CALFLEXHUB SYMPOSIUM

SEPTEMBER 24 | 8am-6pm PT

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THERMAL ENERGY STORAGE, ENABLING TECHNOLOGY FOR DEMAND FLEXIBILITY

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Robert Morton, President, Stasis Energy Group;
Sven Mumme, Supervisor and Technology Manager, U.S. Department of Energy;
Pierre Delforge, Head of Product and Operations, Harvest Thermal
Marco Pritoni, Research Scientist, Berkeley Lab

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BERKELEY LAB

MOMENTUM

2024

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

Thermal Storage – Key Enabler for Building Electrification and Decarbonization

Panel: Thermal Energy Storage, An Enabling Technology for Demand Flexibility, September 24, 4-5PM

Sven Mumme, Department of Energy

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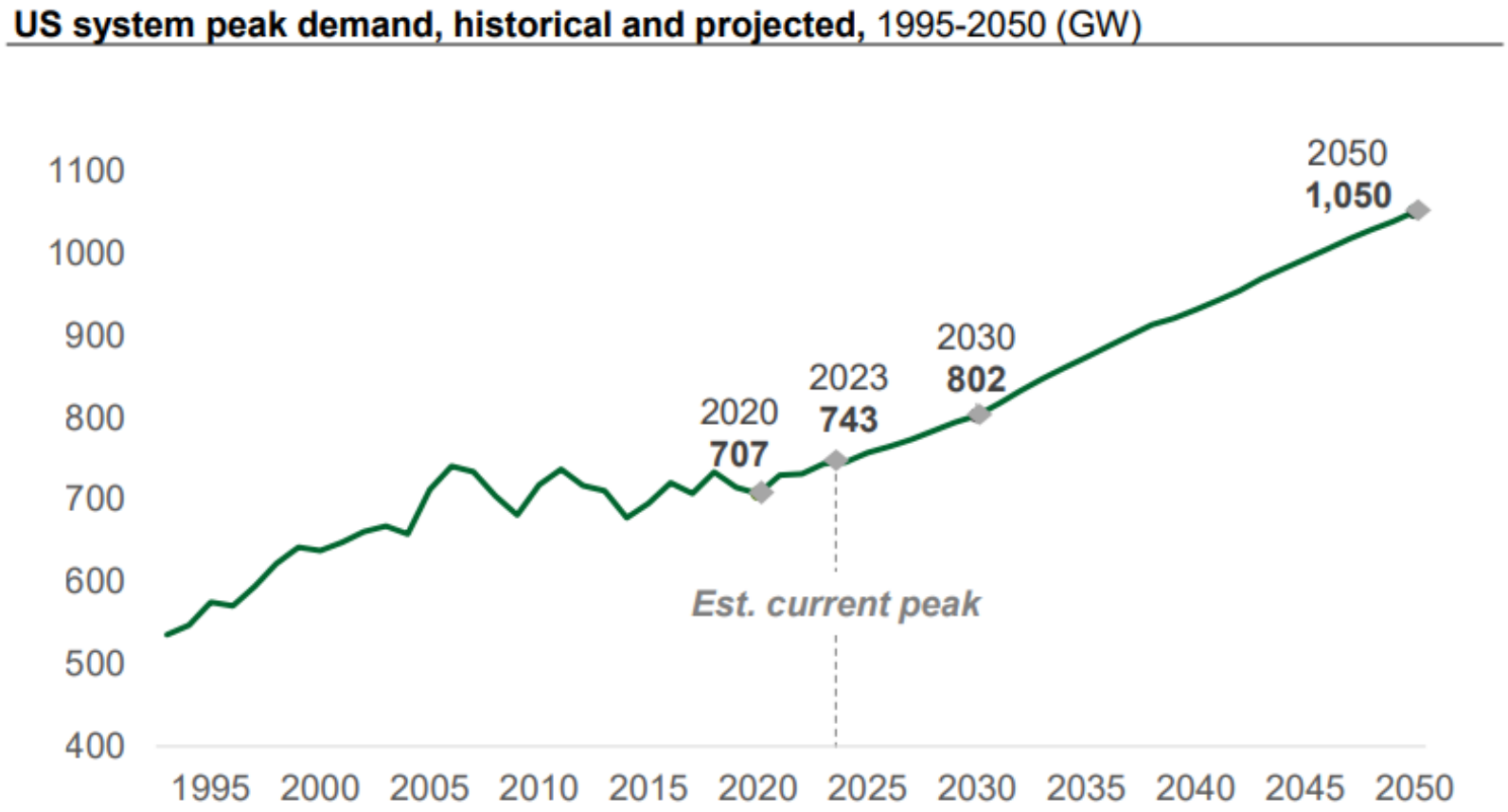
Peak Demand in Buildings is on the Rise

- Widespread electrification goals of building end-uses can lead to 2.5x increase in annual heating electricity, along with higher coincident electrical peak demand, particularly for regions in colder climates. [Source: NREL Electrification Futures Study, 2018
- All-electric heating (high-COP HP) scenario can increase peak demand by 70% throughout US, along with 23 states more than doubling their peak. [Source: Waite 2020]
- New York independent system operator (ISO) forecasts winter peak will be twice current peak while summer peak will remain constant in next 30 years. [Source: NYISO]
- Extreme weather events further exacerbate building thermal load requirement which may not be considered in forecasts and studies

US peak demand is expected to grow by ~60 GW between 2023 and 2030



Source: Historical energy demand sourced from AEO; forecasted energy sourced from OP-NEMS mid-case scenario

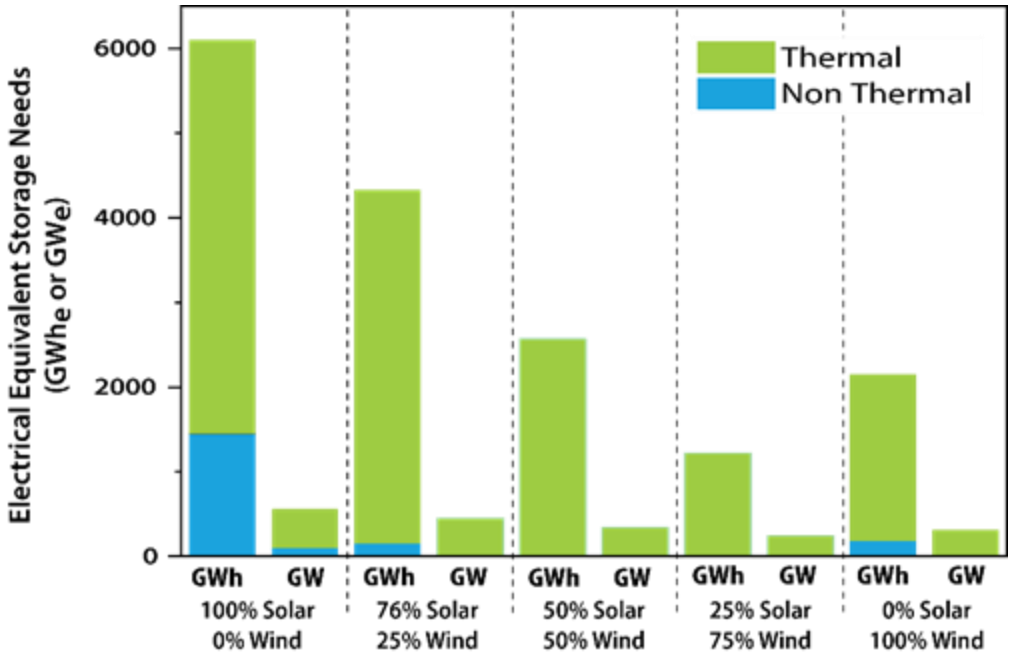
Energy Storage in Buildings

Energy storage makes buildings more resilient and significantly contributes to managing and shifting their peak electrical demand.

Thermal and electrical energy storage are main types of storage used in buildings	
Thermal energy storage • TES systems provide storage capability for heating or cooling loads. • TES can lower heating and cooling equipment costs while increasing thermal system effective capacity.	Electrical energy storage • EES can handle a wide range of end loads to provide backup electrical power. • Useful for buildings that frequently experience power disruptions and need backup for critical loads.

Strategic investments to reduce TES and EES costs can be traded off with investments in electrical distribution system and service upgrades.

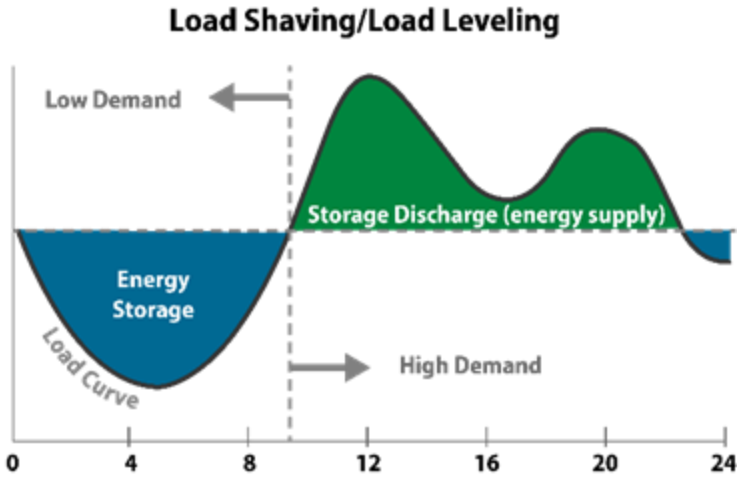
Energy storage required to support commercial and residential buildings in the United States for a 2050 grid with 100% renewable energy, disaggregated into thermal and nonthermal storage, assuming electrified heating with ASHPs.



Source: Odukomaiya 2021

Thermal Energy Storage in Buildings: Why?

- Provides ability to align facility energy use with the clean electricity supplied by grid or onsite photovoltaic system to reduce indirect CO2 emissions.
- Reduce energy cost by cutting peak demand and taking advantage of time-of-use (TOU) rates.
- Opportunities to improve overall system efficiency.
- Flatten the duck curve by storing excess renewable energy in the grid that would otherwise be curtailed.
- Support grid services like demand response and load curtailment during emergency
- Potential to improve resilience by maintaining end-use service delivery and extend acceptable indoor condition duration during brief grid outages and interruptions
- Foster equitable and sustainable electrification by lowering upgrade costs for electrical distribution system components like panel, service, and transformers by reducing system peaks and equipment rating.



Source: Argyrou 2018

Thermal energy storage can be more cost-effective for buildings than Li-ion batteries

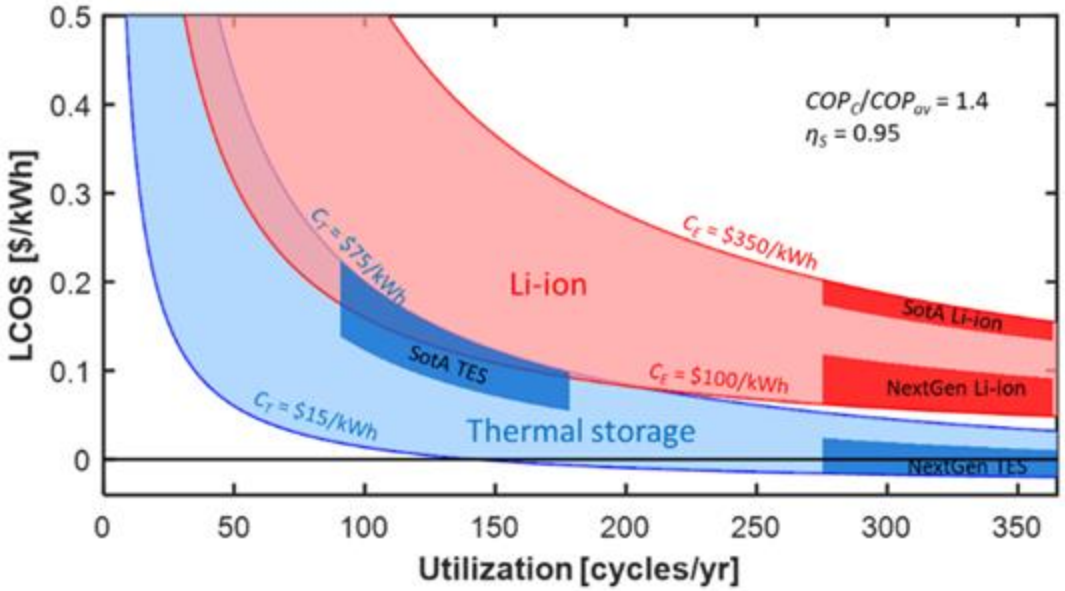
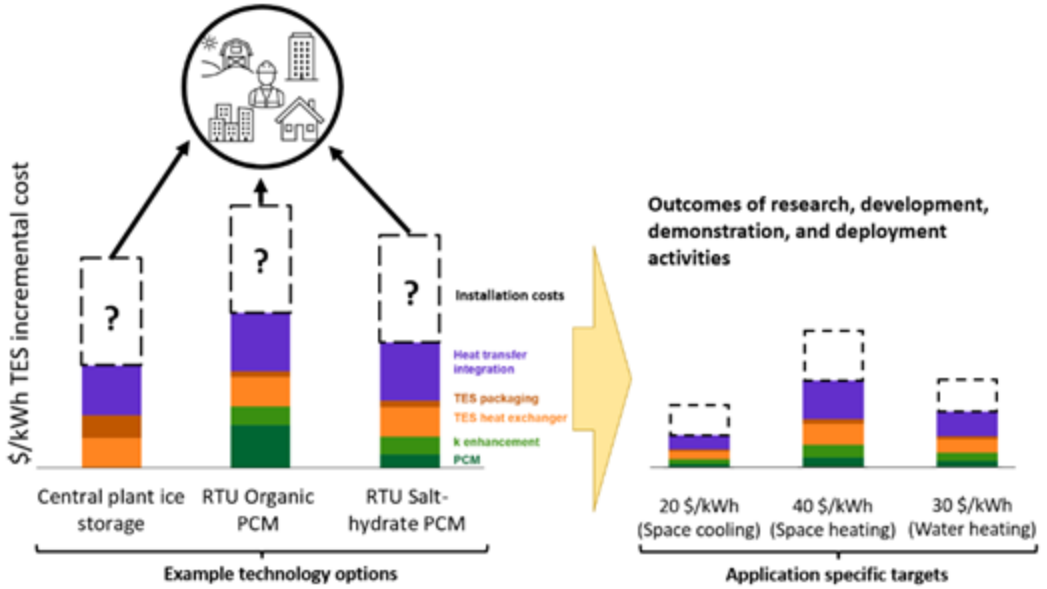


Figure: LCOS projections for TES + heat pump and EES + heat pump with varying capital costs, and utilization assumptions

Thermal energy storage system cost compression and simplification



Priorities for Thermal Energy Storage

Residential central air source heat pumps (heating and cooling), commercial rooftop units, and residential water heaters are the priority equipment types for TES integration to make electrification more viable. Commercial freezers are an early market opportunity, while commercial chillers continue to present a great opportunity particularly for ice storage.

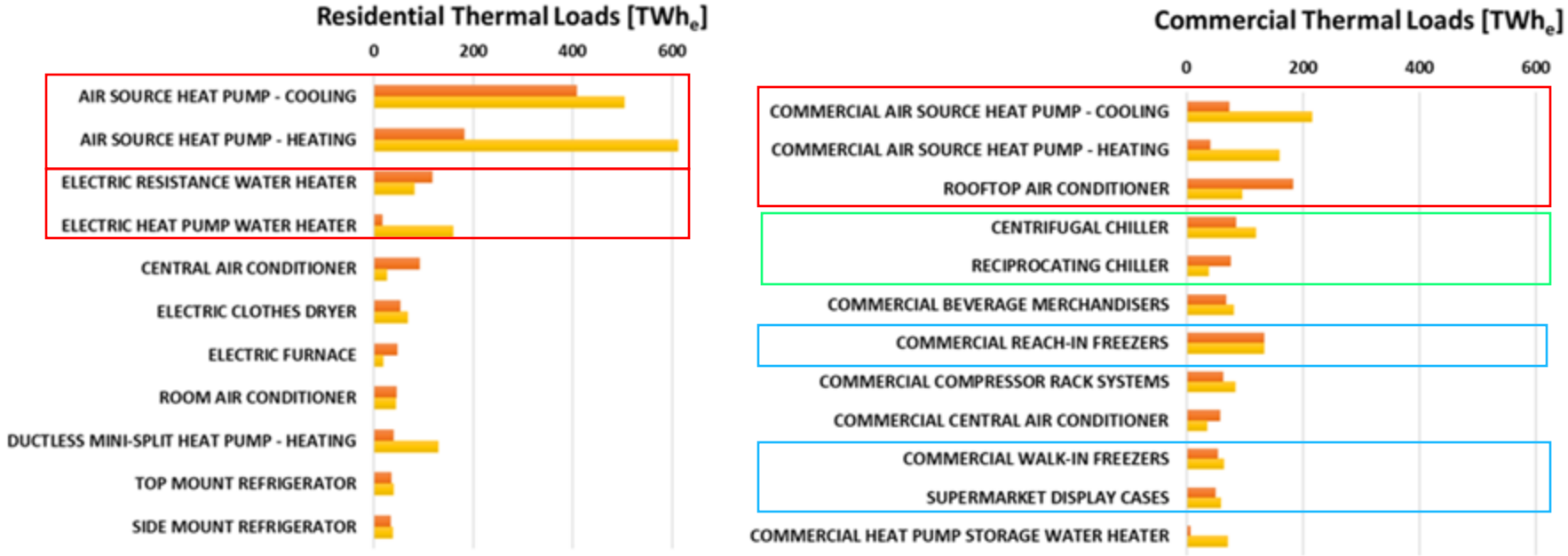


Figure: Predicted annual electricity consumption in 2030 and 2050 by equipment type

Opportunities for TES

Federal Support for TES

- Federal programs like Inflation Reduction Act can provide up to 40% investment tax credit[#] for installation of most TES systems. [Source: IRS Form 3468]

[#]*Disclaimer: Consult your tax advisor for specific details on your project.*

Stor4Build
U.S. DEPARTMENT OF ENERGY

Learn more on Energy.gov

- Stor4Build is a multi-lab consortium designed to accelerate the development and deployment of affordable thermal energy storage technologies for buildings.
- Includes active participants from industry, utilities, nonprofit organizations, communities, building owners, academia, government, and other research institutions.
- Two steering councils (R&D and Market Adoption) support scalable development of building energy storage technologies and market transformation to increase market viability.

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Thank you!

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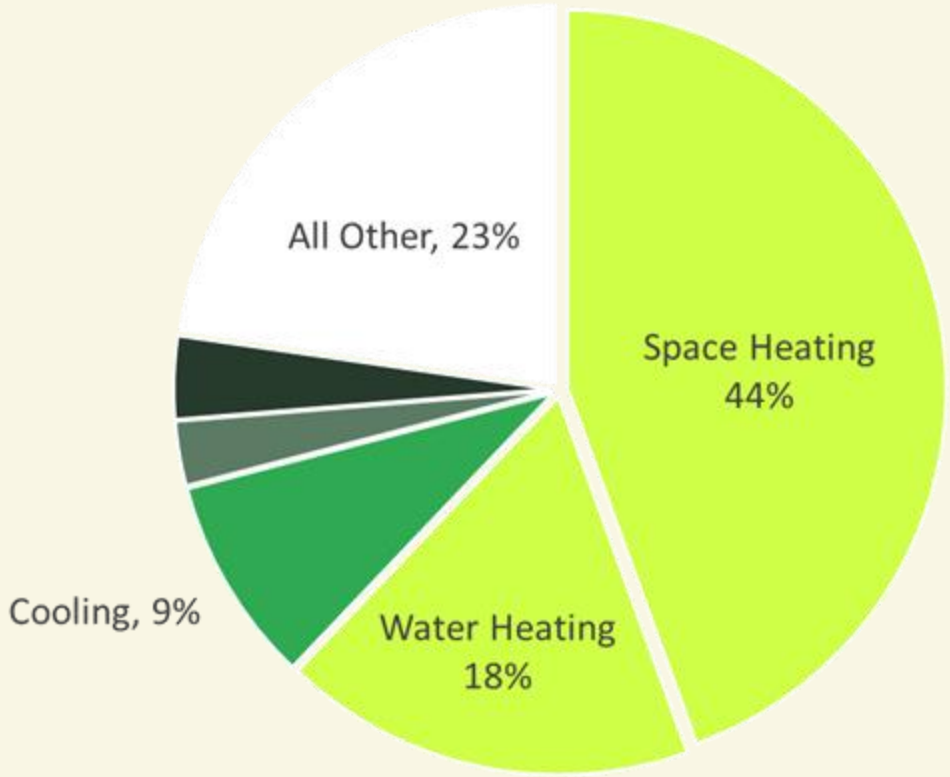
Harvest

Heat Pump Heating and Hot Water with Thermal Energy Storage

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

Sep. 24, 2024

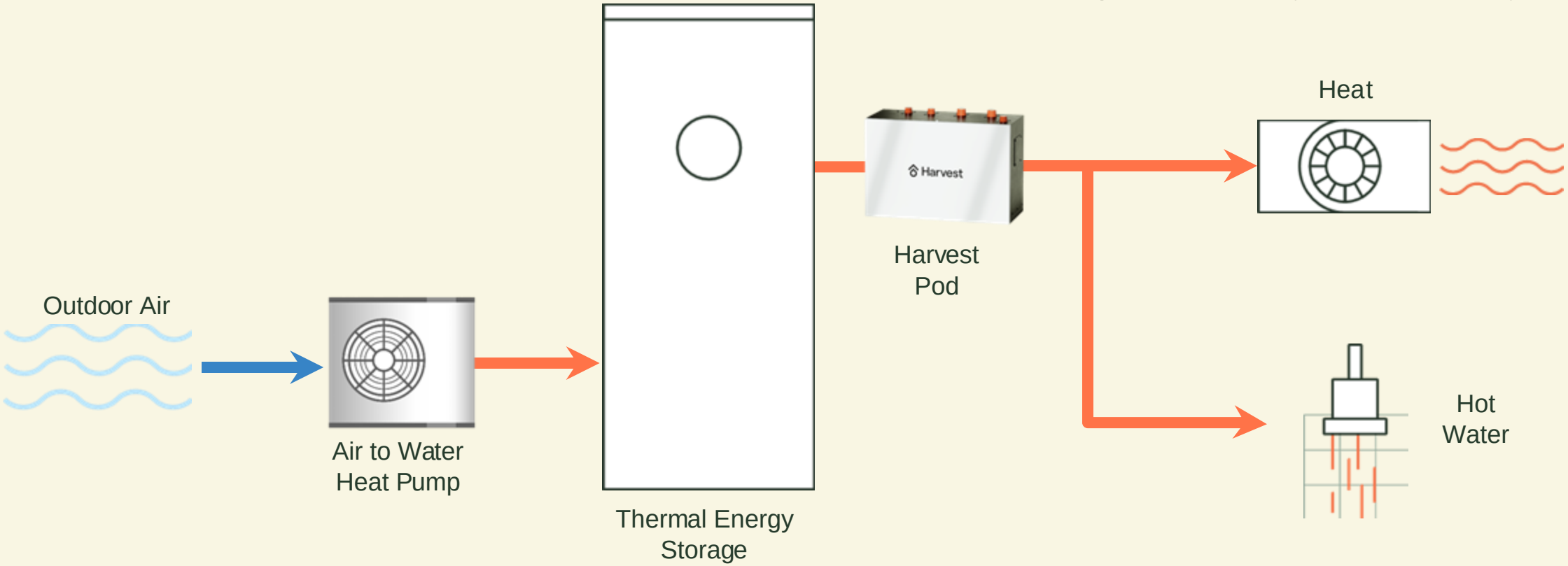
62% of Home Energy Use = Heating and Hot Water



EIA End Use Energy Consumption 2020

HVAC + Hot Water + Thermal Energy Storage

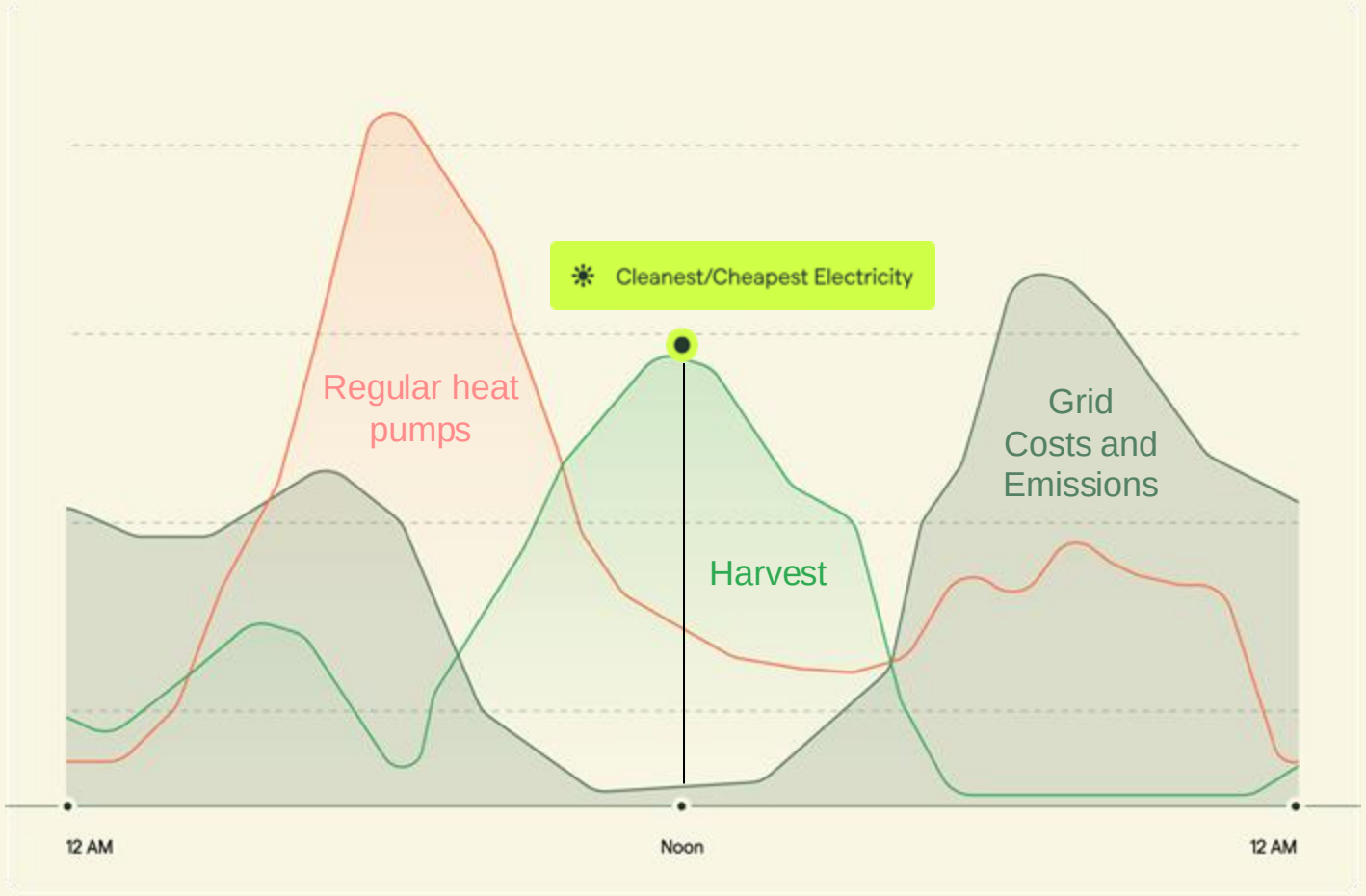
- ✓ **Manages** the tank as a heat battery
- ✓ **Learns** occupants' thermal needs
- ✓ **Forecasts** heat and hot water demand
- ✓ **Shifts** heat pump operation off-peak
- ✓ **Optimizes** heat delivery for comfort & efficiency



Harvest

TES Benefits

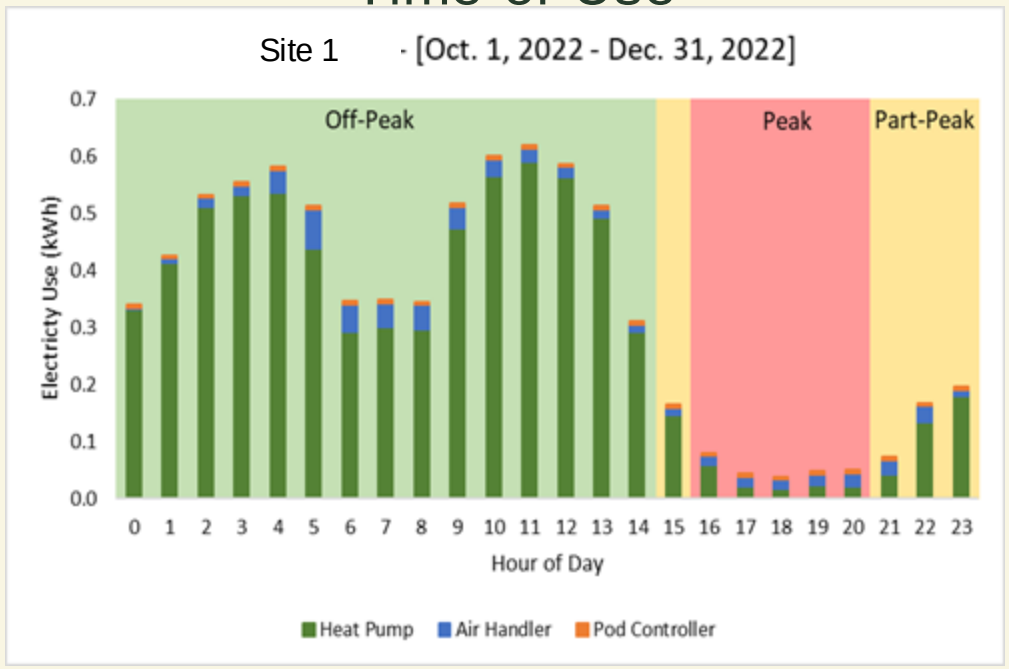
- ✓ Reduced grid costs
- ✓ Higher efficiency
- ✓ Reduced operating costs
- ✓ Better comfort (defrost)
- ✓ Better cost and performance vs. Li-Ion storage



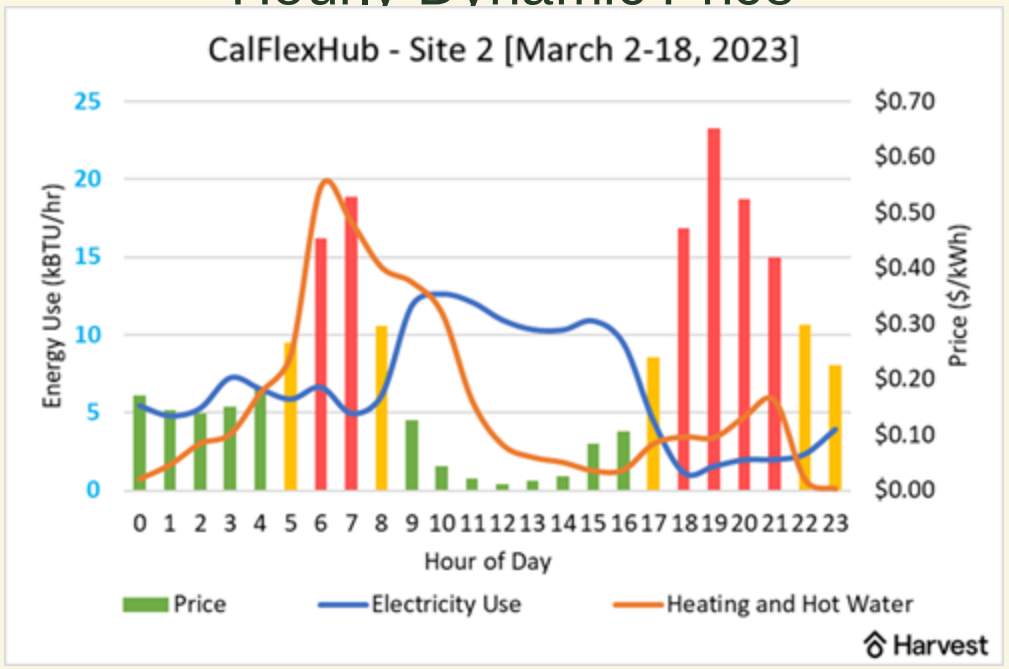
- ➢ TES shifts HP operation from times of highest grid costs to times of lowest grid costs

Load Shifting Results

Time-of-Use



Hourly Dynamic Price



Capture the Cold

World's First In Duct Thermal Storage

Rob Morton
Founder & CEO
rmorton@stasisenergygroup.com

Load flexibility is the answer.

All regulators, utilities, and National Labs are aligned.

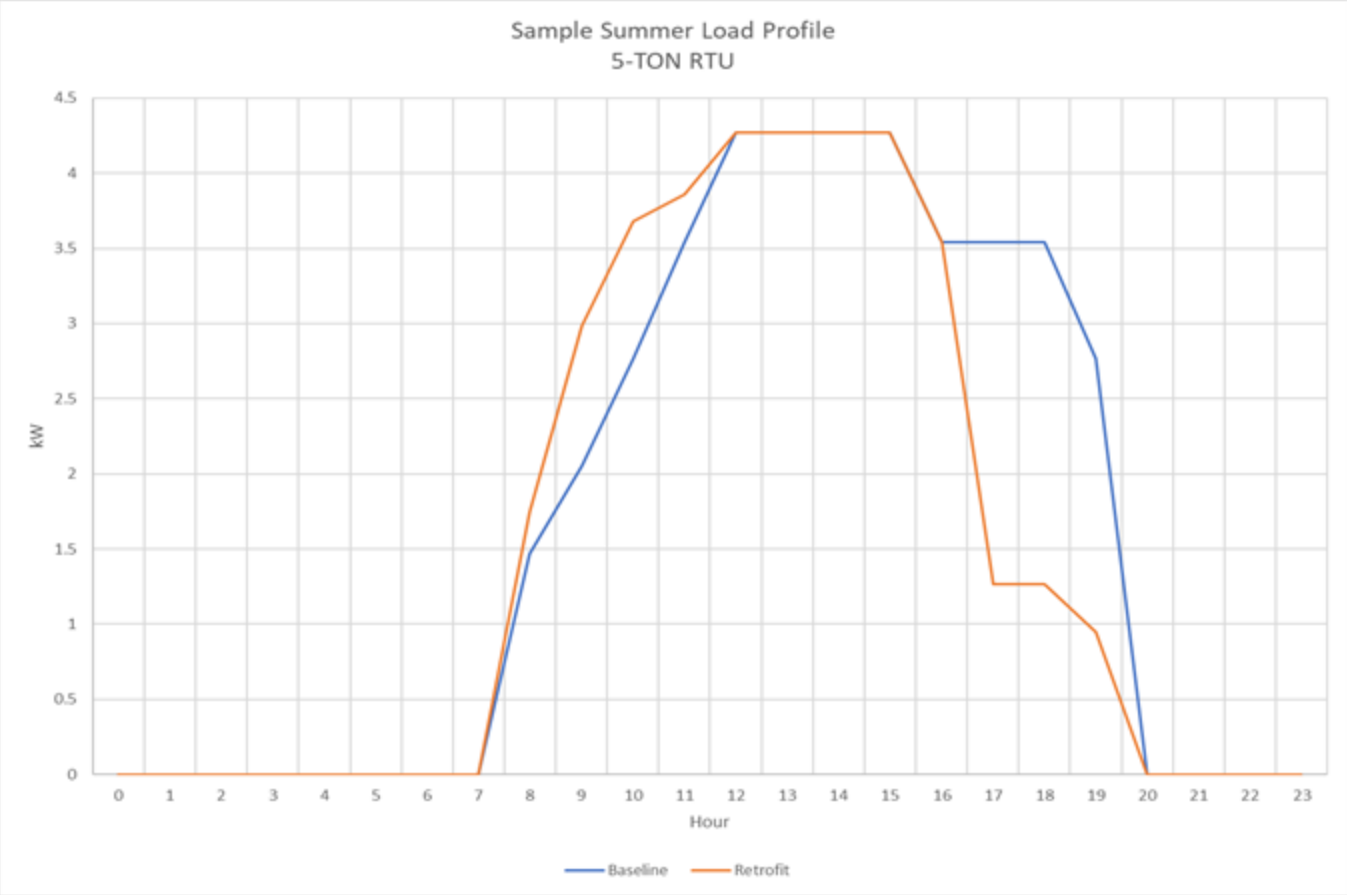
We **Capture the Cold (CtC)** when energy is sustainable and cheap

Charges during normal cooling calls

We **Release the Cold** when energy is dirty and expensive

Discharges during peak periods

Proven Performance



"Assuming all existing RTUS less than 10 tons adopted CtC units, **we meet 77% of our 2030 load-modifying mandate."**

Martin Vu, PE, RMS Engineering 2024 CEC BRIDGE Final Report

- 60% kW peak period reduction
- 54% kWh shift to off-peak
- 13-15% EE
- Up to 86% GHG mitigation
- Dynamic Price ready technology
- Built for HTR retrofit markets

Stasis CtC **is** Load Flexibility.

NOSTROMO
COOLING GLOBAL WARMING

Grid-Interactive **Energy Storage** for C&I Building

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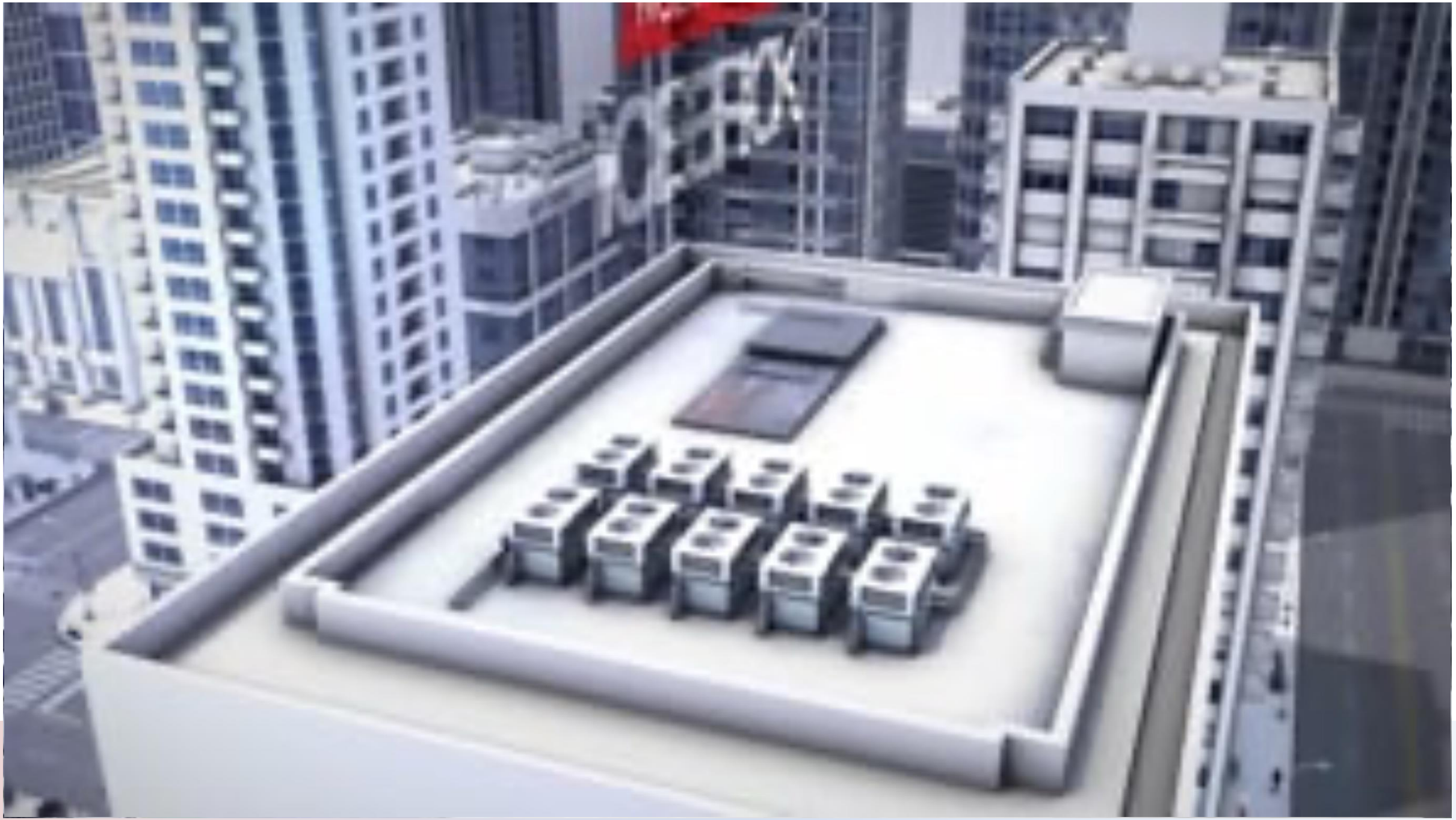
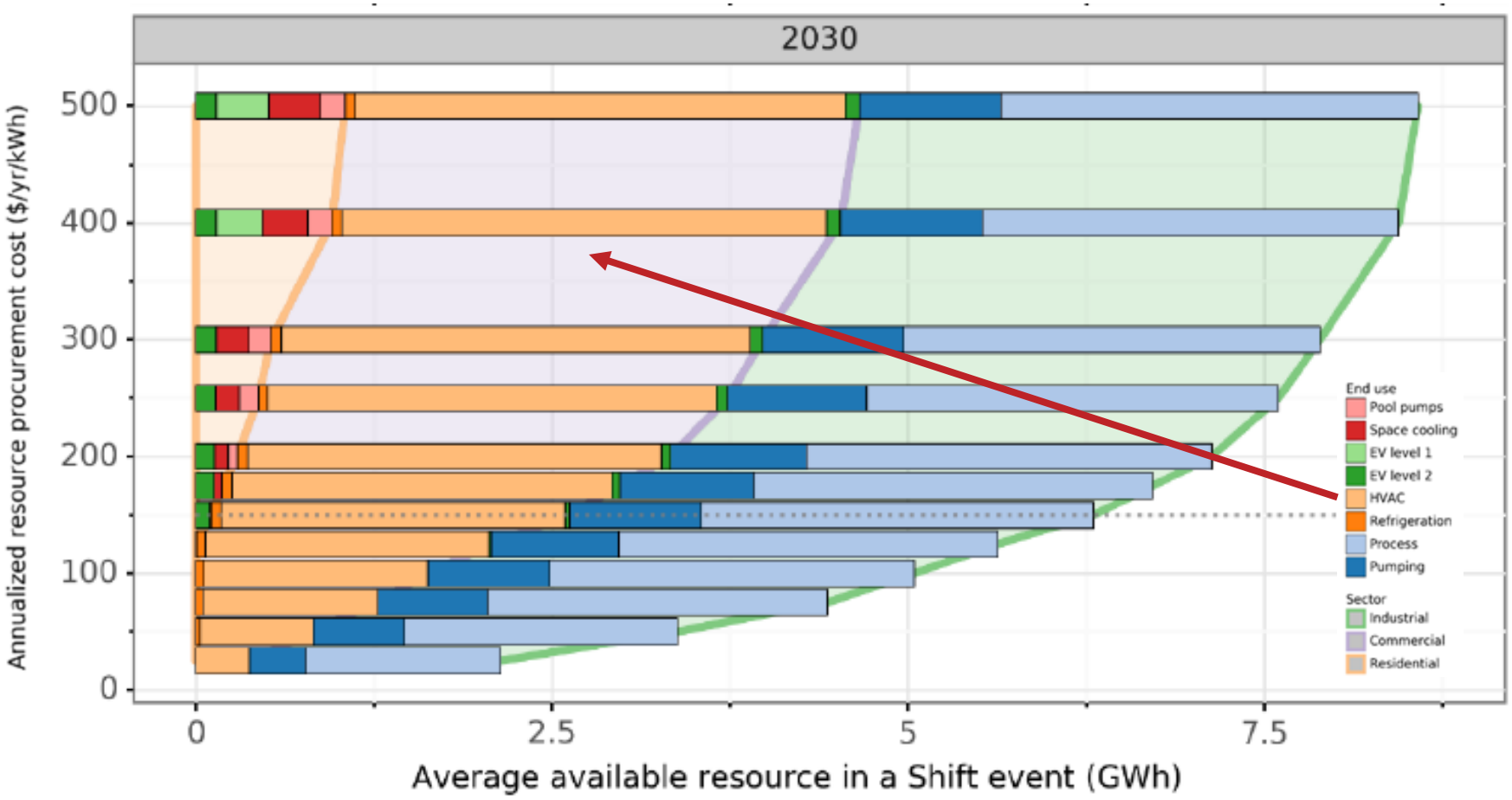


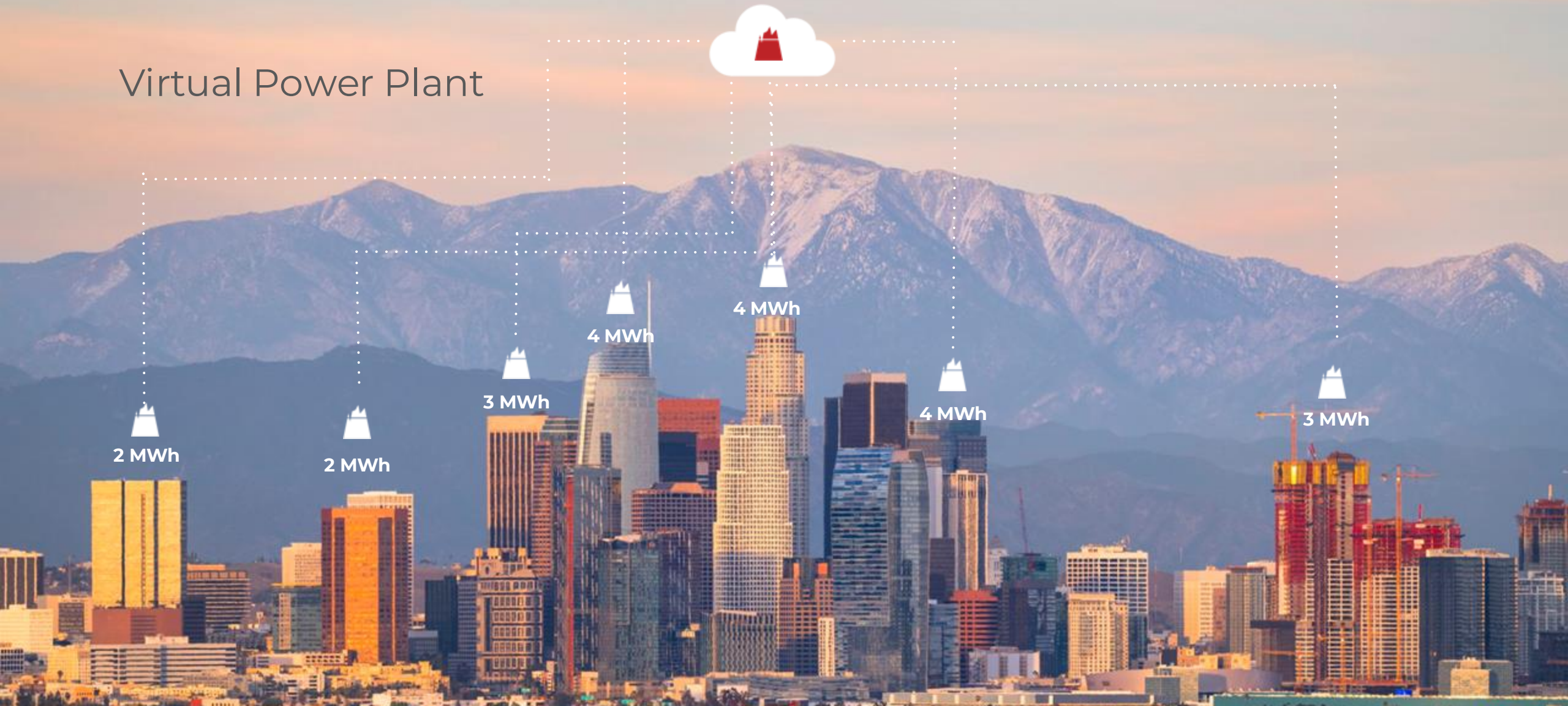
Commercial HVAC is the biggest opportunity



Cooling demands account for 30-70% of peak-time loads

LBNL, Calif DR Study (phase 3) (7/2020)

Control the biggest loads, at any time, without anyone feeling the difference...



PANEL DISCUSSION