Performance of a Hybrid HVAC-Integrated Thermal Storage Device

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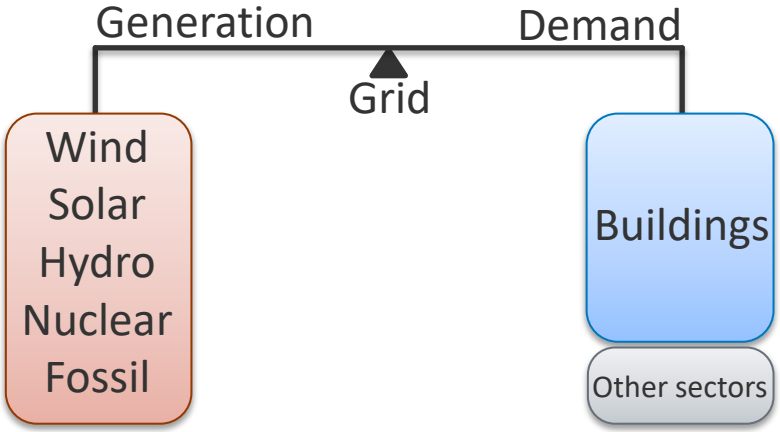
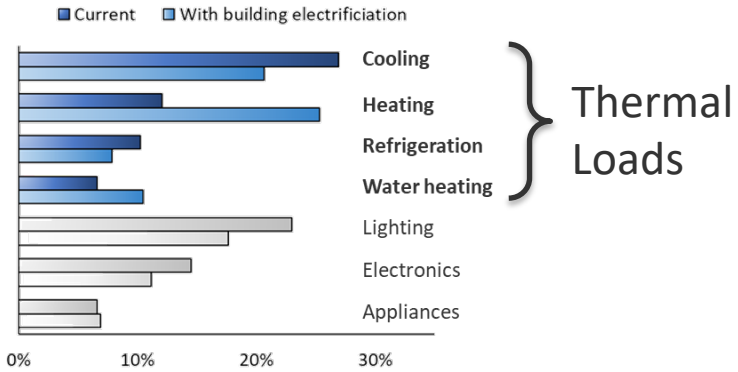
2021 ASME Summer Heat Transfer Conference

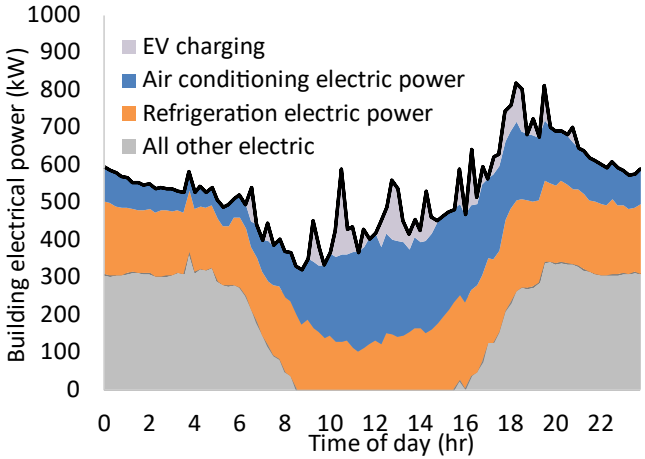
Why thermal storage?





There is a need for more flexible (and higher power) thermal storage.

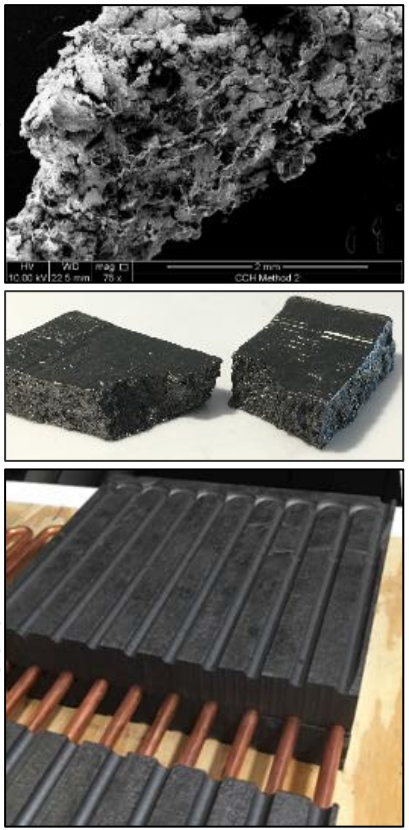
Building + PV + EV charging

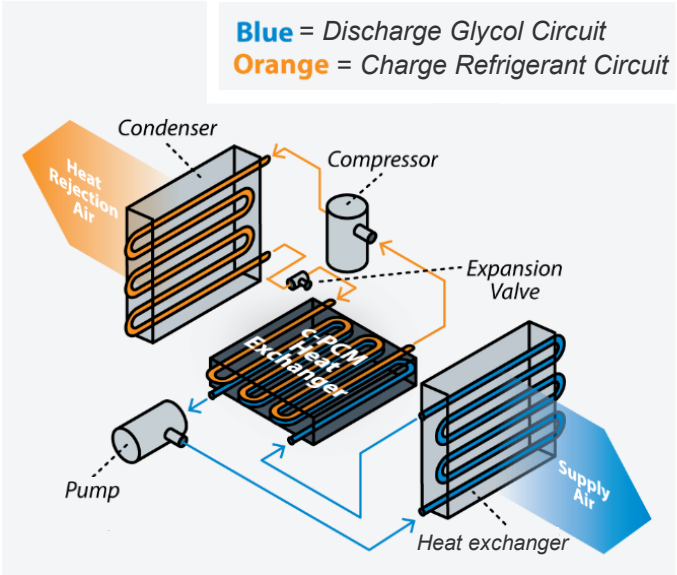


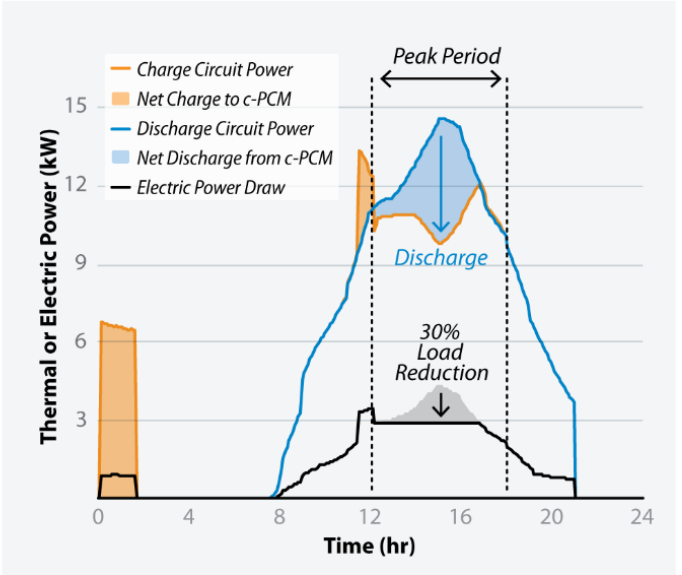
Thermal storage components

*Patent No: US 10,648,743

PCM composite material:



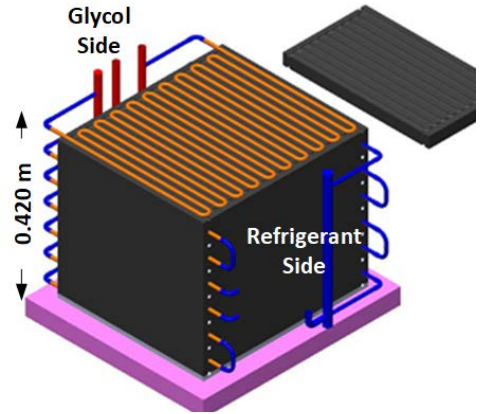


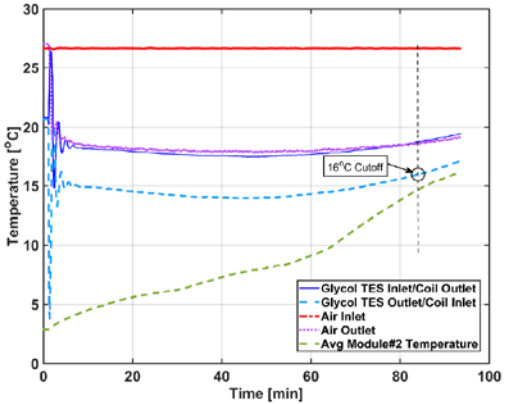


- Integrating high thermal conductivity PCM composites into directly into HVAC system can ***improve economics and boost environmental benefits***
- Makes systems more flexible during grid peak periods

Improvements over previous designs

*Patent No: US 10,648,743

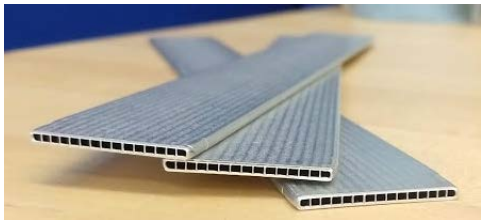


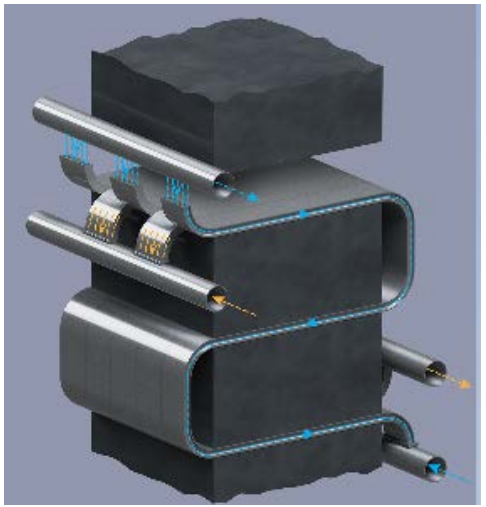


Goyal et al. (2021) *International Refrigeration and Air Conditioning Conference at Purdue*

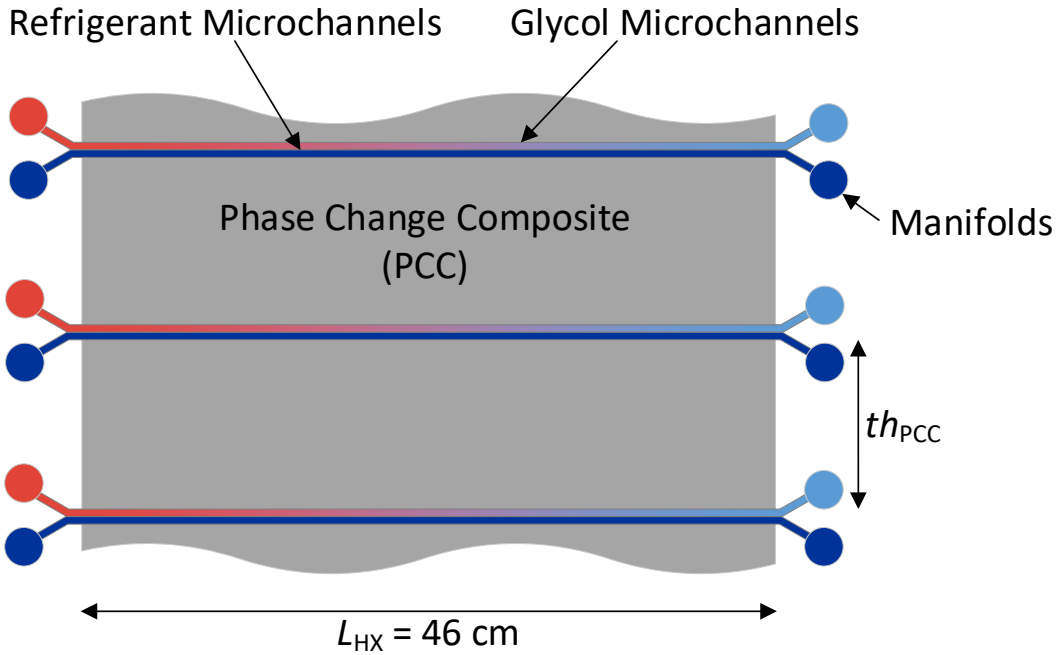
Replace round-tubes with microchannels to:

- Reduce contact resistance
- Reduce fluid inventory in evaporator
- Thermally connect fluid circuits
- Simplify PCC manufacturing





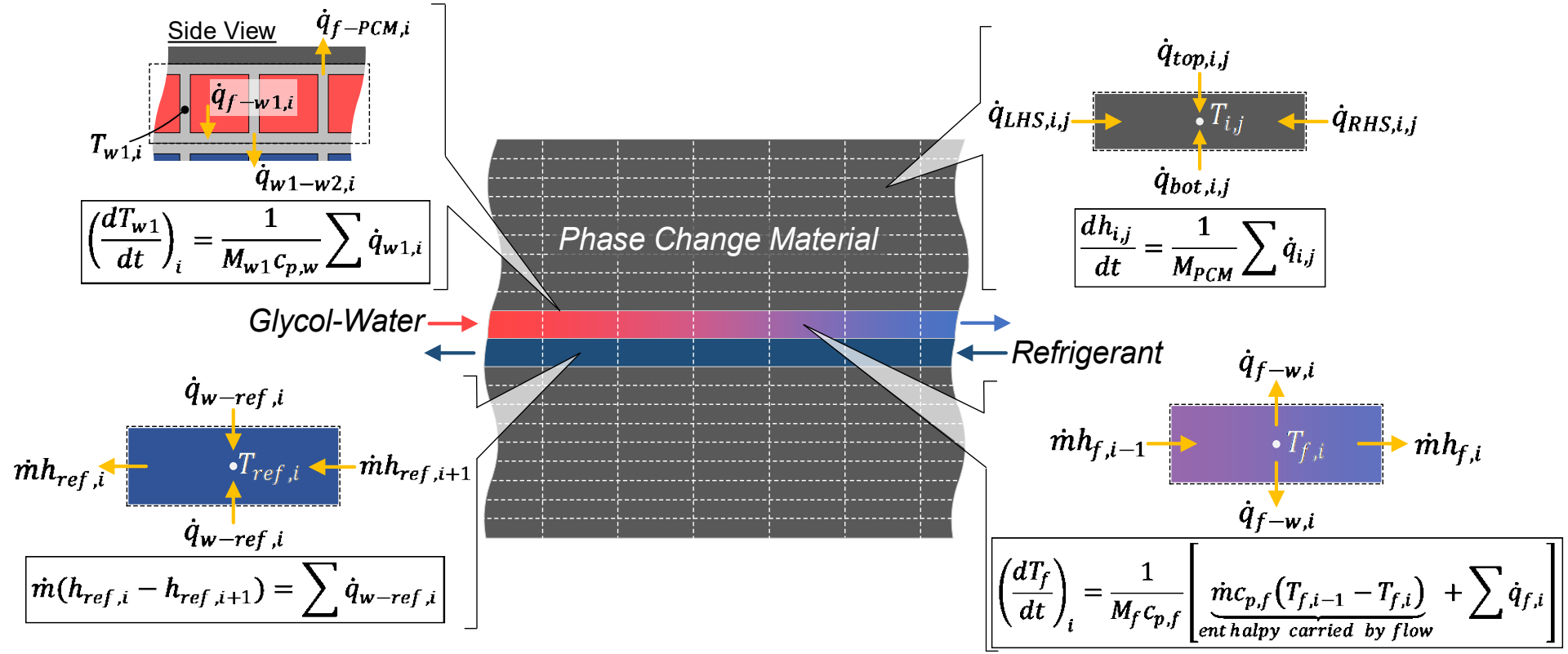
Component design



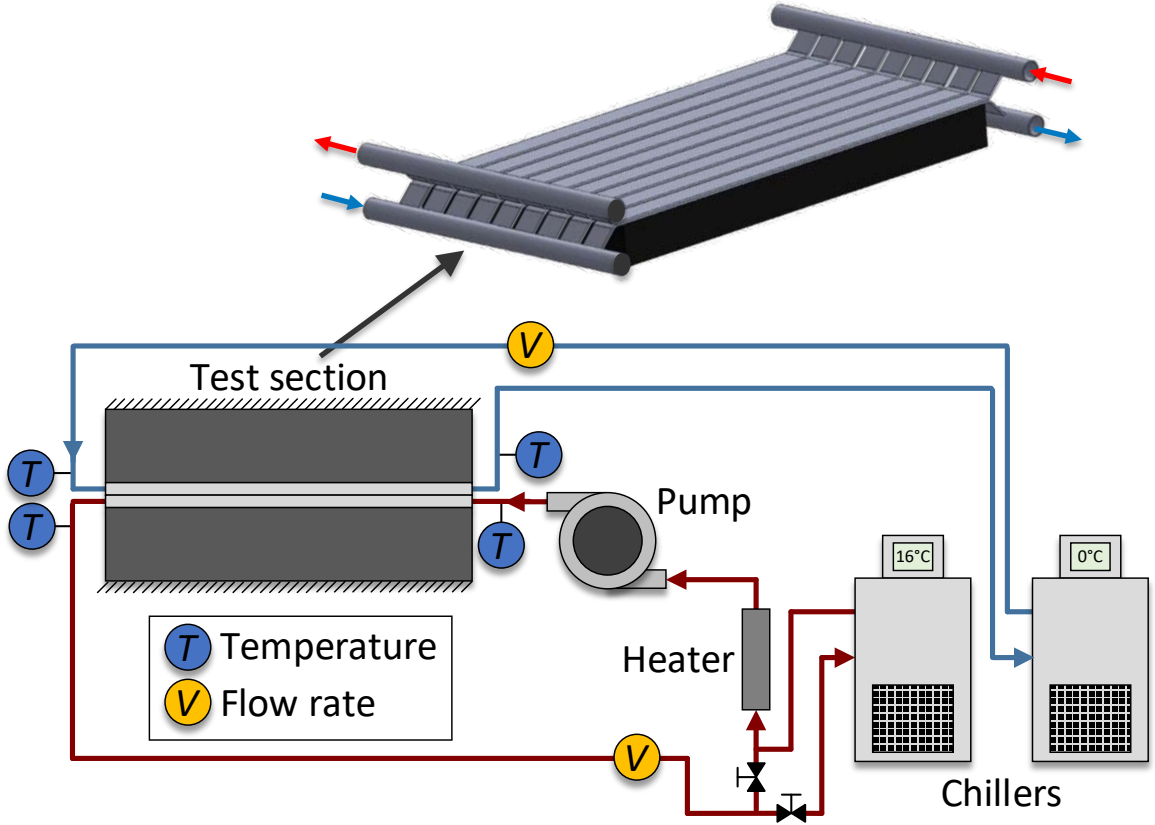
Control

- Constant power supplied to load by discharge circuit (glycol) – constant fluid ΔT
- Constant power supplied by charge circuit (refrigerant) – iterative solution of saturation pressure

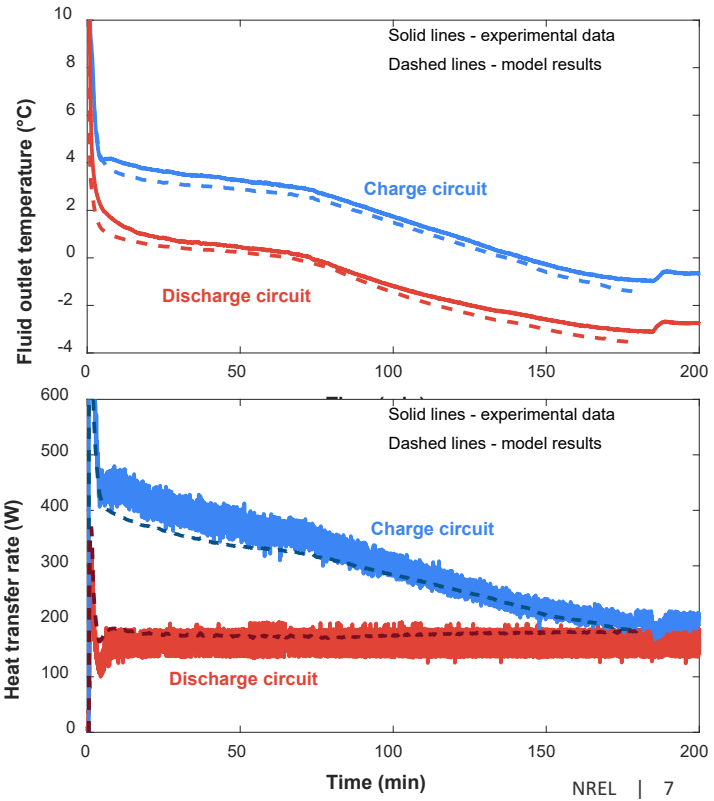
Component model



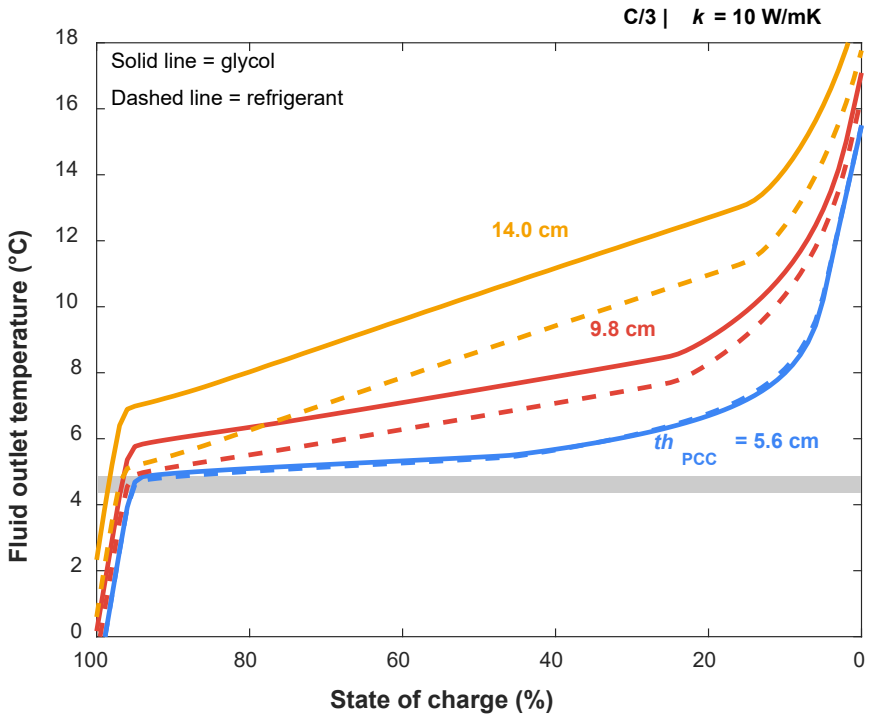
Model Validation



2 hour net charge case:



Discharge Performance (3 hour)



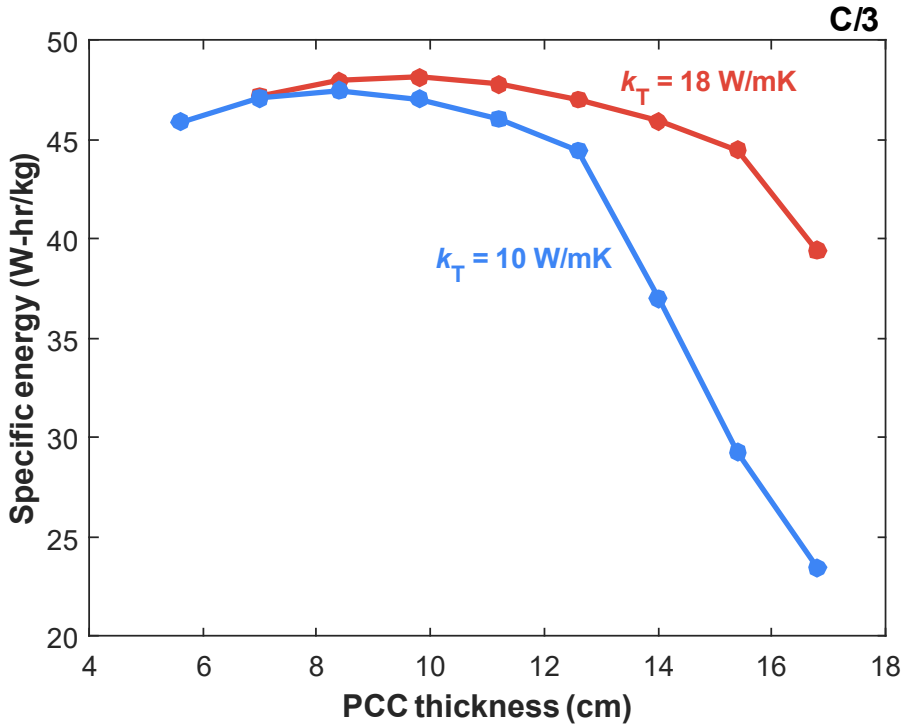
Trends with increasing *R*:

- Glycol temperature must go up to transfer the required amount of heat to the PCC
- Refrigerant temperature also goes up because of higher glycol temperature, but lower relative to glycol.

Impact on storage capacity

Competing Effects:

- Decreasing the number of tubes increases specific energy because more active mass
- Increasing thickness results in device reaching cutoff earlier (higher resistance)



Summary

- Hybrid HVAC-integrated storage components can improve the economics and decrease the environmental impact of HVAC
- Components must be designed carefully considering both the supply temperature and system performance
- During discharge, there is a peak in both the thermal and electrical storage capacity

We would like to thank ***NETenergy*** for their financial and technical assistance

Thank you

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