Speaker: David Grupp Ph. D
Associate
Engineer
WCEC

Hosted by: Paul Fortunato,
Western Cooling
Efficiency Center

THANK YOU TO OUR AFFILIATES AND PARTNERS

DAIKIN

Coolerado

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT
The Power To Do More.

AIRMAX INDUSTRIES, LLC

HONDA
The Power of Dreams

E Source

Pacific Gas and Electric Company

Xcel Energy

SEELEY INTERNATIONAL

Sempra Energy utilities

TOKYO GAS

SHEET METAL WORKERS' INTERNATIONAL ASSOCIATION

BEUTLER CORPORATION

STATE OF CALIFORNIA ENERGY COMMISSION

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

Walmart
Save money. Live better.

LA DWP
Los Angeles Department of Water & Power

TARGET

NV Energy

TRANE

EVAPORCOOL

INTEGRATED COMFORT INC.

WELLS FARGO

Munters

Carrier

WHAT'S NEW AT WCEC

WESTERN COOLING CONNECTION UPDATE

WCEC January 2014 UCDAVIS

IN THIS UPDATE

Xeros Laundry System

WCEC Project Updates

WCEC Upcoming Webinar

ABOUT THE CENTER:

The Western Cooling Efficiency Center was established in 2007, alongside our UC Davis partner centers, the Energy Efficiency Center, California Lighting Technology Center, Center for Water-Energy Efficiency and the PHEV Research Center through a grant from the

Welcome

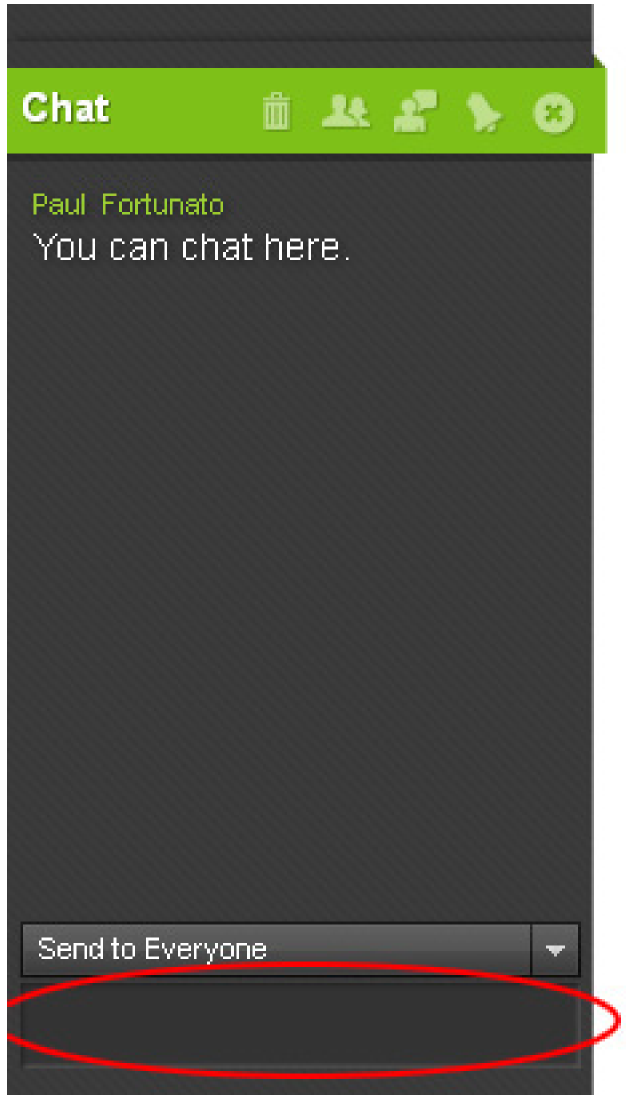
To the Western Cooling Connection Update Newsletter! This issue's featured article highlights WCEC's field testing of a new laundry machine technology that has significant potential to reduce energy in water heating and water-use. Also in this issue are brief updates on some of WCEC's main research including the Western Cooling Challenge, the Technology Demonstrations Program and Aersol Sealing of Building Envelopes.

Small Grime Fighting Beads Clean Laundry without Hot Water

When you want your laundry seriously clean, what do you do? For the most part, we crank up the heat on the water to sterilize and remove grime from the most soiled laundry. This is also true for most commercial laundry systems as well, expending a significant amount of energy to heat up water to

http://bit.ly/WCECJan2014Newsletter

COMMENTS/QUESTIONS?



1. Write your question in the comment box during the session or after the presentation.

UPCOMING WEBINAR IN FEBRUARY

Speaker:
David Grupp
Associate Engineer
WCEC

PROP 39: BASIC OVERVIEW OF THE CEC GUIDELINES DOCUMENT

- Funding for 5 years, **$550 million dollars annually**
- **$381 million** per year to local education agencies (LEA): K-12 schools including Charters and public, but not private
- **$47 million** per year to California Community Colleges
- **$28 million** per year for low-interest or no-interest revolving loans and technical assistance to the CEC
- Funding can only be used for **EXISTING Construction**

PROP 39: AWARD ALLOCATION & ENERGY PLANNING FUNDS RESERVATION

AWARD ALLOCATION

- **85%** funding based on Average Daily Attendance (ADA)
- **15%** funding based on number of students eligible for free and reduced-priced meals

ELIGIBLE ENERGY PLANNING FUNDS ACTIVITIES

1. Energy audits and energy surveys or assessments
2. Prop 39 program assistance
3. Hiring or retaining an energy manager
4. Energy related training

PROP 39: PROCESS TO RECEIVE AWARD FUNDING

1 School to provide Electric and Gas usage data for past 12 months

2 Determine EUI of their buildings (See Appendix D)

3 Project Prioritization Considerations

4 “Low hanging fruit assessment”

- Low risk/non-invasive retrofits first
- More involved clean energy generation second
- Non-renewable projects that combine heat and power

APPENDIX D: Benchmarking Process

Energy Benchmarking Steps

1. Gather Energy Data and Summarize Energy Data

Gather and summarize energy usage data for all energy sources, including electricity, natural gas, and fuel oil. To accomplish this, an LEA gathers the last 12 months of utility bills, including electricity, natural gas, and fuels, to calculate the EUI. If a school has two or more meters for electricity, natural gas, or other fuels, the utility data shall be combined for one EUI calculation. Benchmarking a facility must be performed on a school-by-school basis. Table D-1 shows the data required to calculate EUI. If LEA staff members have difficulty gathering this information, they may contact their local utility or energy provider.

Table D-1: Example of School Energy Use Data Annual Summary

FACILITY	XYZ School								
UTILITY:	PG&E								
School SQFT:	11,000								
		Electricity Account No.		Rate	Gas Account	Rate	Other Fuels (propane/diesel)		Total Energy Cost
	Year	Average Peak Demand (kW)	Total Energy Use (kWh)	Electric Charges ($)	Total Gas Use (Therms)	Natural Gas Charges ($)	Total Fuel Use (Gallons)	Fuel Charges ($)	Total Charges ($)
Total	2012	63.3	86,816	$ 16,465	6,928	$ 6,030	0	$ -	$ 22,495

Source: California Energy Commission

2. Establish Energy Use Intensity

Establish an EUI for your school. After collecting 12 months of energy cost data and knowing the square footage of your school, the next step is calculating the EUI by dividing the annual energy use by the gross[6] square footage of the school for each end-use energy category. For example, in Table D-1, the LEA staff looking at XYZ School divides the total 85,815 kWh use by the total square footage of 11,000 to obtain the electricity use intensity of 7.8 kWh/sq.ft/year. Next, perform the same calculations for natural gas, other fuels, and total cost.

Table D-2 bel...

...wo numbers (highlighted in ...t./year are the two numbers

...Z School

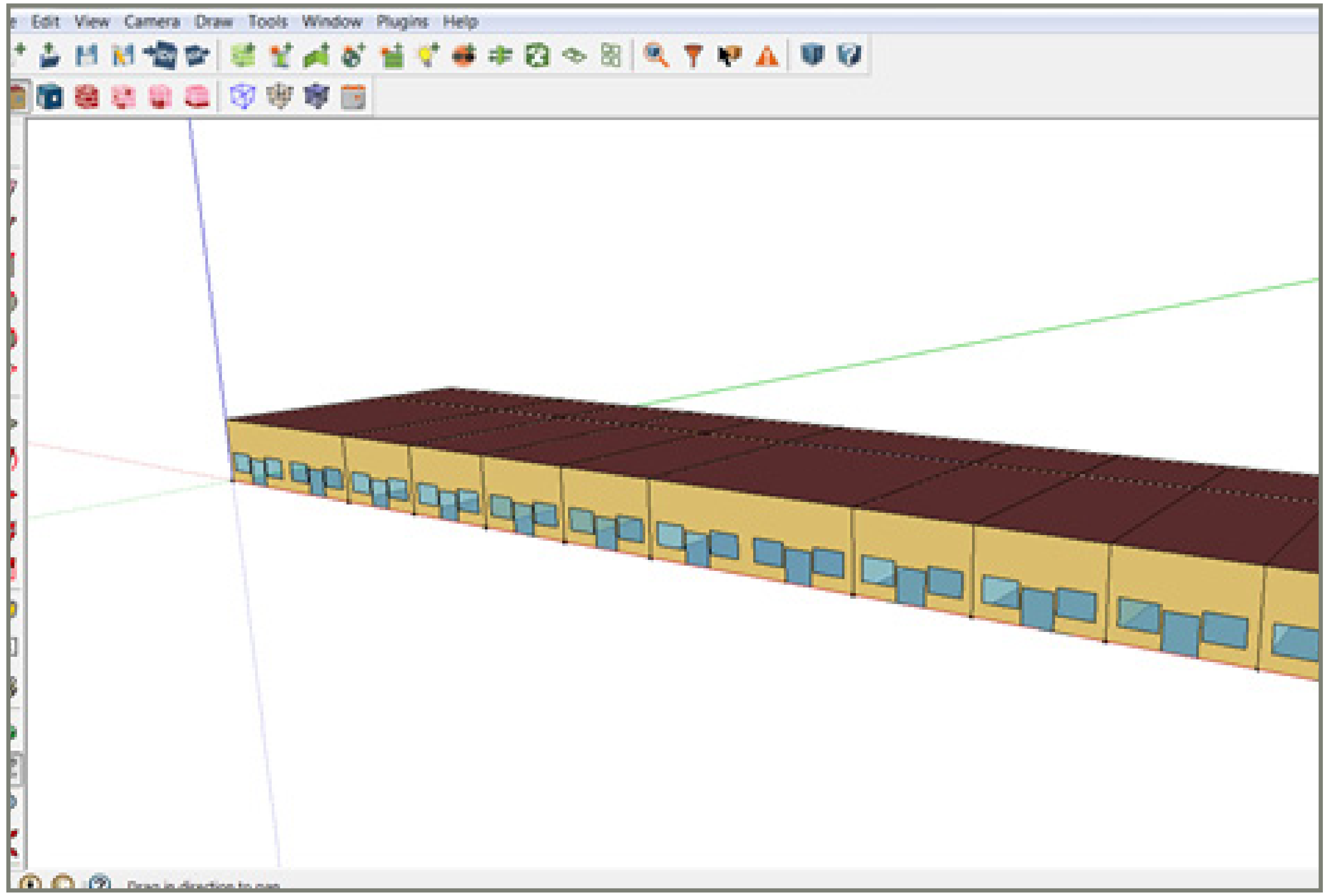
... Fuel	Energy Costs/ sq.ft/ year	Kbtu/ sq.ft/year
0		
...0.00	$1.55	127.8

...mple report that lists the ...e energy use intensity

...hools with the ...t. The report ranking ...red to others in the

PROP 39: ELIGIBLE ENERGY MEASURE IDENTIFICATION

1. **Energy Survey:** Looks at simple, more obvious EE measures (Appendix B)
2. **Data Analytics:** Energy modeling software. Must be software approved by their Utility
3. **ASHRAE Level 2 Audit:** For more in depth retrofits. Can be deployed through an Energy Manager, third party contractor, or Utility Program Audit.



PROP 39: COST EFFECTIVENESS DETERMINATION

ELIGIBLE ENERGY PROJECTS MUST ACHIEVE A MINIMUM **SAVINGS-TO-INVESTMENT RATIO (SIR) OF 1.05 TO RECEIVE FUNDING**

FORMULA FOR SIR (Appendix E): *SIR = NPV/(Project Installation Cost – Rebates – Other Grants – Non-energy Benefits)*

NPV = Energy savings dollars over the projects' useful life

REAL WORLD EXAMPLE: EVAPORCOOL RTU PRE-COOLER AT BEALE AIRFORCE BASE

1. kWh Savings per year: 14,000 kWh x $0.12 (cost per kWh) = **$1,680 savings per year**
2. Useful life for this type of retrofit: 15 years.
   Total savings for the useful life is: $1,680 x 15 = **$25,200**
3. Subtract new expenses(not install cost)**:** $48 per year for water x 15 years = **$720**
4. NPV is: $25,200 - $720 = **$24,480**
5. Project Installation Cost = **$17,261**
6. SIR = **$24,480/$17,261 = 1.42**

Contrails Dining Facility at Beale Air Force Base in Marysville, California

PROP 39: HOW CAN UTILITIES BENEFIT?

- Utilities must invest in these projects to claim savings on their portfolios
- How much do they need to invest to claim?
- Claim based on how much savings their particular investment saved?

CONTACT INFORMATION

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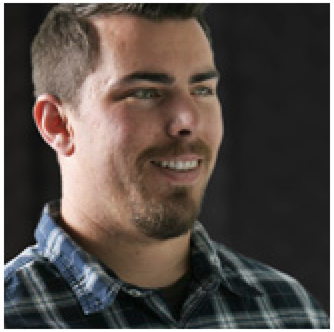
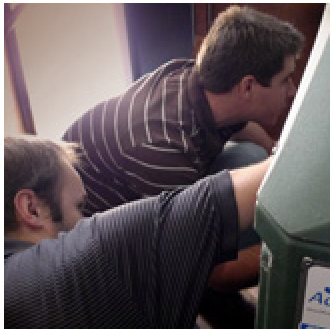
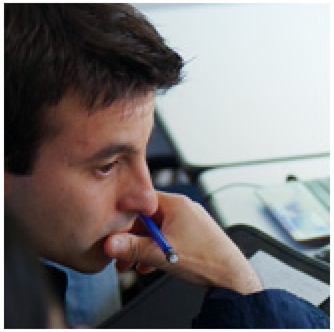






HVAC for California Schools

January 30, 2013

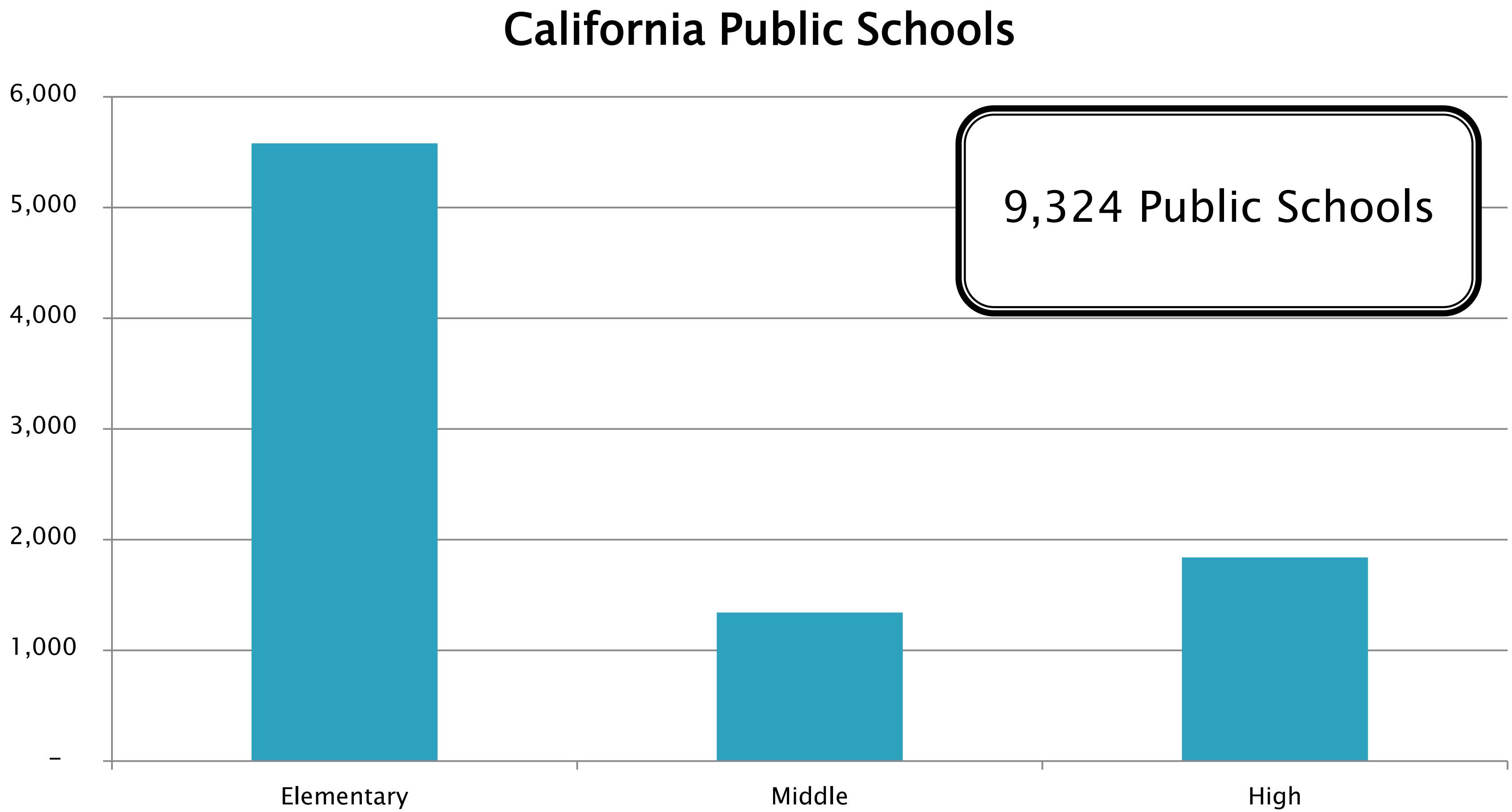
David Grupp, WCEC-UC Davis

Presentation

- Schools in California
- Heating and Cooling
  - Energy use and equipment types
  - Occupancy patterns and loads
- Ventilation and IAQ
  - Importance of IAQ in schools
- Potential Energy Savings Technologies
  - RTU Retrofit Controllers
  - Evaporative Condenser Pre-coolers
  - Demand Control Kitchen Ventilation

California Public Schools

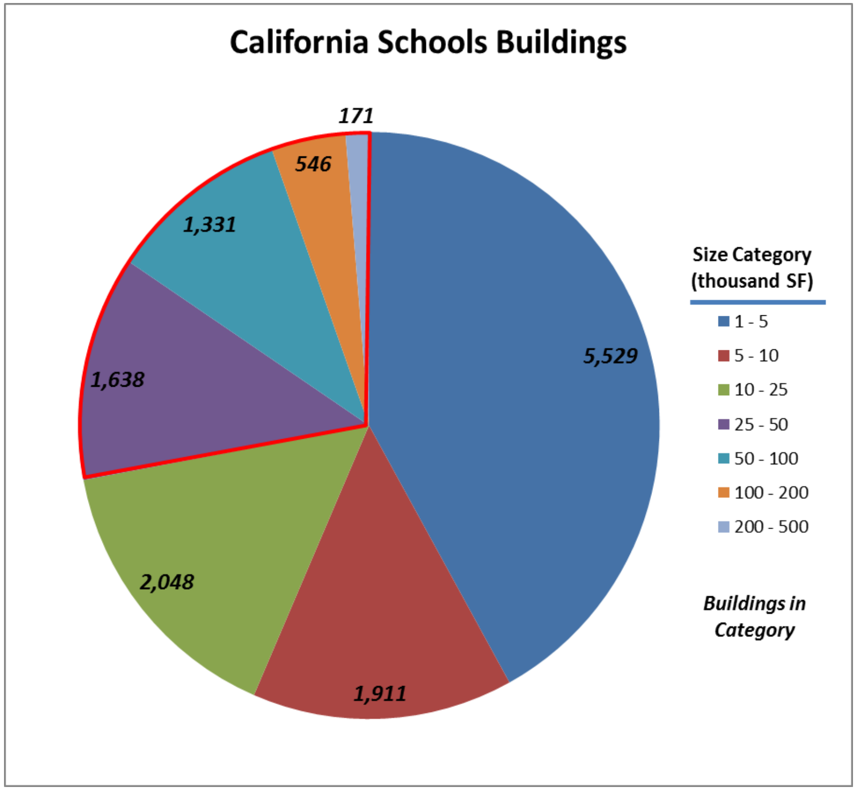
California Public Schools

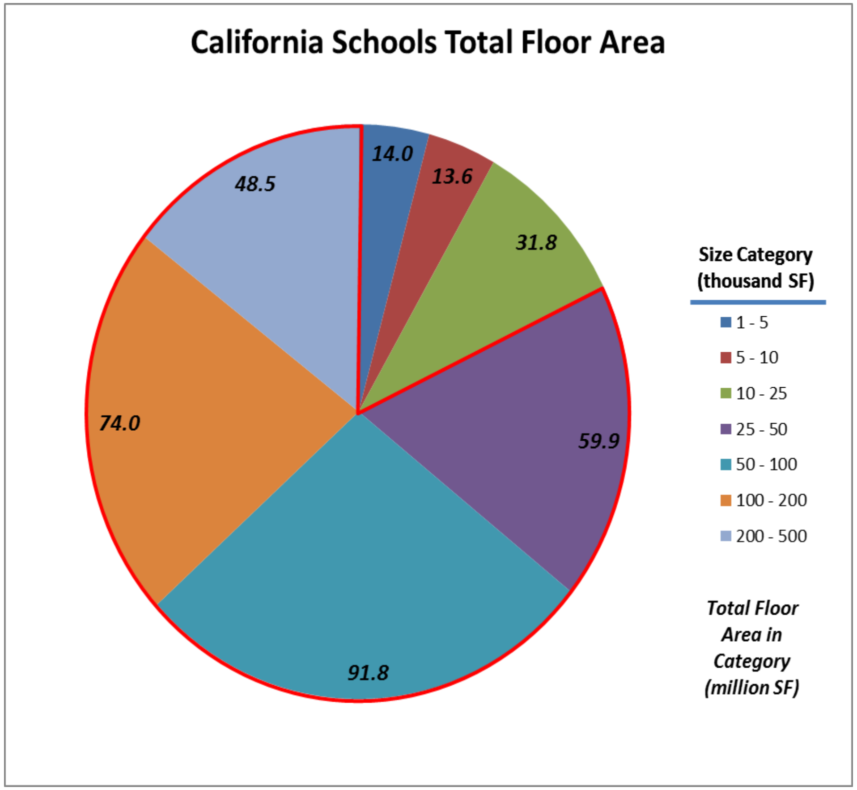


Source: EducationBug

A small number of **large** schools have the majority of floor area

California Public Schools



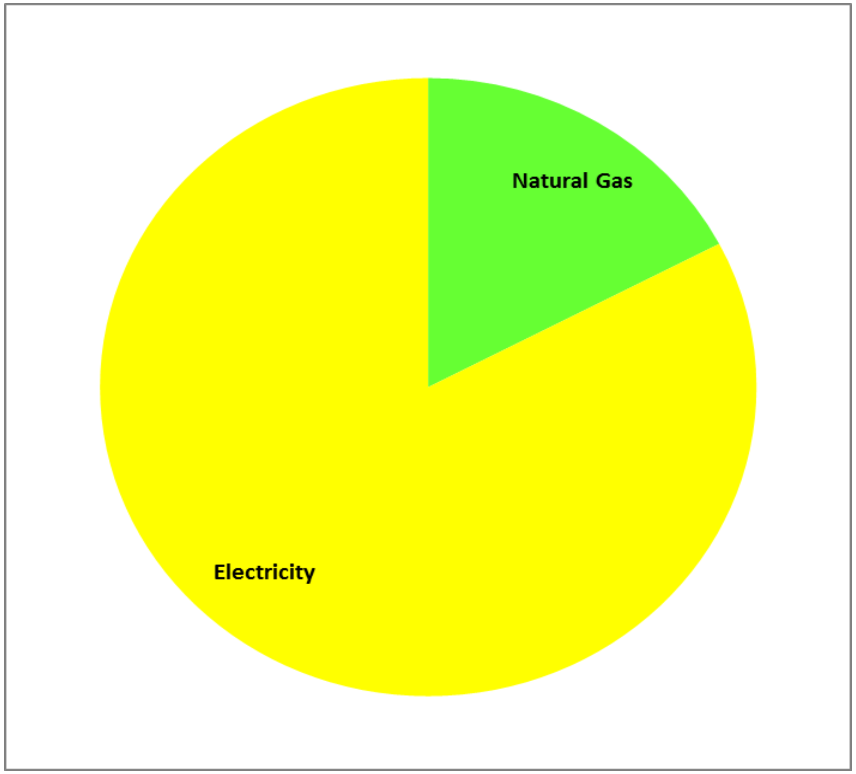


28% of Buildings account for 82% of the Floor Space

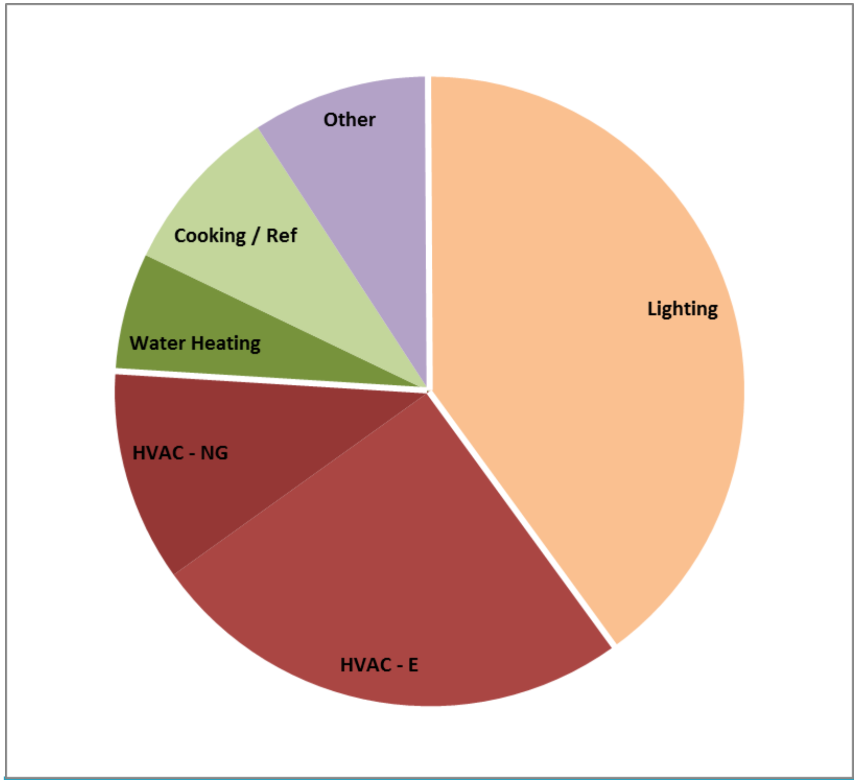
Source: CEUS Database

On a source energy basis, lighting, HVAC, and all other loads are split almost evenly.

California Schools - Source Energy



Source Energy - Fuel

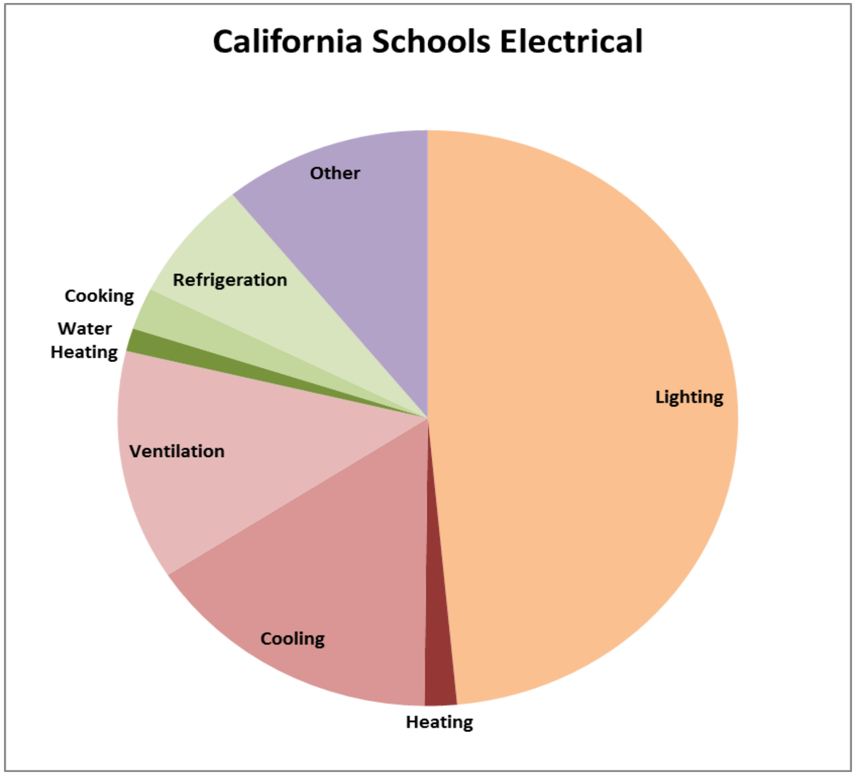


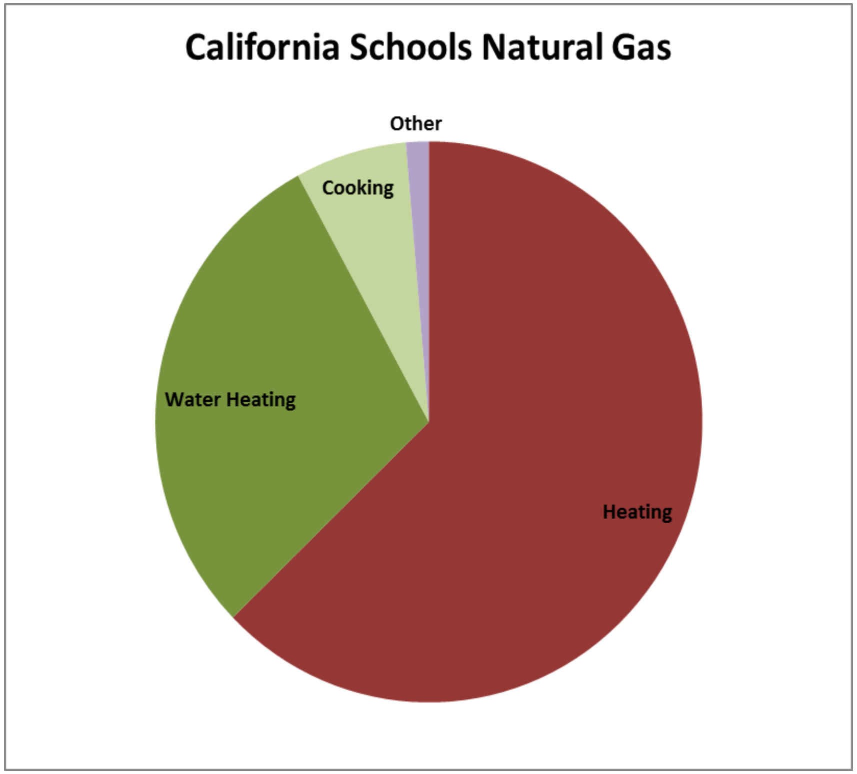
Source Energy – End Use

Source: CEUS Database

Lighting is the primary use of electrical energy and space heating is the primary use of natural gas.

California Schools – Site Energy





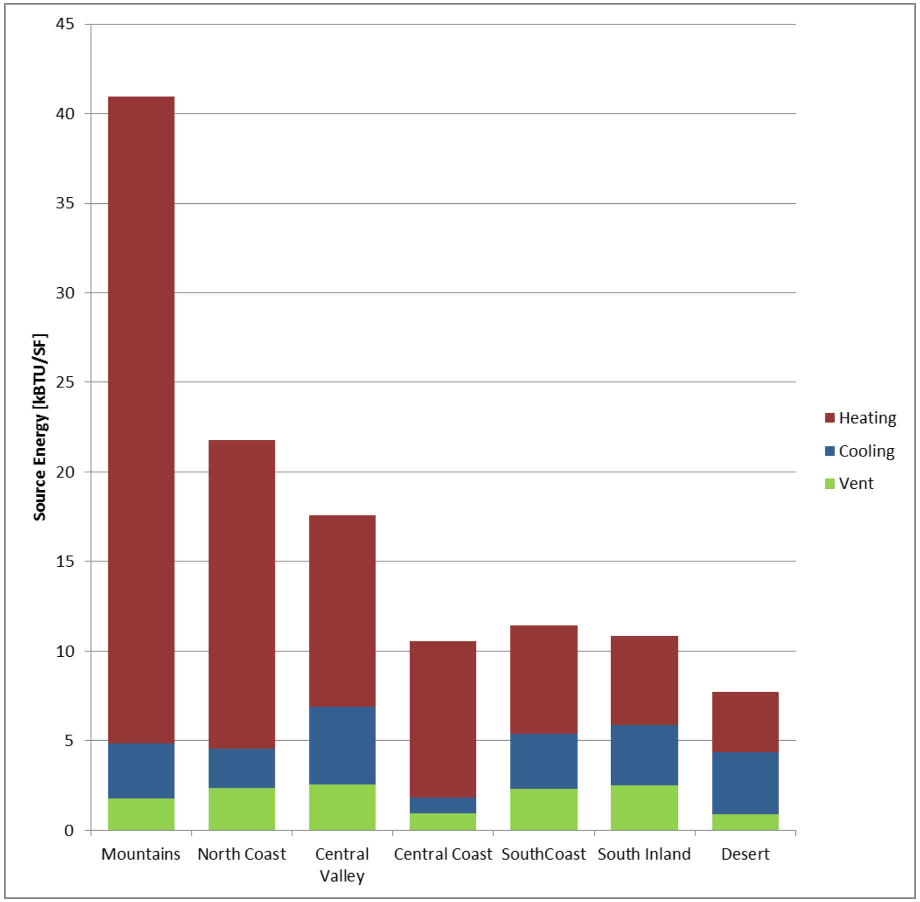
7.5 kWh / SF

.16 Therm / SF

Source: CEUS Database

Heating and Cooling Energy

- **Heating in California is relatively less intense than rest of US**
  - **Milder climate than rest of US**
- **Wide range in heating energy use throughout the state**
- **Cooling energy use relatively consistent**
  - **Summer vacation?**



Source: DOE Building Performance Database

Equipment

Equipment Distribution in K-12 Schools

Equipment Type	Characteristic	Installed Base
Packaged DX unit	Single zone	60 to 65%
Packaged DX unit	Multiple zone	5%
Split System	Single zone	10 to 15%
Bard	Single zone	10%
Unit Ventilator/fan-coil	Central plant	10%
Split System	Variable Ref Flow	~1%

Data courtesy of Resource Solutions Group and Trane

HVAC Equipment in CA K-12

- Typical sizing is similar to light commercial buildings
  - 1 CFM / ft2 Ventilation
  - 350 CFM / ton
- Preferred configuration is one 4-ton RTU per classroom – many small units
- Simultaneous retrofit could be economical

Data courtesy of Tim Sisson Trane

Ventilation

- High occupancy - highly variable
  - Many multipurpose rooms, gyms, assembly areas
  - Schools benefit greatly from Demand Control Ventilation
- Large internal gains – sensible and latent
  - Larger peak cooling needs than normally would be expected – lots of breath and sweat
- Natural ventilation – natures solution!
  - Used in some coastal climates (Peninsula and North Coast)
  - Being eliminated in San Diego. Concerns about noise and security.
  - Optimized and operational economizers are the next best thing.

Ventilation

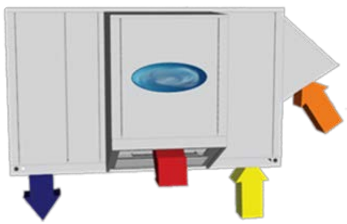
- Higher Ventilation - IAQ vs. Energy vs. Absences
  - Recent LBNL study in 150 classrooms found that more than 50% of classrooms statewide (and 95% of central valley classrooms) don't meet ventilation standards (15 CFM / person)
  - Findings indicate that increasing ventilation to the state standard in schools would reduce absences by 3.4%
  - The research suggests that increases in energy use are more than compensated by reductions in student absences (increased state funds) and reduced medical and missed-work costs

Source: Indoor Air 2013; 23: 515-528

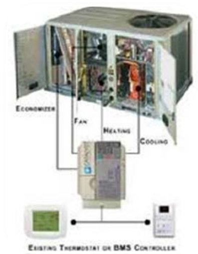
HVAC Efficiency Technologies

Technologies

Packaged Unit Efficiency



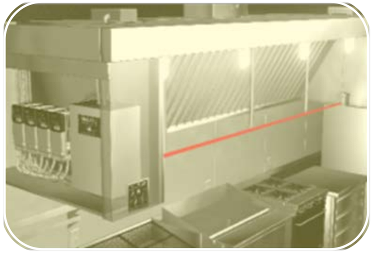
Climate Optimized RTU



RTU Optimizer Controller

Evaporative Cooled Condenser

Smart Ventilation



Kitchen Hood DCV

Laboratory Fume Hood DCV

Laboratory ACH DCV

Shut-the-Sash Campaign

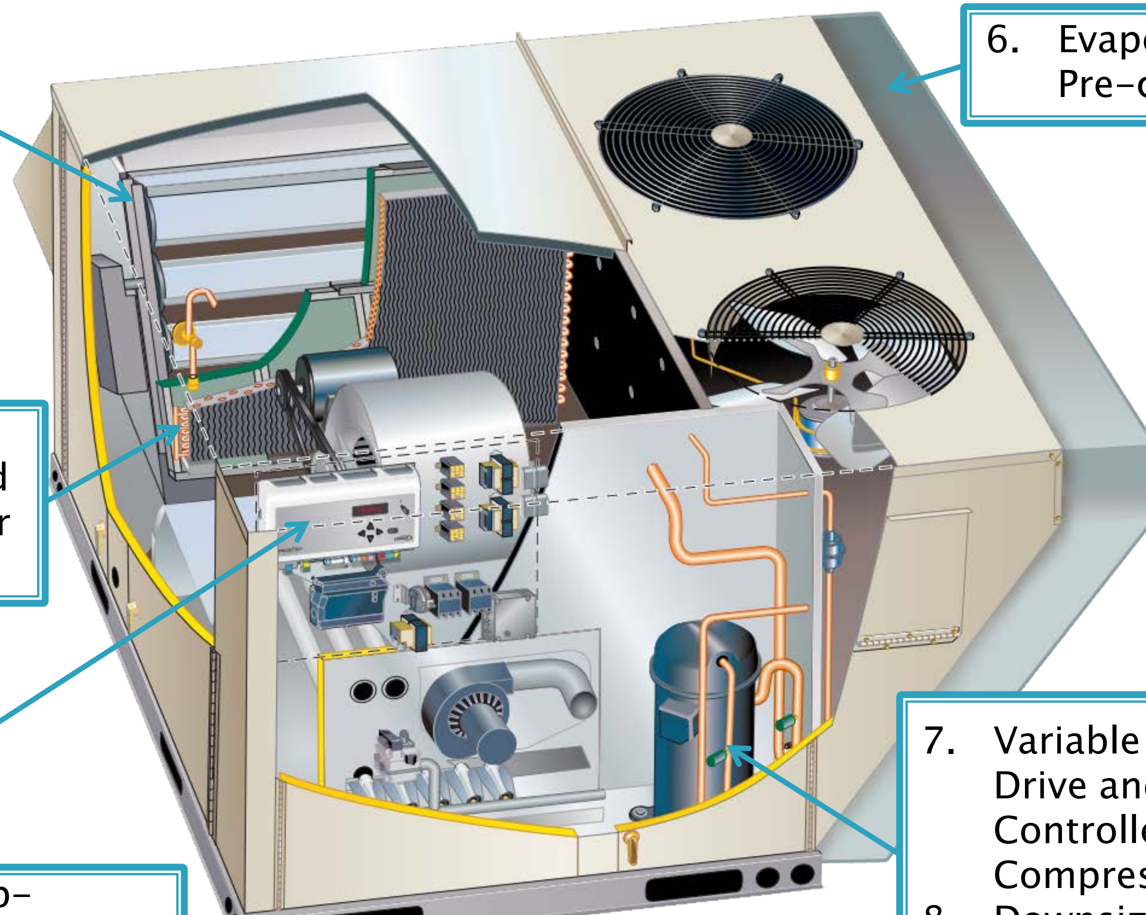
RTU Retrofit Opportunities

1. Advanced Economizer Controls
2. Demand Control Ventilation

3. Downsizing Fan Motors
4. Variable Speed Drive and Controller for Evaporator Fan

5. Fault detection and diagnostics

6. Evaporative Pre-coolers



7. Variable Speed Drive and Controller for Compressor
8. Downsize Compressor

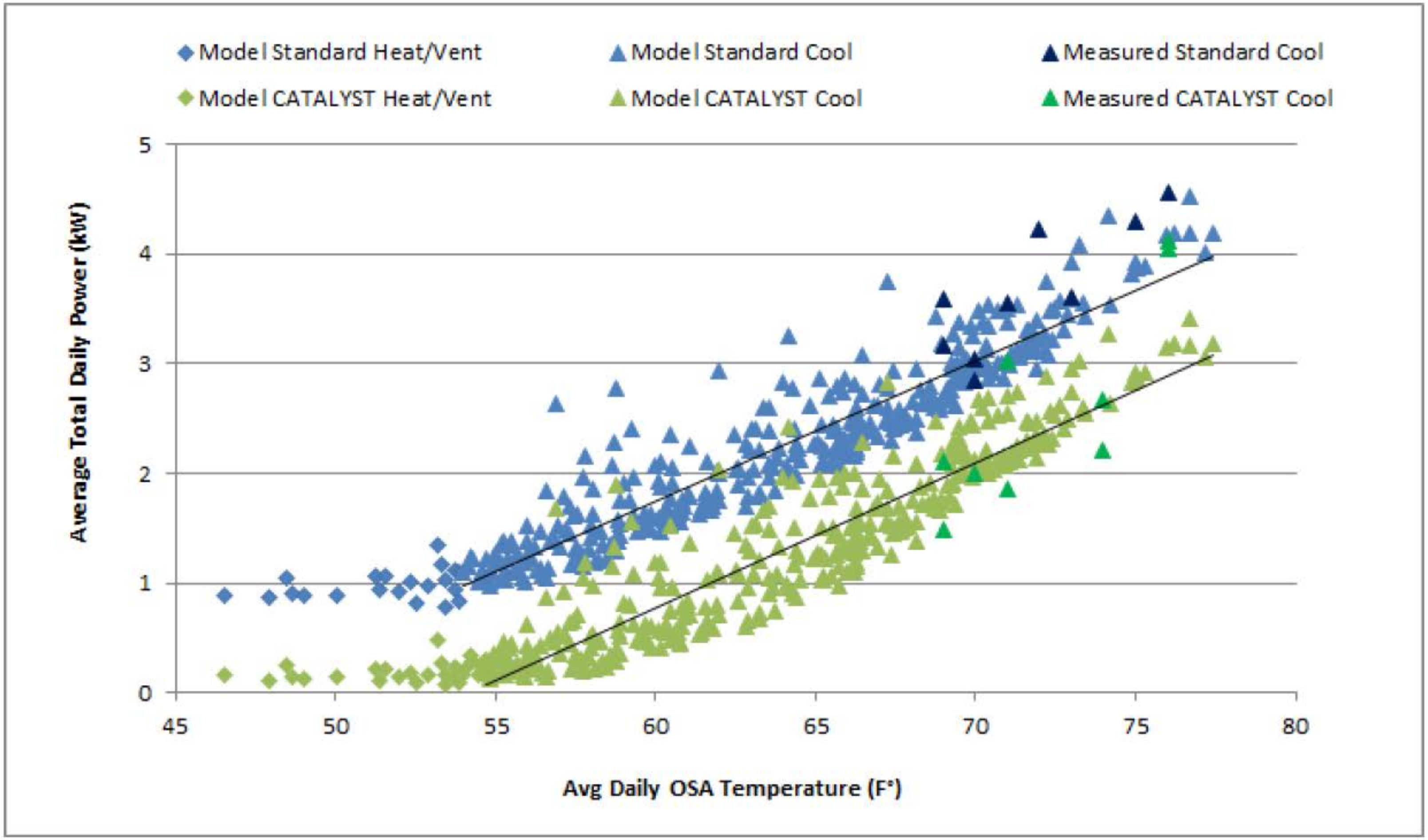
9. “Smart” web-connected Thermostat

Technologies

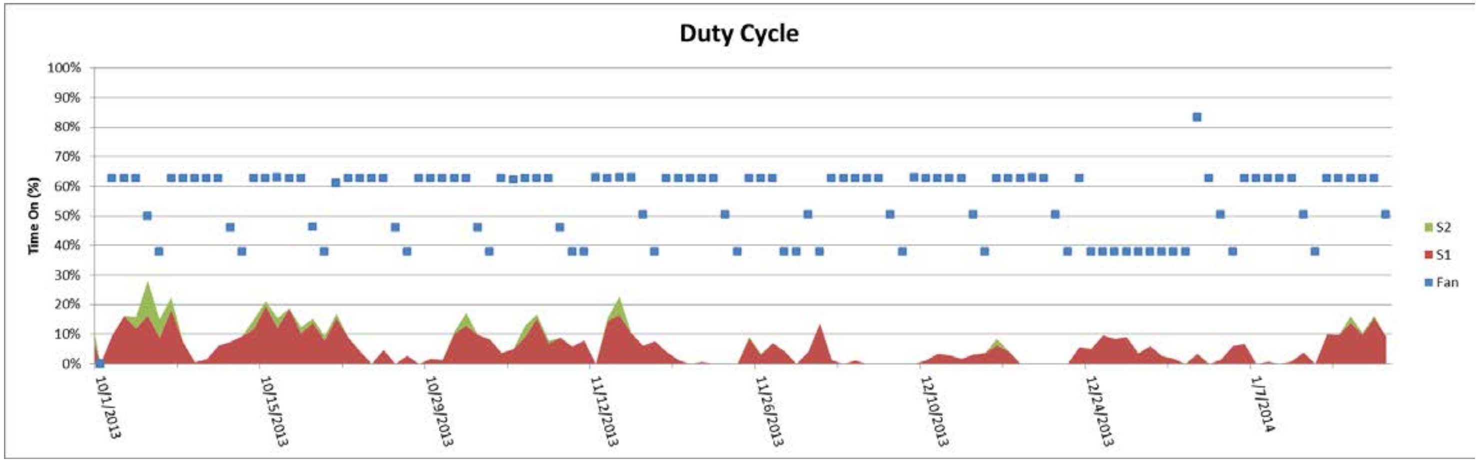
RTU Optimizer Controllers

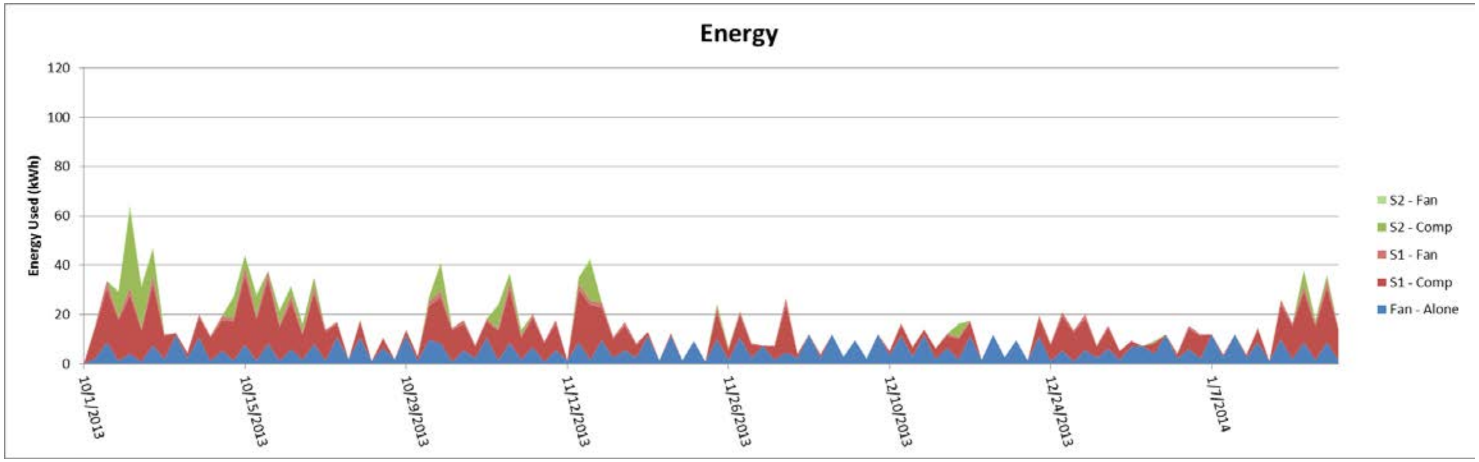
- Variable speed supply fan control
- Demand controlled ventilation
- Differential economizer control
- Extended fan runtime
- Fault detection diagnostics

Catalyst – CSU LB

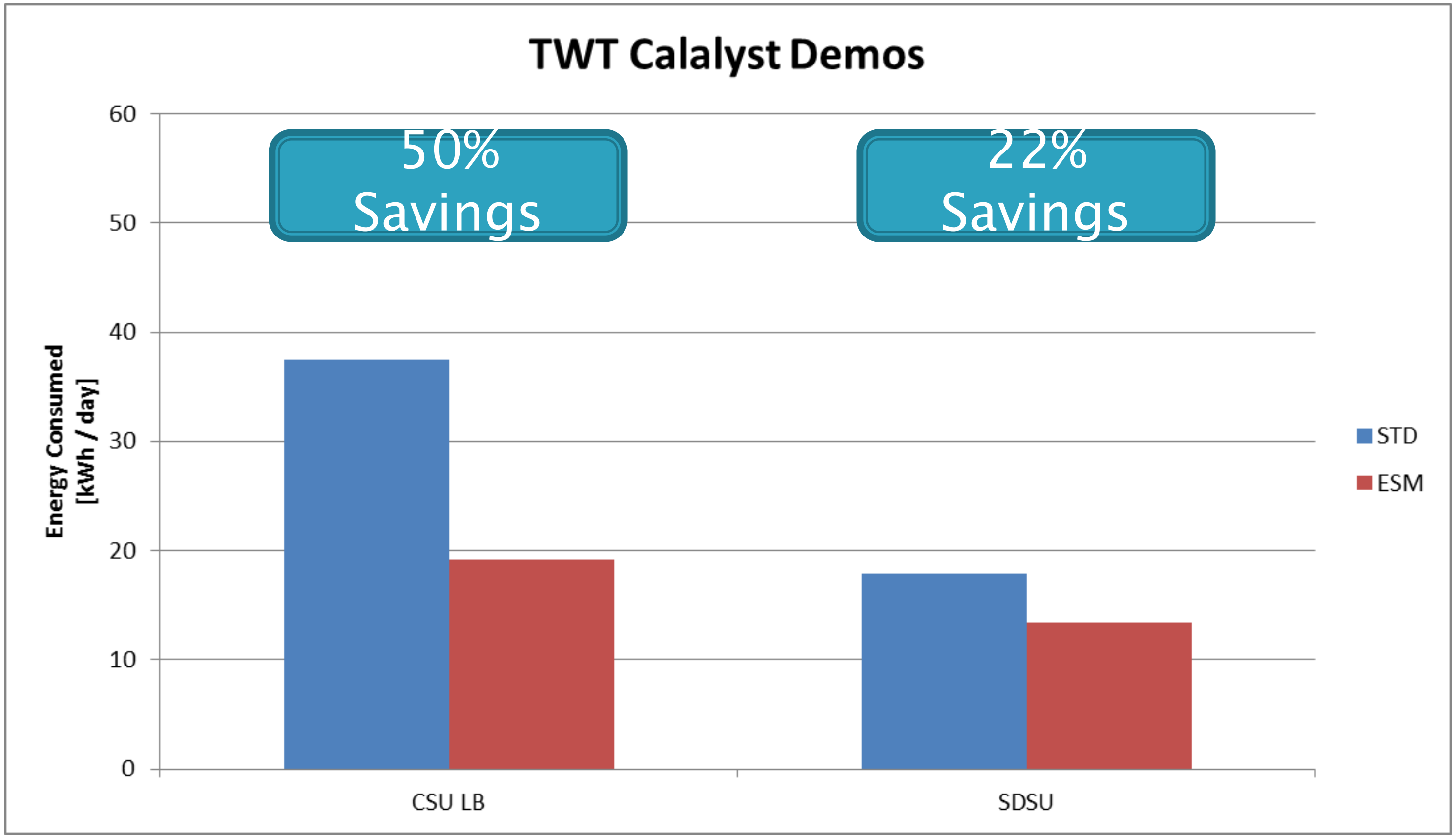


Catalyst – CSU LB

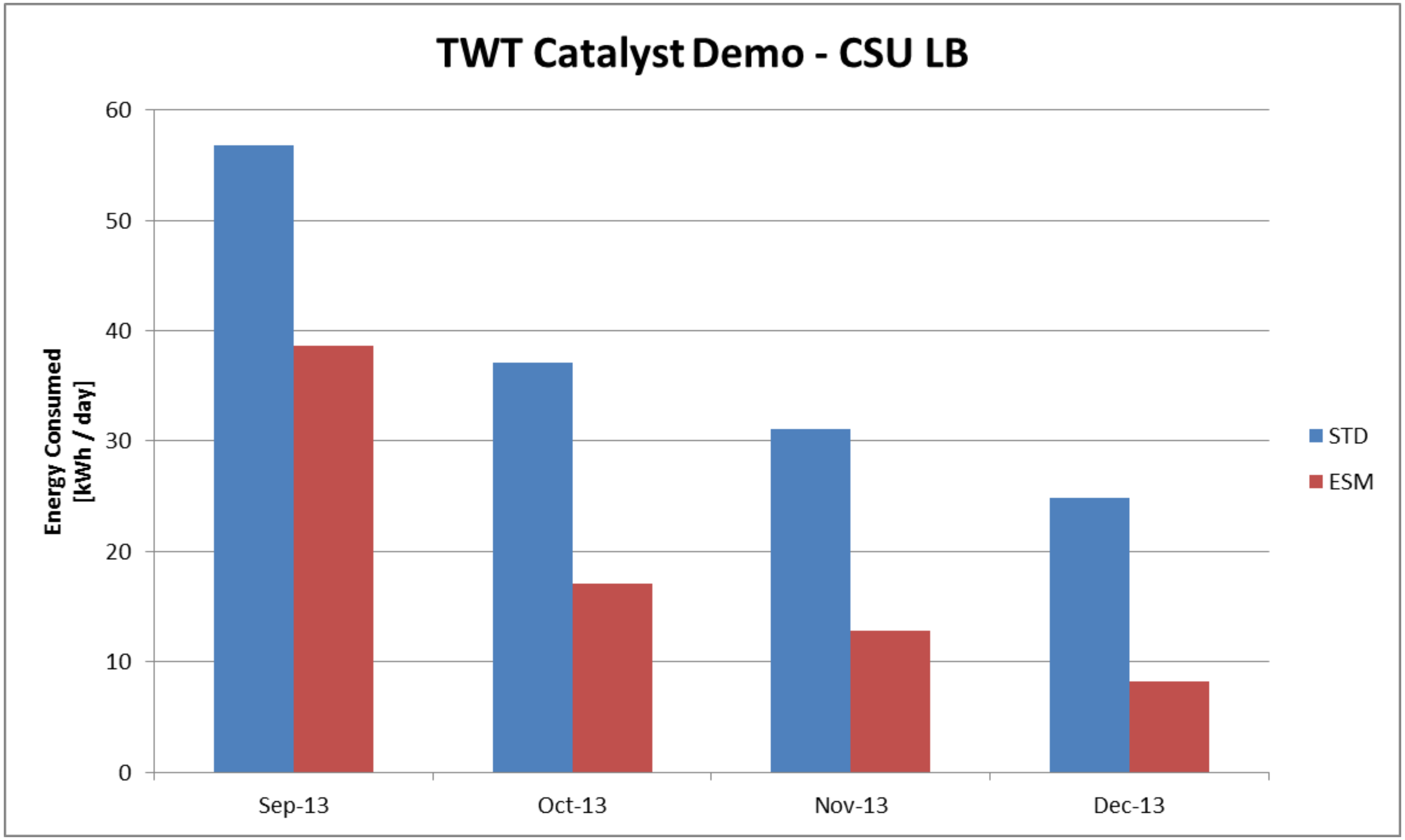




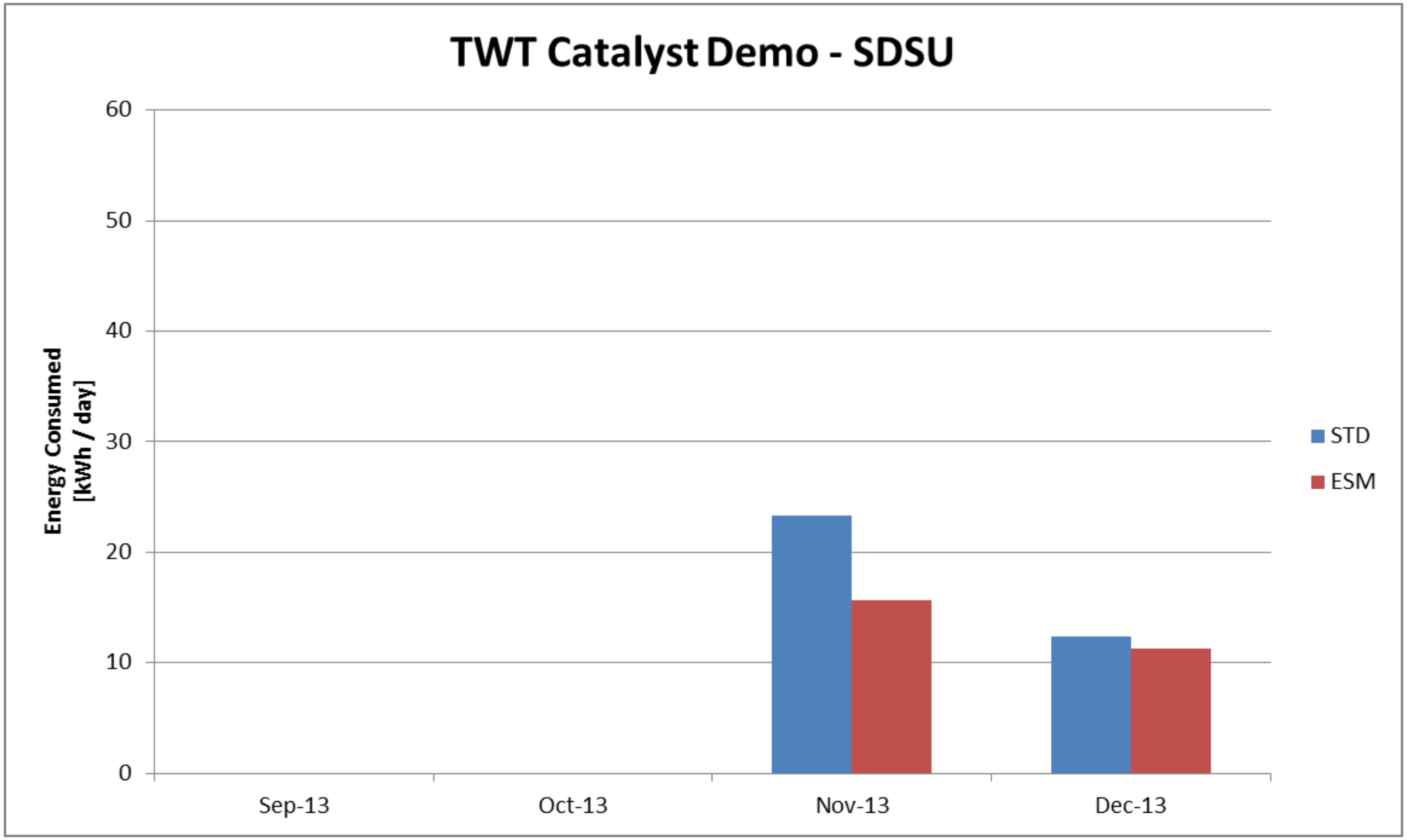
TWT Catalyst Summary



CSU Long Beach



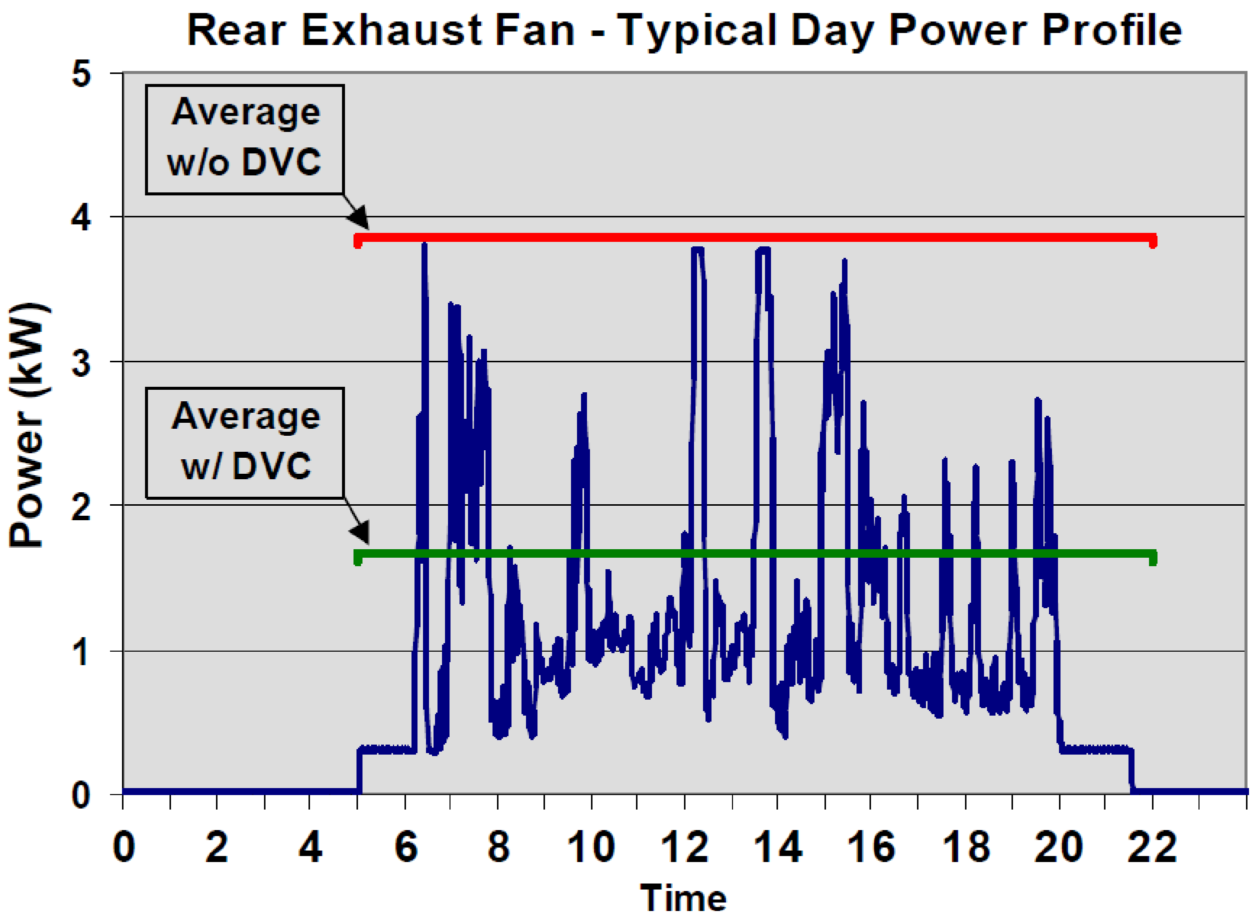
San Diego State University



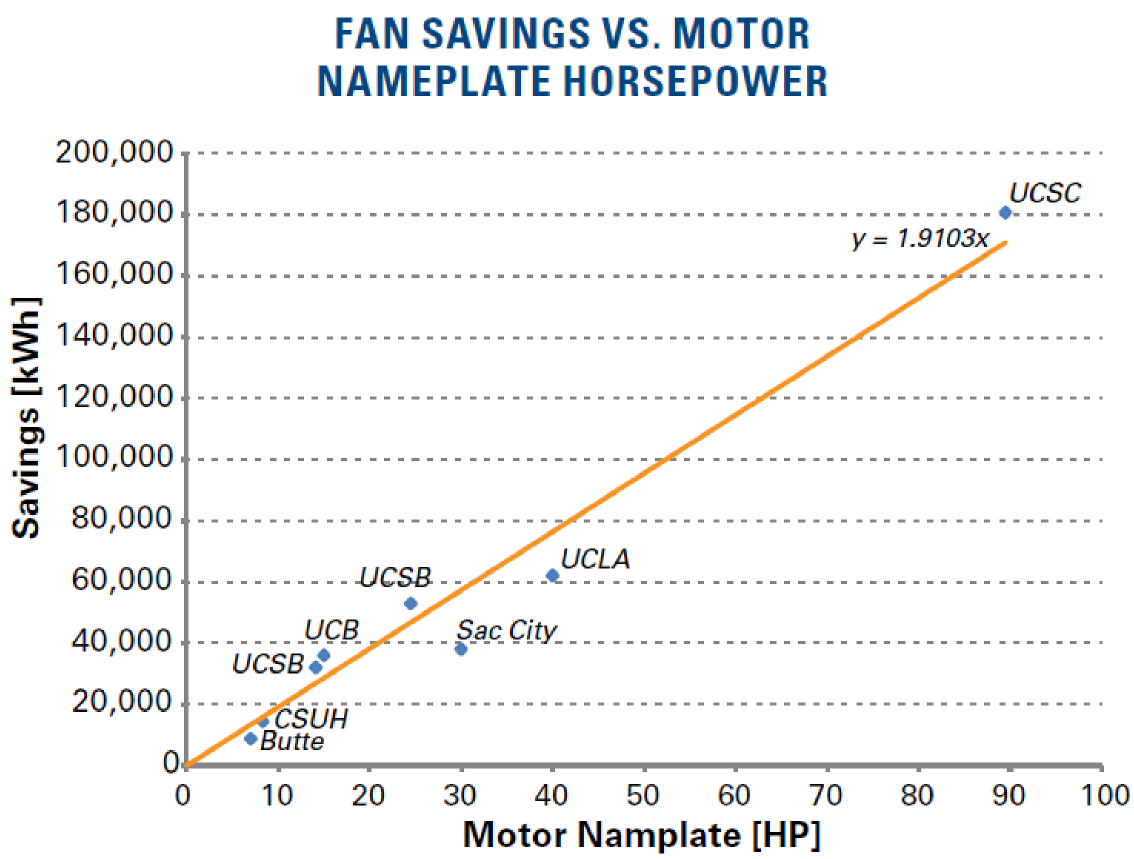
Demand Controlled Kitchen Ventilation

- VFD controlled fan motor responds to
  - Heat
  - Particulates
- Typical fan energy reduction of 40 – 70%
- Typical thermal energy reduction of 15 – 40%
- Typical simple paybacks 3 – 5 yrs

Demand Control Kitchen Ventilation



Demand Control Kitchen Ventilation

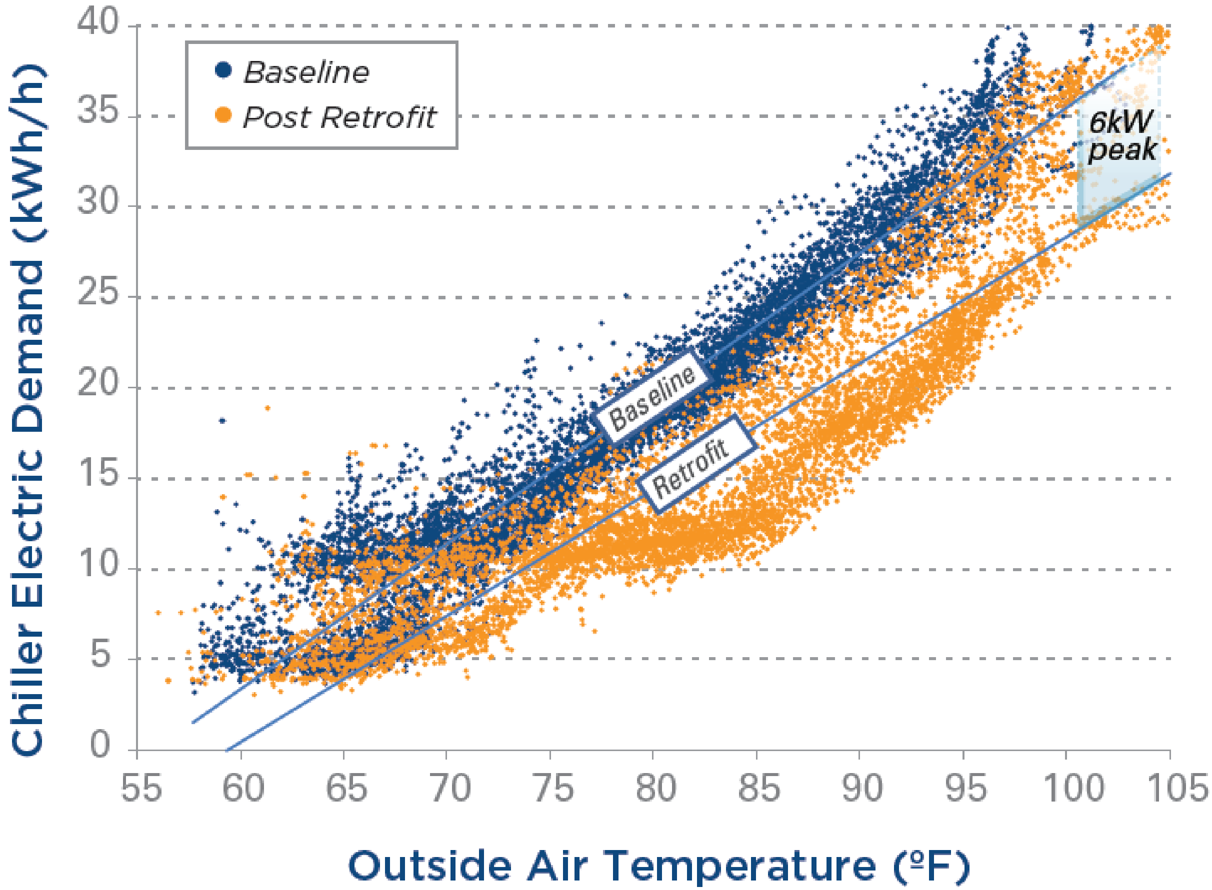


Technologies

Evaporative Condenser Precoolers

- Reduces refrigerant condenser temperature
- Lowers head pressure
- Reduces compressor power

Evaporative Condenser Pre-coolers



Thank you!

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