FY 2024
BENEFIT DoE Program

Low Cost and High Performance Modular Thermal Energy Storage for Building Equipment

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Award No.
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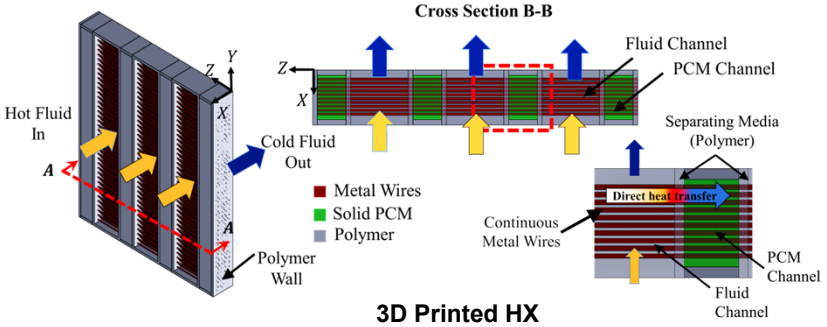
Problem Statement

Design and develop a TES capable of delivering 5 hours of 80% heating demand and 10 hours of 50% cooling demand for 1-1.5-ton heat pump.

- **Plug-and-play:** Can be field integrated by consumer within 30 minutes
- **Low-cost:** Should be affordable to residential customer
- **Smart:** Predict the optimum TES schedule

Innovation

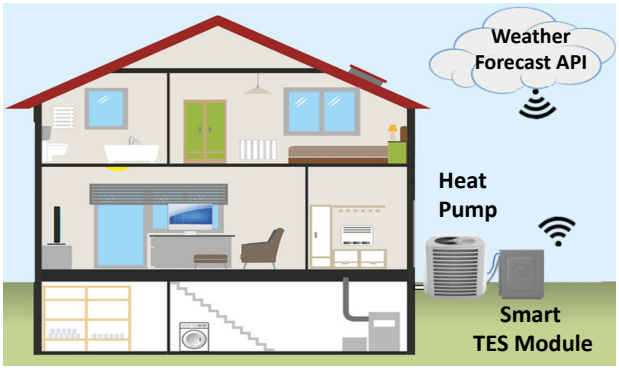
Cross-Media construction



3D Printed HX

k_{eff} = 100 W/m-K

Heat Pump – TES integration



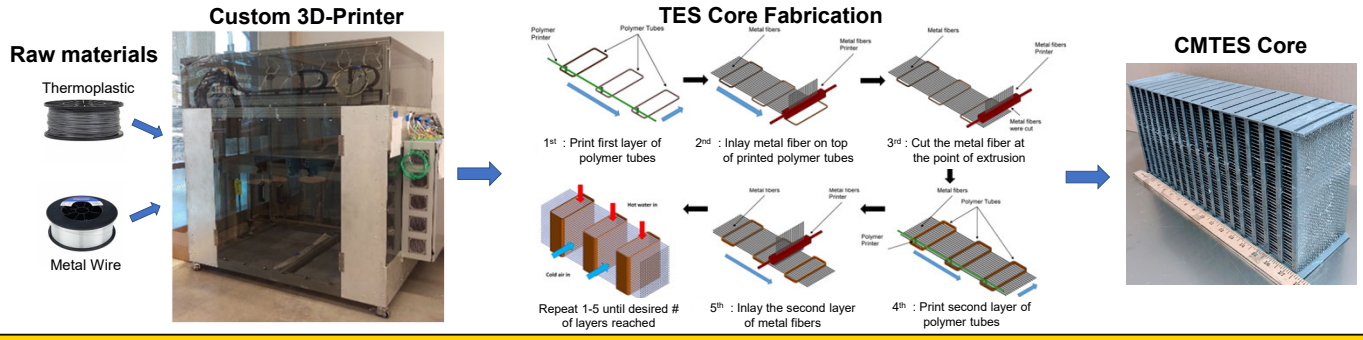
Tasks

Budget Period-1: Design and model a subscale TES unit, test PCM reliability, fabricate the unit, and conduct lab performance tests for cooling and heating.

Budget Period-2: Develop a system-level model for TES in a residential heat pump, scale up printing capabilities, and optimize the TES design for a 1.5-ton unit.

Budget Period-3: Characterize a full-scale CMTES module, integrate it into a 1-1.5 ton heat pump

Cross-Media TES Fabrication



Progress

Salt Hydrate PCM Characterization: A composite PCM, 2E-3SPA was formulated based on Glauber's salt suitable for the current application

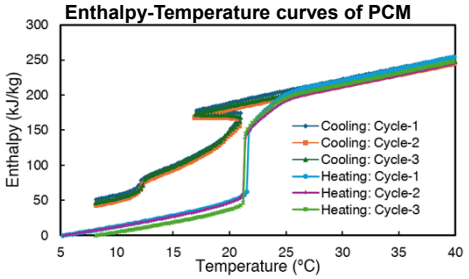
Cyclic Stability Characterization: A test section was built to characterize the effect of dwell time at the maximum temperature on the cyclic stability. The test is currently underway.

Compatibility testing: The candidate PCM 2E-3SPA is found to be compatible with ABS, PolyCarbonate, ER5054 (Welding grade Aluminum alloy).

Subscale unit fabrication: A prototype was fabricated in-house capable of storing 0.5 kWh

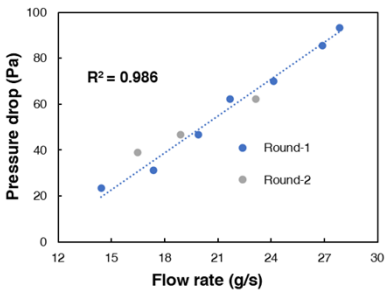
0.5 kWh CMTES Core+ Manifold + Header

Enthalpy-Temperature curves of PCM



ΔH_f :139 kJ/kg, T_m : 21 °C, ESD: 282 MJ/m^3

Pressure drop in CMTES channels



PCM Cyclic tester