



**WEBINAR  
SERIES**

# Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California)

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Willdan

## Overview

- Goals
  - Prove the viability of technologies
  - Accelerate the market adoption
- Requirements
  - Innovative and pre-commercial technology
  - Projects that are scalable and widely adoptable
  - Demonstration facility 100,000+ ft<sup>2</sup> and can achieve 20% kWh reduction through the integration and operation of emerging technologies
  - South Coast Air Quality Management District – existing client relationship with a need for new central plant





## Bundle 1: Central Plant

- Replace existing Chilled Water Plant with alternative refrigerant chillers
- Reduce ozone depleting potential
- Urgent need to replace cooling towers at end of useful life
- Challenges with corrosion in existing system
- Optimize efficiency

York Chillers  
with  
R-1233zd  
refrigerant



Aquatherm  
piping





Stainless steel cooling tower

Sheathed Aquatherm piping

Underground pipe run

Not shown – new water treatment system, variable speed pumping, new separators, new central plant controls.

## **Bundle 1: Central Plant Retrofit Details**

- Full retrofit – all piping, cooling towers, pumps, chillers
- Optimizing for both energy and lower GWP
- 24/7 facility
- No temporary chiller!

## Bundle 1: Central Plant Lessons Learned

- Creativity is key
  - Structural engineering
  - Temporary chilling
- Never underestimate the potential for the last 10% of a project to take as long as the rest of the project...
  - Refrigerant monitoring
  - Controls







Pillars from previous cooling tower foundation were poured around to further distribute weight. Prevented removal of existing foundation and saved project 3 additional weeks of construction.

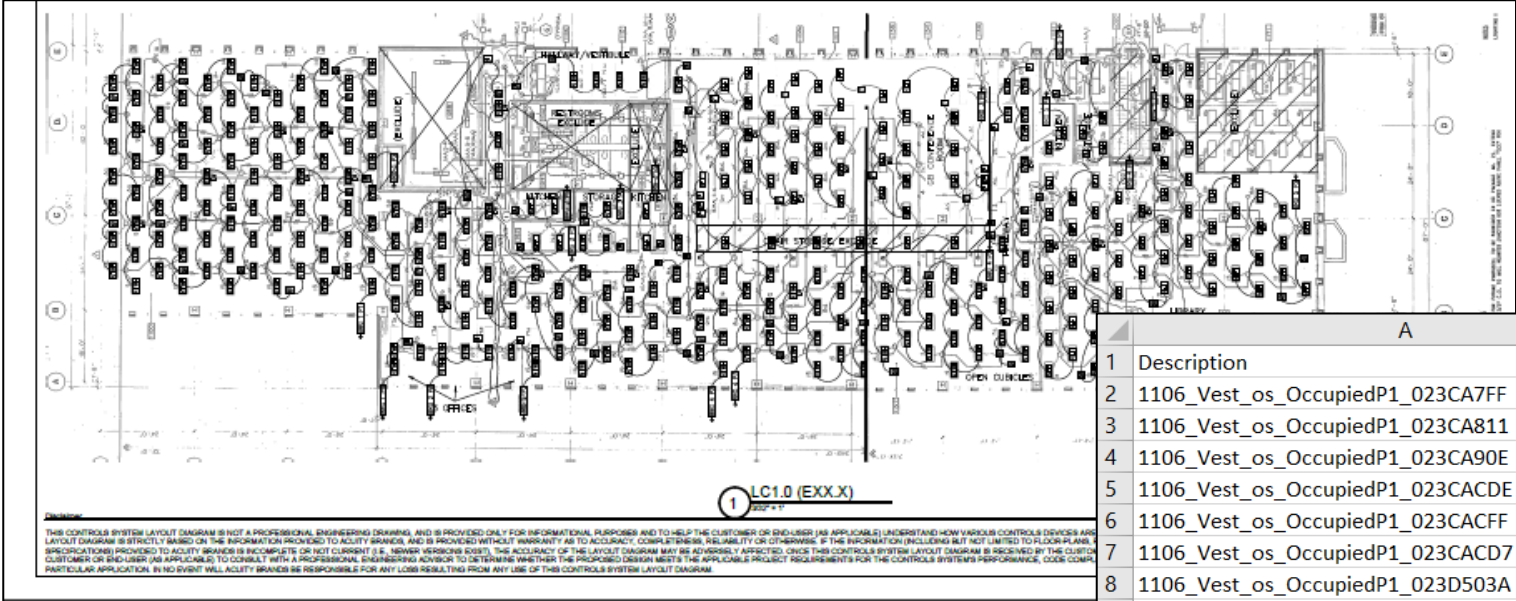


## Bundle 2: Office and Exterior Space

- Existing pneumatic control system in Office Space and fluorescent fixtures
- How can we think about Office Space controls more holistically?





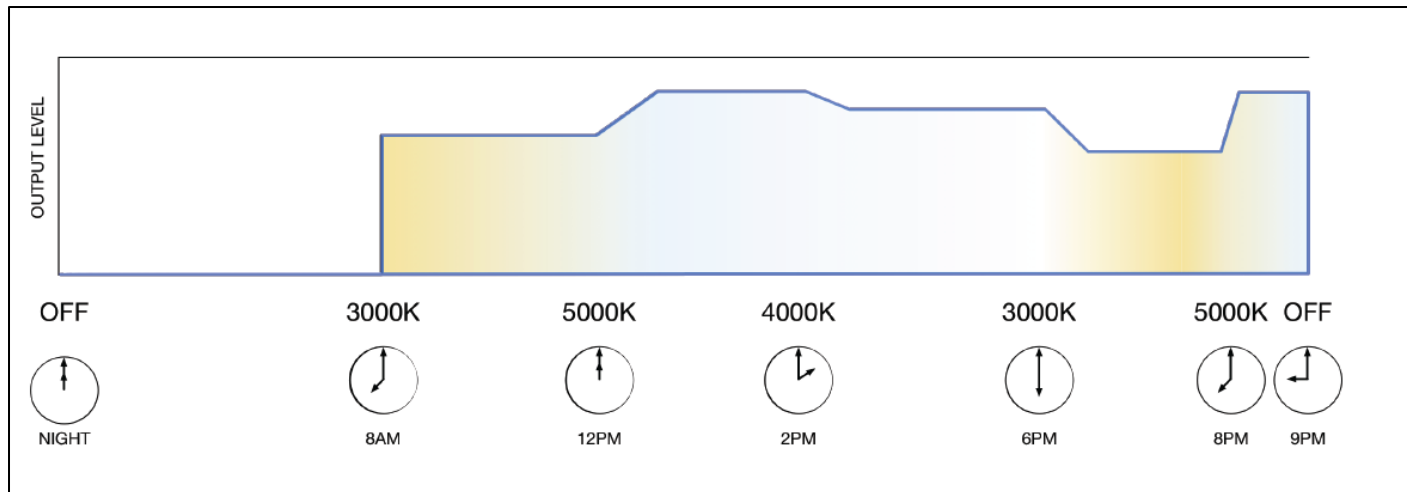


Occupancy sensors that serve VAVs AND lighting.

	A	B	C	D	E
1	Description	Point Type	Instance #	Serial #	VAV Zone
2	1106_Vest_os_OccupiedP1_023CA7FF	binary-input	121321	023CA7FF	702
3	1106_Vest_os_OccupiedP1_023CA811	binary-input	121221	023CA811	702
4	1106_Vest_os_OccupiedP1_023CA90E	binary-input	121121	023CA90E	702
5	1106_Vest_os_OccupiedP1_023CACDE	binary-input	120921	023CACDE	702
6	1106_Vest_os_OccupiedP1_023CACFF	binary-input	120721	023CACFF	702
7	1106_Vest_os_OccupiedP1_023CADC7	binary-input	121021	023CADC7	703
8	1106_Vest_os_OccupiedP1_023D503A	binary-input	120521	023D503A	703
9	1137_Kitchen_wsos_OccupiedP1_0233C19D	binary-input	167921	0233C19D	709
10	1134_Kitchen_wsos_OccupiedP1_0233C1A8	binary-input	122821	0233C1A8	709
11	1140_vest_os_OccupiedP1_023CA97F	binary-input	153921	023CA97F	709
12	1107_Open_os_OccupiedP1_023CAC24	binary-input	153321	023CAC24	709
13	1144_Lobby_os_OccupiedP1_0229E6F8	binary-input	130621	0229E6F8	711
14	1144_Lobby_os_OccupiedP1_023BD094	binary-input	130121	023BD094	711
15	1144_Lobby_os_OccupiedP1_023BD1F7	binary-input	130021	023BD1F7	711
16	1144_Lobby_os_OccupiedP1_023BD222	binary-input	129921	023BD222	711
17	1143_Library_os_OccupiedP1_023BCCDB	binary-input	126821	023BCCDB	715
18	1143_Library_os_OccupiedP1_023BD23E	binary-input	124921	023BD23E	715
19	1143_Library_os_OccupiedP1_023BD240	binary-input	124721	023BD240	715
20	1143_Library_os_OccupiedP1_023BCCE4	binary-input	126721	023BCCE4	716
21	1143_Library_os_OccupiedP1_023BD0A8	binary-input	126121	023BD0A8	716
22	1143_Library_os_OccupiedP1_0229E6F0	binary-input	124121	0229E6F0	717
23	1143_Library_os_OccupiedP1_0230B9E6	binary-input	129721	0230B9E6	717
24	1143_Library_os_OccupiedP1_0232A37E	binary-input	123421	0232A37E	717
25	1143_Library_os_OccupiedP1_023BCCED	binary-input	126521	023BCCED	717

### Circadian Rhythm and overall dimming control:

1. Scene 1 (Twilight) = 75%, 10fc at desk level
2. Scene 2 (Low) = 85%; 15fc at desk level
3. Scene 3 (Medium) = 95%; 25fc at desk level
4. Scene 4 (High) = 100% output; 30fc at desk level





## Bundle 2: Office and Exterior Space

### Lessons Learned

- Draft Scopes of Work + Sequences were provided to several vendors for feedback & ROM pricing, response was less than comprehensive.
  - One company bid on the HVAC work and the lighting controls but not the luminaire replacements themselves. One company did not want to integrate into existing Siemens BMS. One vendor chose not to bid.
- This is typical of the challenge of doing combined lighting and HVAC projects – they are treated as two different disciplines.
- Integrated Acuity nLight into Siemens in order to accomplish our goal of an integrated, advanced system.

## Bundle 2: Office and Exterior Space Lessons Learned

- Initial scope of work!
- Listen to occupants
- Productivity/Happiness improvement...?
- Occupancy is triggered by security throughout the day

## Bundle 3: Laboratory

- Existing laboratory was constant volume exhaust
- Duct modifications had occurred over time
- Upgraded to variable airflow with fast acting, low pressure drop Accutrol valves
- Fume hood sash controls and alarms

New  
transition  
pieces to  
existing  
Constant Air  
Volume (CAV)  
boxes



Accutrol  
Accuvalve

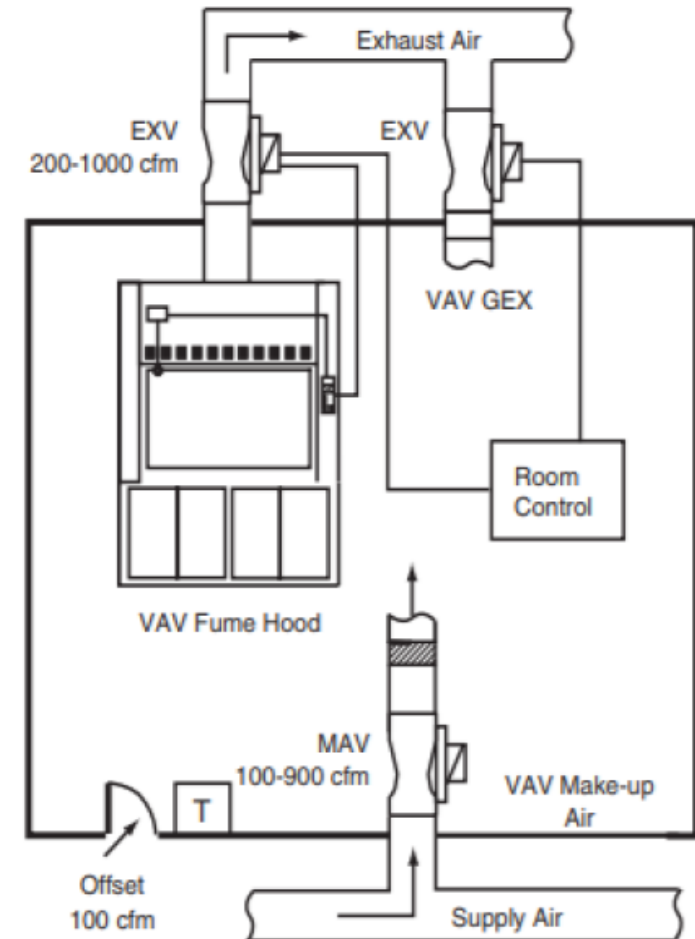


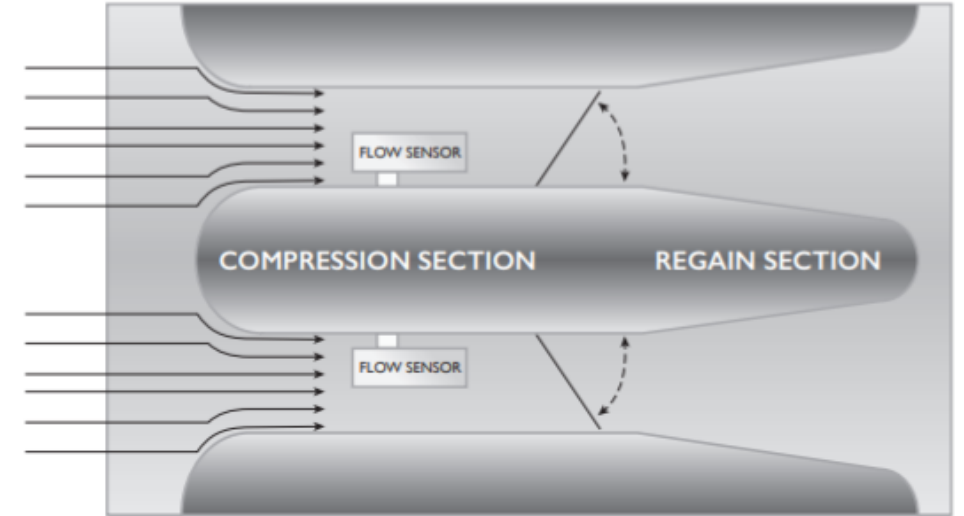




## Bundle 3: Laboratory Retrofit Details

- Replaced 100 valves
  - Removed previously installed Phoenix valves
- Replaced 40 CAVs
- Added new laboratory controls
- Brought overall lab ACH from 12 to 4





## Bundle 3: Laboratory Lessons Learned

- Coordination with laboratory staff!
  - Construction disruption to critical environments requires careful planning
- Ask about future retrofits – not too early to set up for success
- Lab retrofits are not new... but there is still a significant barrier to implementation due to:
  - Disruption
  - ROI (8-10 years)
- Staff comfort – noise and temperature control

## Replicability and Scalability

- In California, there are over 80,000 buildings that can deploy one, two, or all three of the “bundles”.
- If 2% of California’s existing commercial building market adopts one or any combination of these the technology bundles, potential energy savings will be:
  - more than 136,000 megawatt hours (MWh) annually
  - \$21 million in energy cost savings to facility owners
  - 44,900 metric tons of CO2 reduction
  - in order to accomplish our goal of an integrated, advanced system.

## Overall Results

EEM	Electric Usage Savings (kWh)	Electric Demand (kW)	Gas Use (therms)
New CHW Plant	819,522 (10%)	237	2
LED Lighting and HVAC Zone Controls	53,281 (8%)	8	-838
Lab Exhaust Upgrade	590,447 (1%)	38	45,945
<b>Totals</b>	<b>1,463,250 (19%)</b>	<b>237</b>	<b>45,109</b>

- Measurement and Verification still in progress, 1% short of goal!
- Opportunity for further reduction with conversion of HVAC controls to DDC in remainder of building
- Coordination is key
- One vendor opted out of the project... installing emerging technology does come with some uncertainty and risk



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