

Reduced Cost Heat Pump **Space- and Water-Heating in Cold Climates**

Kashif Nawaz, Section Head—Building Technologies Research, nawazk@ornl.gov

Problem Statement and Objectives

• Space and water heating account for • This project aims to support decarbonizing

- nearly 60% of residential building energy in the US
- **Decarbonizing heating** in buildings is crucial to decarbonize the US economy •
- The cross-cutting and strategic goals set by DOE for decarbonizing the US economy by 2050 emphasize "affordability" and "increasing energy efficiency"

space and water heating by reducing cost and augmenting system efficiency for coldclimate multifamily buildings

Specific project goals are (1) use air-towater heat pumps (AWHPs) and thermal energy storage (TES); (2) use R290 refrigerant (GWP = 3), (3) design low-cost polymer heat exchangers for TES; and (4) reduce overall cost by 20%–40%



Refrigeration

26.4%





Key Design Features

- Polycarbonate tubes: Low cost and corrosion-resistant
- Cross-flow design: Minimizes charging time
- Salt-based phase change material

(PCM): Inexpensive, well-defined phase change temperature, and ideal for residential use (no toxicity)

Model Development

- Perform high-fidelity CFD calculations of flow and heat transfer (HT) between HT fluid and PCM
- Investigate and characterize thermal-fluid behaviors for various spatial locations of subchannels
- Perform sensitivity studies with respect to various design and operating parameters
- Use high-resolution CFD results to derive system-level models representing the flow and HT between HT fluid and PCM



Alignment and Impact





U.S. DEPARTMENT OF Office of ENERGY EFFICIENCY ENERGY & RENEWABLE ENERGY

BUILDING TECHNOLOGIES OFFICE