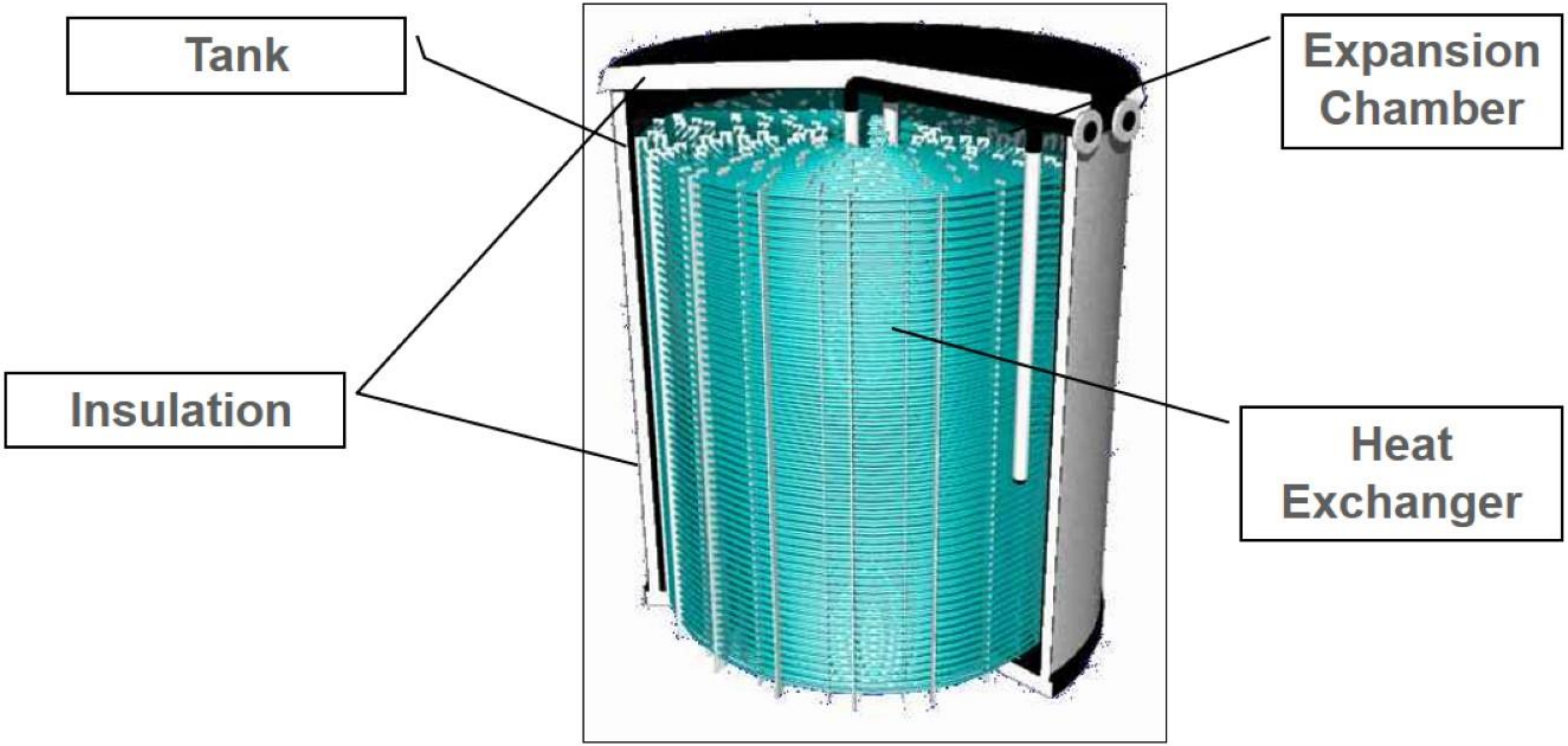
Thermal Storage Tank
Ice-on-Coil Internal Melt

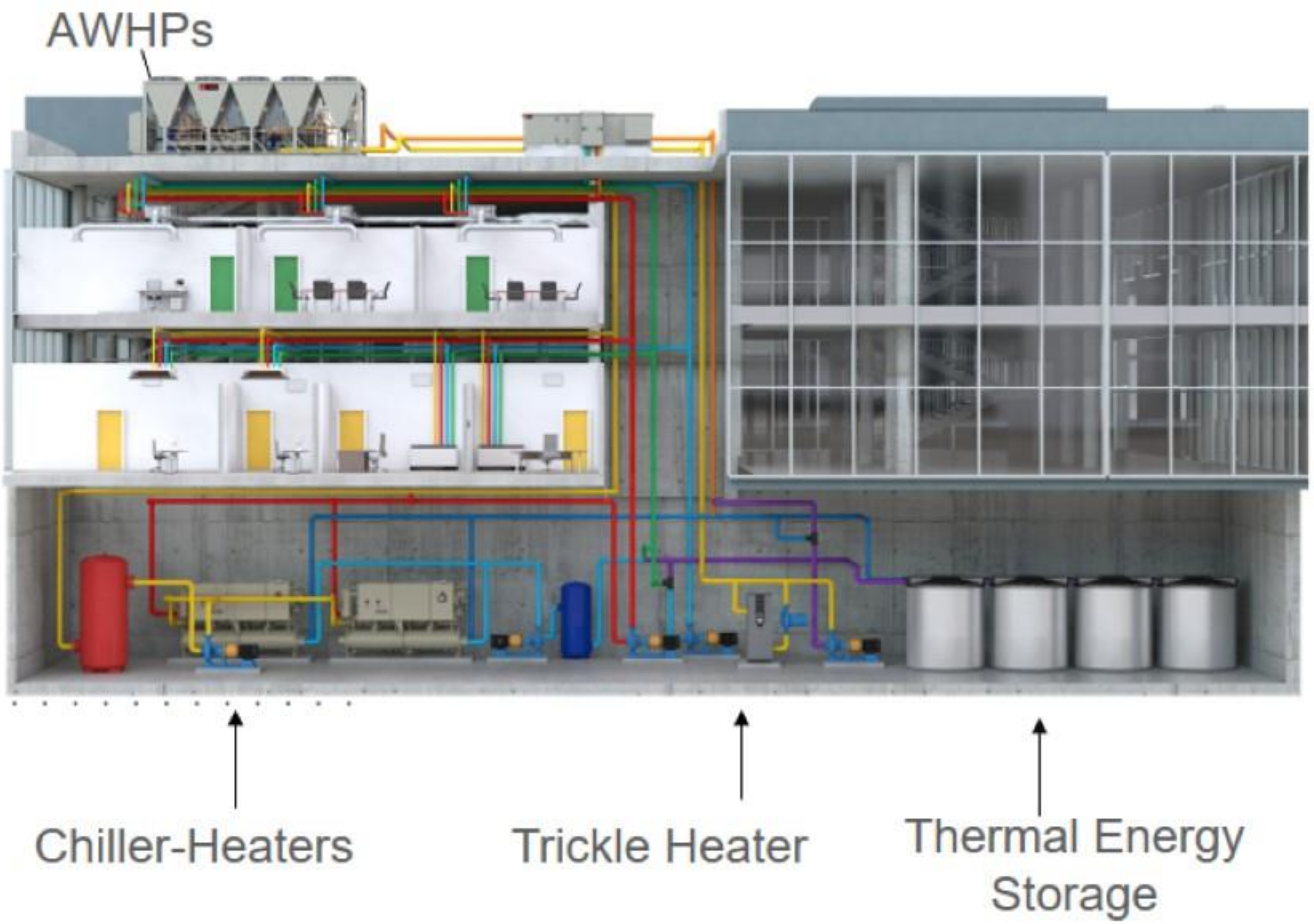


Heating in Cold Urban Cities

- Replace gas boilers with electric
  - Resistance heat will exacerbate winter peaking
- GSHP restricted by underground infrastructure
- ASHP limited by ambient
  - Electric reheat supplemental
  - Defrost derating
  - Limited roof space

Storage-Source Heat Pump System (SSHP)

An innovative way to make all-electric heat pump heating possible even in cold climates and dense urban environments where there is limited roof space.



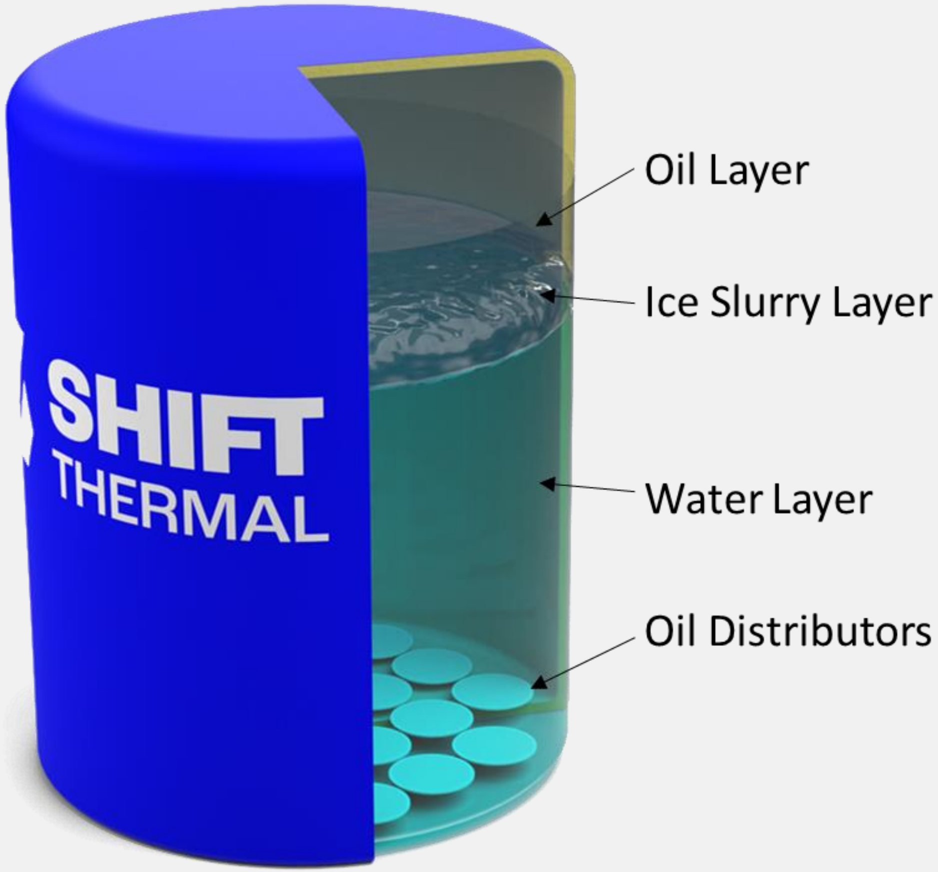
FEATURES

- **Energy efficient:** Reclaims excess heat from the building using it to heat when needed.
- **Reliable operation:** Collects and stores heat from air-to-water heat pump operation during favorable conditions enabling heating at **all** outdoor conditions including extreme cold.
- **Save roof space:** Collecting and storing heat over 24-hour period for later use, can reduce required air-to-water heat pump capacity and cost.
- **Higher supply water temperatures:** Sourcing energy from a stable thermal energy storage source enables up to 130F.
- **Lowers costs:** Storing thermal energy for later use provides flexibility to use lower-cost electricity. Thermal energy storage can frequently qualify for up to 40% tax credit reducing overall system costs.

SHIFT THERMAL

Smart HVAC. Brilliant Savings.

FLEX™ direct-contact heat exchange increases TES responsiveness



- 100 ton-hrs (latent); 10 ton charge; 20 ton discharge
- 8'D x 10'H; 3,000 gallon tank
- Steady temperature charge & discharge
- Scalable to larger tanks
- Expanding to: ice/hot water (heat pump), salt hydrates, glycol brine (cold chain)

Shift Thermal seeks to partner with industry leaders to rapidly commercialize TES

- Team of seven full-time employees with a diverse set of backgrounds
- Deployed first commercial install in Akron, OH in Feb. 2024
- Currently in lab testing at NREL
- Received one issued patent and one patent pending for the company's heat exchange and thermal storage technology
- Raised over $5M in funding from public and private sources of capital

The Team

Support

OAK RIDGE National Laboratory
NEW YORK STATE OF OPPORTUNITY. | NYSERDA
CEVG CLEAN ENERGY VENTURE GROUP
Launch Tennessee
NSF
THREE ROOTS CAPITAL
QUEEN CITY ANGELS
E8
AVESTA FUND
TENNESSEED evergreen fund

ETS for Space Heating

Al Takle – Steffes
8/27/2024

STEFFES

It All Began with Room Units

80,000 SYSTEMS INSTALLED SINCE 1987

EZ ZONING

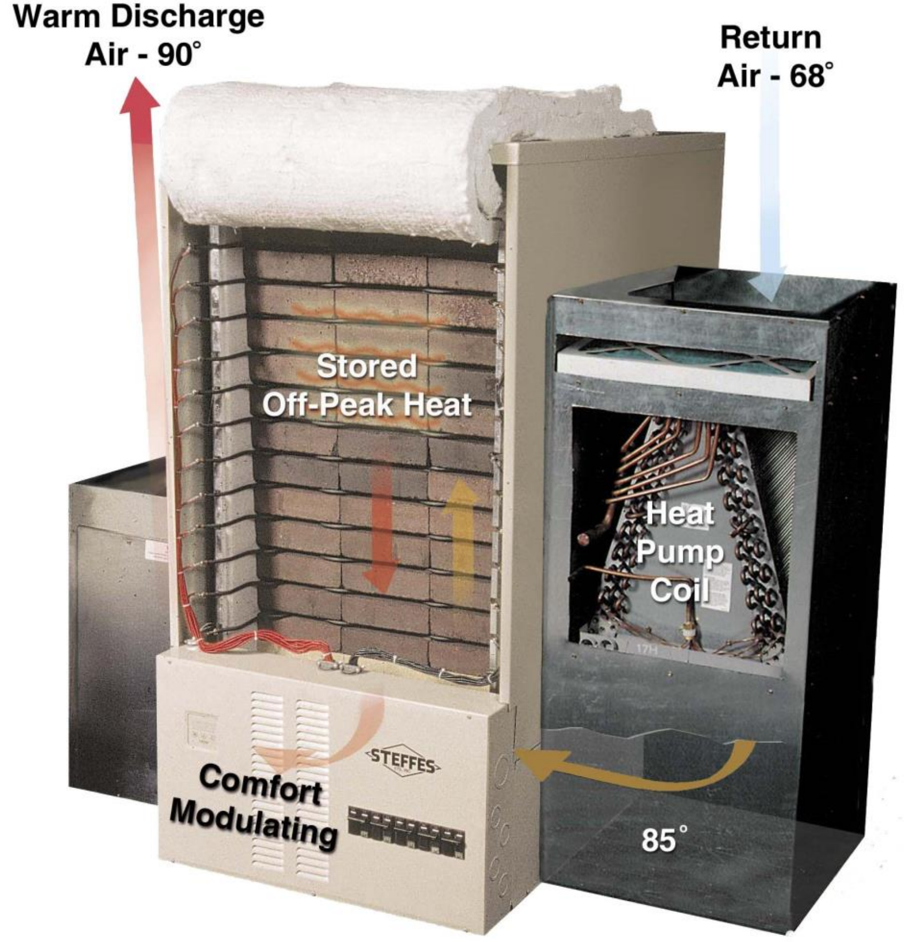
COMFORT

2100 SERIES

STEFFES

Enhanced Heat Pump Performance

Storage of Renewable or Off-Peak Electricity in the form of Heat



(Transparent View)

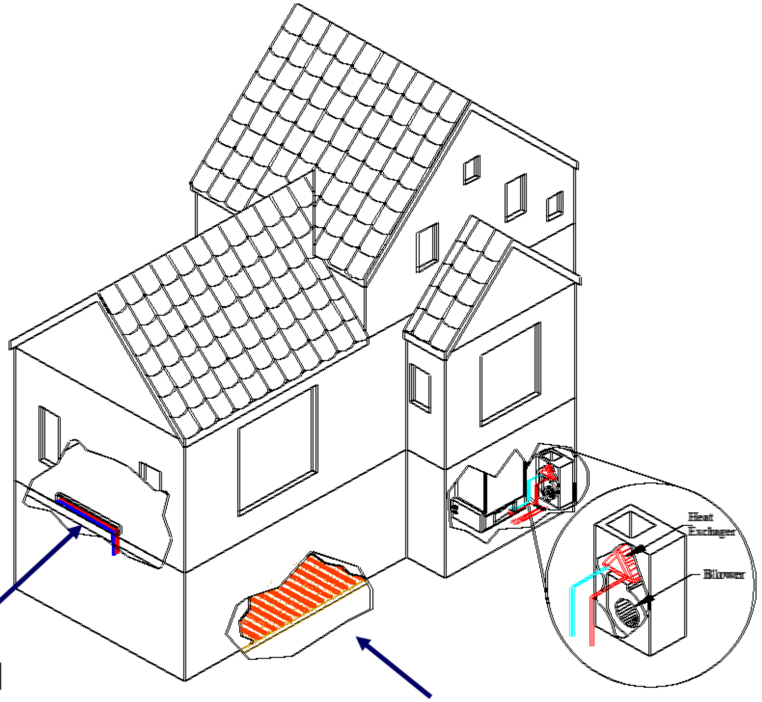
- Electricity is stored as heat in a well-insulated brick core.
- Combination of heat pumps and Electric Thermal Storage heaters maximizes home and the electric grid system efficiency.
- On-board controls regulate charging and discharging.
- Internal blower system delivers heat to the conditioned space as needed to maintain total home comfort 24/7.

It's FULLY AUTOMATIC!

A typical installation

STEFFES

5100 Series - Comfort Plus Hydronic



Ducted Heating & Cooling

Baseboard

In-Floor Tubing

Commercial, Industrial and Institutional

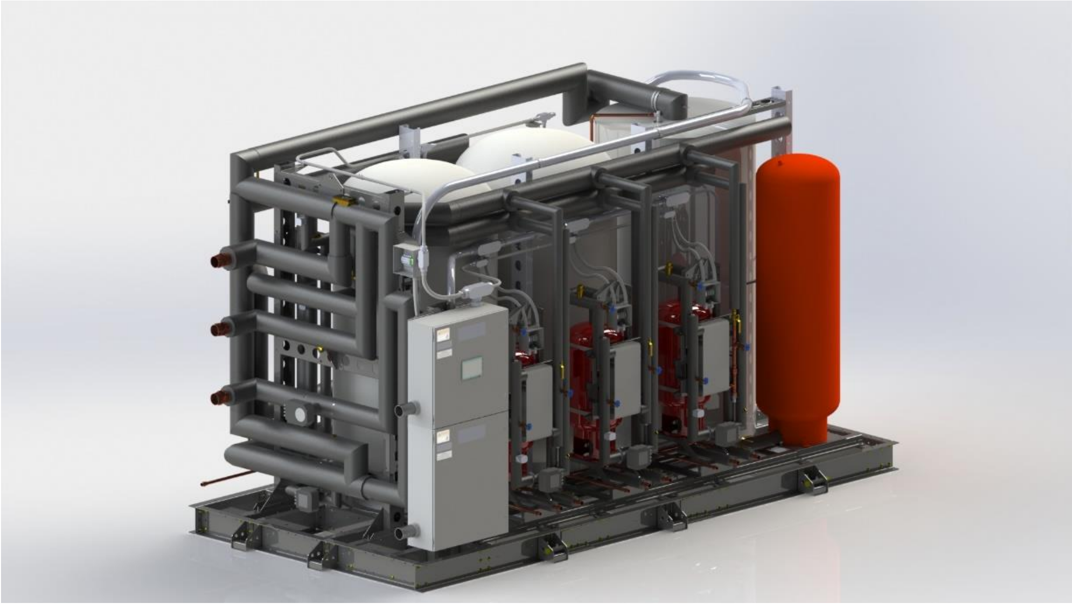
ThermElect

- Schools have been the primary application
- BACnet Compatible
- Increased building load factor

ORIGIN
HOT WATER SYSTEM
STEFFES

Heat Pump Water Heating

- Multi-Family Residential
- Up to 1500 gallons of storage
- CTA-2045 compatible for utility control
- Plug and Play Design



STEFFES

CONCLUSION

ETS technology is a proven solution that can reduce peak demand and improve climate resilience.

THANK YOU!

Stay connected with us at
www.steffes.com

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STEFFES

Harvest

Heat Pump Heating and Hot Water with Thermal Energy Storage

Pierre Delforge, Co-founder and Head of Product
pierre@harvest-thermal.com

Aug. 27, 2024

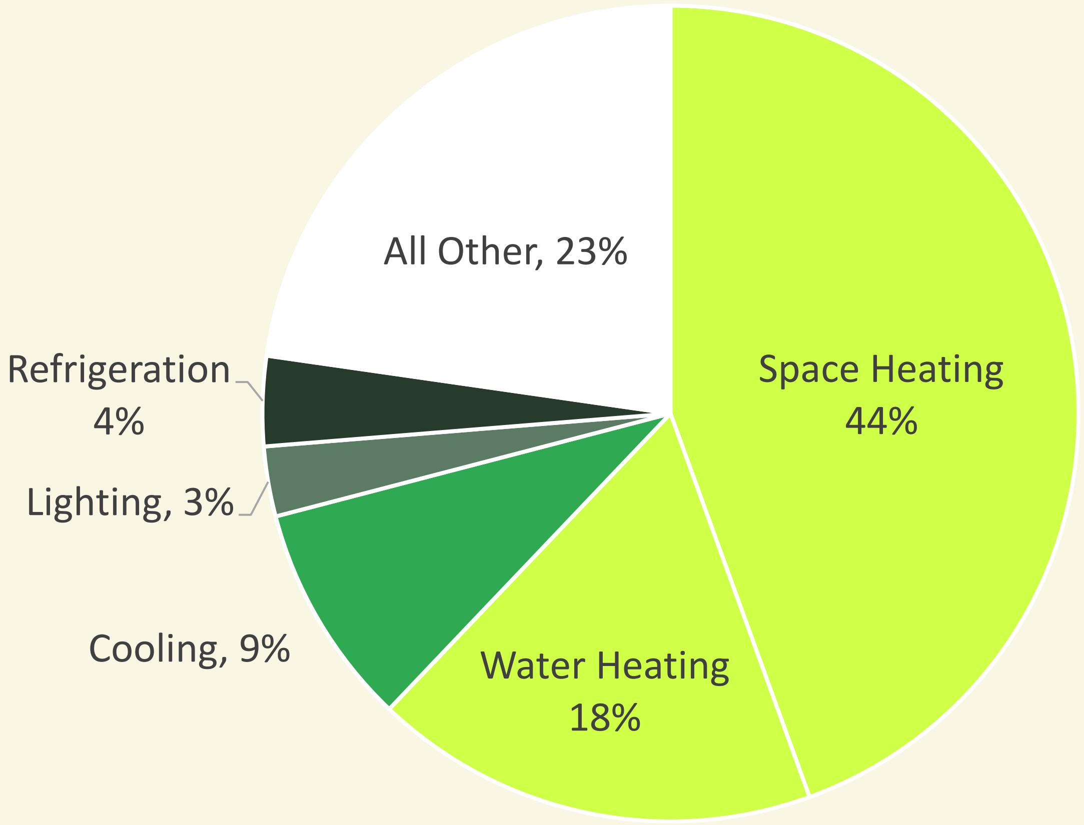
Markets

✓ Residential single-family and low-rise multi-family

✓ Retrofit and new

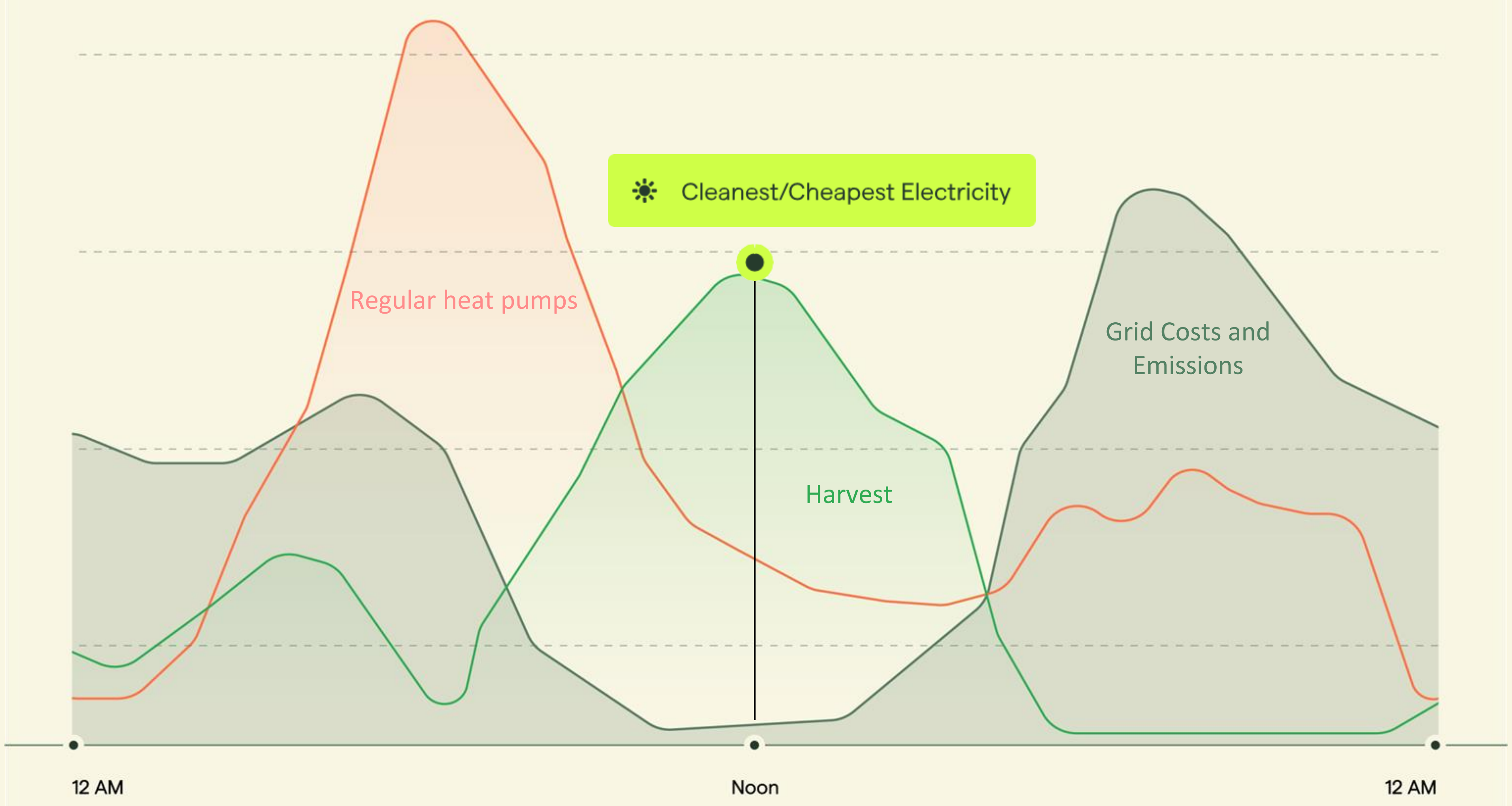
✓ Forced air and radiant floor

62% of Home Energy Use = Heating and Hot Water



EIA End Use Energy Consumption 2020

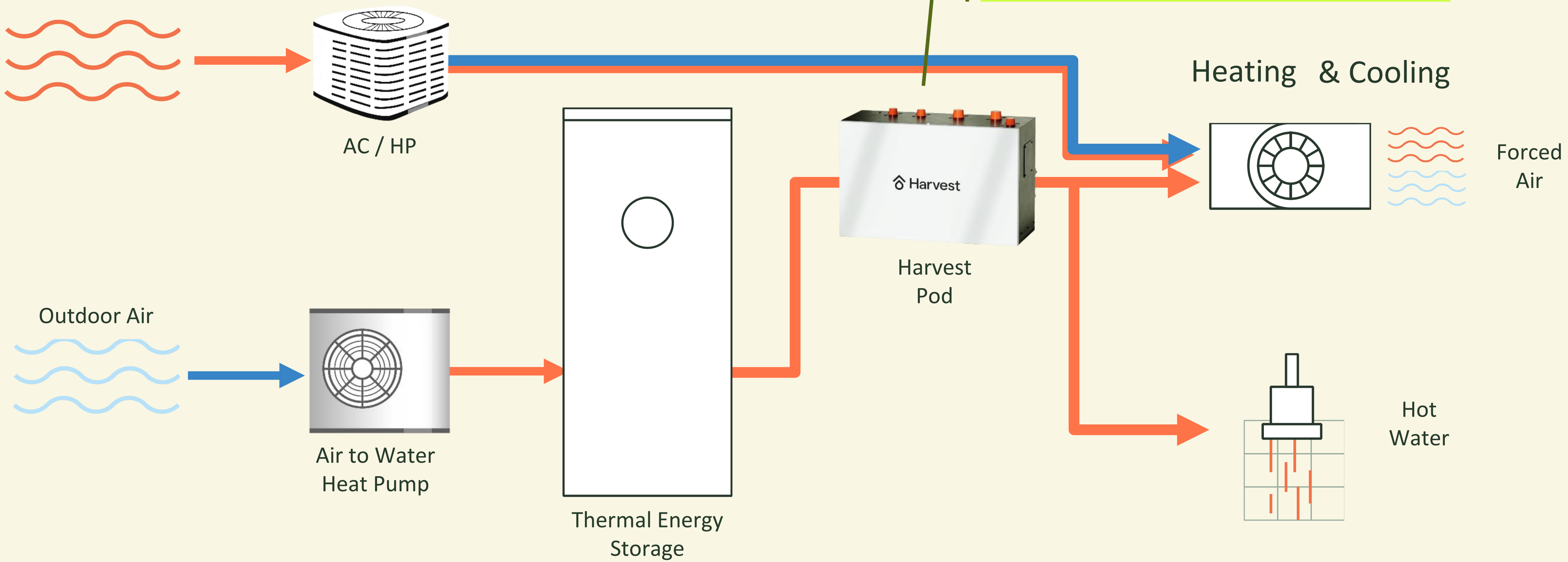
Making Heat Pumps Run on Renewable Energy



Harvest

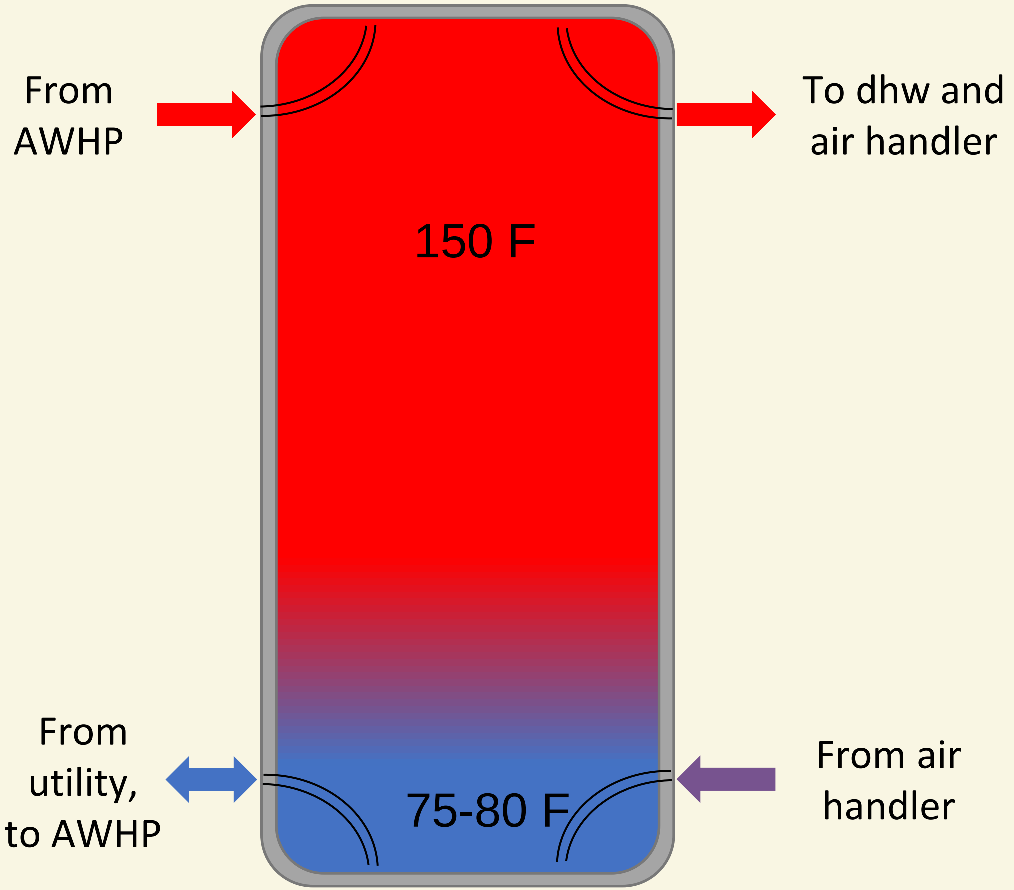
Smart Thermal Battery System

- ✓ **Manages** the tank as a heat battery
- ✓ **Learns** occupants' thermal needs
- ✓ **Forecasts** heat and hot water demand
- ✓ **Shifts** heat pump operation off-peak
- ✓ **Optimizes** heat delivery for comfort & efficiency



Highly Stratified Sensible Storage

- High temperature differential achieves good energy density with low-cost sensible storage
- Single pass AWHP raises water temp to 150 F
- Hydronic coil designed for high dT, hydronic flow rate controlled for return temp = 85 F



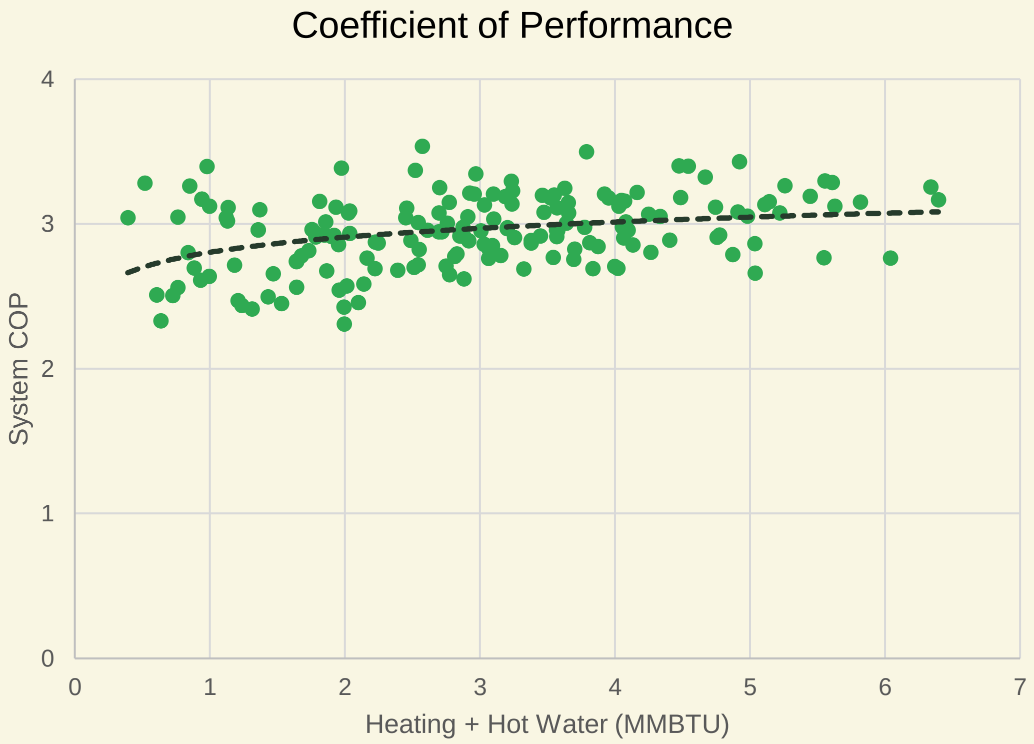
System Performance

Field measured efficiency:

- **370%** average field-measured <u>heat pump</u> performance
- **300%** average field-measured <u>system</u> performance (including fan, pump, electronics, thermal losses)

M&V studies:

- ❑ CVRH 2022
- ❑ PCE-TRC 2022
- ❑ CalNext 2024
- ❑ CVRH 2024



60 field systems, winter 2023-2024, each dot represents average system performance over one month

Storage Performance: TES vs. Li-Ion Batteries

Harvest TES Beats Li-Ion on Efficiency and Capacity

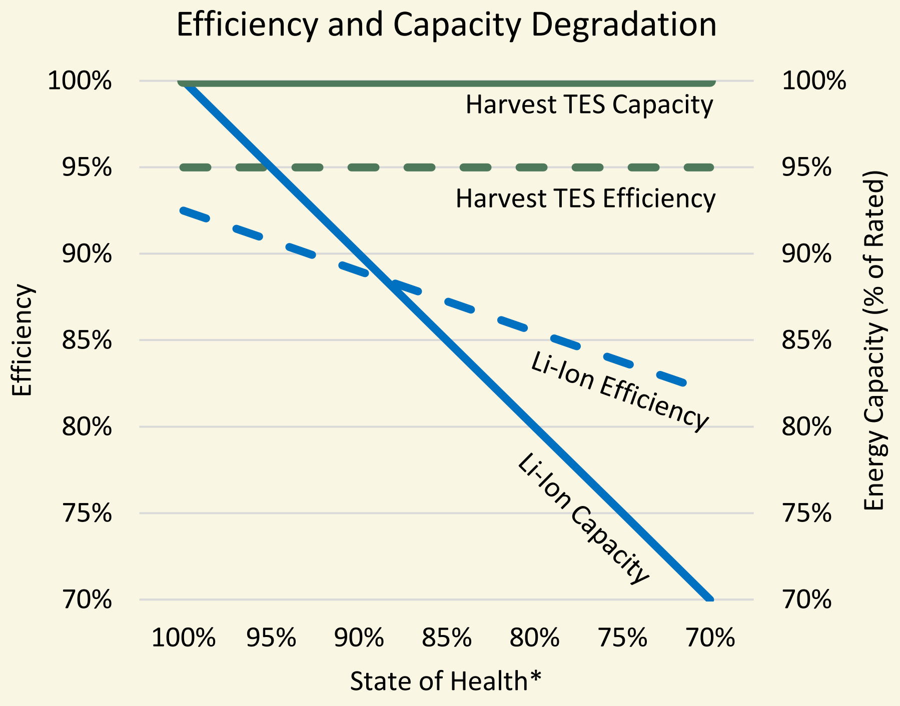
Li-Ion Performance:

Tesla Powerwall round-trip efficiency (RTE) = 92.5%* when new, and below 70% at end-of-life

* Tesla Powerwall User Manual

Harvest TES performance:

Harvest TES RTE is 95% with negligible degradation in efficiency and capacity over its life

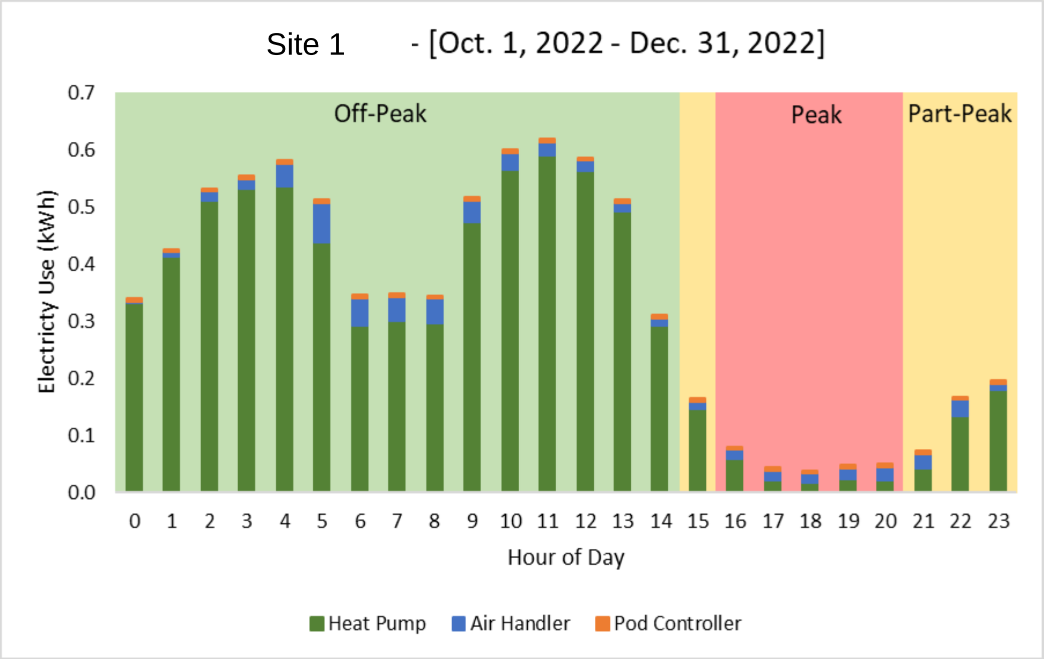


*Li-Ion battery state of health declines with cumulative energy throughput and age

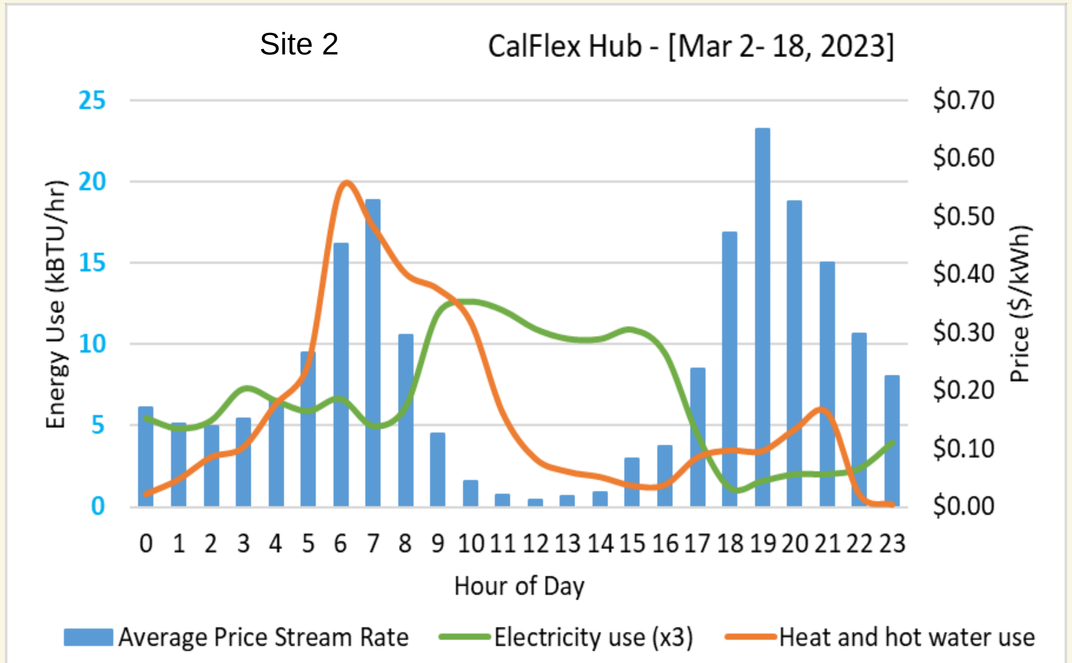
Source: Guannan He et al., "The Economic End of Life of Electrochemical Energy Storage", https://arxiv.org/pdf/1811.08486.pdf

Load Shifting Field Results

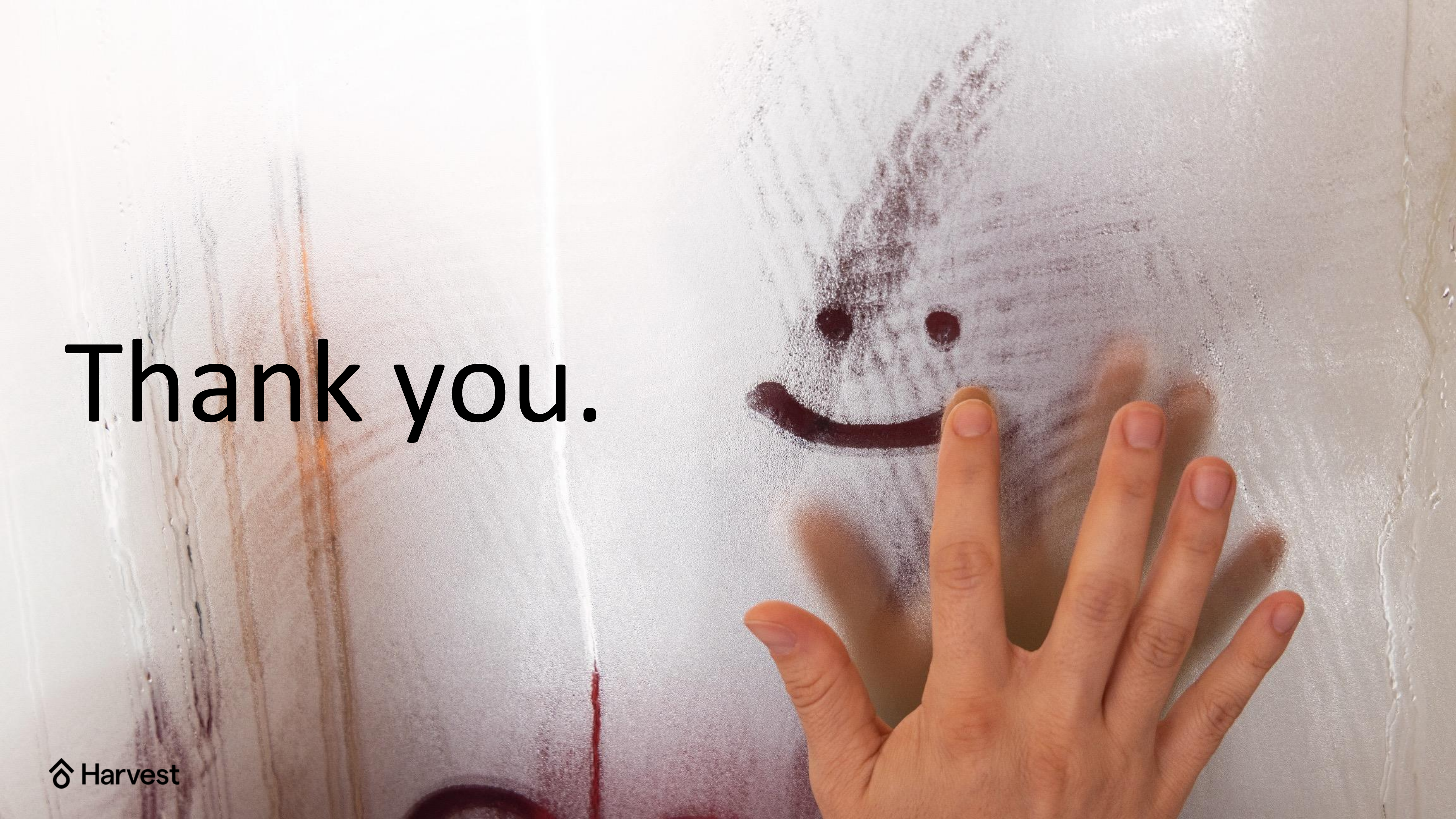
DR / TOU / Real-Time Pricing



Demand Flexibility: TOU Rates



Demand Flexibility: Day Ahead Pricing


Thank you.
Harvest