obtained after monitoring	3.82	3.68
- obtainable*	4.99	4.21
improvement	+ 35%	+ 12%

OVERALL PERFORMANCE

- GHX cheap solution both for **sink and/or source** and **short term energy storage**
- commercial PVT excellent solution to cover **auxiliary needs' energy requirement**
- prototype automation allowed optimisation of thermal sources (GHX **de-superheating** in summer and **de-supercooling** in winter by coupling with AHX or PVT)
- prototype automation allowed the system to reach **good COP** and **EER**
- PCM in GHX **increased soil TES**, but benefit strictly related to mass → too expensive at this moment

CONCLUSIONS

HP_sim&app23 Carnot User Meeting 2023



thank you



June 22-23 2023,
Bologna