



# CALFLEXHUB 2026 Symposium

APRIL 15, 2026 | 8 a.m. – 6 p.m. | Hybrid – Berkeley, CA & Online

## Project Showcase: Achieving Flexible Loads with Speed & Scale

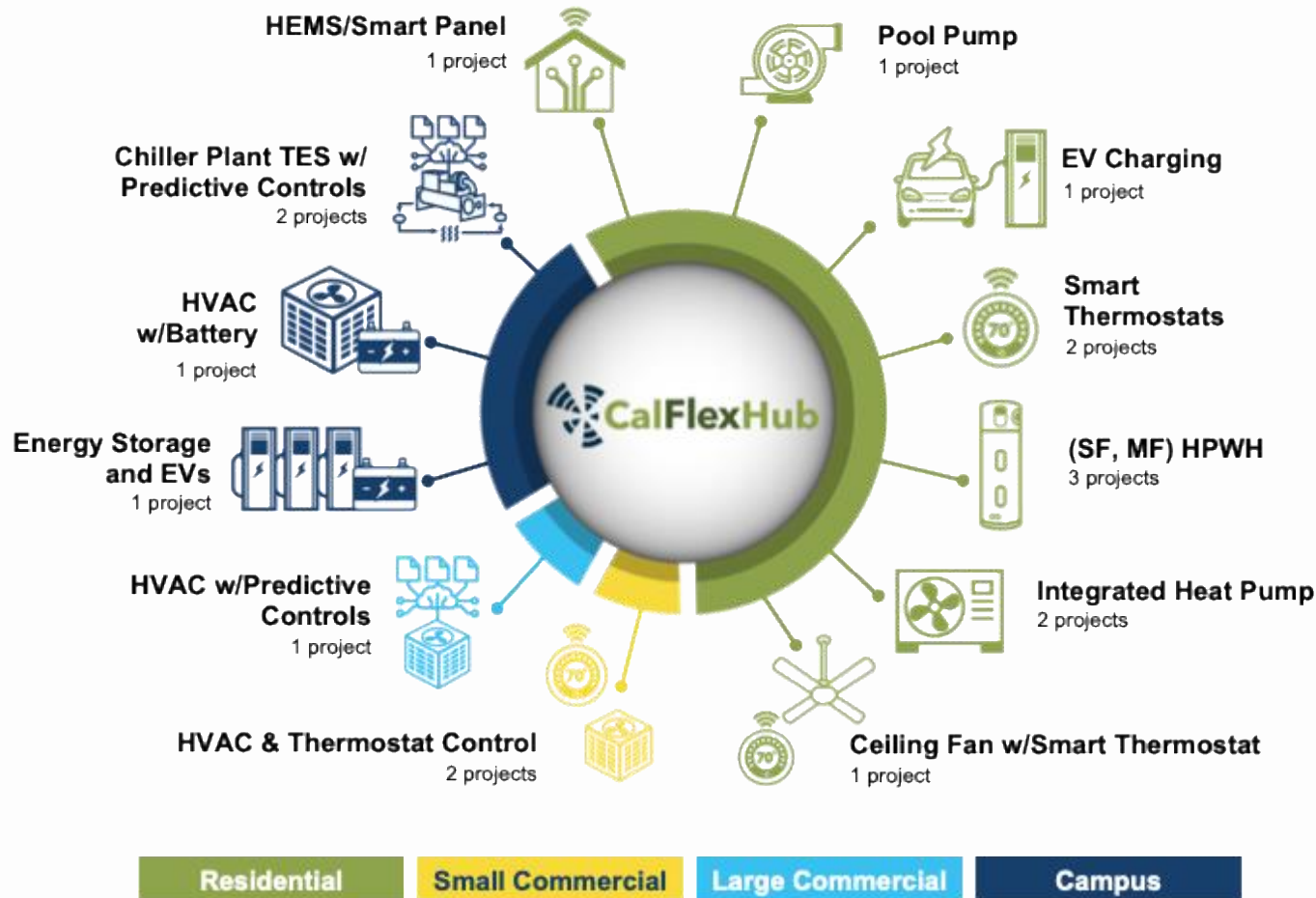


Jingjing Liu  
Technology Researcher  
Berkeley Lab



Marco Pritoni  
Research Scientist  
Berkeley Lab

# CalFlexHub Technology Portfolio

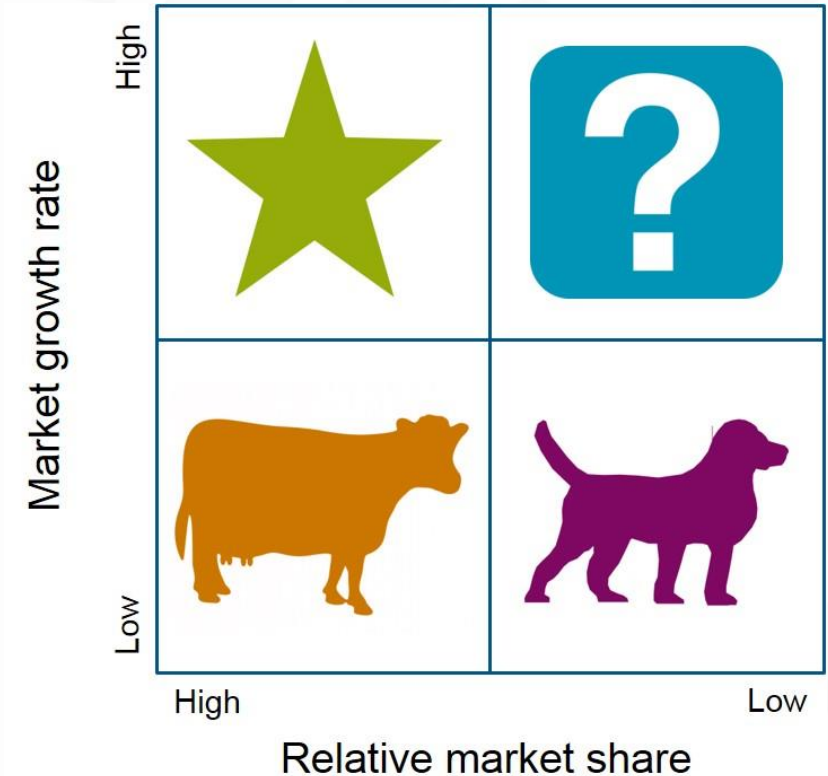


- ❖ 18 demo projects
- ❖ 95 field sites (259 units)
- ❖ 53 sites with high-CalEnviroScreen score
- ❖ 938 EVs
- ❖ 544 test days

# Promising LF Technologies

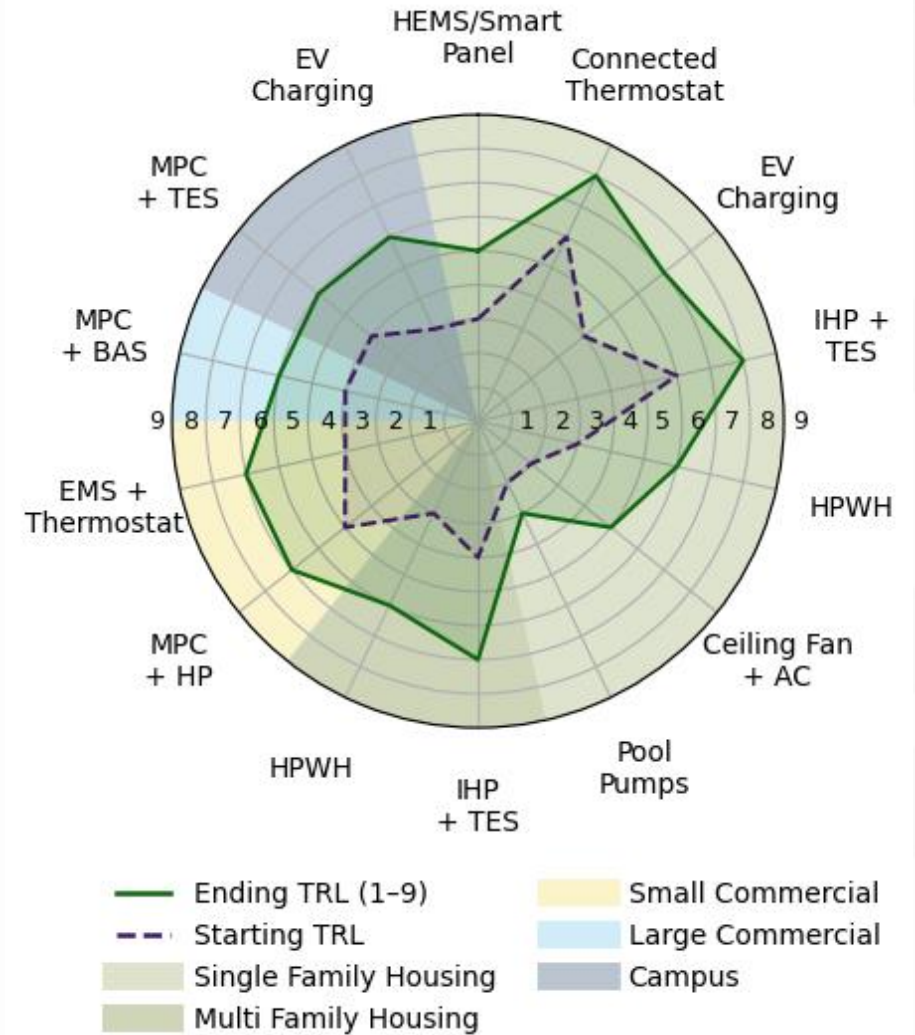
- ❖ Continuous & deeper LF:
  - Stationary batteries, EVs
  - Dedicated active thermal energy storage (TES)
  - Model predictive controls (MPC)
  - HEMS/smart panel/breaker
- ❖ Quick to deploy in scale:
  - Connected thermostats; EVs; HPWHs
- ❖ Low user impact:
  - HPWH; Integrated HP systems
- ❖ Reliability and safety benefit:
  - Ceiling fan; HEMS/smart panel/breaker

## Growth-Share Matrix



# Technology Readiness Status

- ❖ Technology Readiness Level (TRL)
- ❖ Demo Scale
- ❖ Load Impact Performance
- ❖ User Experience
- ❖ Communication Pathway and Business Model
- ❖ Technical Potential - Grid Impact
- ❖ Cost Effectiveness

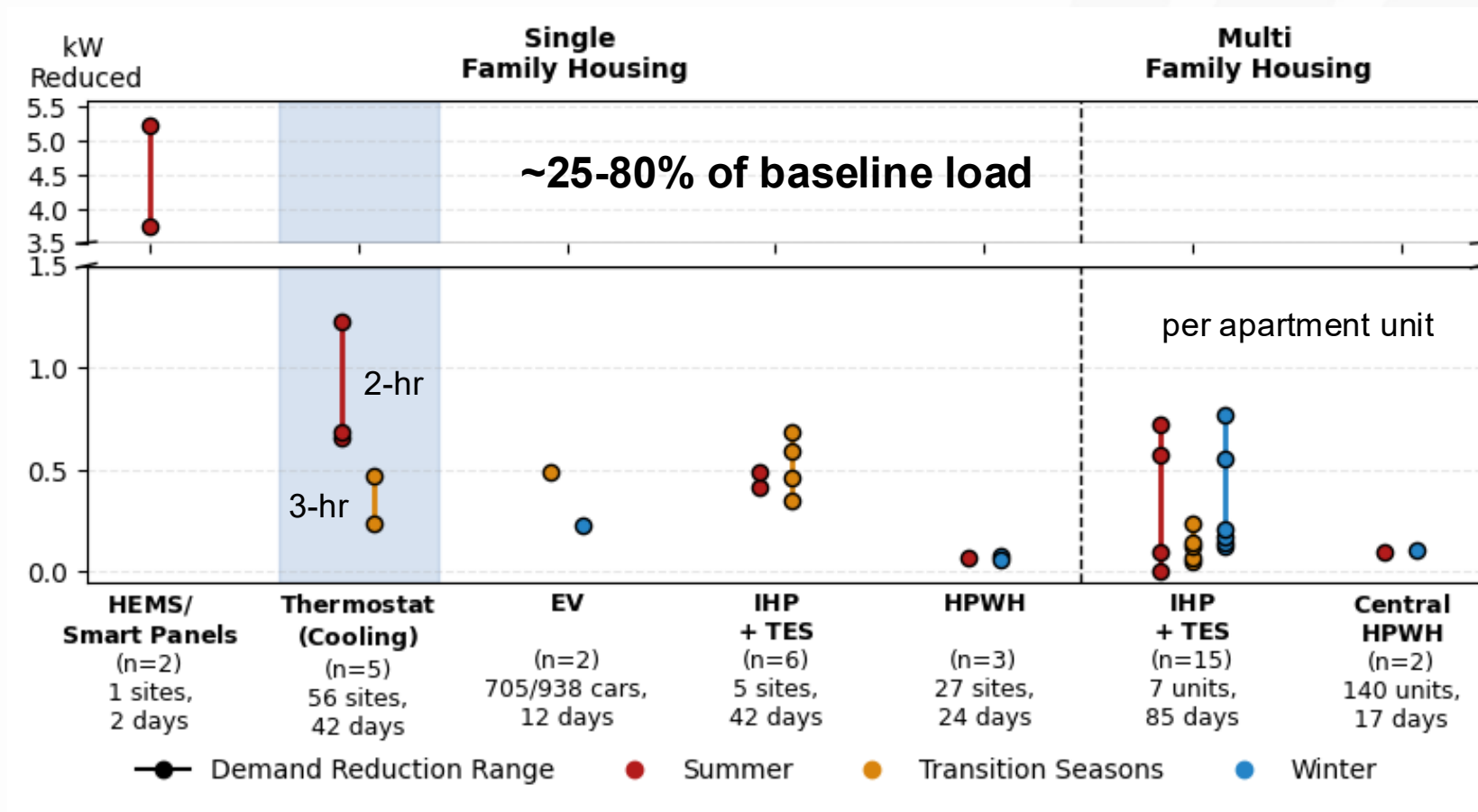


# Technology Field Testing Scope – Residential

No.	Project Partner / Vendor	Technology	Location	# Test Sites*	Test Periods	# Test Days per Site
1	UC Davis, Villara	IHP + TES	Davis, Central Valley	SF: 1; MF: 1 (2)	Summer 2023; Summer, Fall, Winter 2024	119
2	Harvest Thermal	IHP + TES	Bay Area	SF: 4; MF: 1 (6)	Spring 2023; Winter, Spring 2025	50
3	Olivine, Ecobee	Connected Thermostat	Across CA	SF: 19	Winter, Spring, Summer 2023	24
4	Olivine, Sensi	Connected Thermostat	Across CA	SF: 37	Summer, Fall 2024; Summer 2025	18
5	SkyCentrics, Pentair	Pool Pumps	Burbank	SF: 3	Summer 2025	1
6	NBI, Rheem	Unitary HPWH	Across CA	SF: 10	Winter, Summer 2025	10
7	ASK Energy, Ecotope, Mitsubishi	Central HPWH	San Francisco	MF: 1 (140)	Winter, Summer 2025	17
8	UC Davis WCEC, Rheem	Unitary HPWH	Woodland, San Jose	MF: 2 (17)	Winter 2025	20
9	UC Davis, Eaton	Smart Panels/HEMS	UC Davis	SF: 1	Summer 2025	17
10	UC Berkeley, Big Ass Fans	Ceiling Fan + AC	Stockton	MF: 1 (5)	Summer 2023	3
11	Olivine, BMW	EV Charging	Across CA	938 EVs	Fall, Winter 2025	12

\*SF: Single Family Housing; MF: Multi-Family Housing

# Load Impact Results – Residential



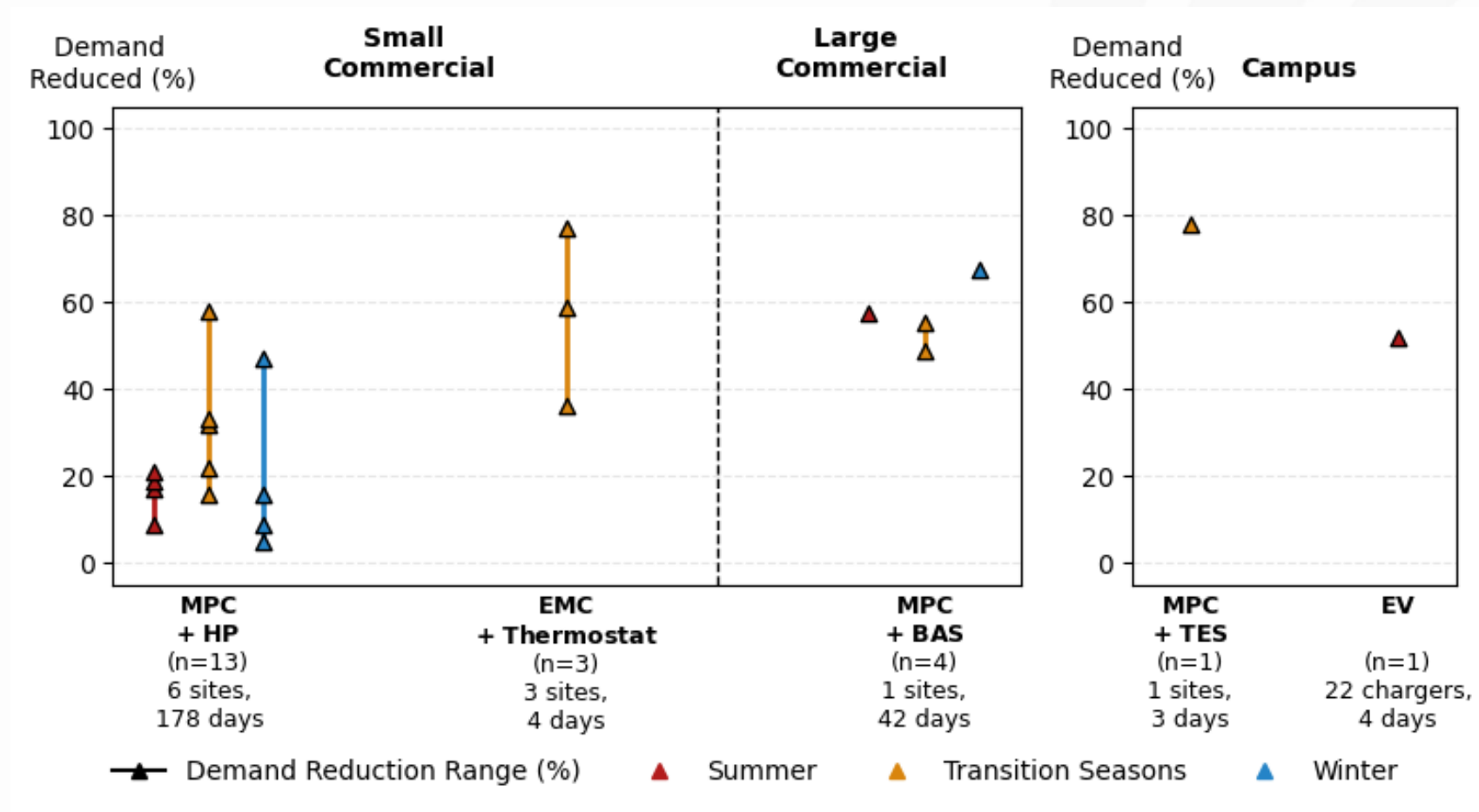


# Technology Field Testing Scope – Commercial

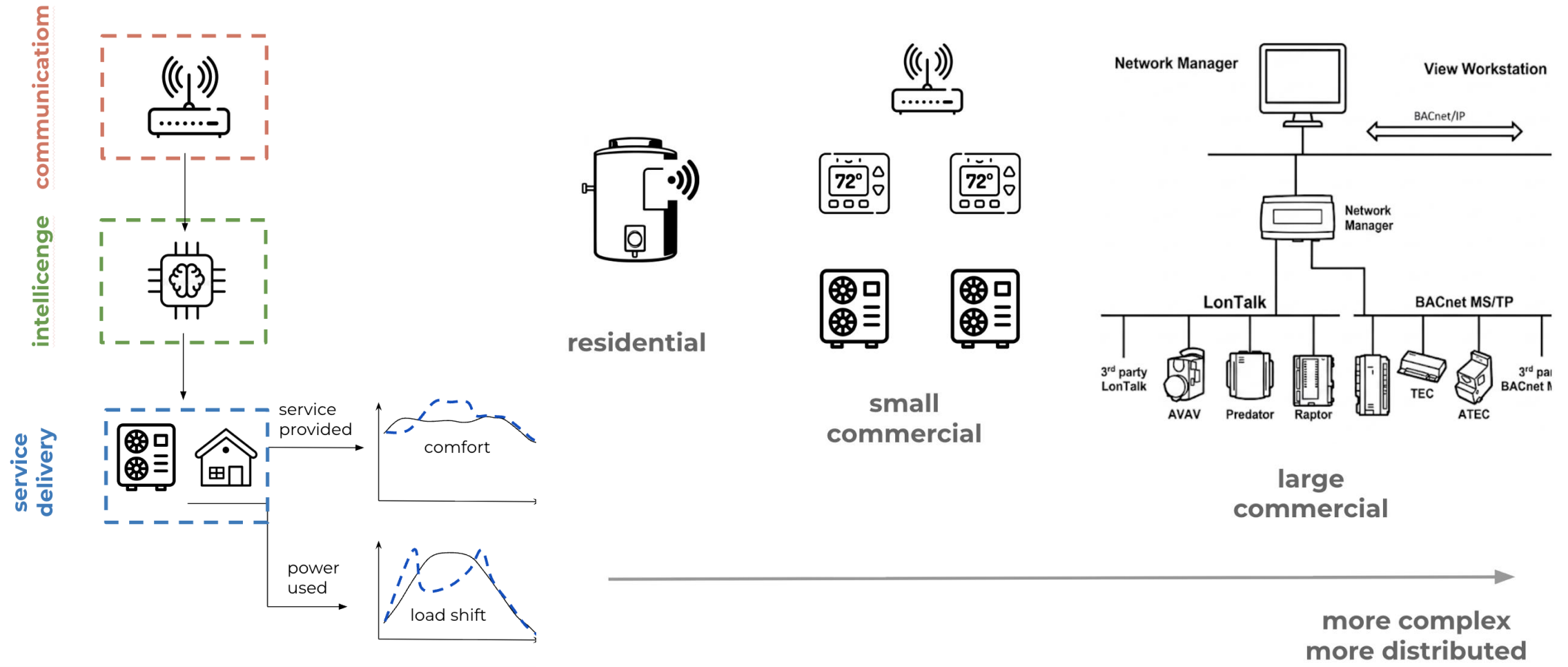
No.	Project Partners	Technology	Location	# Test Sites*	Test Periods	# Test Days per Site
12	Melrok, LA County, LACCD, KCCD, UC Davis	MPC + HP	Across CA	SC: 6	Spring 2024 to Fall 2025 (all seasons)	178
13	UC Davis, Elexity	EMS + Thermostat	Davis, Claremont, San Juan Capistrano	SC: 3	Summer 2023; Spring, Summer 2025	10
14	LBNL	MPC + BAS	LBNL	LC: 1	Fall 2023 to Summer 2025 (all seasons)	42
15	Olivine, Santa Rosa JC	MPC HVAC	Santa Rosa JC	LC: 1	Summer 2025	9
16	Olivine, UC Davis	MPC + TES	UC Davis	Campus: 1	Spring, Fall 2025	7
17	UC Merced	MPC + TES	UC Merced	Campus: 1	Fall 2023	3
18	UC San Diego, PowerFlex	EV Charging	UC San Diego	Campus: 1	Summer 2022	4

\*SC: Small Commercial; LC: Large Commercial

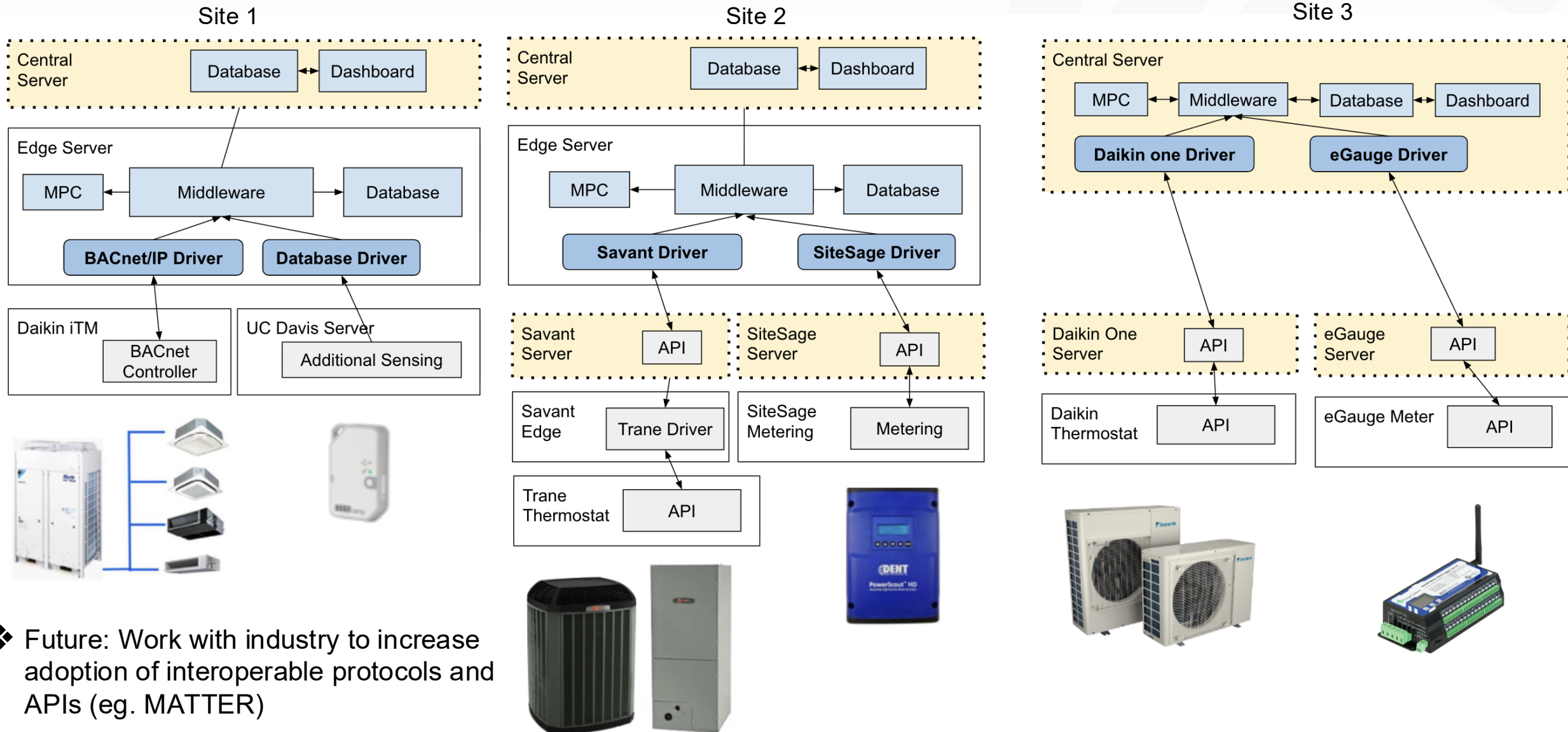
# Load Impact Results – Commercial (Cont'd)



# Interoperability and Integration Challenges



# Each building (integration) is a snowflake

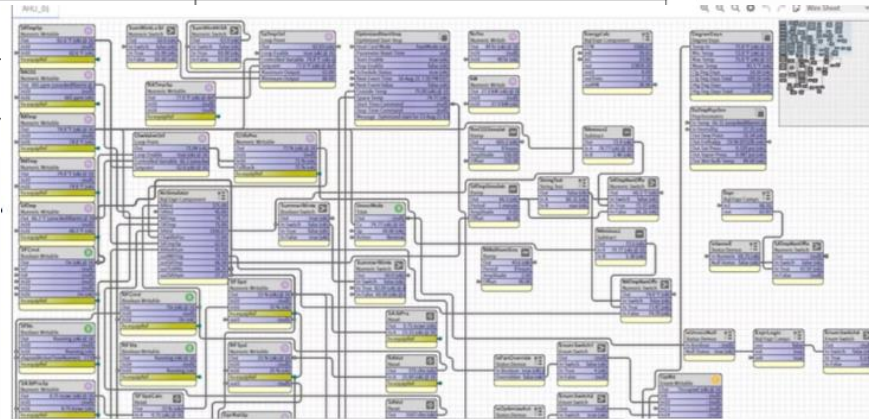


- ❖ Future: Work with industry to increase adoption of interoperable protocols and APIs (eg. MATTER)

# Large commercial buildings are even more complex and heterogeneous

## Examples of Names for **Discharge Air Pressure Sensors**

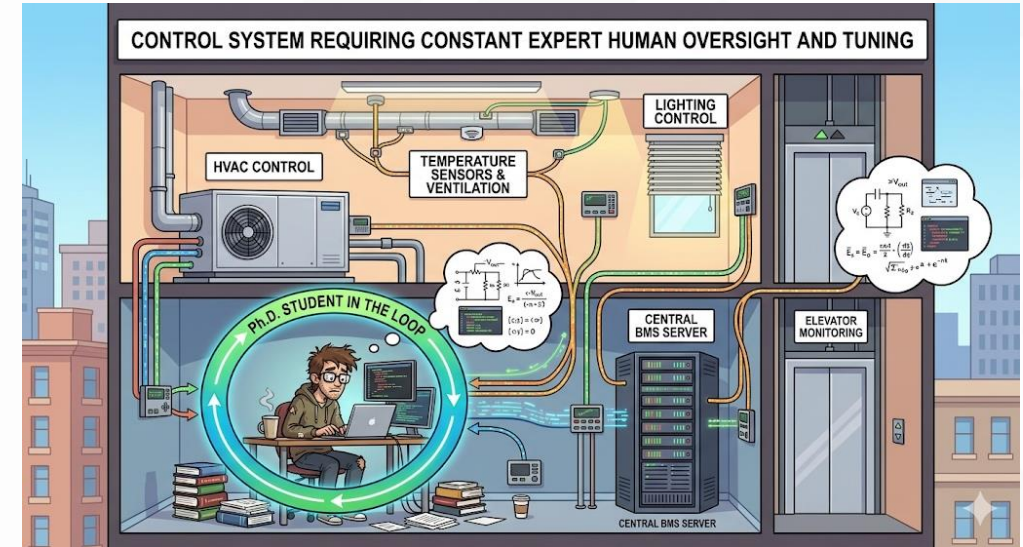
BAS Implementation 1	BAS Implementation 2	BAS Implementation 3
ACAD.AHU1. <b>Supply Air Pressure</b>	15 AHU 1 <b>SA PRESS</b>	30_ahu-001/ <b>dstpr</b>
BJ1.AHU1_2. <b>SSP</b>	015-AHU-008. <b>DA1-P</b>	30_bl-023_024/ <b>statc_press</b>
GIEDT.AHU.AHU1. <b>SSP1</b>	AHU00150. <b>SA4-SP1</b>	33_ahu-01/ <b>stat_press</b>
GHA.AHU1. <b>FAN SSP</b>	70_BL184. <b>DS-P</b>	59-ahu_001/ <b>control_pressure</b>
BRIG.SF1A. <b>SUP STATIC</b>	77 AHU 7 SA <b>DUCT PRESSURE</b>	59-ahu-004/ <b>da_stat_press</b>
GBSF.AHU3. <b>SPD</b>	86 BL5- <b>DP</b>	
CHEM.AH2N. <b>DUCT STATIC</b>	90_BL4-5. <b>DUCT-DP</b>	



- ❖ Future Work:
  - ❖ Develop trusted sequence specifications for LF
  - ❖ Increase digitalization of building metadata and control sequences (ASHRAE 223, 231)
  - ❖ Create workflows to simplify configuration of controls
  - ❖ Work with industry for implementation in commercial products and field testing
  - ❖ Follow on CEC-funded and NYSERDA-funded projects.

# MPC deployment for commercial buildings needs to be streamlined and simplified

MPC Implementation Phase	Time required	Expertise required
Building Audit	days	Energy Efficiency Audits
(Optional: Building Retro-commissioning)	weeks	Mech Systems, Building Science
(Optional: Control Software/Hardware Upgrade)	weeks	Mech Systems, Electrical Systems, Control Systems, Networking
Data Assessment and Integration	days to weeks	Data Science, Computer Science
MPC Design and Development	weeks to months	Control Systems, Optimization, Data Science
MPC Deployment and Tuning	weeks	Control Systems, Optimization, Data Science
System Handoff	days to weeks	Customer relations



## ❖ Future Work:

- ❖ Use templates, semantic models to configure MPC rather than starting from scratch
- ❖ Use AI agents to automate some of the tasks
- ❖ Work with industry to integrate MPC with commercial software platforms
- ❖ Demonstrate in the field
- ❖ Work with Utilities to adopt machine-readable tariffs and programs (like MIDAS)
- ❖ Follow on NYSERDA-funded project

# Lightning Round Speakers Introduction

- ❖ Pierre Delforge, Head of Product and Operations, **Harvest Thermal**
- ❖ Steven Rowsey, Program Operations Associate, **Olivine**
- ❖ Afshan Qamar, Research Assistant, **UC Davis**
- ❖ Peter Grant, Technology Researcher III, **Berkeley Lab**
- ❖ Therese Peffer, Program Director, **CIEE / UC Berkeley**
- ❖ Felipe Godinez, Engineer, **Olivine**
- ❖ John Powers, Founder and CSO, **Elexity**
- ❖ Armando Casillas, Technology Researcher III, **Berkeley Lab**



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Pierre Delforge  
Head of Product & Operations  
Harvest Thermal

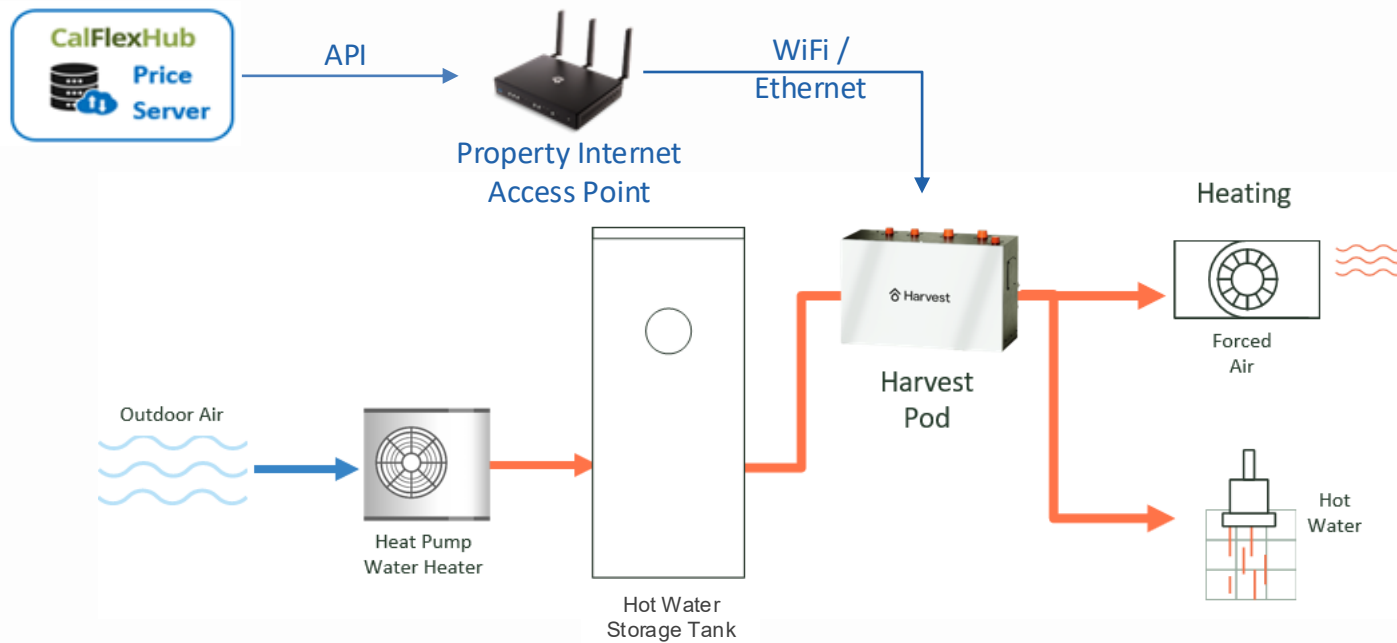
# Demand Flexible Heating and Hot Water

Integrated Heat Pump with Thermal Energy Storage  
in Low-Income Multifamily

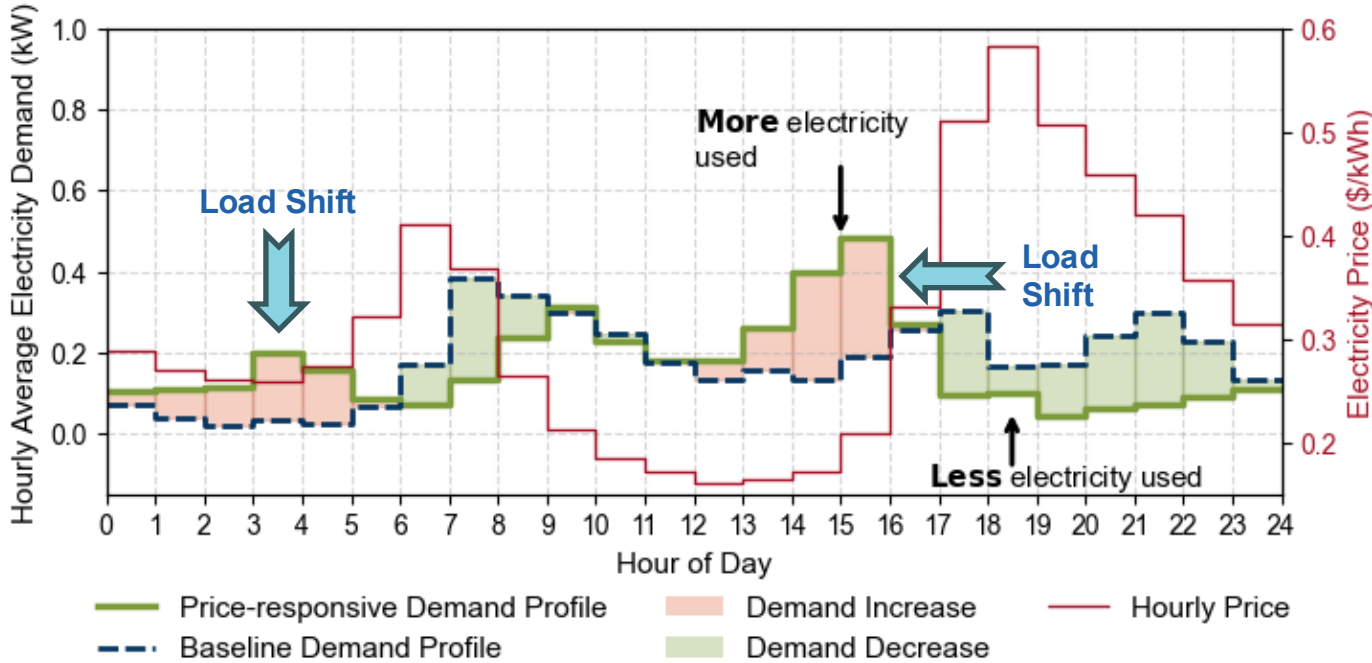


# Integrated Heat Pump (IHP) with Hot Water Storage (Harvest Thermal)

HVAC and hot water with thermal energy storage in low-income multifamily



# Test Results



- **60-80%** of heating and hot water load shifted off-peak
  - **35-50%** of entire home peak energy use shifted off-peak
- No compromise on occupant comfort
- **29%** heating/hot water bill savings

*Average Percent Peak Load Reduction across the Five Test Homes*

Average % Peak Load Reduction	6-Hour	4-Hour	2-Hour
Winter	67%	66%	59%
Spring	72%	75%	82%

# Scaling Residential HVAC & Hot Water Load Flex

- ✓ **500+ systems deployed** in both single- and multi-family
- ✓ **Federal tax credit** for thermal energy storage for HVAC: **30-40%**
- **Leasing program: \$0** down, leverage tax credits for affordable monthly payments, **30%** bill reductions
- **Still needed:** utility rebates that monetize grid value to accelerate adoption

**Market Growth Strategy:**  
Monetize **grid value** to reduce **first costs** and **operating costs**

# Thank you!

Contact: Pierre Delforge, [pierre@harvest-thermal.com](mailto:pierre@harvest-thermal.com)





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Steven Rowsey,  
Program Associate,  
Olivine

# What Real Homes Reveal About Smart Thermostat Flexibility

Presenter: Steven Rowsey – Olivine, Inc.

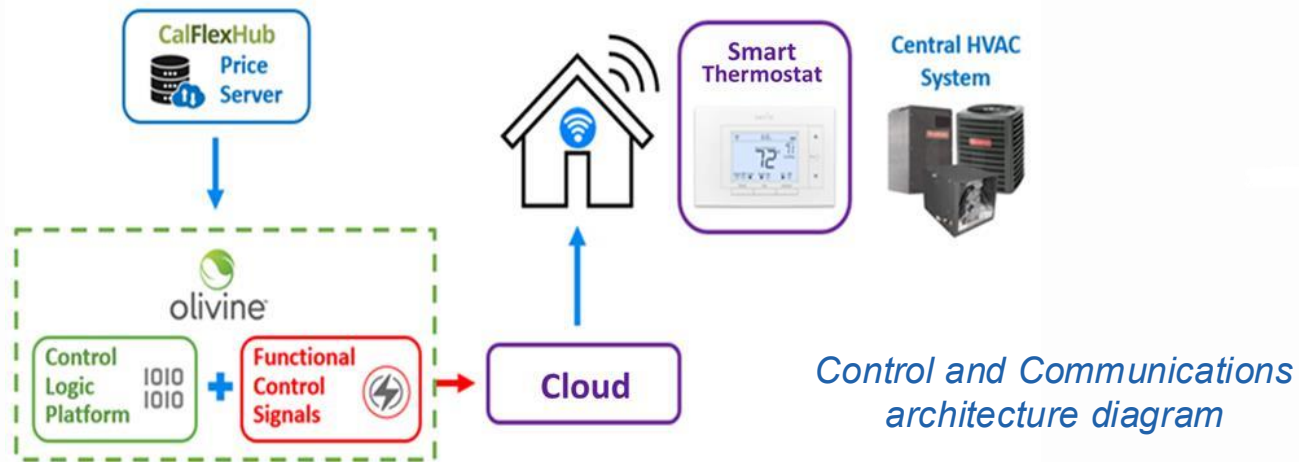
Project Team: Joseph Bourg, Jingjing Liu, Felipe Godinez & Steven Rowsey



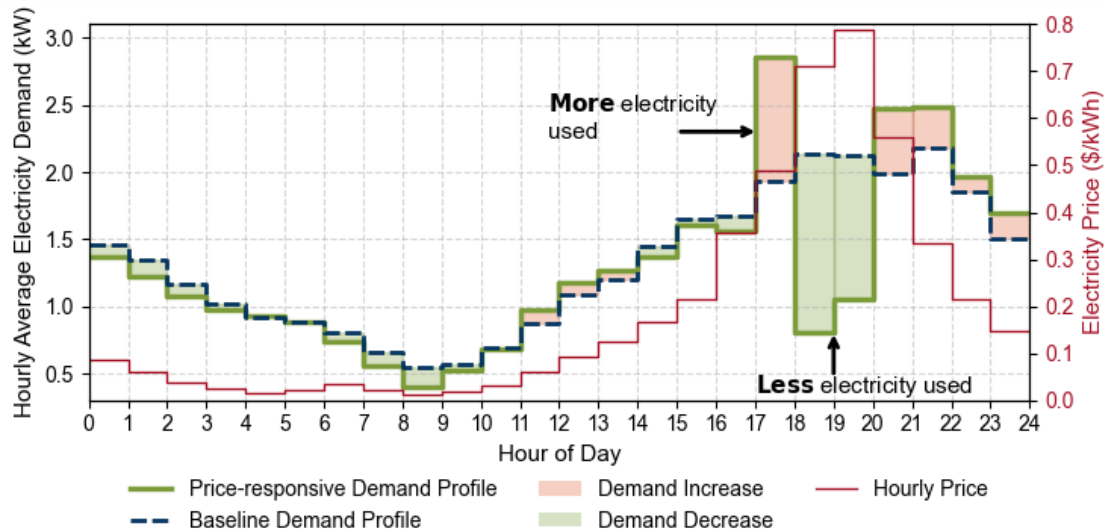
# Residential Connected Thermostats

Demonstration of third-party optimization of smart thermostats in response to hourly price signals

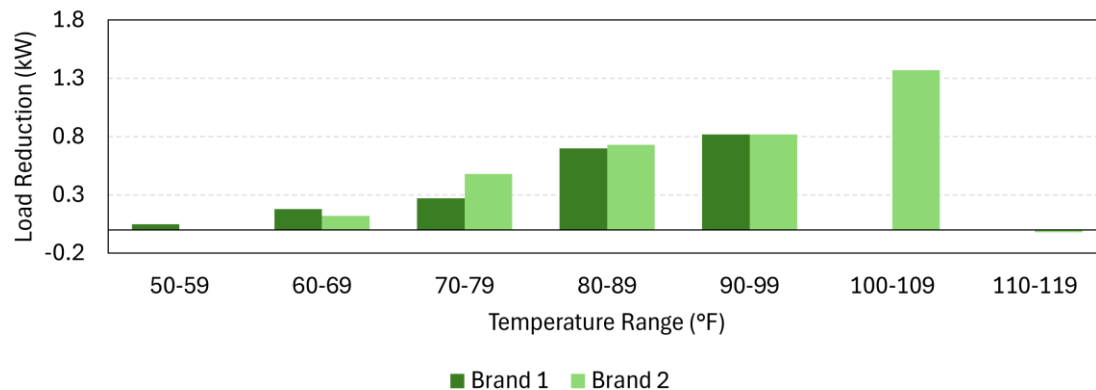
- 75 thermostats from two vendors installed across 63 households
- Single-family detached homes, townhomes and multi-family complexes
- 41 households identified in areas with high CalEnvironScreen scores
- Sites distributed across climate zones 9 through 14



# Test Results



Load shift response to price signal from example test day



Average load reduction per temperature band for all test days

- An average of **0.67kW** of load reduction was seen across all test periods
- Average of **\$0.79 (11%)** daily energy bill savings
- Load reduction capacity is **correlated** to outdoor temperature
- **No significant impact** on load reduction from **pre-cooling** was observed
- **Load reduction across brands** was consistent

# Key Learnings / Technology Transfer

- **Smart thermostats are already commercialized**; the priority is scaling current and future devices as flexible load resources
- **Cost-effectiveness is currently a challenge** due to high OEM device fees and customer acquisition expenses adding to ASPs' costs
- **Wider adoption of open communication protocols** can reduce ASPs' implementation cost
- **Participant education, device response rates, and baseline accuracy** are critical factors in achievable load flexibility
- **Benefit of pre-cooling cannot be assumed** – it can reduce comfort and potentially increase customer opt-out rates

# Thank you!

Contact:

Steven Rowsey, [srowsey@olivineinc.com](mailto:srowsey@olivineinc.com)





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## Project Showcase: Achieving Flexible Loads with Speed & Scale



Afshan Qamar  
PhD Researcher  
UC Davis

# Balancing Costs and Capacity: Intelligent Load Management for Electrified Homes

Presenter: Afshan Qamar<sup>1,2</sup>

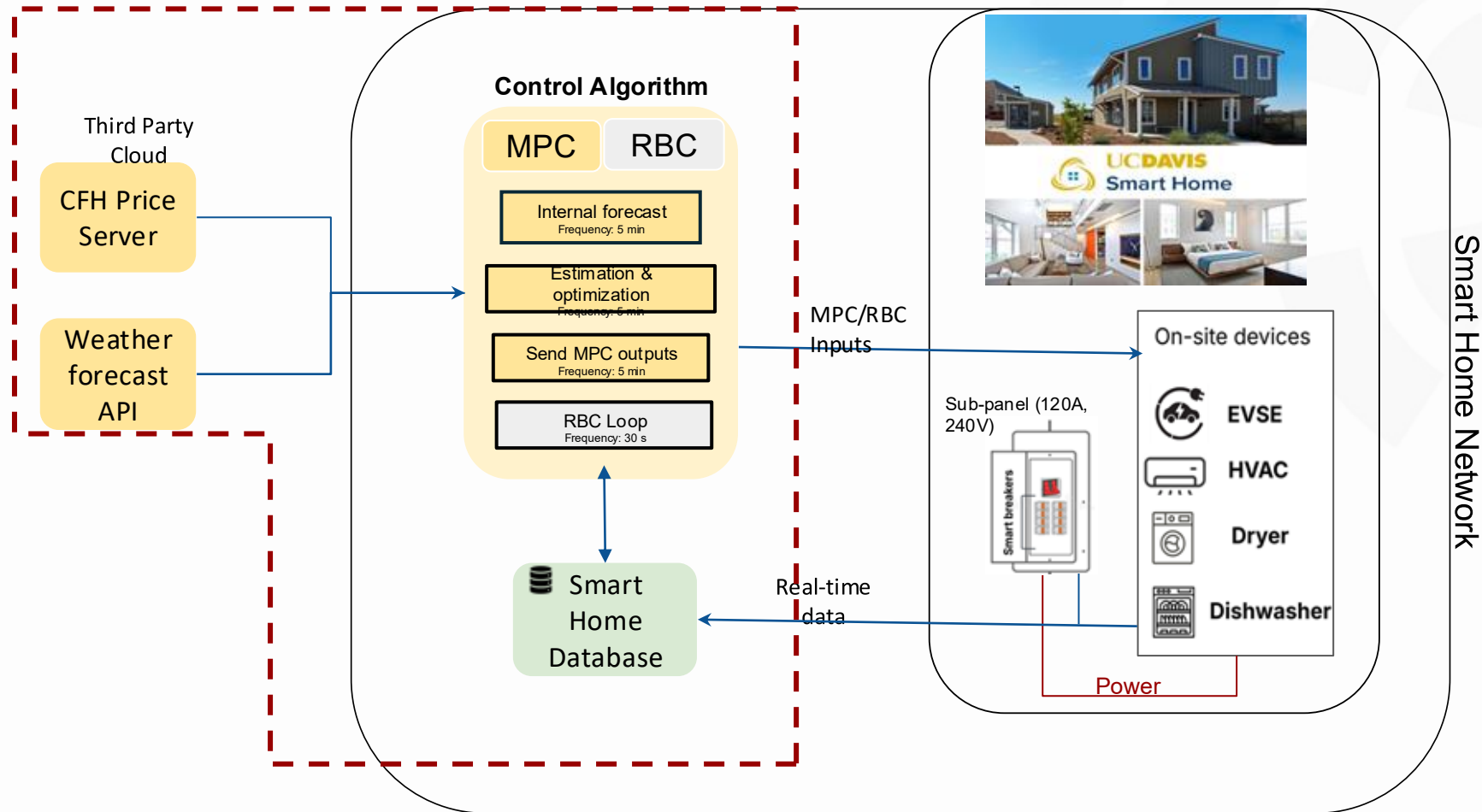
Project Team: Afshan Qamar<sup>1,2</sup>, Kelly Kisson<sup>1</sup>, Marco Pritoni<sup>2</sup>, Daniel Gerber<sup>2</sup>, Ettore Zanetti<sup>2</sup>, Tao Yang<sup>2</sup>, Pablo Avaloz-Ruiz<sup>3</sup>, Keith E Graeber<sup>3</sup>

<sup>1</sup> Energy and Efficiency Institute, UC Davis

<sup>2</sup> Lawrence Berkeley National Laboratory, Berkeley, California

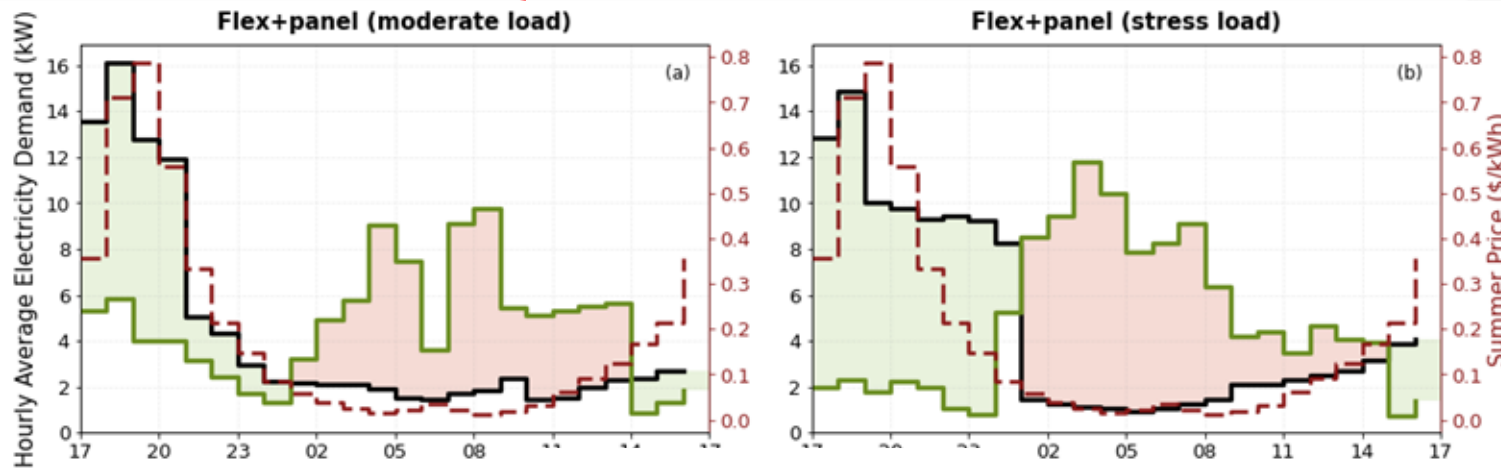
<sup>3</sup> California Lighting Technology Center, UC Davis

# Coordinated multi-load control for dynamic price response under panel capacity constraints

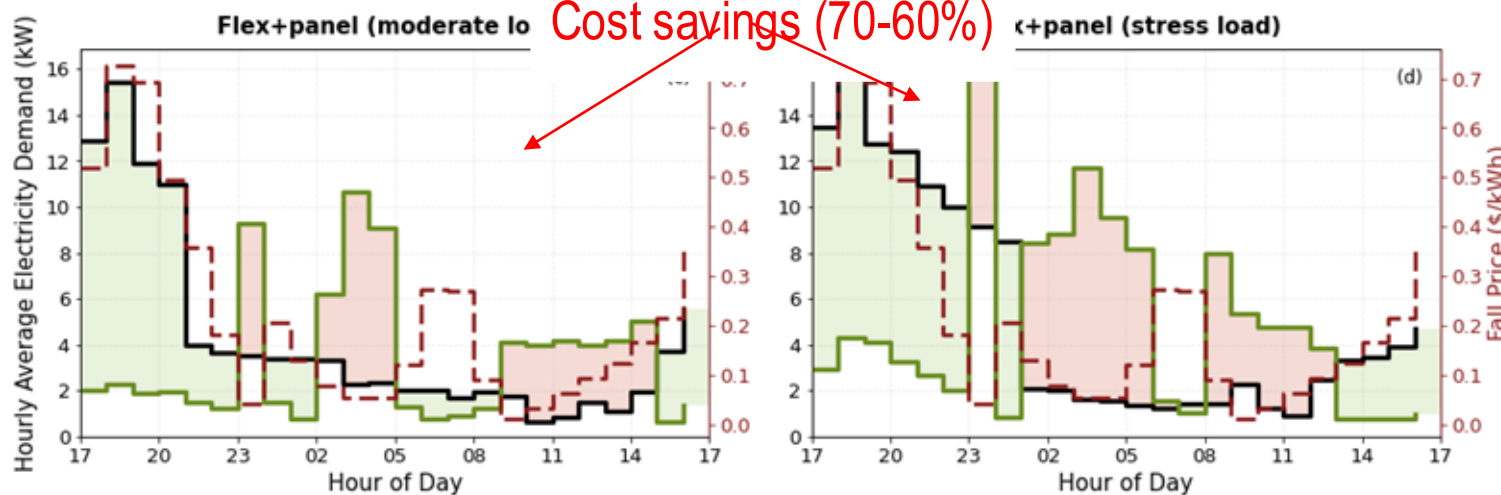


# Test Results

Cost savings (55-51%)

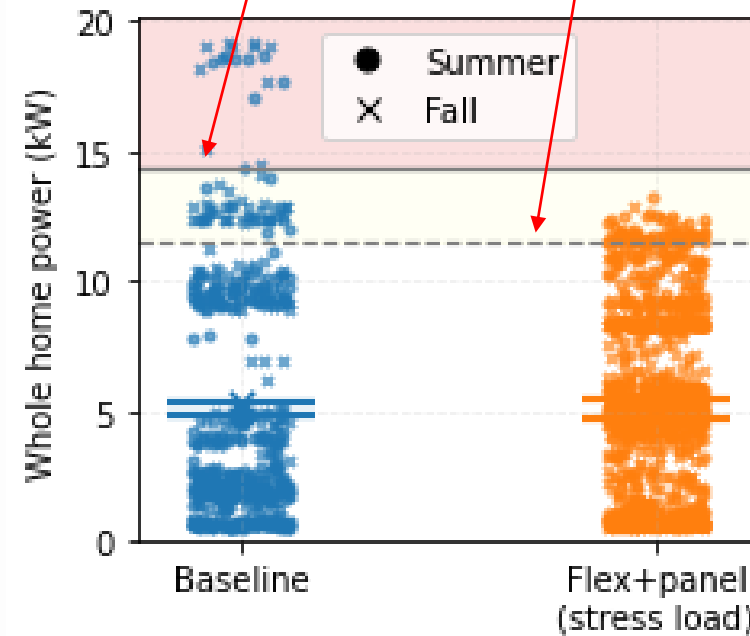


Cost savings (70-60%)



rated: 60A, 240V (14.4kW)

safety threshold: 11.52kW



~75-80% less excursion time

~91-92% lower exceedance

Legend: Demand increase (pink), Demand decrease (light green), Baseline demand profile (solid black), Price-responsive demand profile (solid green), Price (dashed red)

# Key Learnings / Technology Transfer

## Key Learnings

- Coordinated load shifting of multiple home loads and capacity limiting is feasible with current commercial hardware.
- Performance depends on user preferences: min. battery SOC, comfort bounds, flexibility in scheduling appliances.
- During test measured load reduction of 50-70% under tested scenarios and non-trip panel excursions

## Scalability/Commercialization Barriers

- Unreliable device connectivity
- Lack of open APIs
- High integration effort and commissioning/debugging overhead.

# Thank you!

Contact: [aqamar@ucdavis.edu](mailto:aqamar@ucdavis.edu)  
<https://www.linkedin.com/in/afshan-qamar-055823223/>





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Peter Grant  
Technology Researcher  
Berkeley Lab

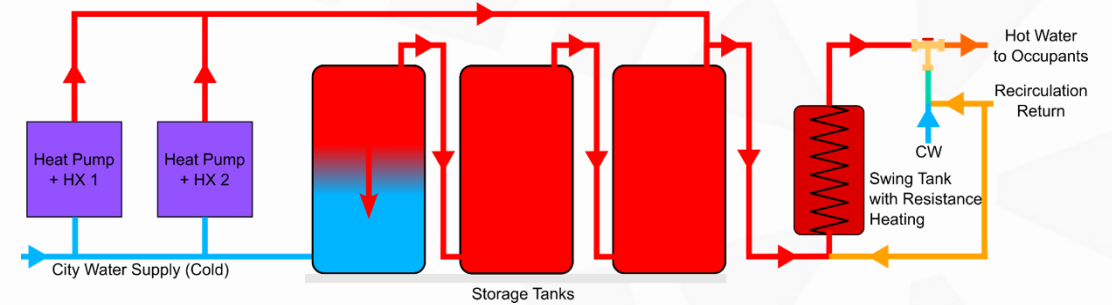
# Simple Controls to Minimize Electricity Costs of Central Heat Pump Water Heaters

Peter Grant and Brian Woo-Shem

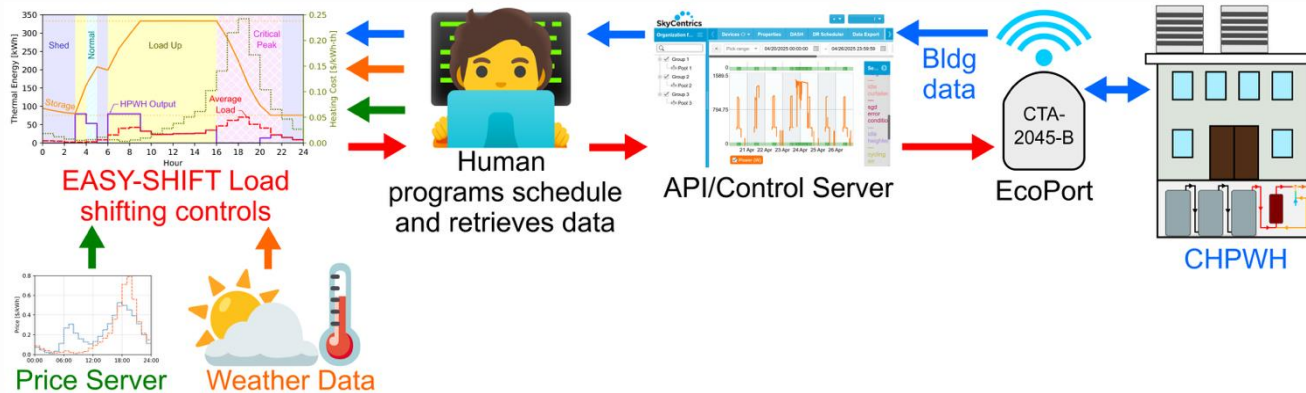


# Simple Controls to Minimize Electricity Costs of Central Heat Pump Water Heaters

- Multifamily buildings
- Domestic hot water
- Large, central water heating systems

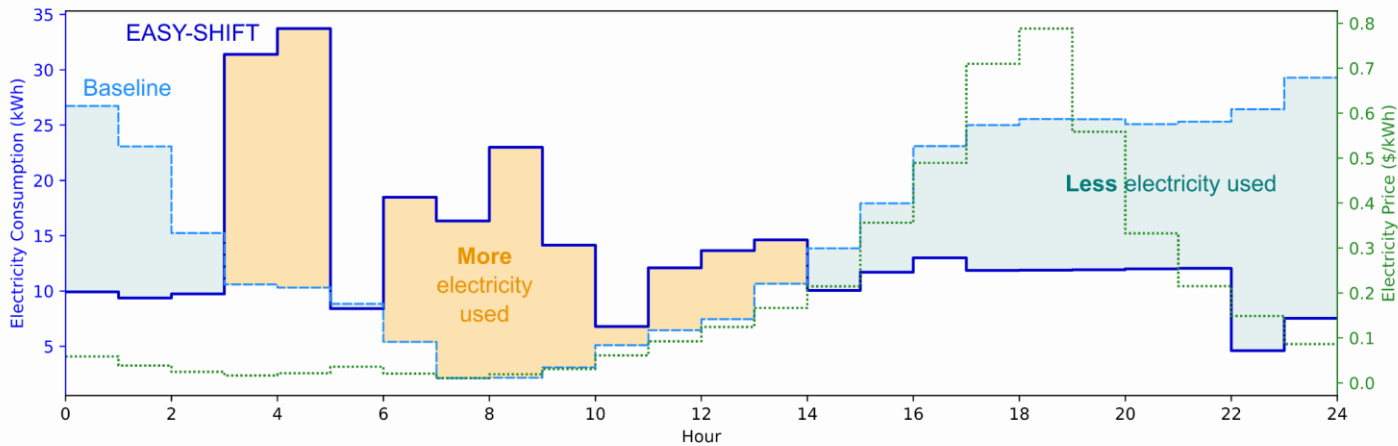


## Communication Architecture

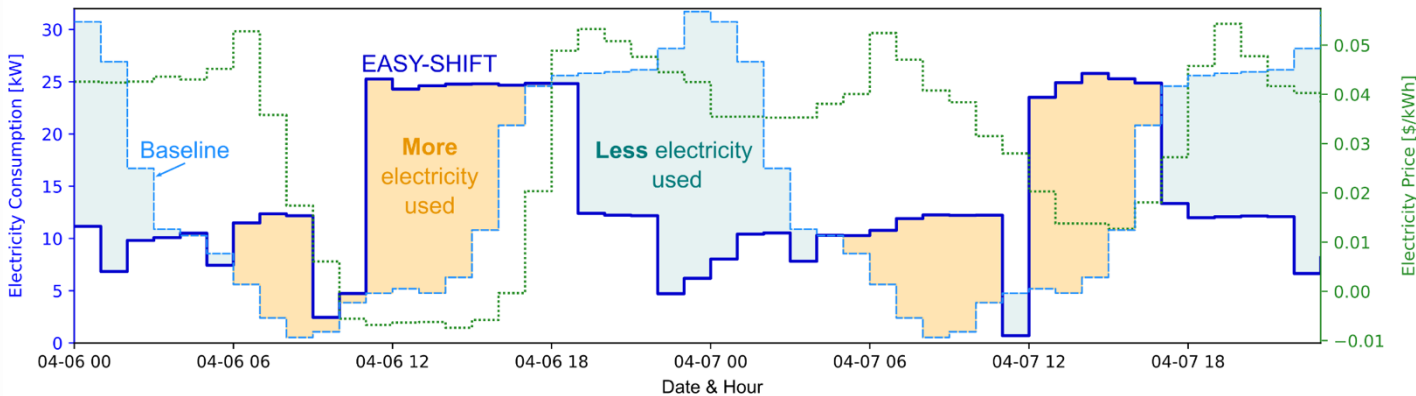


# Test Results

CFH SummerHDP



PG&E Hourly Flex Pricing



- CalFlexHub SummerHDP
  - 42% cost savings
  - 58% high price demand reduction
- PG&E Hourly Flex Pricing
  - 36% cost savings
  - 52% high price demand reduction
- 2 manufacturers seeking to adopt

# Key Learnings / Technology Transfer

- **Performance:** Storage enables flexibility
  - 30-50% bill reduction
  - Occupants don't notice a change
- **Market-readiness:** Industry can adopt
  - 1 manufacturer seeking to license
- **Scaling:** 25-150 kW/site
  - Reduced recruitment and communication costs
- **Challenges:**
  - Communication not standardized
  - Need automated control-device communication



Thank you!

Contact: [pgrant@lbl.gov](mailto:pgrant@lbl.gov)





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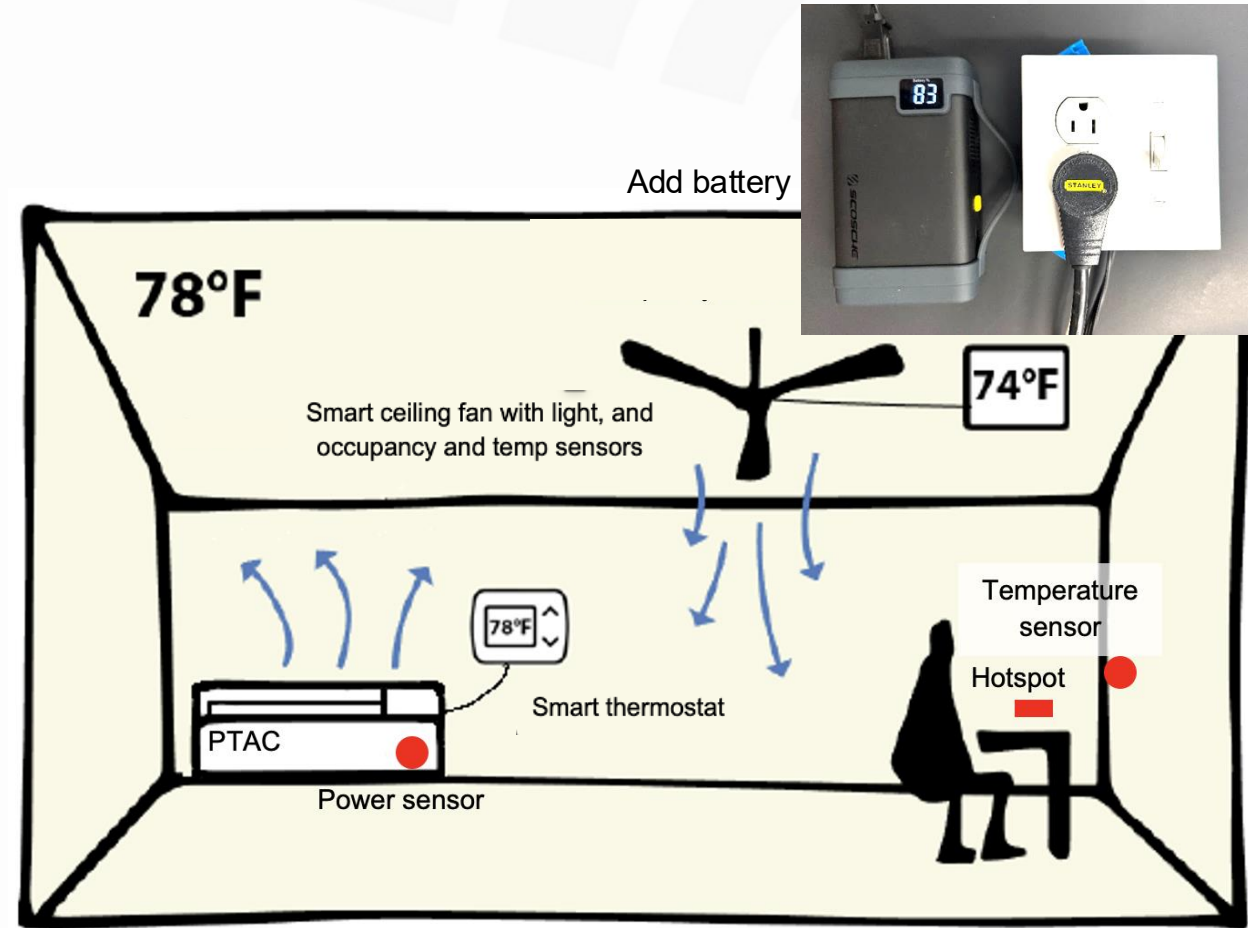
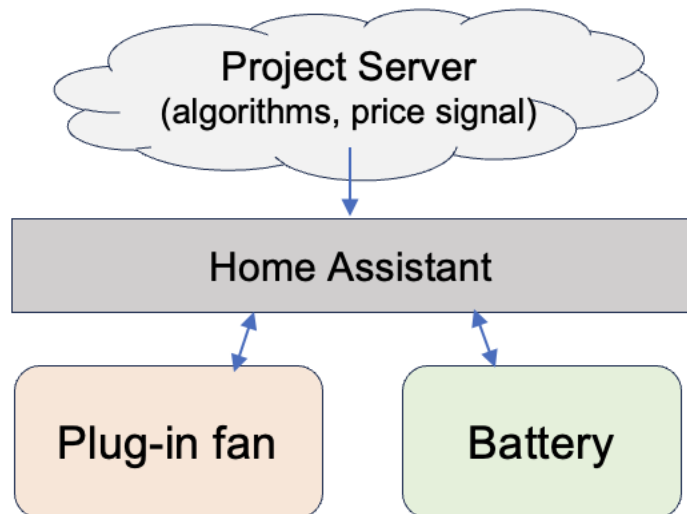
Therese Pepper, Associate Director  
UC Berkeley California Institute for Energy and Environment

# CoolFIT

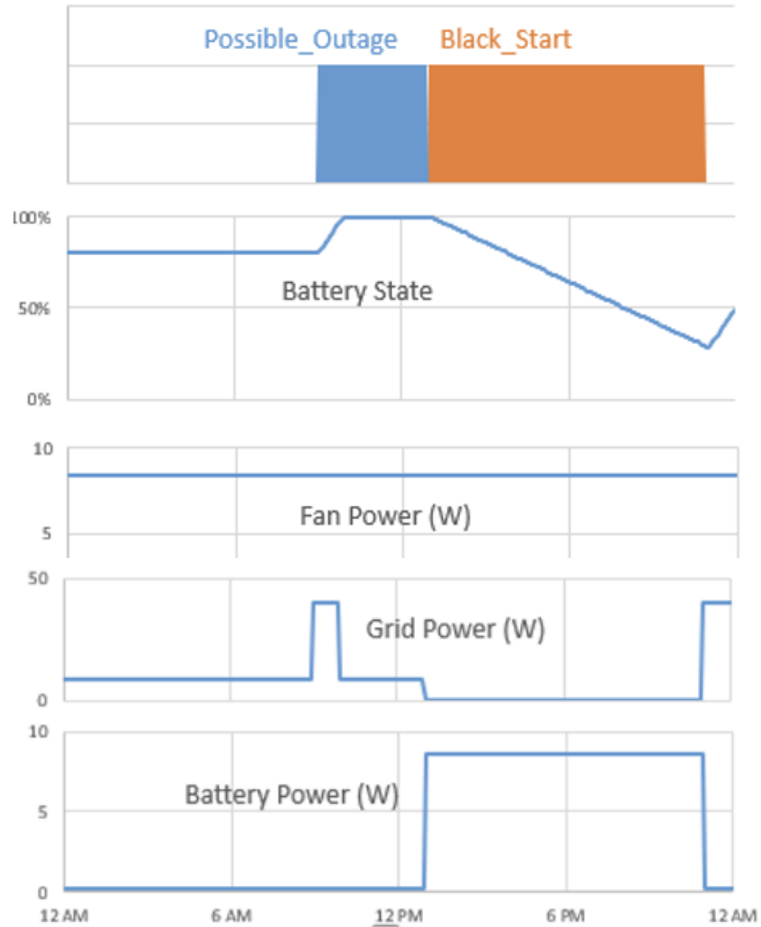
Integrating a ceiling fan with smart thermostat  
and  
powering a fan with a battery

# CoolFIT: Residential battery-integrated Fan with Thermostat

Integrating residential (SF & MF, DAC) fans with batteries and smart thermostats for HVAC/Package TAC



# Test Results



- Ceiling fan successfully provided comfort when AC setpoint was raised to reduce peak energy
- Switching fan power to battery versus grid successfully reduced load during event.

# Key Learnings / Technology Transfer

- One can add a smart thermostat to an existing Packaged Terminal Air Conditioner (PTAC).
- Ceiling fans (2-8 Watts) kept people comfortable during warmer-than-normal temperatures (>90F).
- Raising the thermostat setpoints reduced HVAC “on” time (1000W power).
- Seniors found the remote control for the fan more convenient than the chain switch.
- Senior residents required some time to learn how to use smart thermostats; need larger text.
- Off-the-shelf batteries can power an efficient ceiling fan for >24 hours (depending on fan speed)



# Thank you!

Contact: Therese Peffer, [tpeffer@berkeley.edu](mailto:tpeffer@berkeley.edu)





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Felipe Godinez  
Solutions Engineer  
Olivine

# Control and Coordination of Residential BMW EV Charging Through Onboard Vehicle Telematics

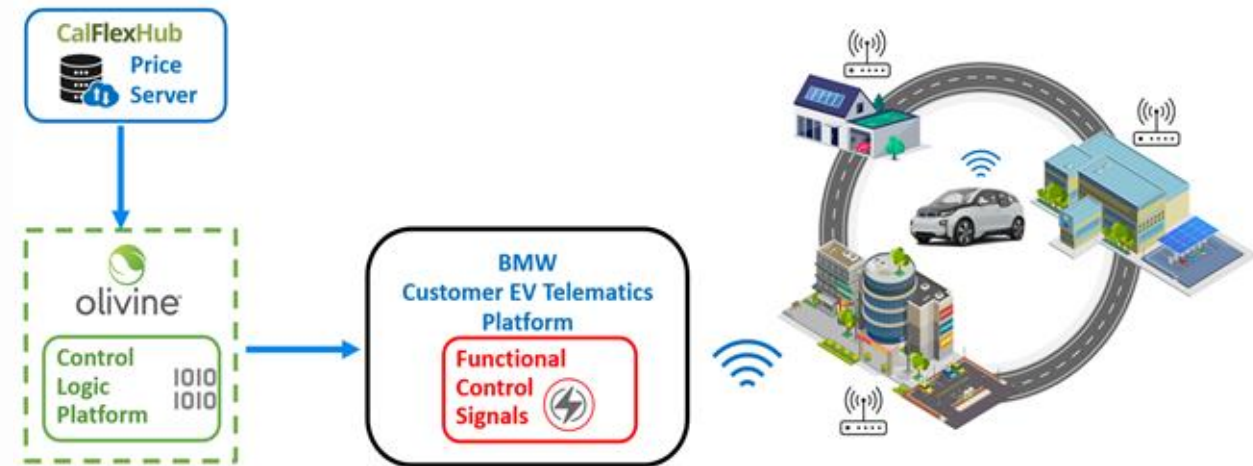
Presenter: Felipe Godinez

Project Team:

Tim Lipman, Jonas Schiller, Joseph Bourg, Jingjing Liu, Felipe Godinéz & Steven Rowsey

# Orchestration of Residential EV Charging

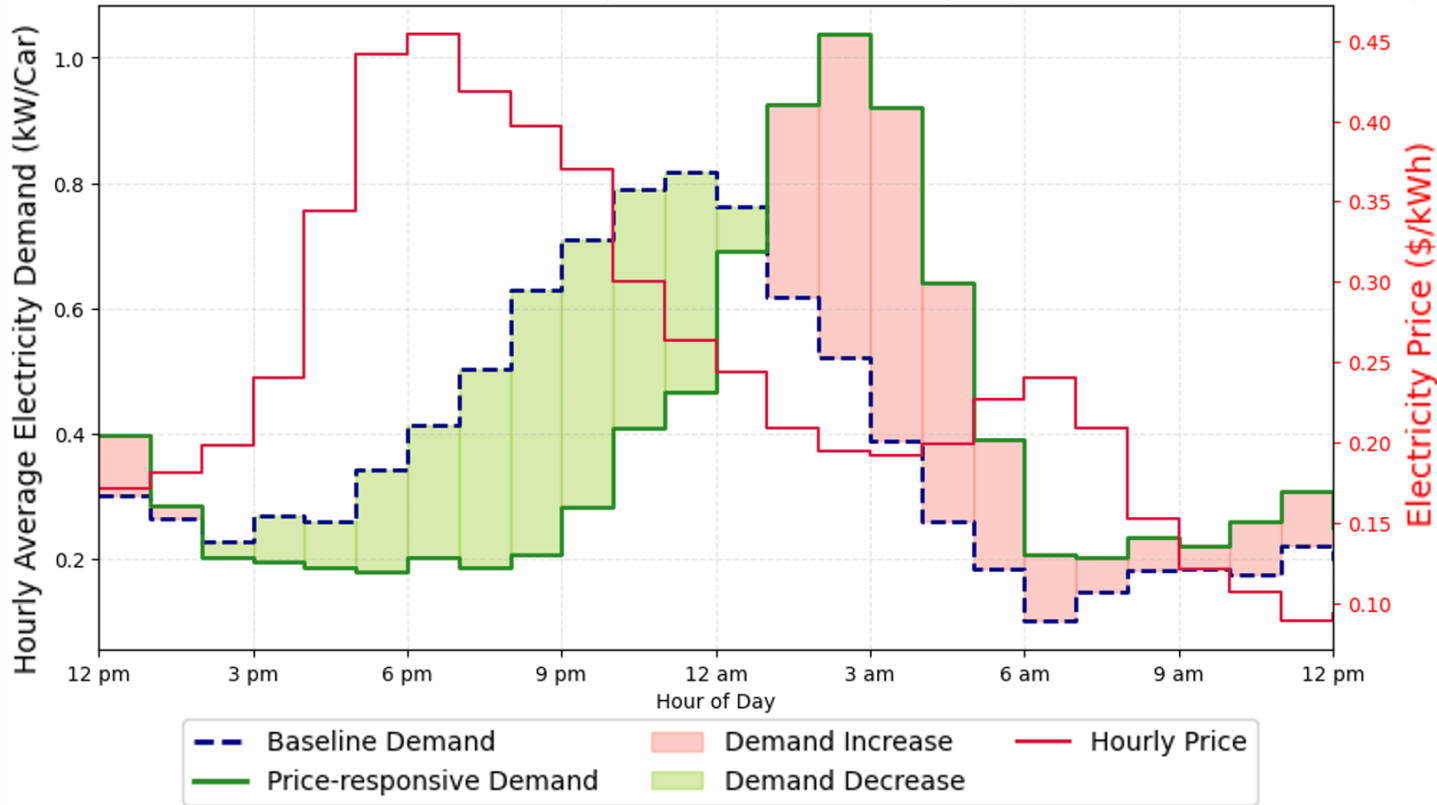
- **BMW fleet** with 938 EVs in California
  - *Small Batterie EVs (<35kWh)*
  - *Large Batterie EVs (>35kWh)*
- **Mobile app** used by participants to set desired SOC and departure times
- **EV telemetry** used for price informed charge control
  - *EV response at any charge location*
  - *Primarily home charging*



*Signal communication and control diagram*

# Test Results

Demand Shift from 2024-12-06 12pm to 2024-12-07 12pm (Number of Vehicles: 266)



*Example 24-hour test period with averaged hourly charging*

- **705 EVs** had charge session during a total of 12 days of CFH testing
- Average hourly load reduction of **0.35 kW per vehicle** during 2-, 4-, and 6-hour high price periods
- **Smaller battery vehicles**, on average per charging session, shifted approximately **4.74kWh**
- **Larger battery vehicles**, on average per charging session, shifted approximately **21.33kWh**
- Average 24-hour cost savings of **\$2.57** or **21%**

# Key Learnings / Technology Transfer

- **Aggregate EV charging Load Flexibility** varies based on:
  - *Vehicle charging frequency*
  - *Opt-outs*
  - *Charge session interruption*
  - *Telemetry communication success (e.g. garage)*
- **Percentage of vehicles that completed optimized charging** averaged ~30% for all control periods

- **EVs are fully commercialized** and increasingly attractive as costs decline, charging access expands, and range improves.
- **EV ROI is already strong** in CA and can be further improved with dynamic electricity rates.
- **Effective EV telemetry control** requires EV OEM or 3<sup>rd</sup> party ASP's platforms able to identify, retrieve, and optimize price signals at current charge location.
- **Further research is needed** to improve communication and optimization completion rates, including whether education can increase engagement and performance.

# Thank you!

Contact:

Tim Lipman, UC Berkeley, [telipman@berkeley.edu](mailto:telipman@berkeley.edu)





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John Powers  
Founder & CSO  
Elexity

# Medium Commercial Customers

## California's Load Flexibility Goldmine

John Powers  
Elexity



# Elexity: Commercial Load Flexibility A/B Test

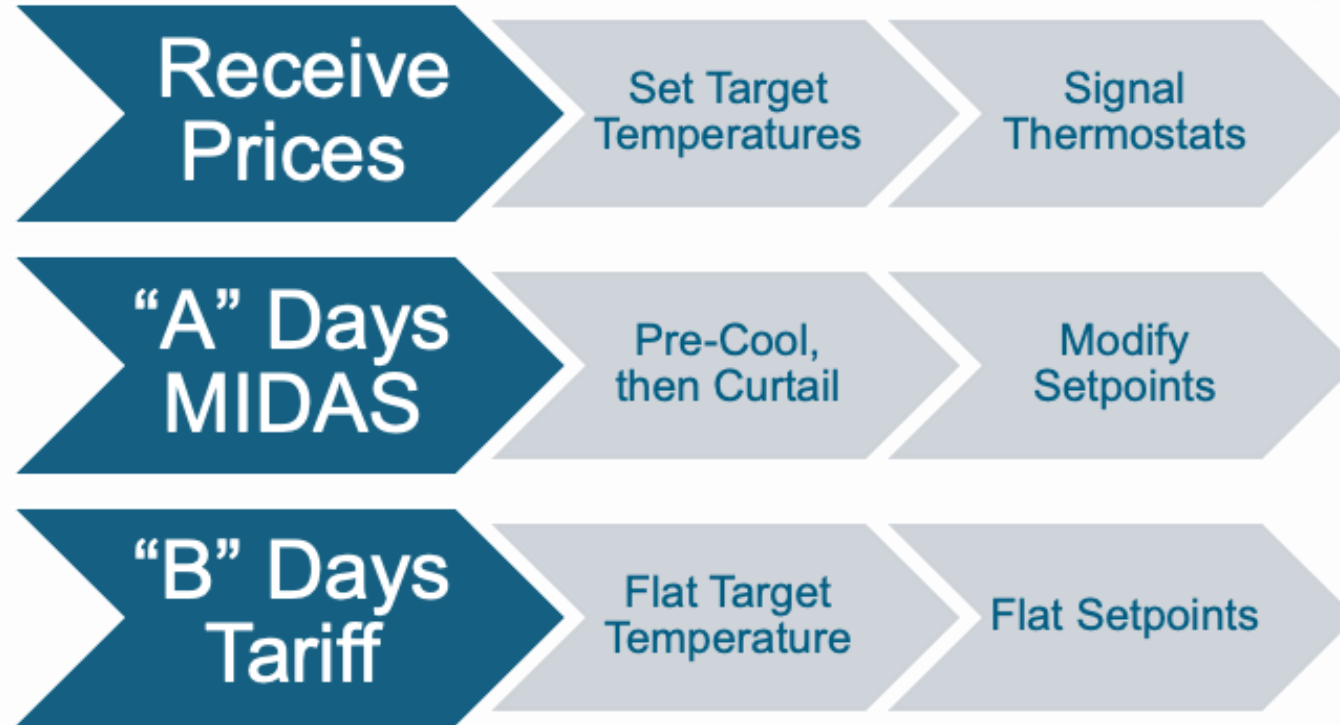
- Two auto dealerships in Southern California
- HVAC and EV charging Control
- Total of 32 Heat Pumps and 2 EV chargers

## Architecture:

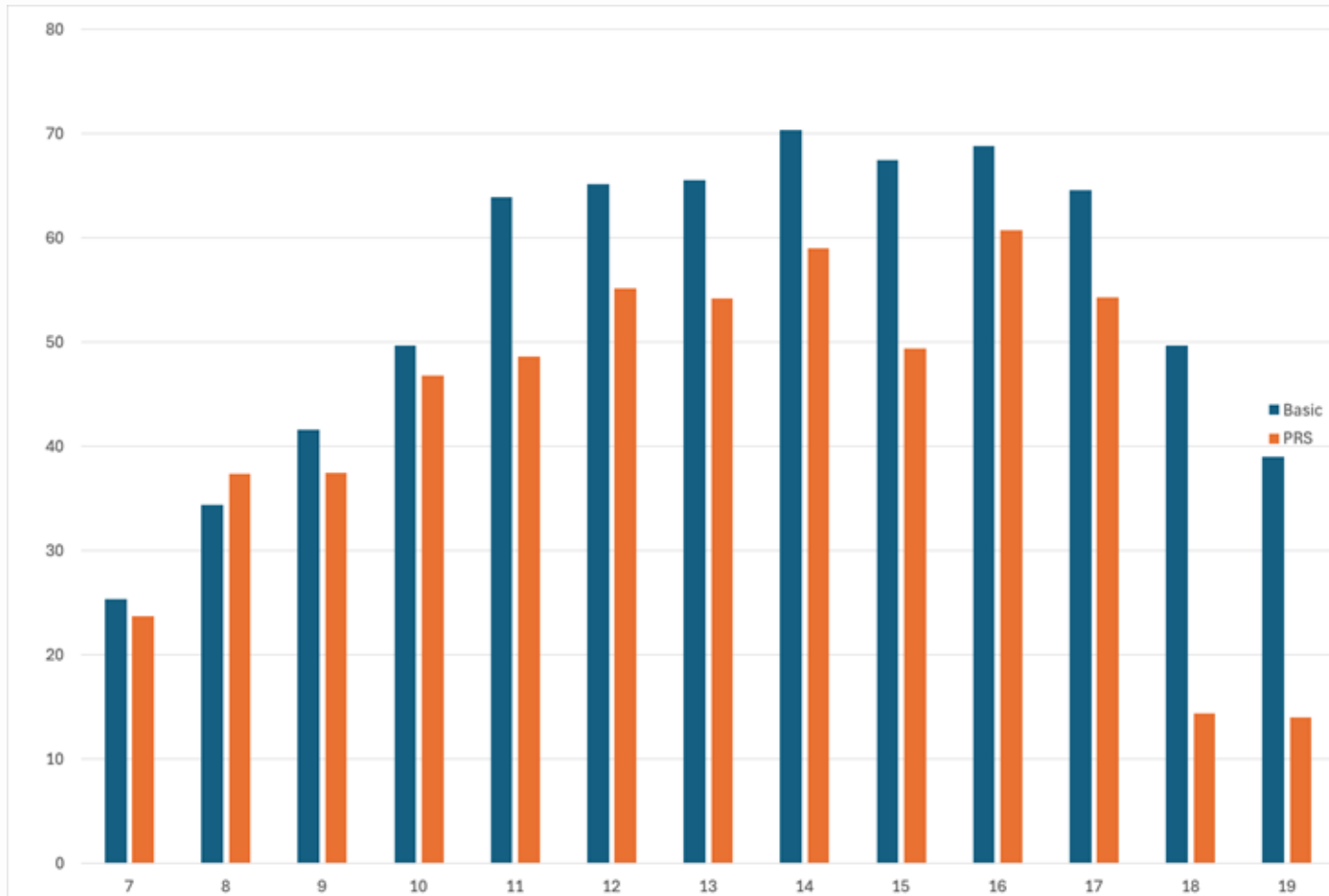
- Cloud processing of CalFlexHub price signal.
- On-site controller (Elexity EMS) using smart thermostats (Pelican Wireless) and EV chargers (ChargePoint)



# Controlled Experiment



# A/B Test Results



- >50% HVAC Savings over 2-hour peak
- No change in t-stat overrides or self-reported comfort
- Price Responsive Shifting Works!

# Key Learnings / Technology Transfer

Readiness: Elexity's tech is ready - Prices are not.

User Insights: Users like being in control. This is important. Price response is THEIR decision, not someone remotely operating their site as part of an aggregated grid project.

Cost Implications: Many buildings are ready, but many more are not - incentives to enable response are key. Similar to EE programs of 1990s.

Applicability: No brainer for buildings that are ready; non-starter for buildings that are not (without incentives and tech assistance)

Most important remaining barriers:

- Get the prices right
- Incentivize flexibility enablement

Low-hanging fruit =  
facilities with existing  
smart thermostats  
Major future potential =  
C&I batteries

# Thank you!

John T Powers  
Elexity

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510-326-1761

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Technology Researcher  
Berkeley Lab

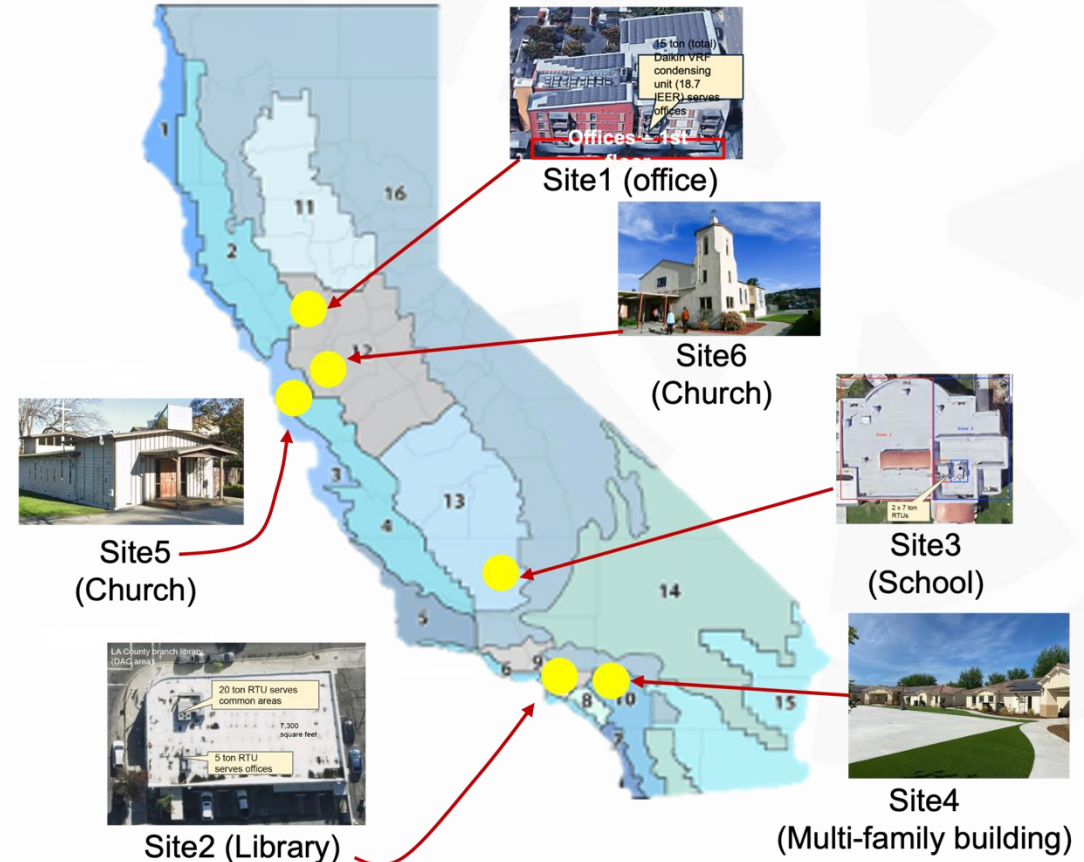
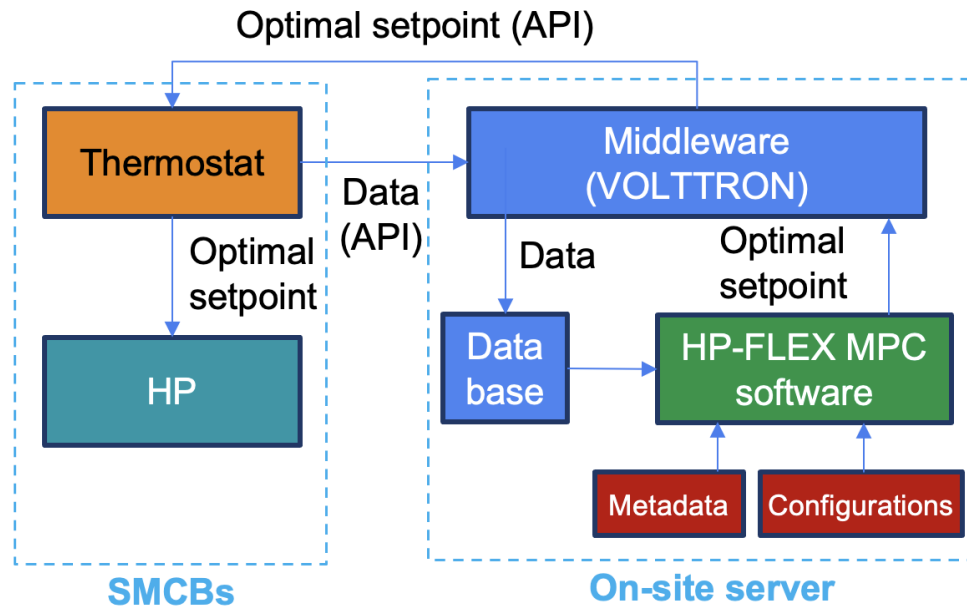
# Load Flexibility for Small Commercial Buildings with Heat Pumps

Presenter: Armando Casillas – LBNL

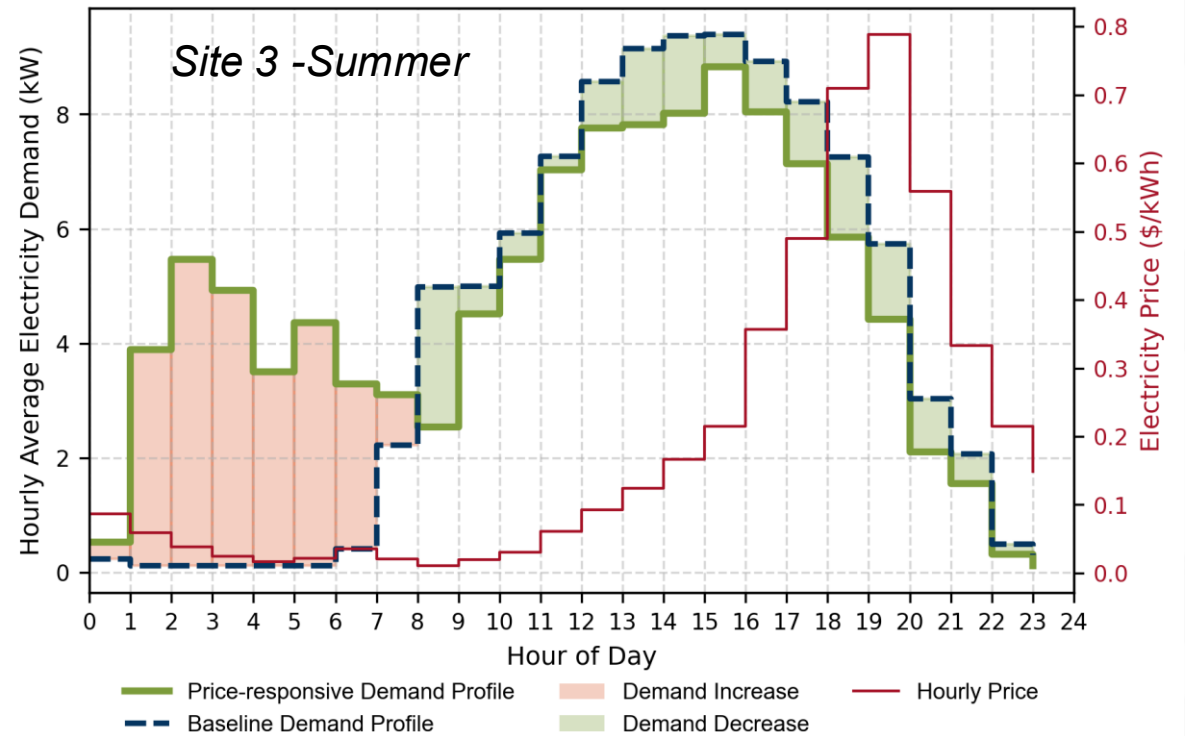
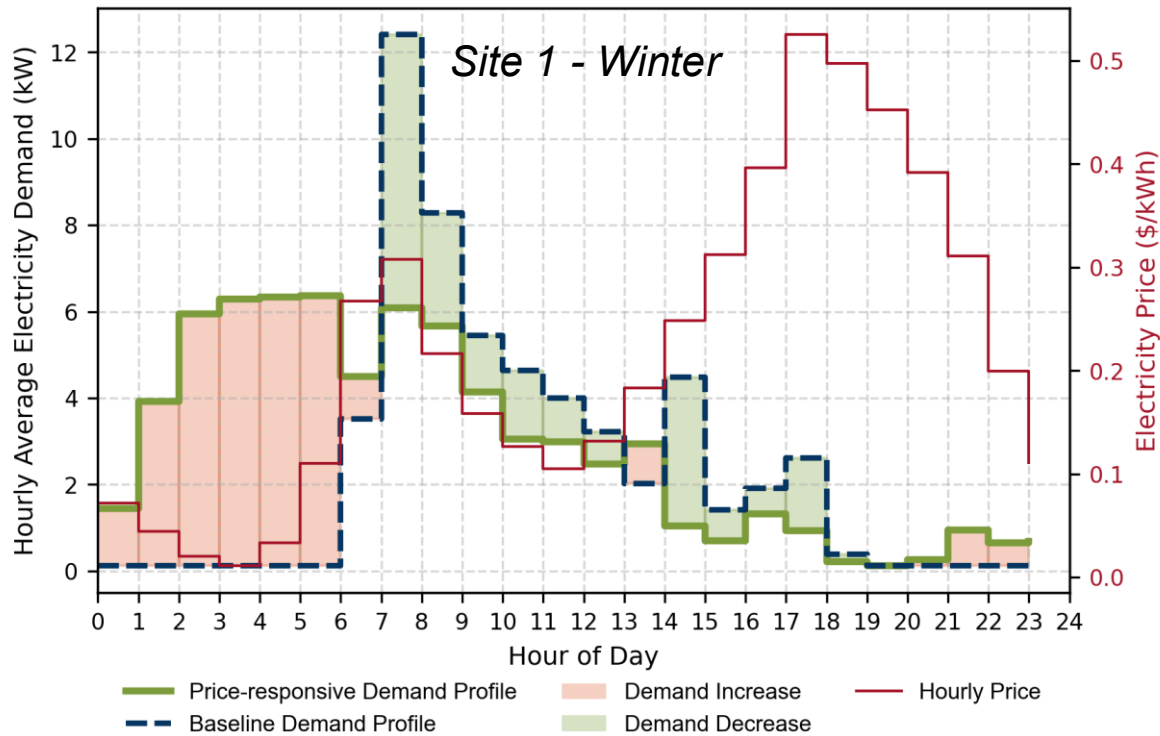
Project Team: Marco Pritoni, Donghun Kim, Armando Casillas, Sang woo Ham,  
Lazlo Paul, Dmitry Bratslavsky, Tao Yang, Anand Prakash, Rich Brown

# Load Flexibility for Small Commercial Buildings with Heat Pumps

- Developed an open-source control platform for HPs in small commercial buildings
- Designed to respond to price signals and optimize operations
- Deployed and tested in 6 sites across CA



# Test Results



- **~35% avg load reduction during high-price periods**
- **~11% avg cost reduction**
- **Comfort was improved on most sites**

# Key Learnings / Technology Transfer

- **Performance:** On average model-predictive control shows good performance on all metrics across sites (35% load reduction, 11% cost savings, 30% better comfort)

## Challenges and Barriers

- **Low Performance in Some Cases:** Current results vary significantly by site, season and weather
  - **Solutions:** broader testing in diverse climate, building types, business types to assess best candidates. Develop site targeting tool to maximize effectiveness.
- **Connectivity:** Lack of open APIs and protocols creates a "one-off" integration burden, preventing scalable solutions.
  - **Solutions:** engage with MATTER, other vendors' consortia on open protocols
- **High Integration Costs:** still require significant customization and engineering time
  - **Solutions:** use templates, semantic modeling, AI to simplify configuration workflows.

**Continued R&D is required to streamline implementation and transition from pilot to scale.**

# Thank you!

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