ET Summit 2024

Presented by

A Design, Development and Testing Framework for Demand Flexible Technologies

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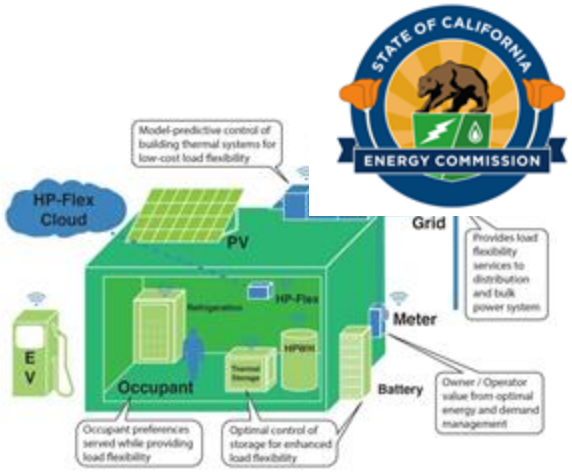


Key Takeaways

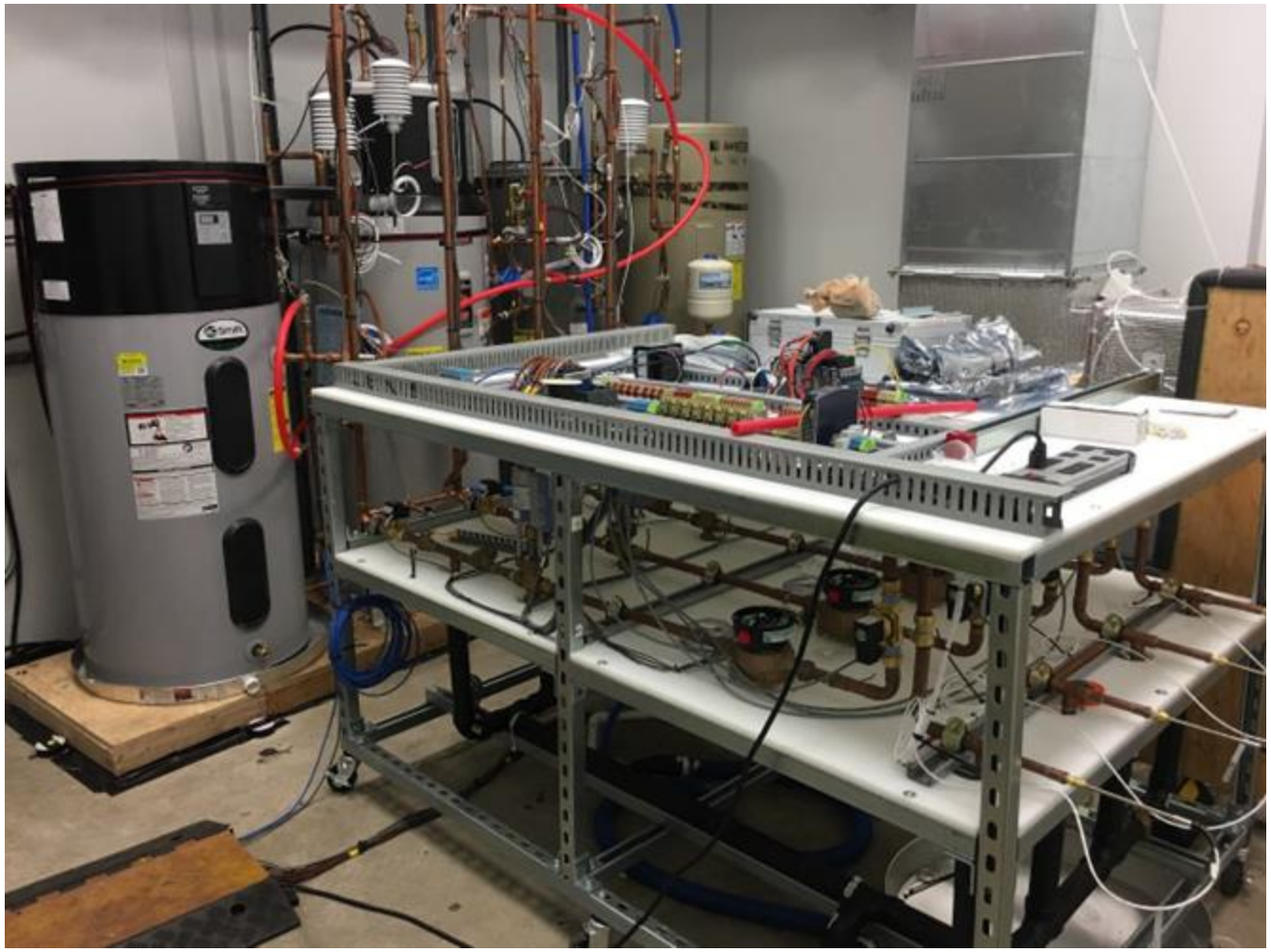
- Evaluating demand flexibility is challenging
- Lab and field tests have limitations for certain technologies
- We can use FLEXLAB + Modeling to reduce tech risk and cost
- This process can benefit vendors, customers and Utilities
- Example: Development and test of demand flexible controls for Heat Pumps (yes they work)

Motivation

Let me introduce you to our new magic Demand Flexible Technology

Does it work?

Lab Test



Advantages:

- Highly controlled environment

Disadvantages:

- Conditions may not be realistic

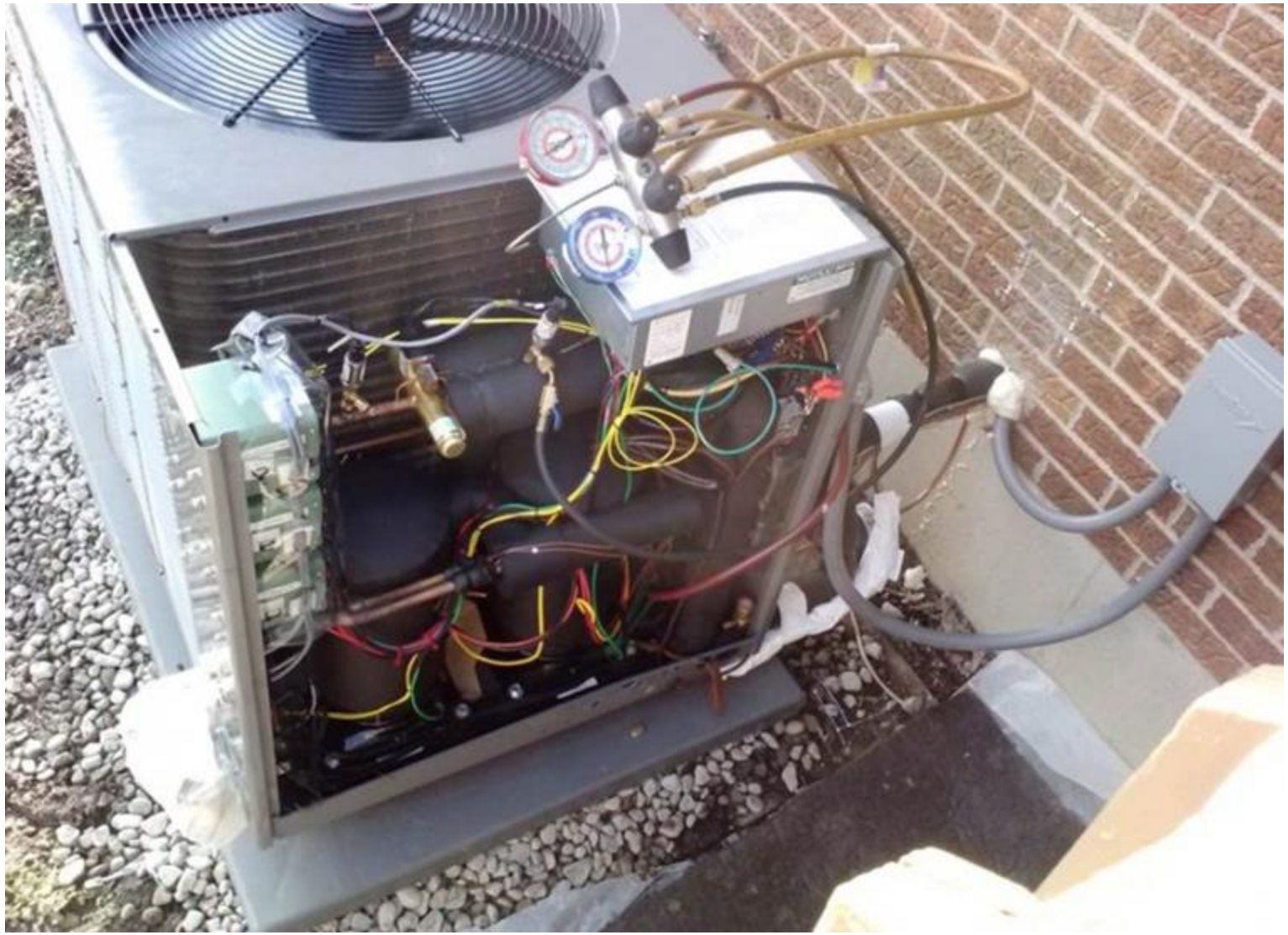
Field Test

Advantages:

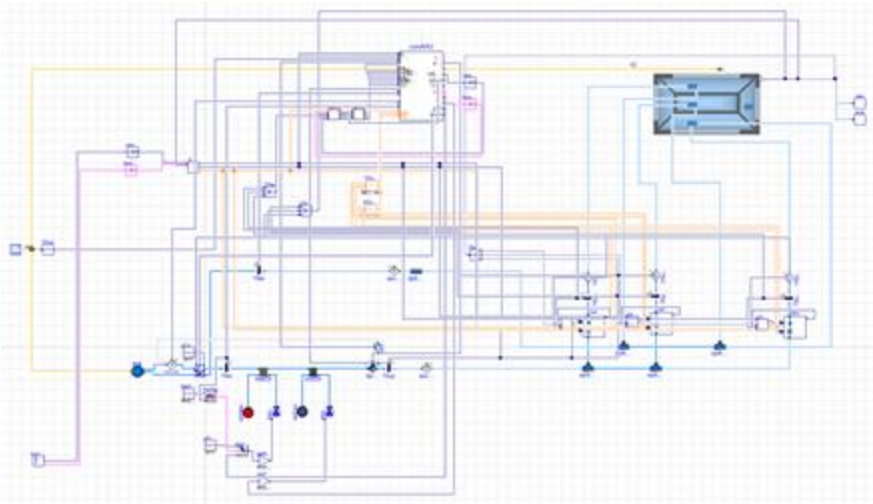
- Realistic conditions

Disadvantages:

- Very expensive ($$$)
- Take a long time
- May not be representative of all customers (hard to generalize)

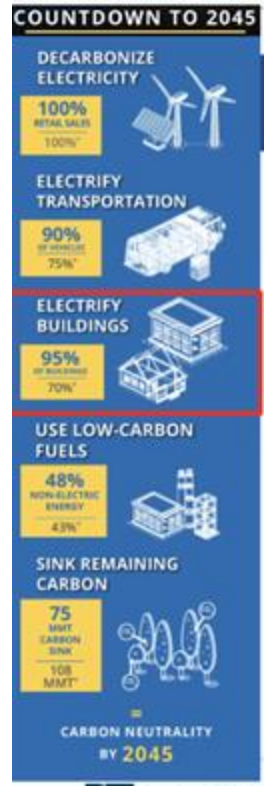


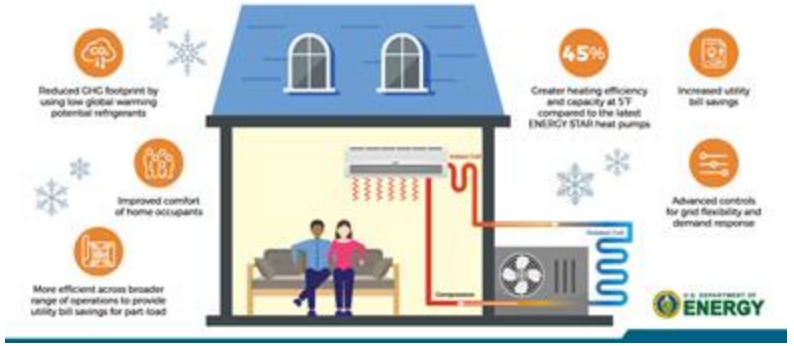
FLEXLAB + Physics-Based Models



(Hardware in the Loop)

Decarbonization ->electrification -> heat pumps





Can they provide demand flexibility?

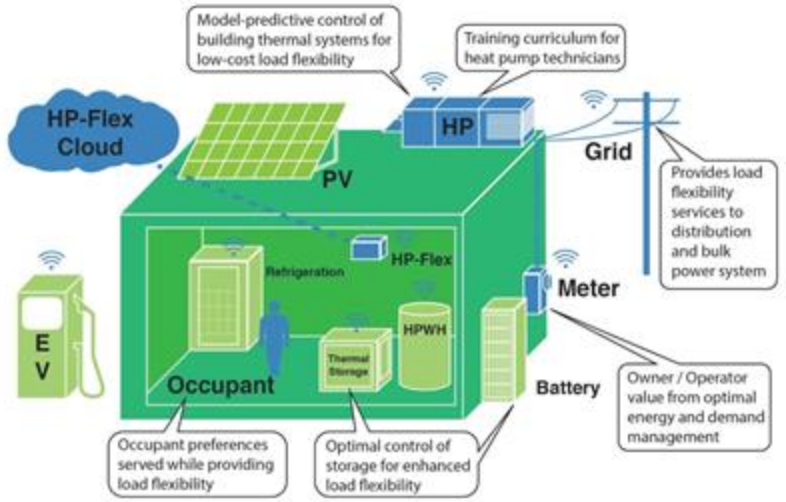
Heat pumps for Small Commercial Buildings

Status quo

- Native controls are **not typically demand or price responsive**, do **not coordinate** operation of multiple units**.**

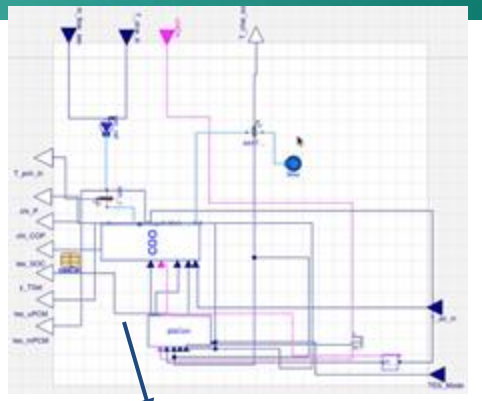
What we want to test:

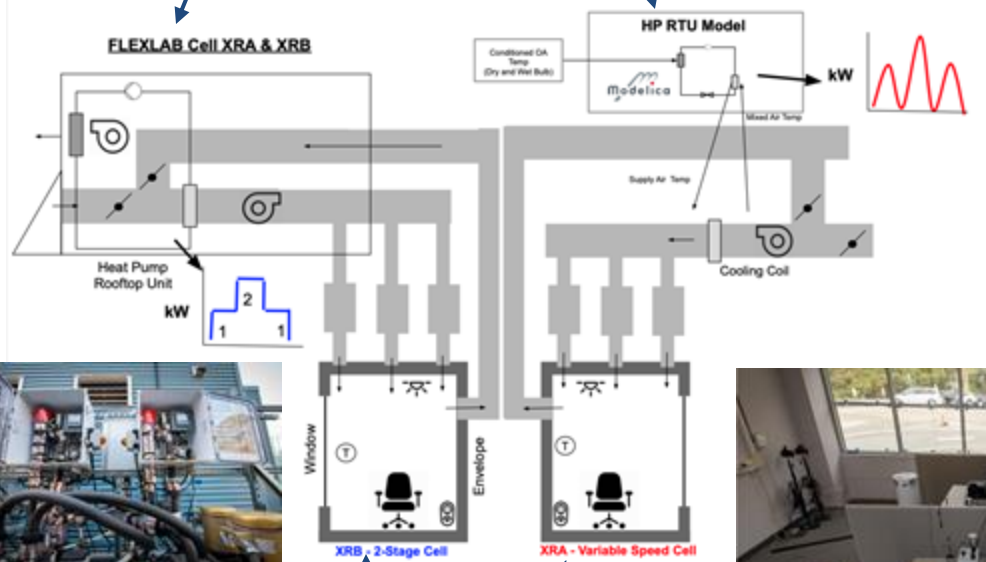
- **A new control "platform":**
  - Shifting load by responding to **dynamic prices**
  - Reducing **peak load**
  - Reducing **GHG emissions**
  - Maintaining **comfort**



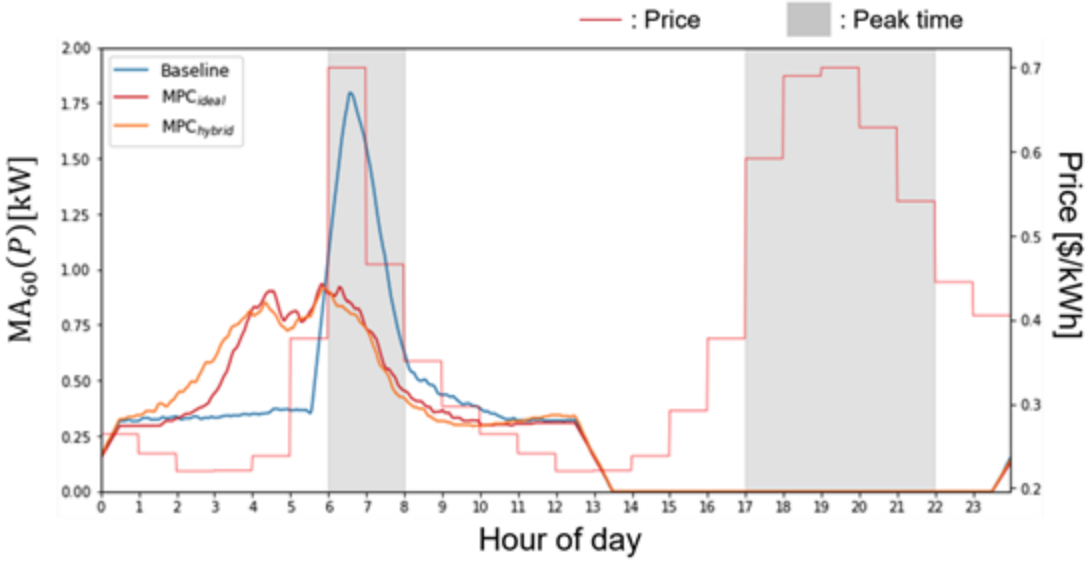
Test Setup

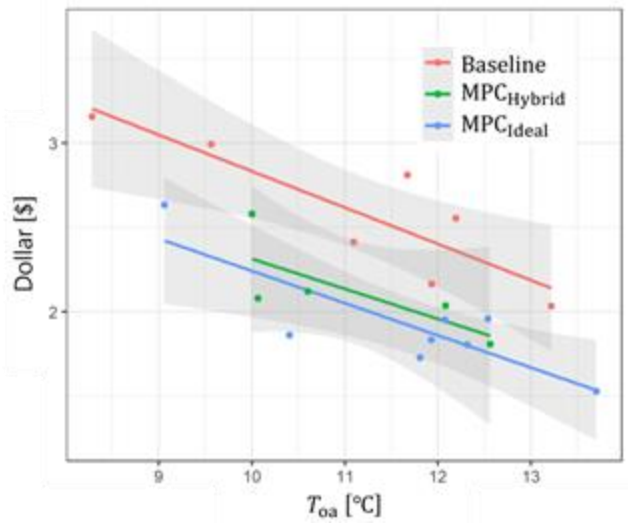
- **System tested**: RTU-HP
- **Baseline system**: Calibrated Model of a HP-RTU in the Loop
- **Demand Flexibility Tested**: Load Shift via Dynamic Prices (CalFlexHub/MIDAS)
- **Control Algorithm Tested**: Model Predictive Controls (MPC)
- **Baseline Algorithm**: Rule-based





Test Results (quantitative)





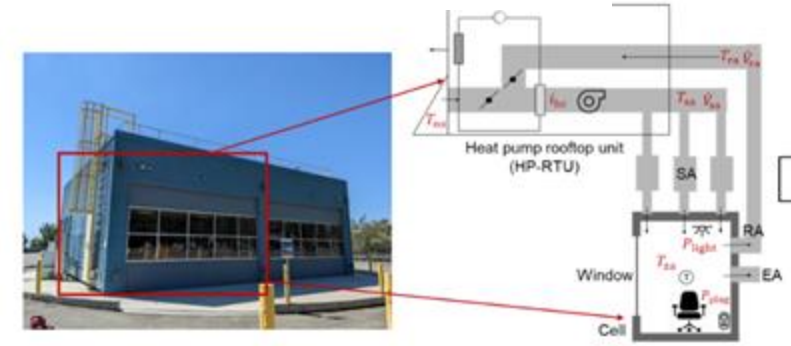
	Peak [kW]	Peak Reduction [%]	Daily HVAC Energy Cost [$]	Daily HVAC Energy Cost Saving [%]
Baseline	3.0	0%	2.6	0%
MPC_{ideal}	2.0	**33%**	2.0	**24%**
MPC_{hybrid}	1.9	**27%**	2.1	**18%**

Test Results (qualitative)

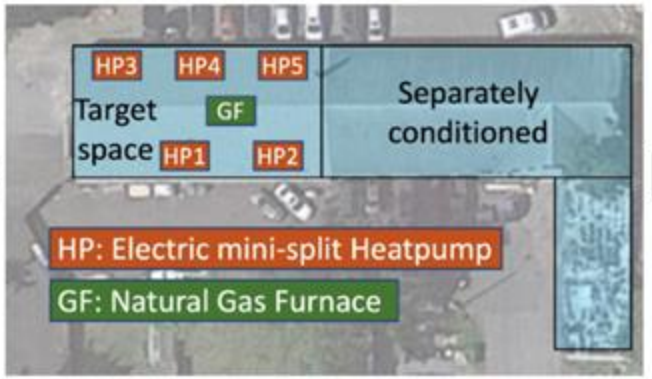
- **Performance**
  - Setting up rule-based controls to minimize cost and maintain comfort is challenge.
  - After setup MPC can respond to several grid signals without code changes
- **MPC can reduce peak load, cost/GHG, and shift load while maintaining comfort.**
  - MPC w/ no additional sensors shows similar performances to the MPC w/ more sensors
- **Interoperability**
  - Protocol translation, API integration, proprietary system are still a barrier to scale
  - Working on automatic configuration to reduce cost
- **HIL can be used to reduce tech risk and cost**
  - Debug and tweak controls
- **This process reduces risk in developing new products!**

From the Lab to the Field

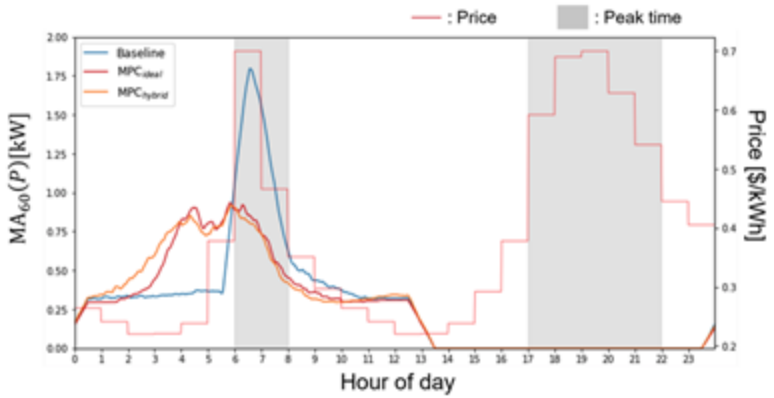
FLEXLAB



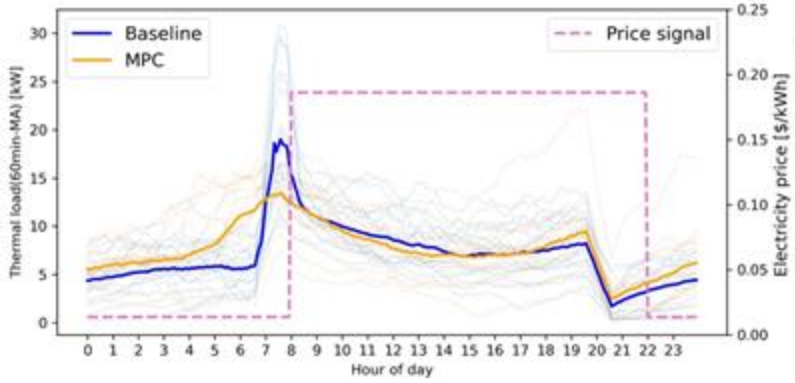
Site in NY



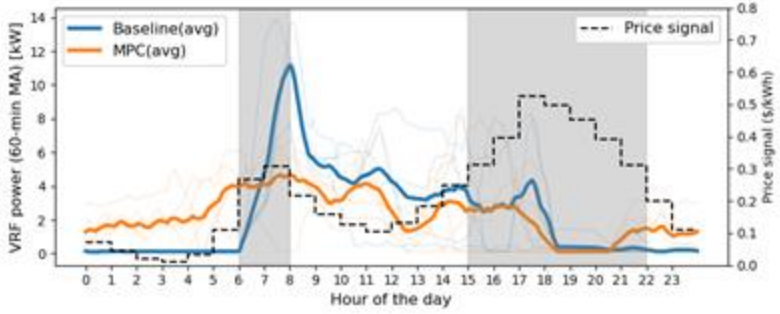
UC Davis



- HVAC Cost Savings 18-24%
- HVAC Peak Reduction 27-33%



- HVAC Cost Savings 27%
- HVAC Load Shifted 23%



- HVAC Load Shifted 21%

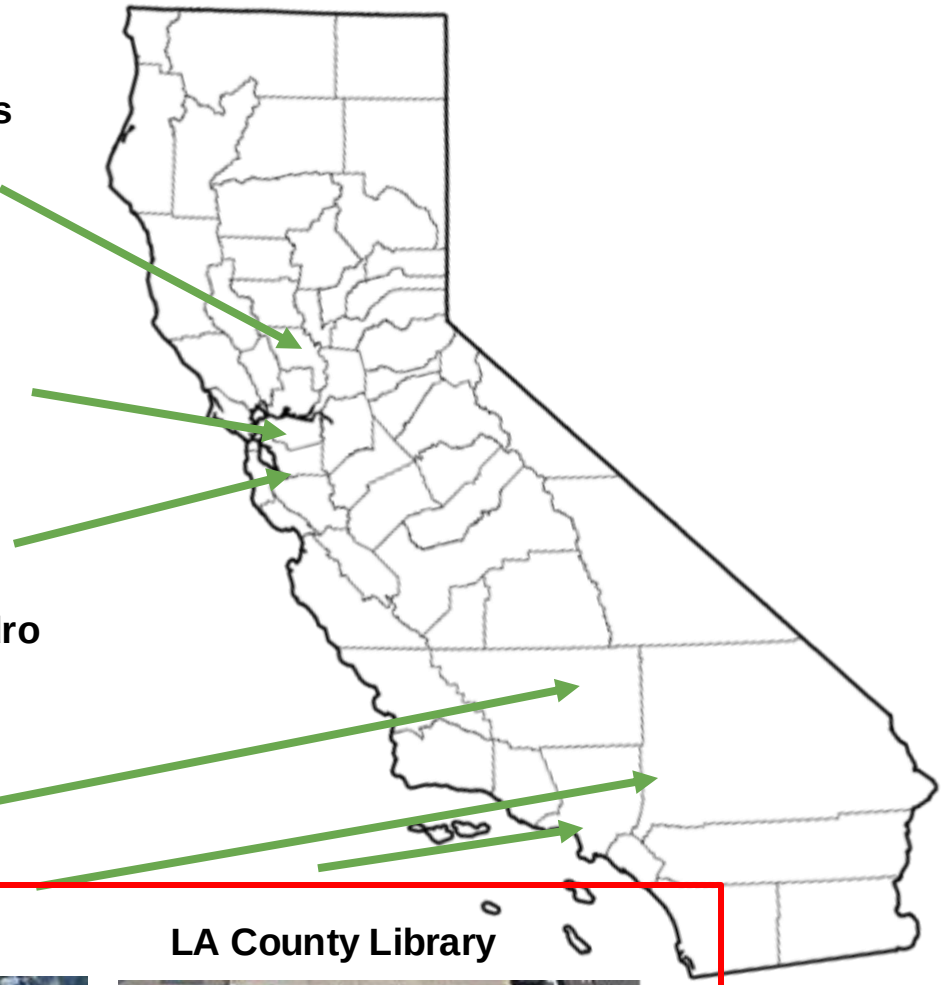
From the Lab to the Field

Western Cooling Efficiency Center, UC Davis

Church of God, Menlo Park

Bethel Community Church, San Leandro

Bakersfield College



Mary's Village

LA County Library

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Thank you

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Lawrence Berkeley National Laboratory

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