


Targeting Energy Efficiency and Demand Response Projects



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EE and DR definitions (for this talk)

- **Energy Efficiency** is a permanent* reduction the in energy use associated with a specific “energy service”
- **Demand Response** is a temporary and on-demand reduction the in power allocated to a specific “energy service”

*hopefully!

Problem Statement

Both Energy Efficiency (EE) and Demand Response (DR) programs should* maximize the impact of their finite resources.

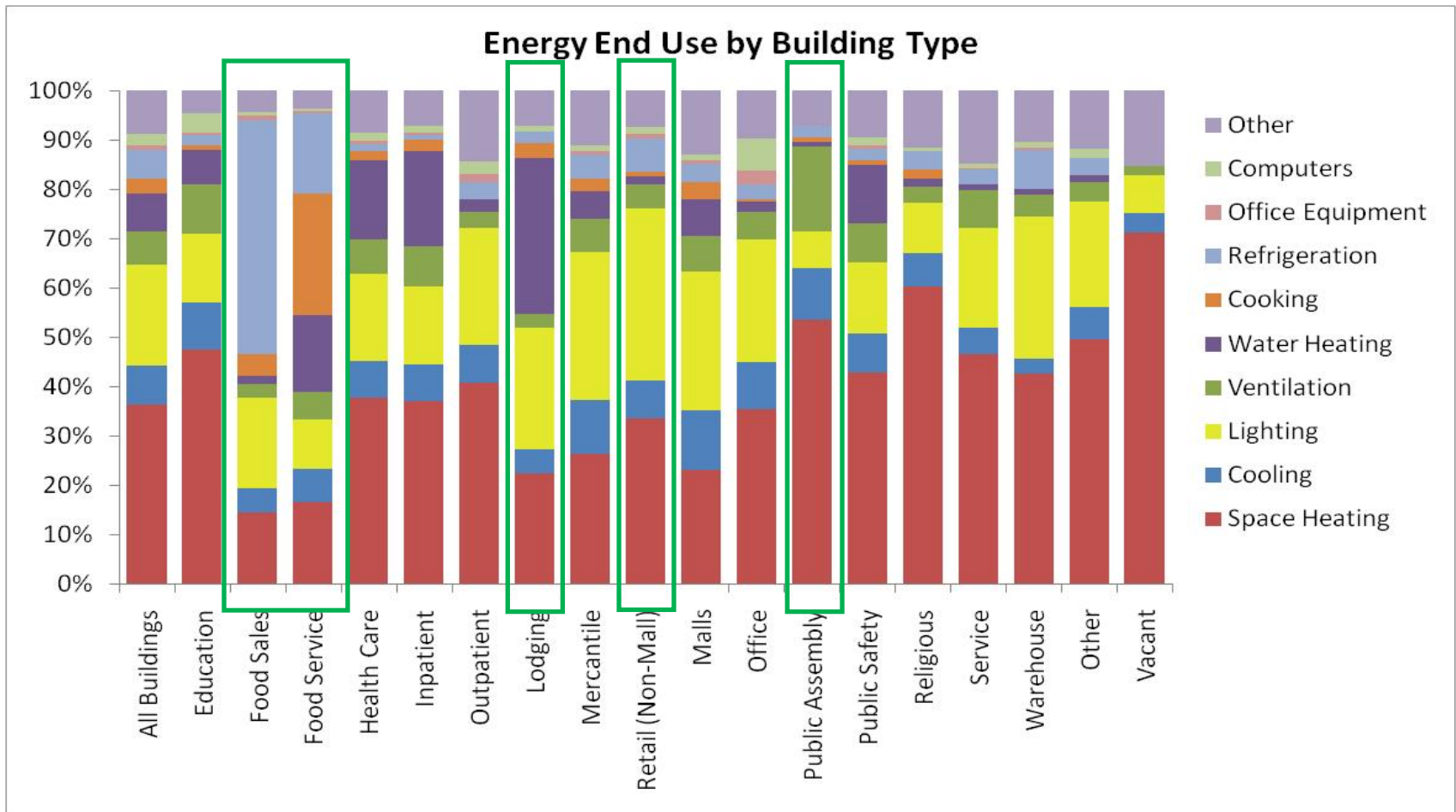
Strategic approaches to targeting high EE/DR potential buildings can make the most of limited expertise, time, and money.

* must? (ask your local utility commission!)

Talk Summary

1. Opportunities for both EE and DR are extremely diverse, especially in commercial buildings
2. Recognizing that diversity and working with it can be extremely important to program outcomes
3. Existing energy meter data can be sufficient to identify high potential program participants
4. Such techniques stand to lower costs and improve outcomes for EE and DR programs

End uses by commercial building type



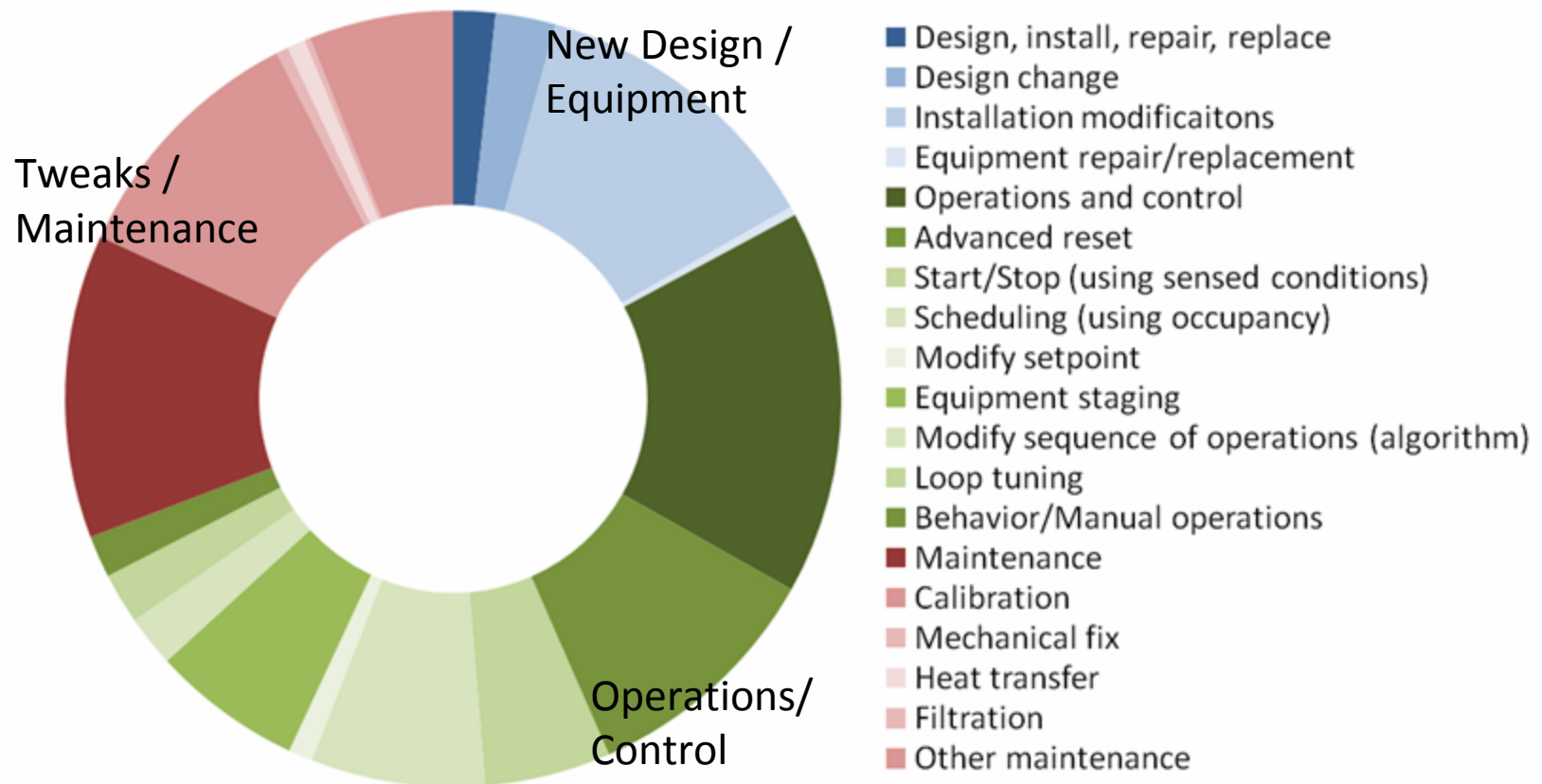
Energy end use percentages by building type for US buildings. Data from CBECS 2003 (EIA 2006)

Building energy use is highly variable

- Many factors contribute to building operating strategies and power demand
 - Building type/purpose
 - Site/weather
 - Construction materials
 - Major equipment
 - **Controls**
 - **Occupancy**
 - **Behavior**

Commissioning: measures implemented

Number of Commissioning measures (N=4000)

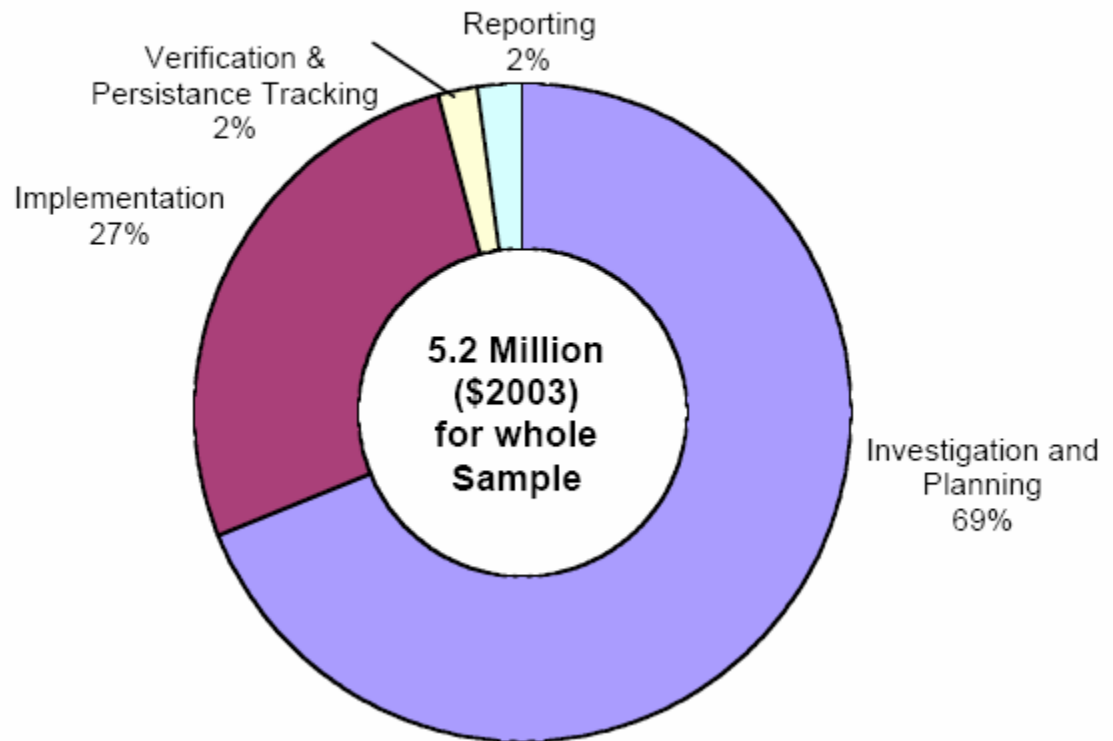


Data Source: Mills (2009)

Commissioning investment

- Driven by *information*
- Process, not an event or product

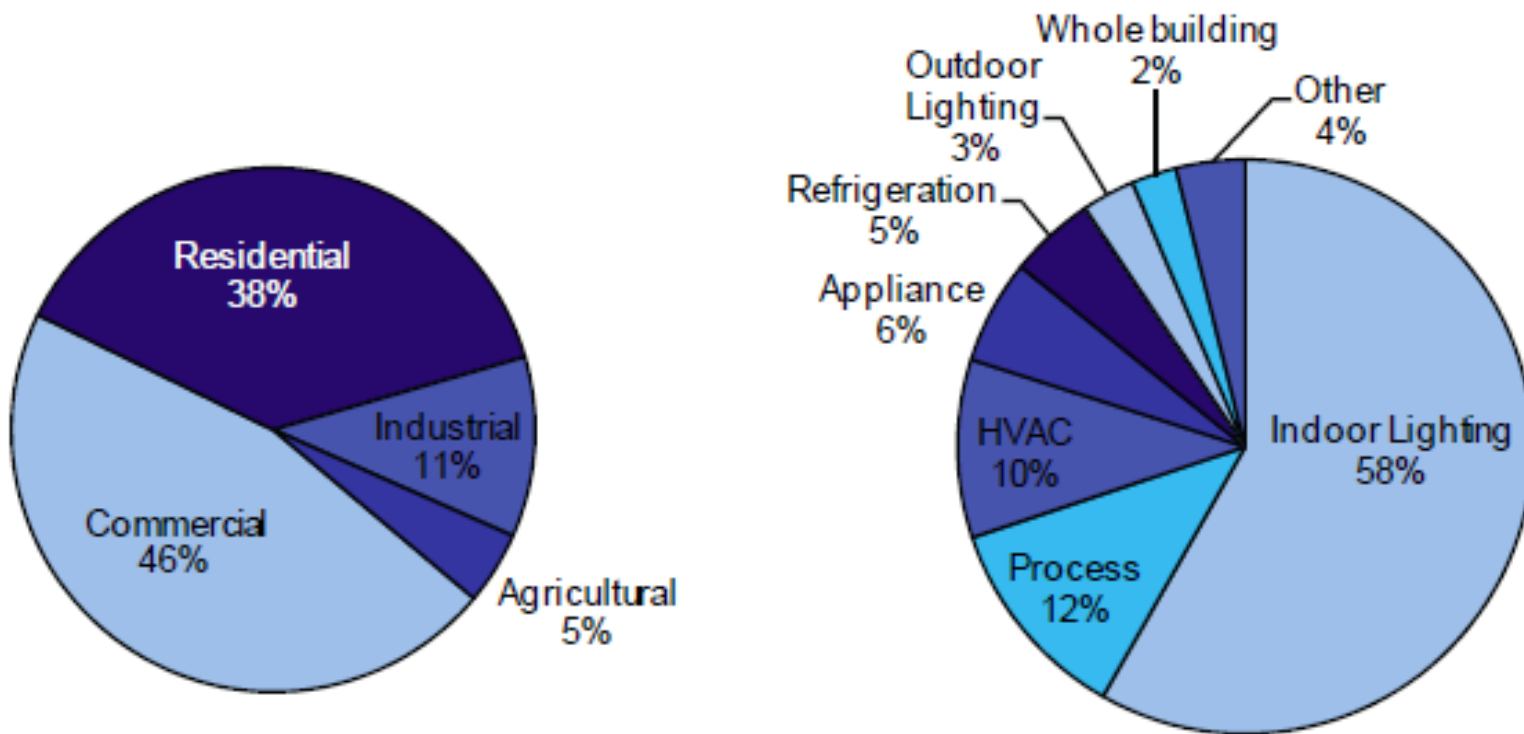
**Fig 13. Commissioning Cost Allocation
(Existing Buildings, N=55)**



Source: (Mills 2004)

CA EE program savings (2006-2008)

Figure 1. Electric (GWh) Savings by Market Distribution and Technology Type



Source: CEC program evaluation

EE and DR types

EE categories

Equipment upgrade

Equipment repair

Control timing change

Control setpoint change

↓service intensity

Substitution of services

Service shutdown

DR categories

Control timing change

Control setpoint change

↓service intensity

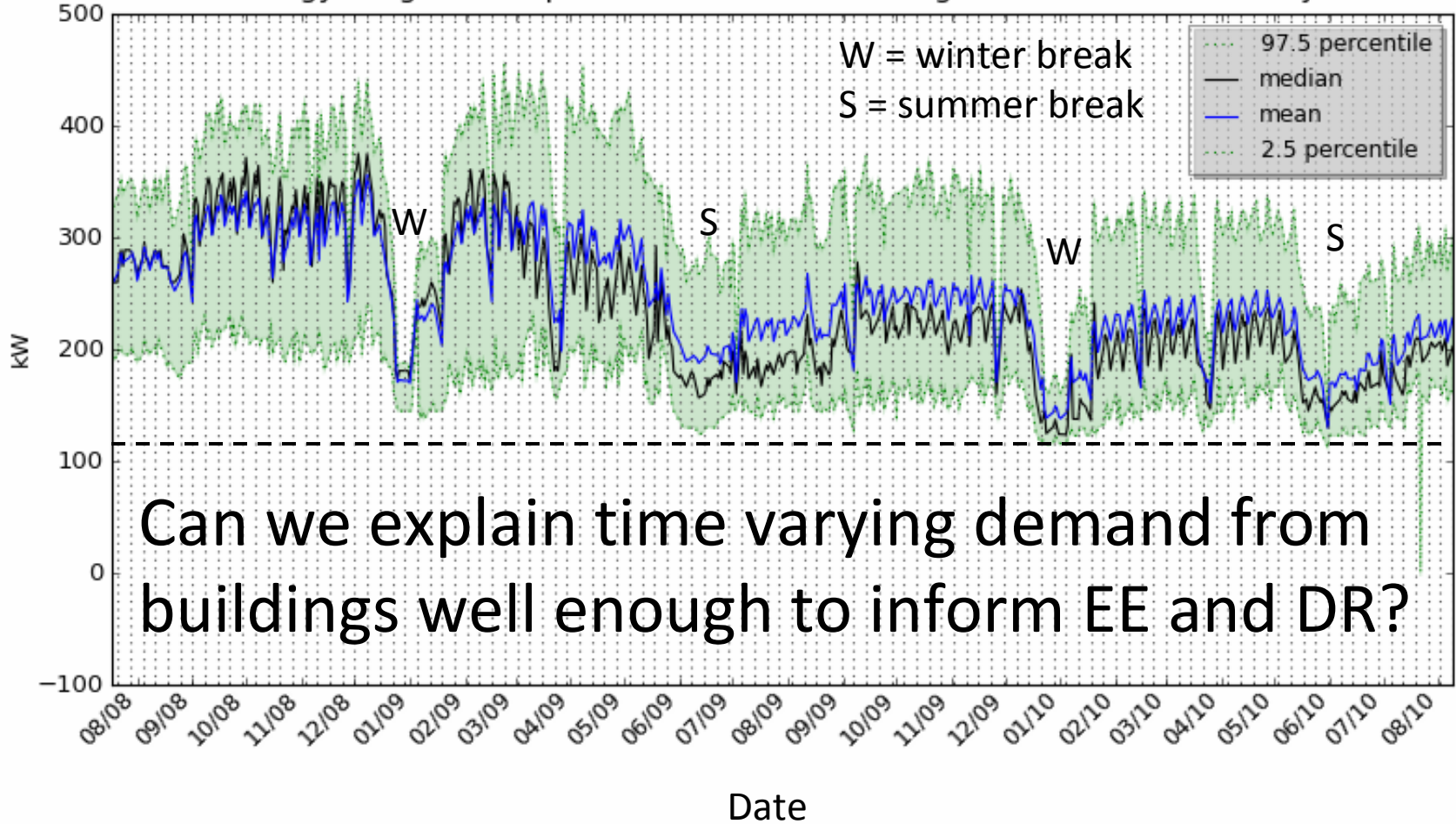
Substitution of services

Process/service shutdown

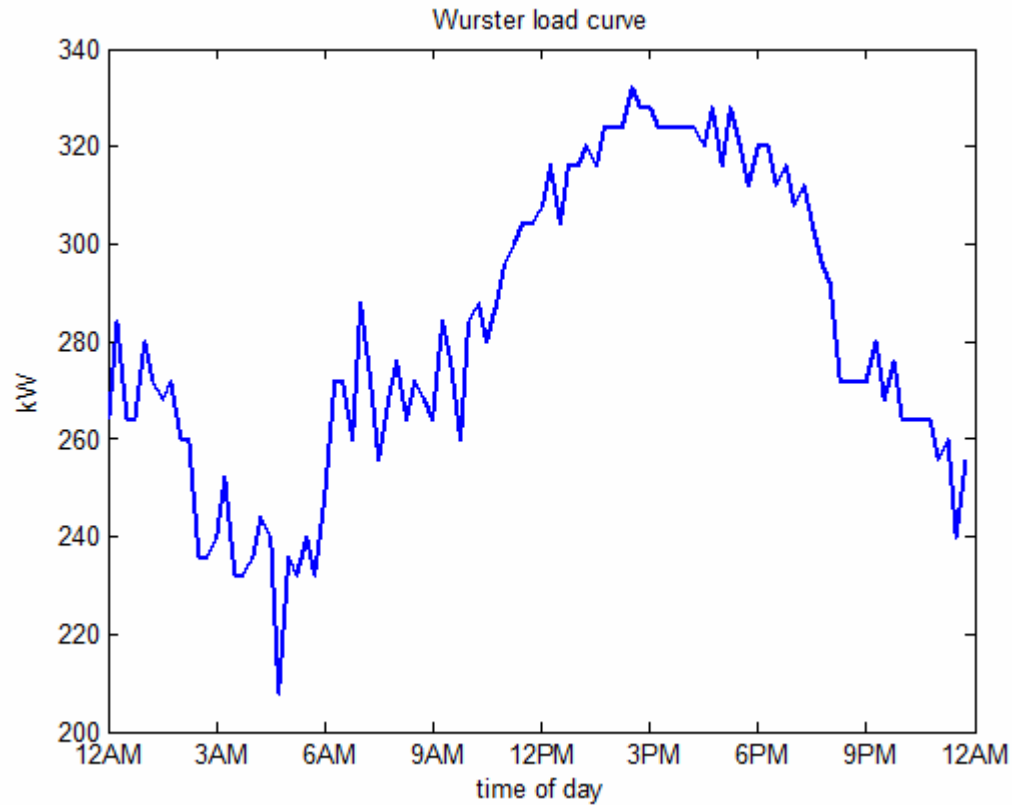
Both require control

Energy envelope

Energy usage envelope for Wurster Hall starting 2008-06-01 for 800 days

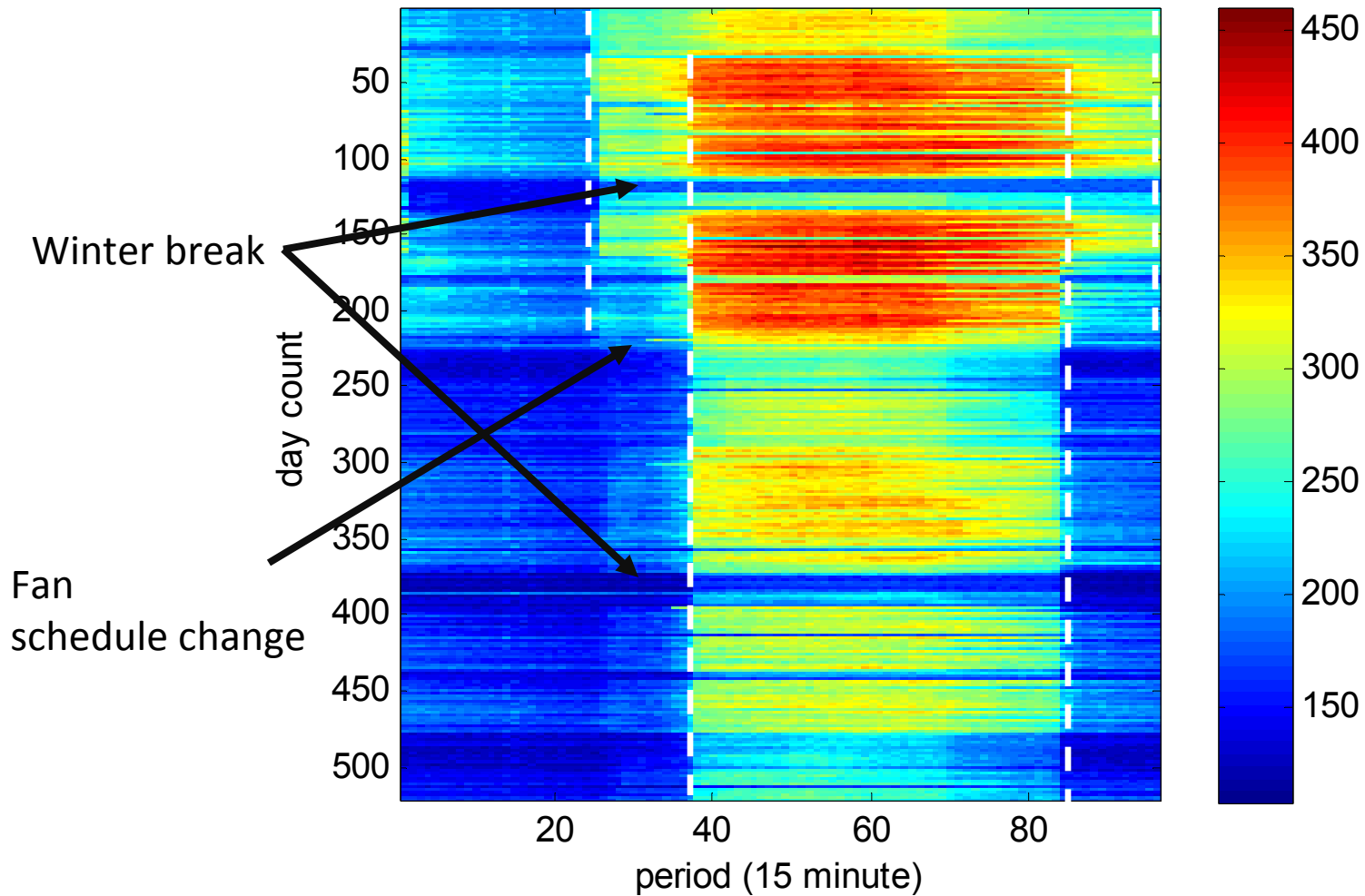


Visualizing load

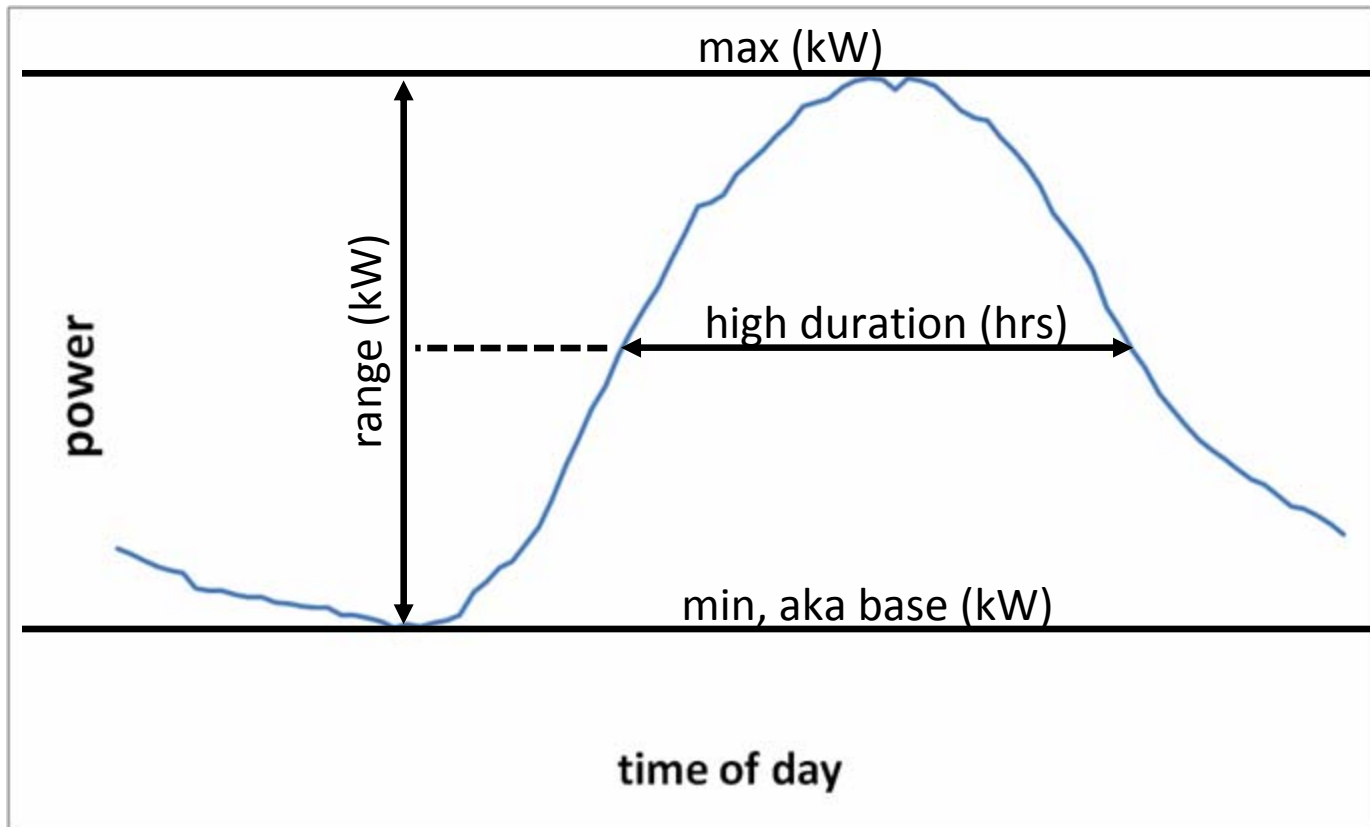


Building load “heat map”

Wurster Hall (kW)

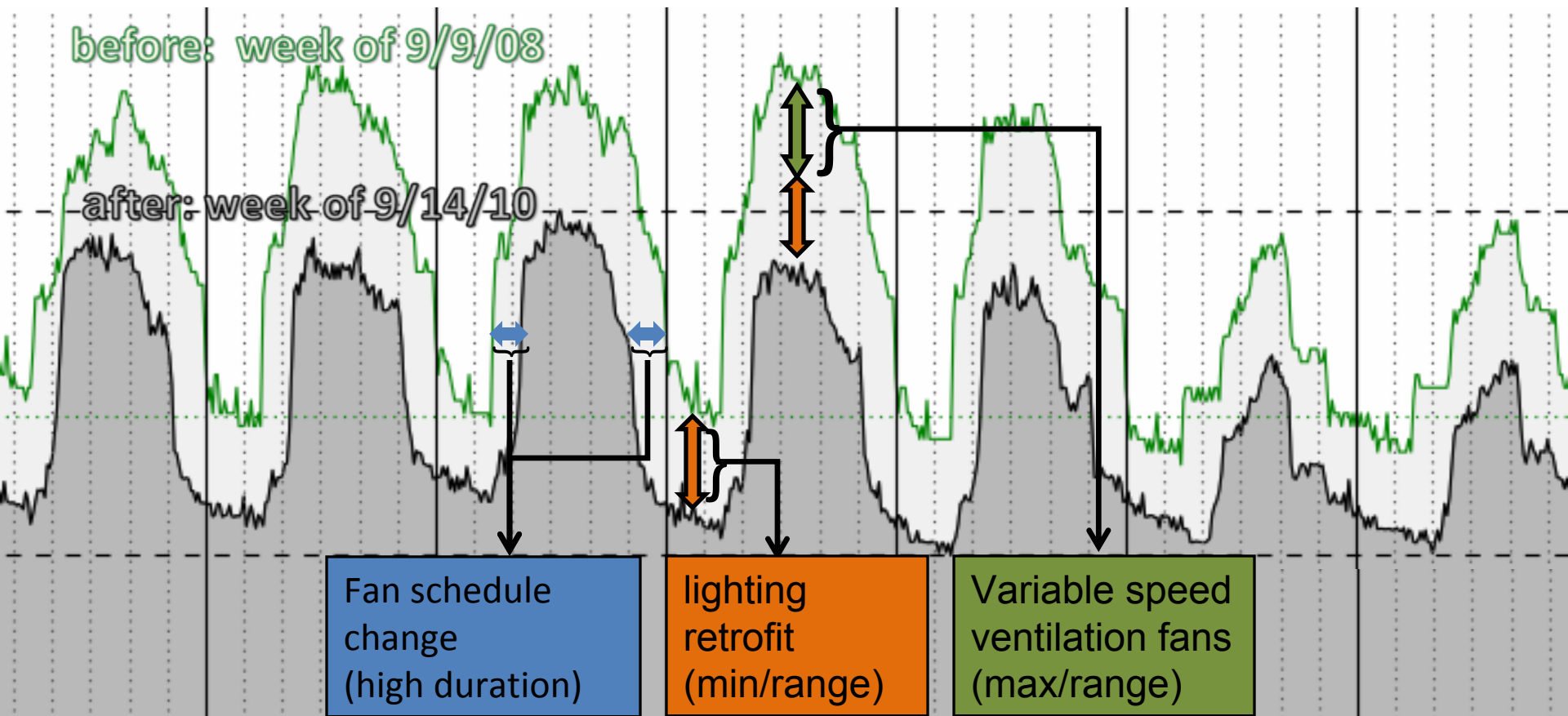


Building load curve metrics

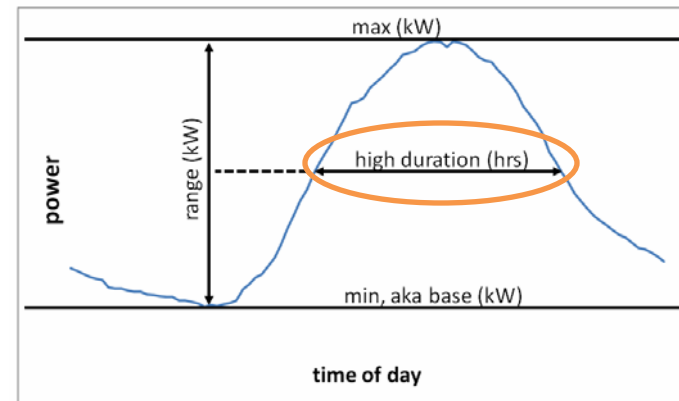
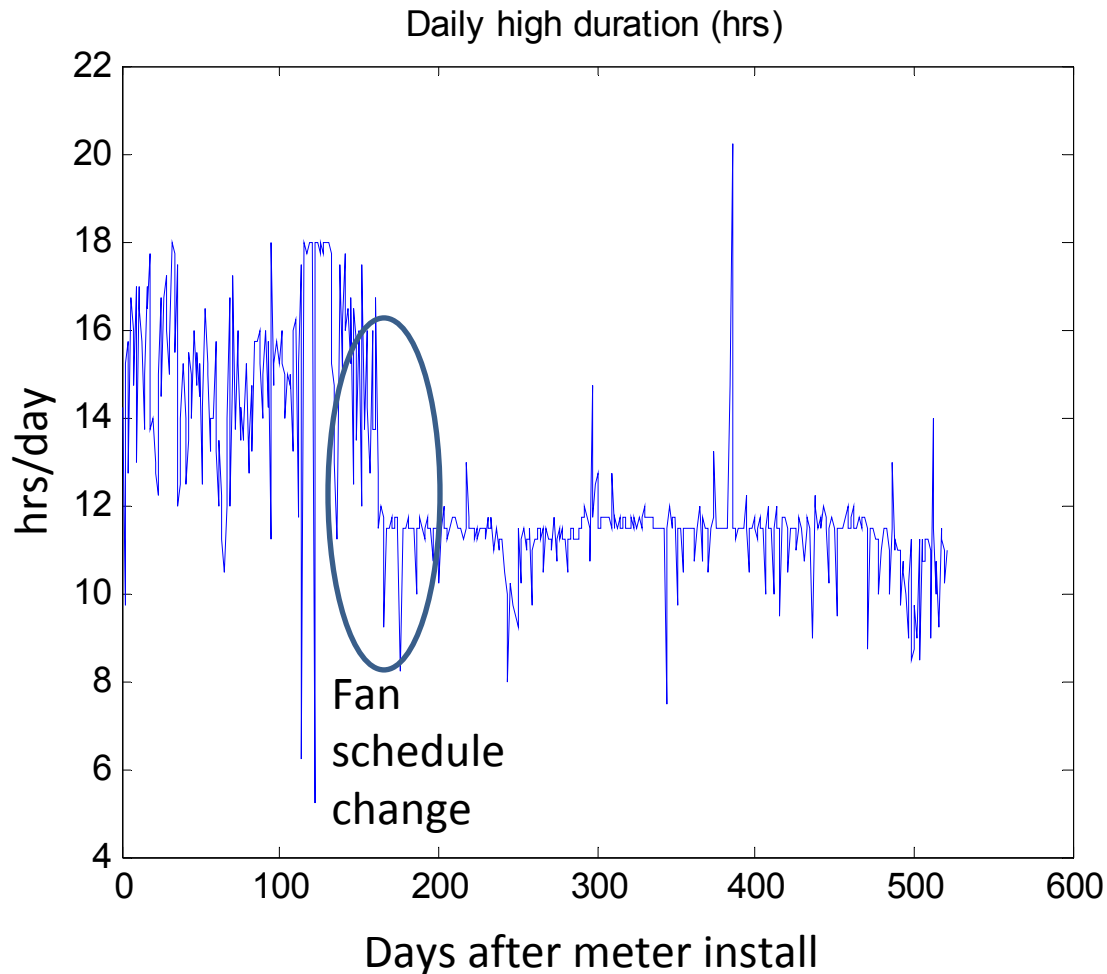


What happened in Wurster Hall?

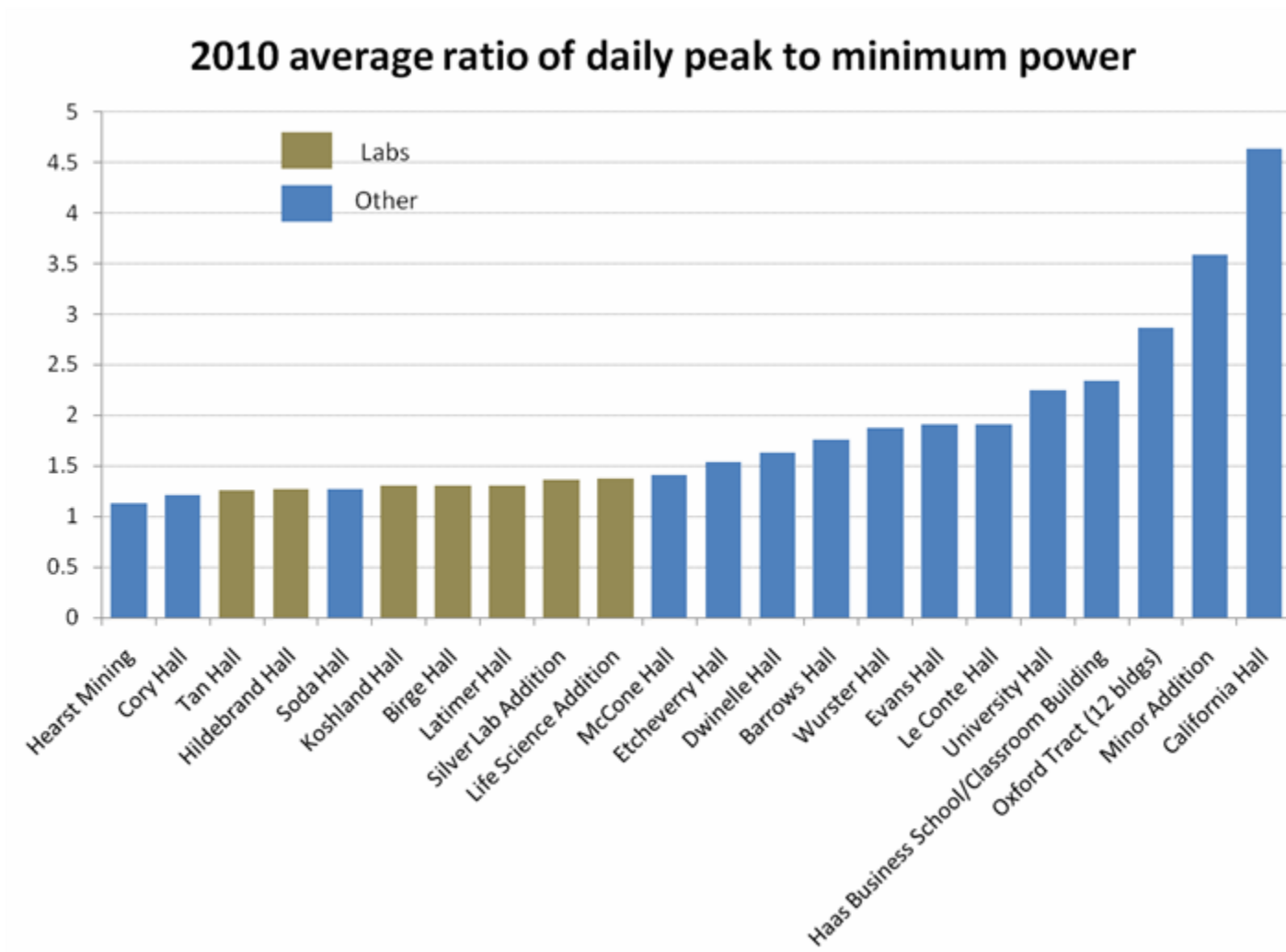
25% reduction in energy...



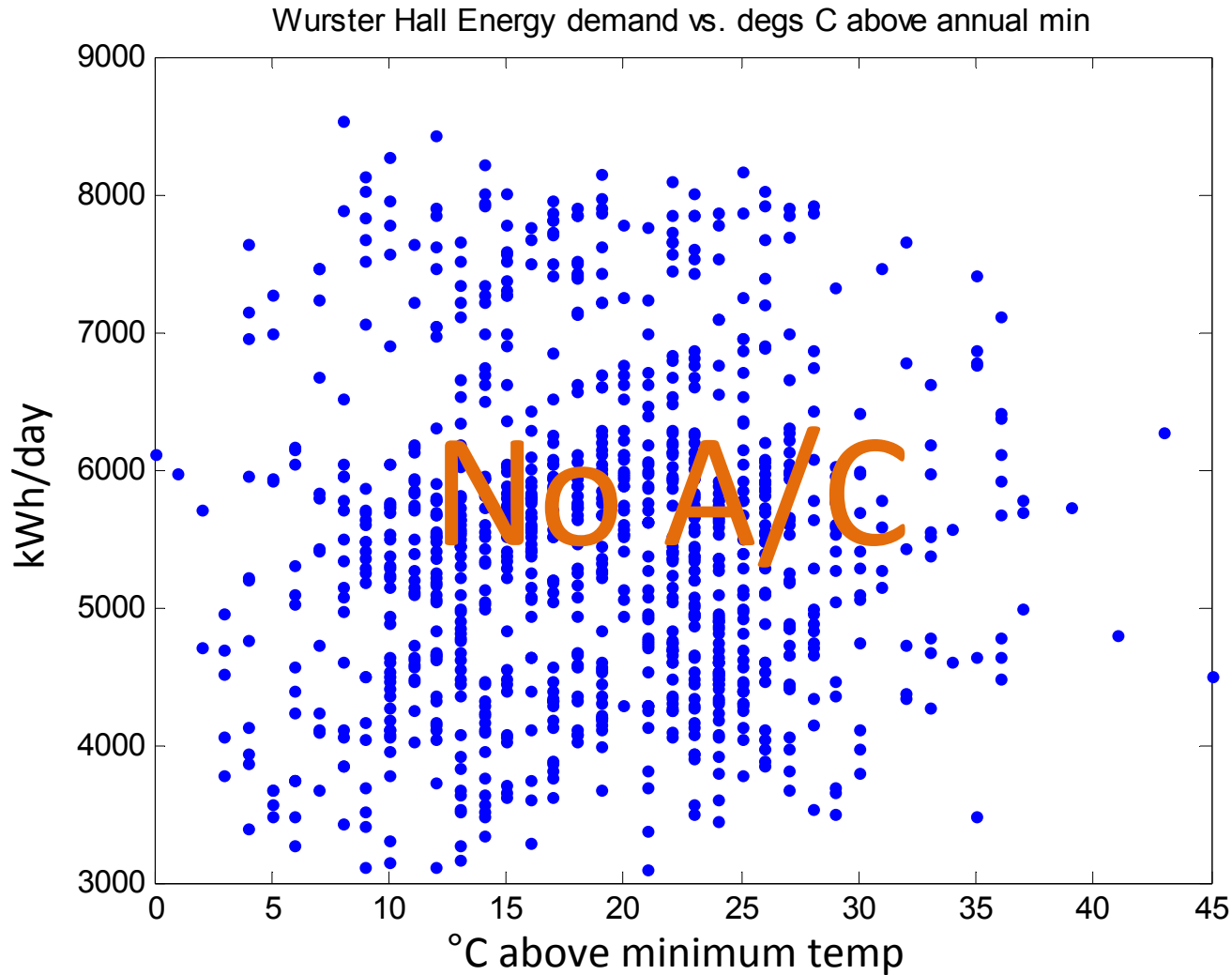
Load attributes: Daily duration of high load



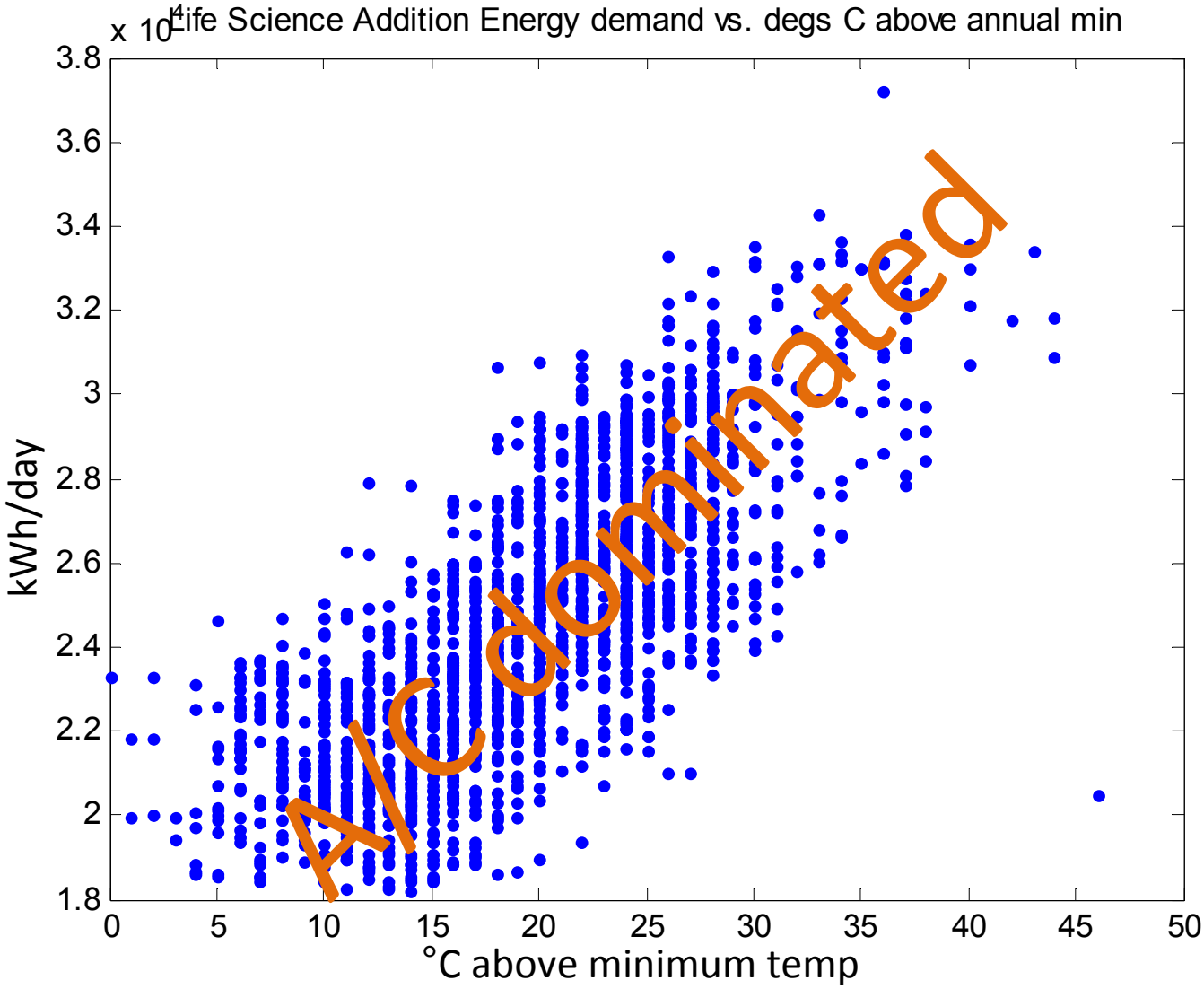
Clusters: Daily max / min



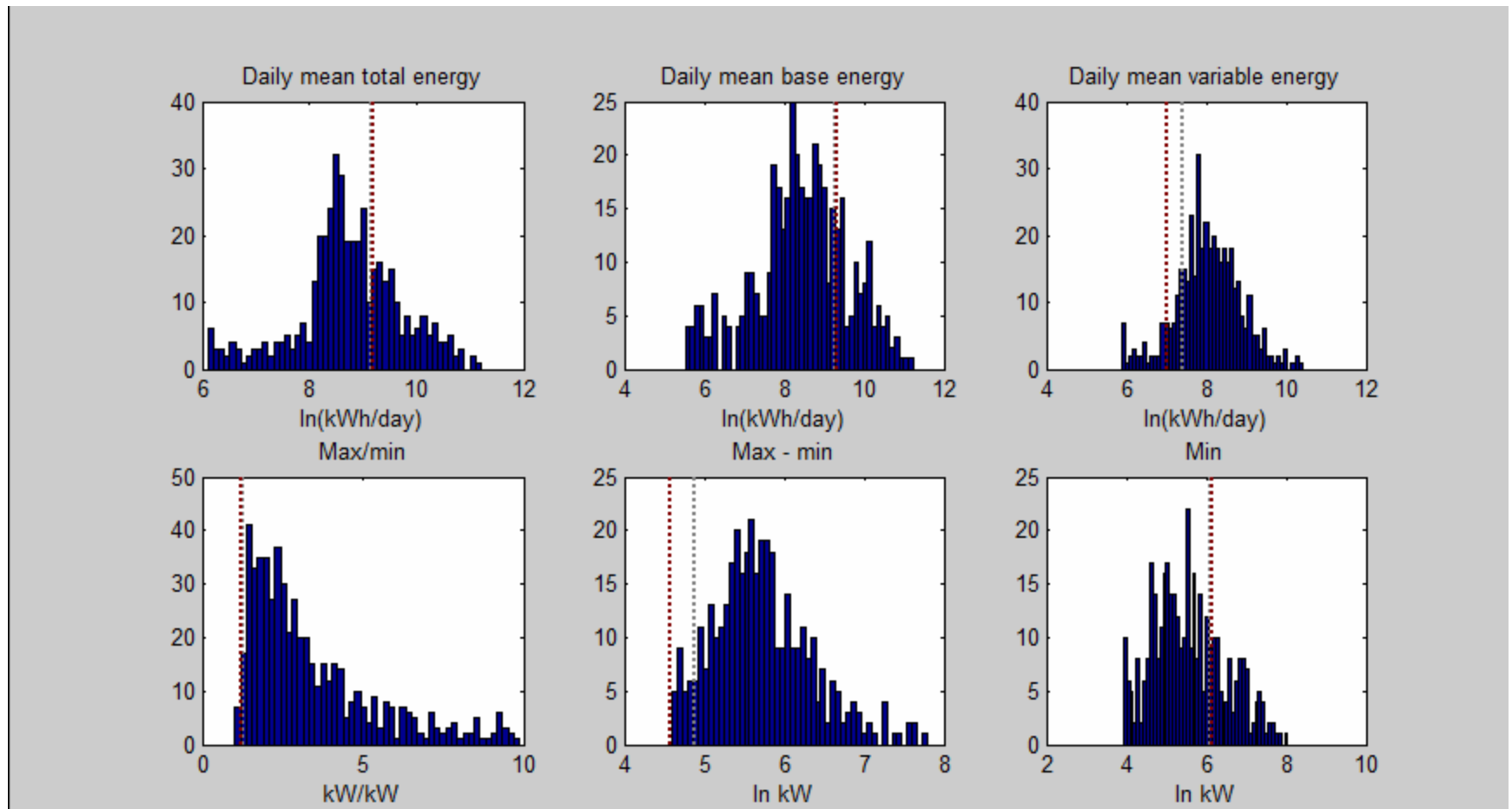
Outdoor temp vs. energy (Wurster)



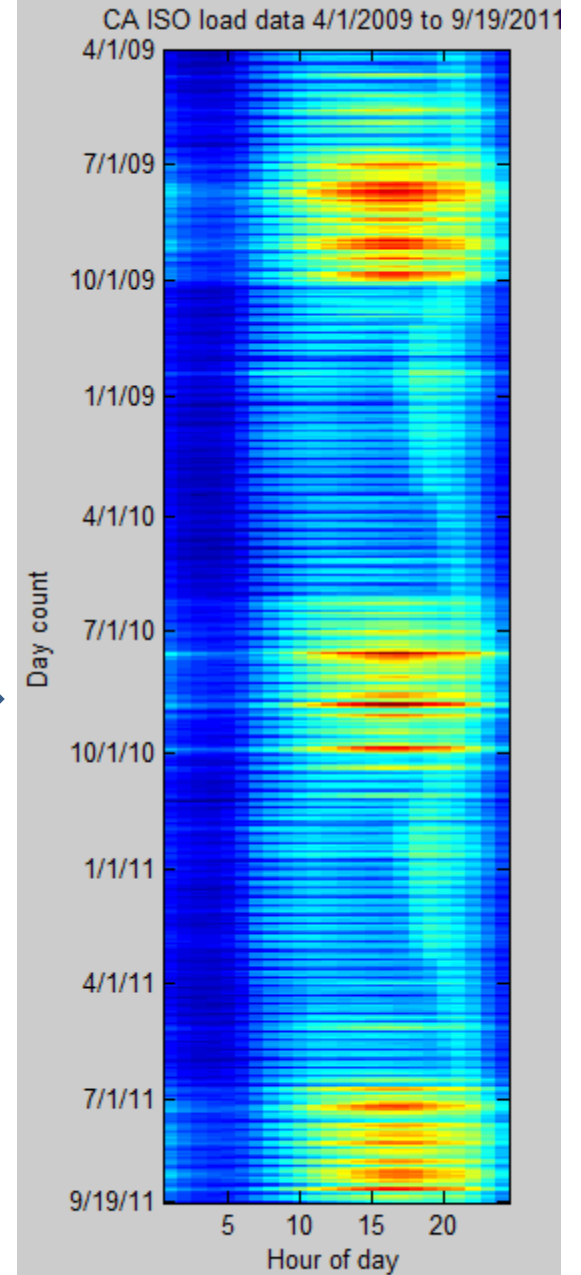
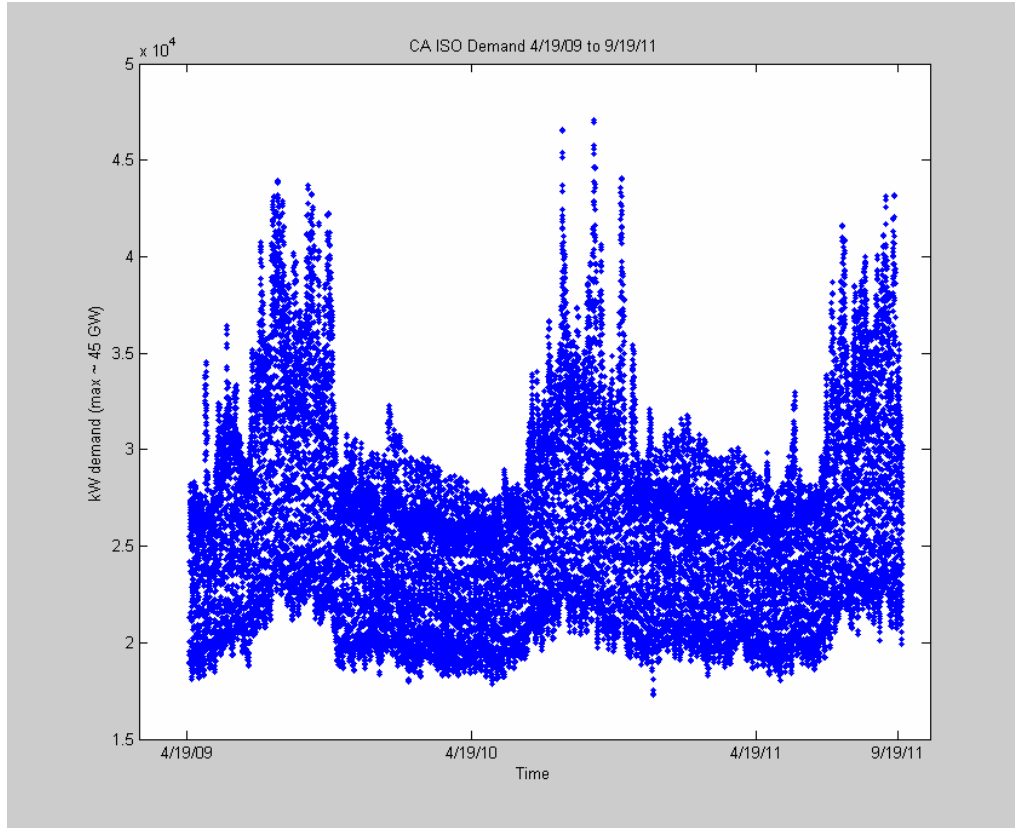
Outdoor temp vs. energy (LSA)



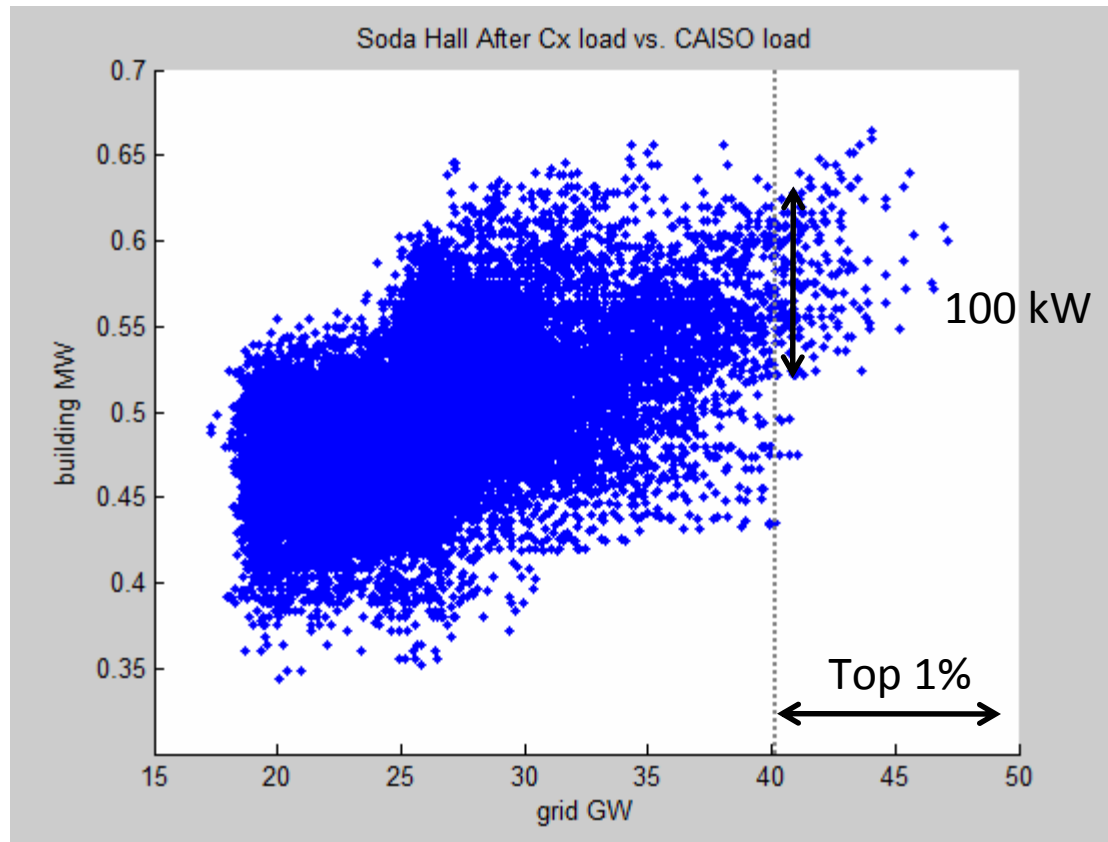
Building energy metric baselines



CA ISO Demand



Building demand vs. Grid demand

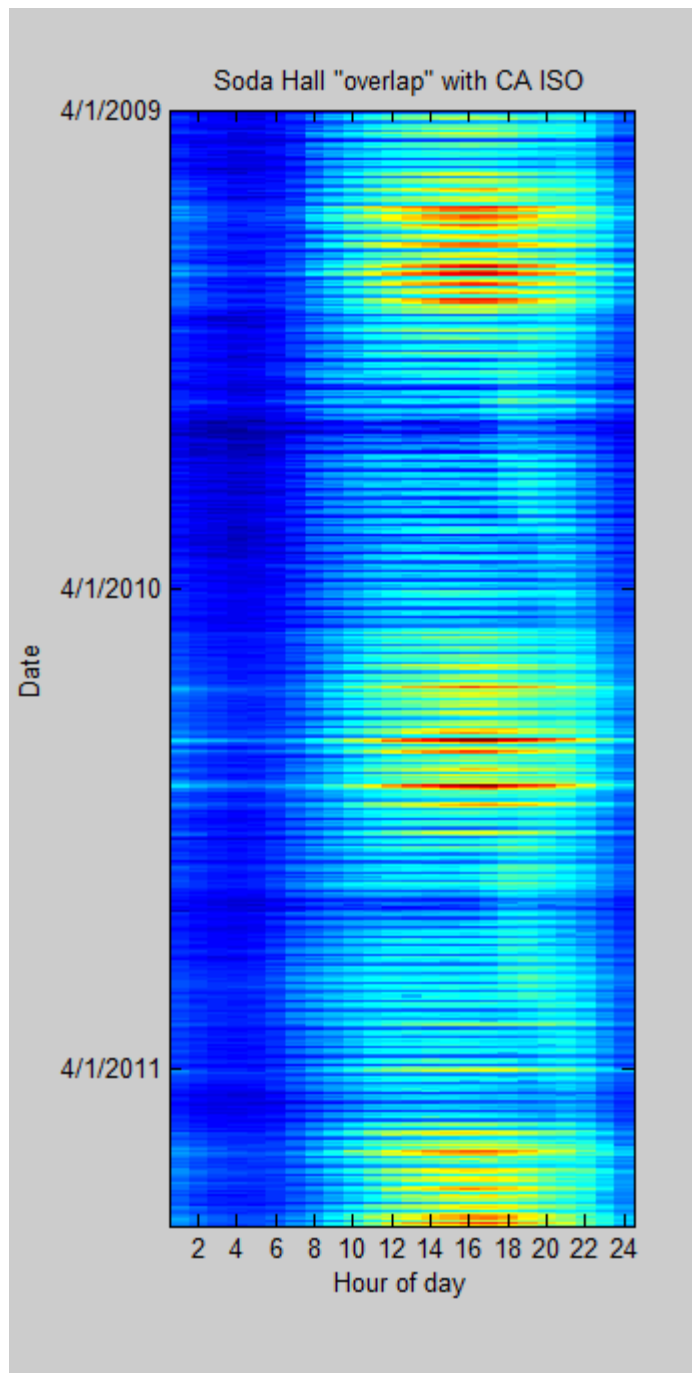


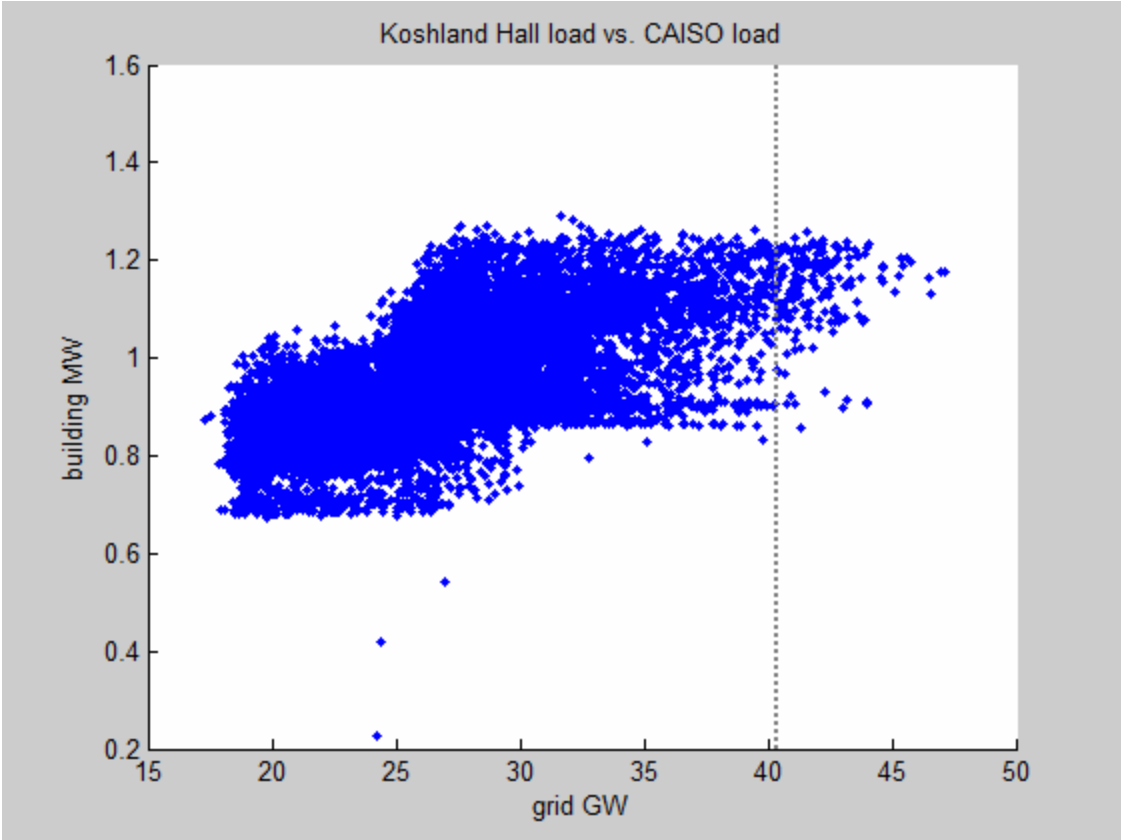
Conclusions

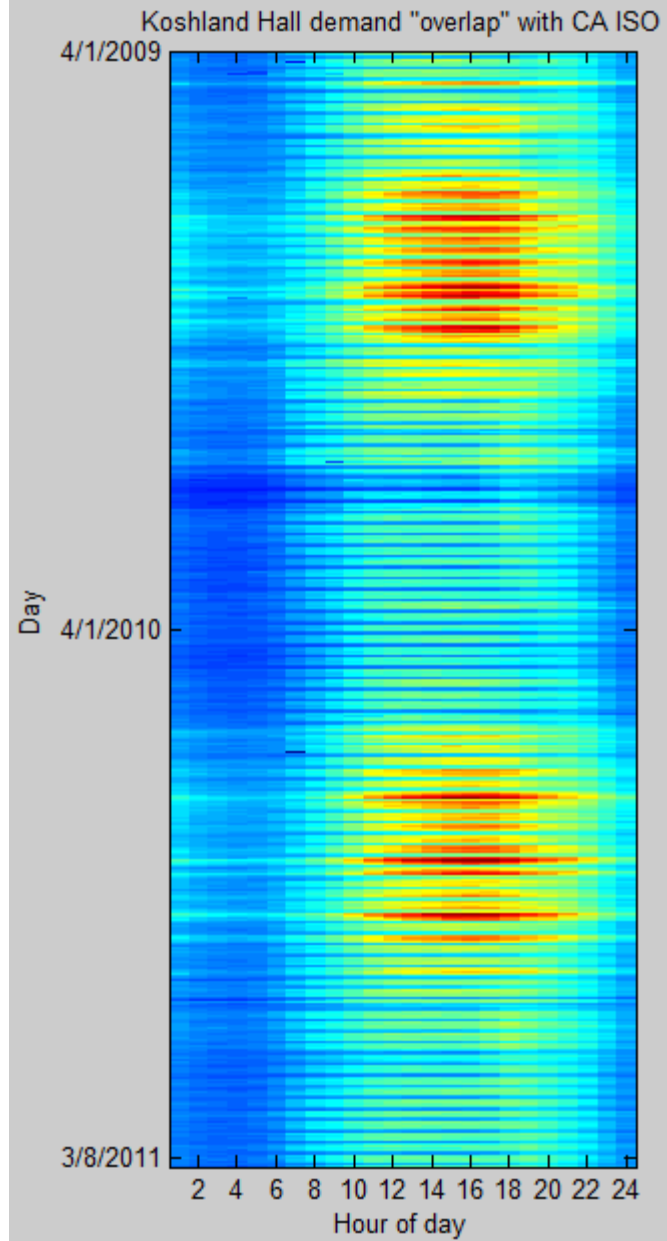
- EE and DR opportunities are as diverse as the building stock
- Both require good **information** to capture and often rely on well functioning controls
- Energy meter data contains sufficient information to improve **targeting** and therefore **measurable outcomes** of EE and DR programs

Questions? Data to analyze?

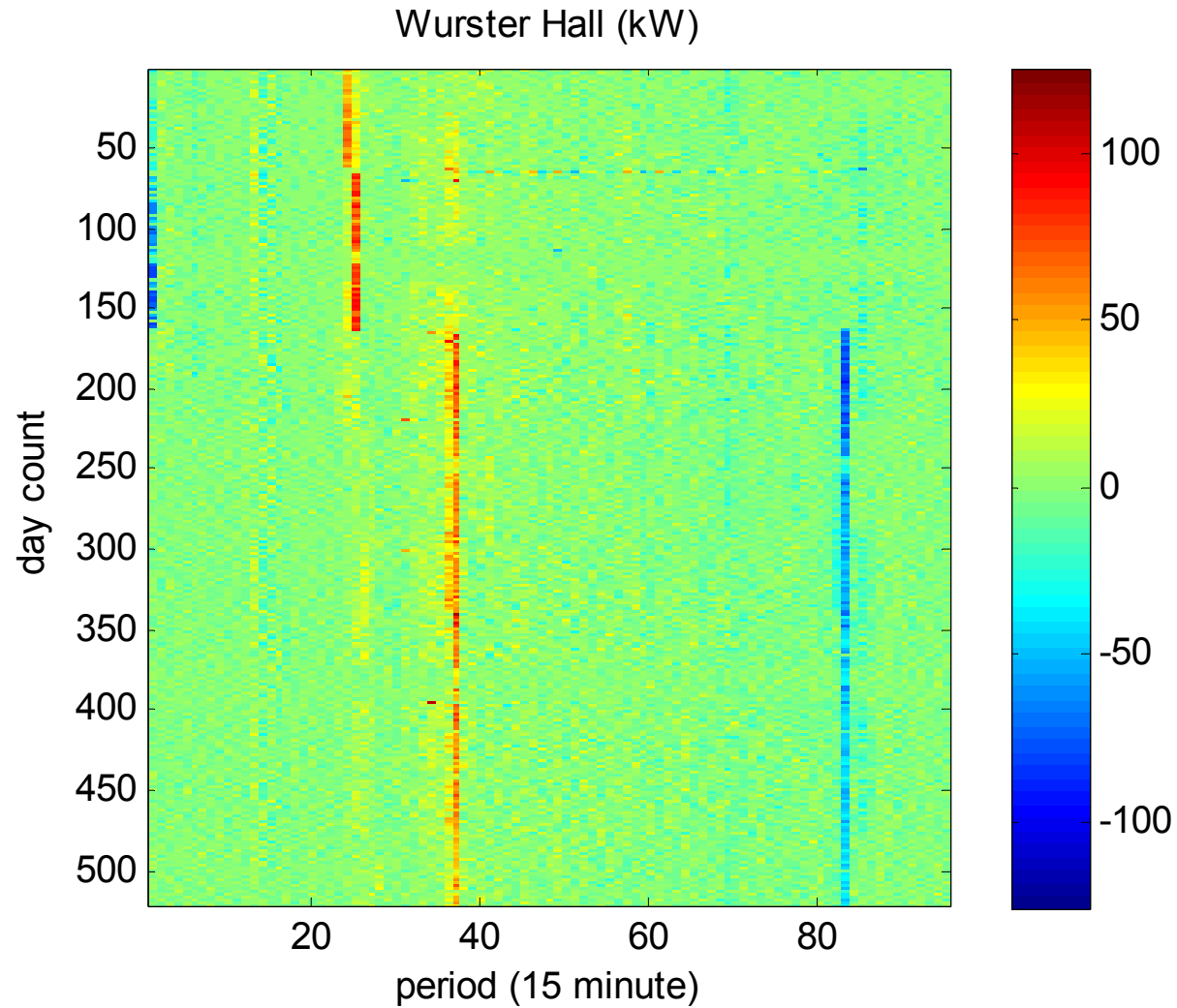
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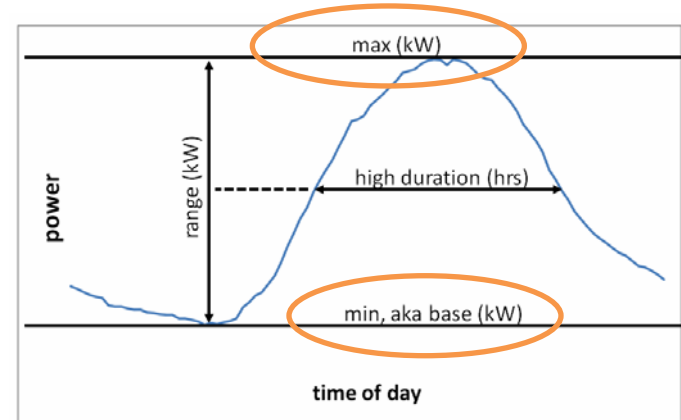
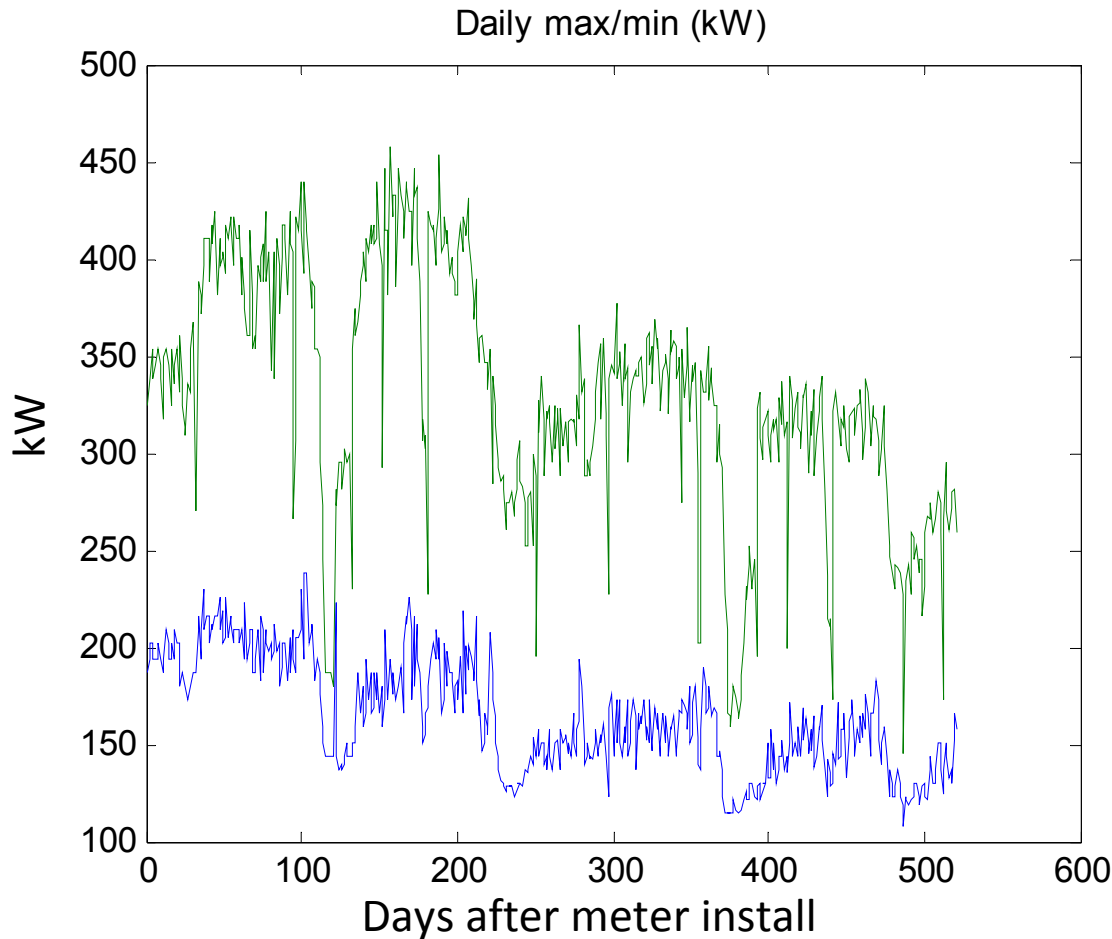




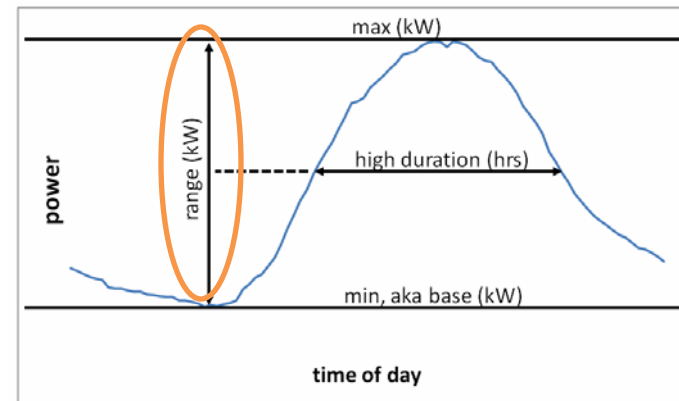
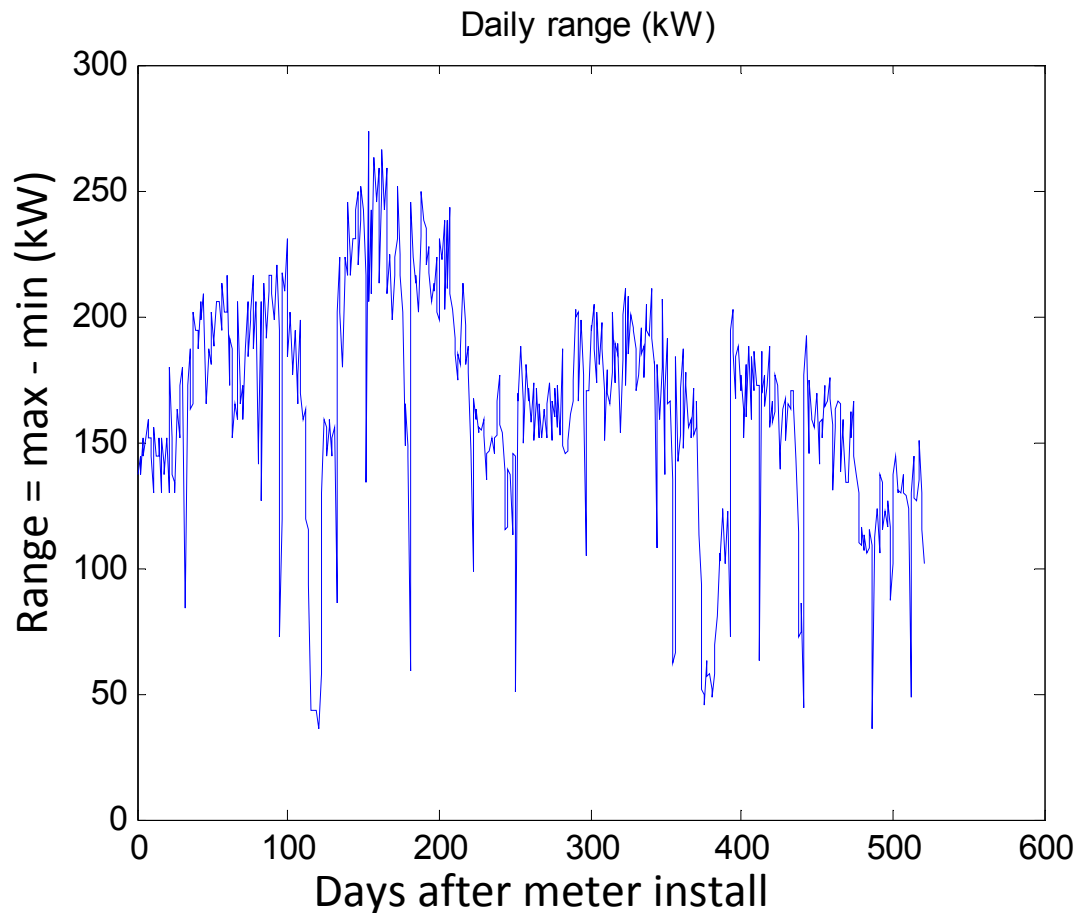
Building load finite difference map



Load attributes: Daily max and min



Load attributes: Daily range of load



The IOU programs implement programs that promote specific energy saving technologies or measures in order to produce energy savings. In the 2006-2008 portfolio fourteen measure groups were responsible for over 90 percent of the reported statewide electricity. These typically were the key measures for any given IOU (with some slight variance for SCG). These measures were:

Interior screw lighting	Refrigerant Charge and Airflow
Linear fluorescent	High bay fluorescent lighting
Recycle refrigerator	Refrigeration Door gasket
Outdoor CFL Fixture	Night light
Refrigeration strip curtain	Lighting – other
CFL Fixture	Linear fluorescent delamping
On-site Audit	Rooftop or split system

There were 12 measure groups that made up over 90 percent of the statewide natural gas savings. These technologies were:

Steam trap	Water heater
Pipe and tank insulation	Furnace
Clothes washer	Food Service
Greenhouse heat curtain	Process boiler
Insulation	Greenhouse IR film
Water heater control	Duct sealing and insulation