HVAC Retrofits

Sustainability Best Practices for HVAC Retrofits

Cal Poly State University, San Luis Obispo

Presented to the UC/CSU/CCC Sustainability Conference

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Presented by
Dennis K. Elliot, PE, CEM
Sustainability Manager

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HVAC Retrofits

- Cal Poly San Luis Obispo
- Founded 1901

  - Wide variety of HVAC equipment and systems
  - Began conversions to DDC control in 1984
  - Many older buildings are still constant volume and have DDC control at the air handler, but not at the zone level.
  - Buildings built since 1990 are VAV and have full DDC control down to the zone level.
  - DDC retrofits expensive, typically $1500 per point.

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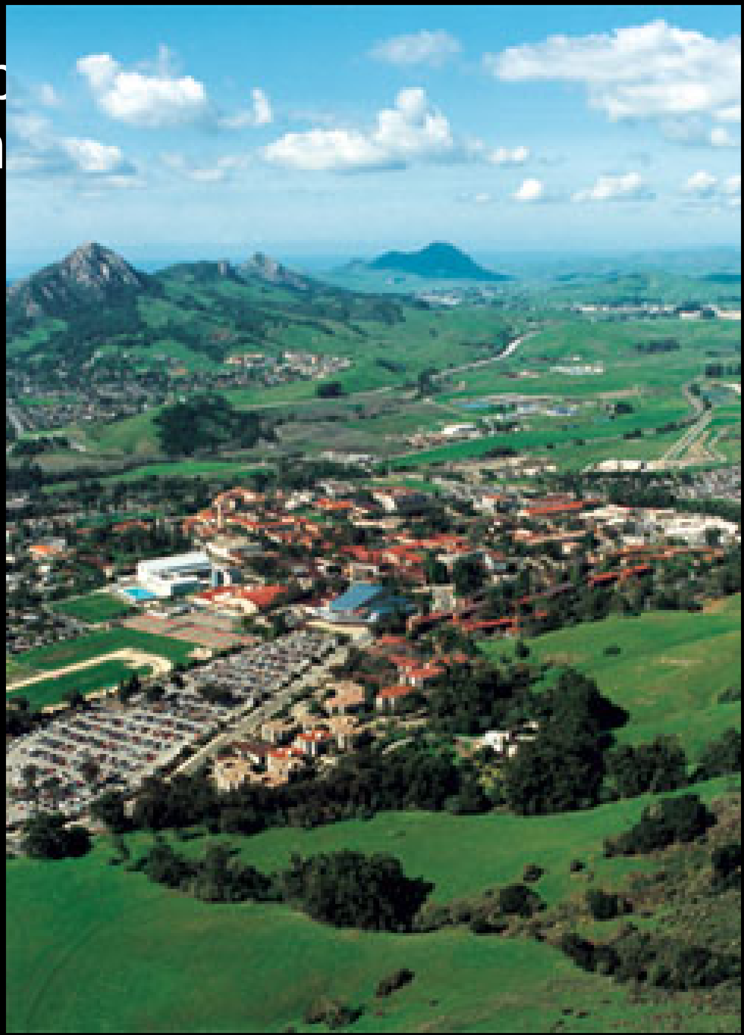
- Four technology demonstration p
  the 2008 Sustainability Conferen

- Partners:
  - Cal Poly
  - CIEE/PIER
  - Federspiel Controls
  - Architectural Energy Corp
  - Melink Corporation
  - CulinAire Systems
  - UC/CSU/CCC Partnership Program



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Constant Volume to VAV Retrofits

Problem:

- Need cost effective solution for VAV retrofits of constant volume systems.
- Must integrate into campus Siemens DDC System.
- Must preserve occupant comfort and minimum ventilation rates.
- Must minimize hazardous material abatement costs.

Solution:

- DART – Discharge Air Regulation Technique
- Federspiel Advanced Control System – Wireless VAV

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What is DART and how does it work?
DART - Discharge Air Regulation Technique

- Monitors all zone temperatures and compares them to an allowable range, i.e. CSU Executive Order 987 – 68 degrees heating, 78 degrees cooling.
- If all zones are within the range, fan runs at minimum speed.
- If zones are outside the range, fan speed is ramped up to provide adequate heating or cooling. Select 2nd or 3rd worst zone for control, rather than worst zone.
- When at low fan speeds, minimum OSA damper position is reset to provide adequate fresh air ventilation rates as per ASHRAE 62.1.
- Requires VFD's on supply and return fans.
- Uses existing building zone temperature controls.

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Federspiel Advanced Control System Components:

- Supervisory controller (microcomputer with integral web server)
- Wireless hub/gateway
- Wireless temperature sensors
- Wireless output modules for connection to VFD's or building DDC system

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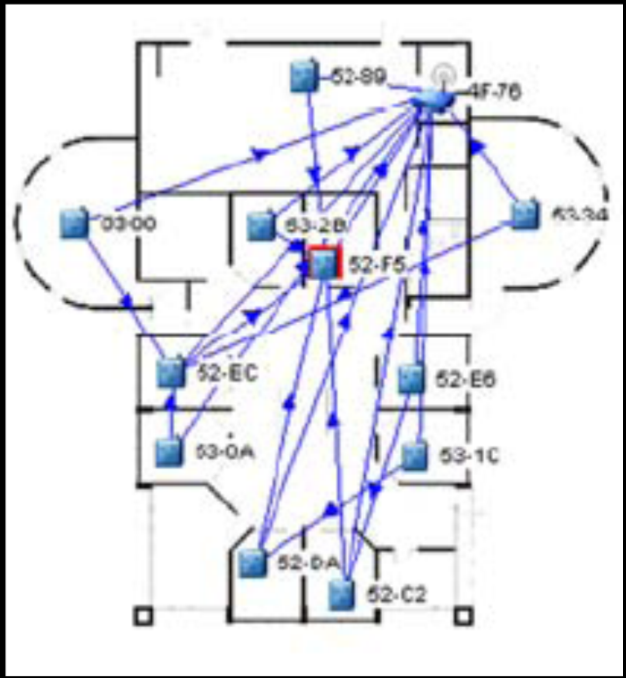
Wireless mesh network:

- All devices are surface mounted
- Minimal electrical work required
- No penetrations of structures or work in plenums/crawl spaces – avoids haz mat abatement!
- Network is self healing, has N+1 redundancy, and uses frequency hopping technology to maximize battery life – expected to be 4 to 8 years.
- Operates in 900 MHz band – will not interfere with WiFi



Integration/Interoperability

- Many open protocol options for integration with existing DDC systems.

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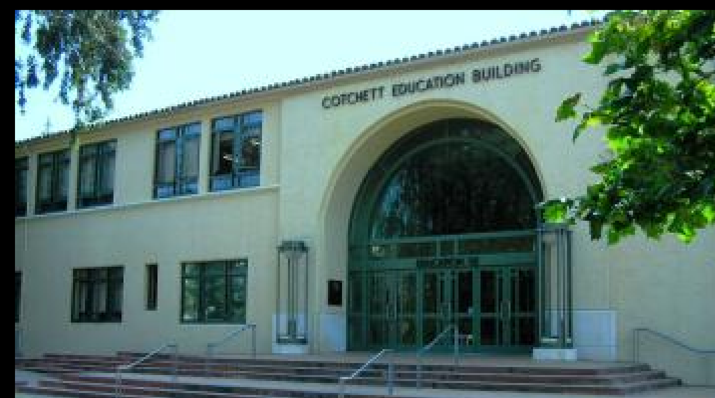
Cal Poly demonstration projects Implemented in three buildings:

- College of Science and Math
  Double duct CAV, heating only

- Education Building
  Double duct CAV, heating only



- Health Center
  Single duct CAV, heating and cooling, terminal reheat

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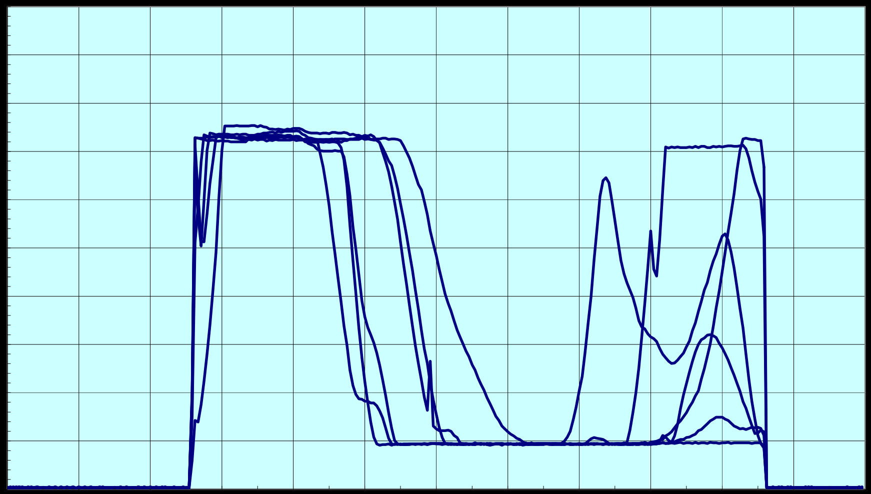
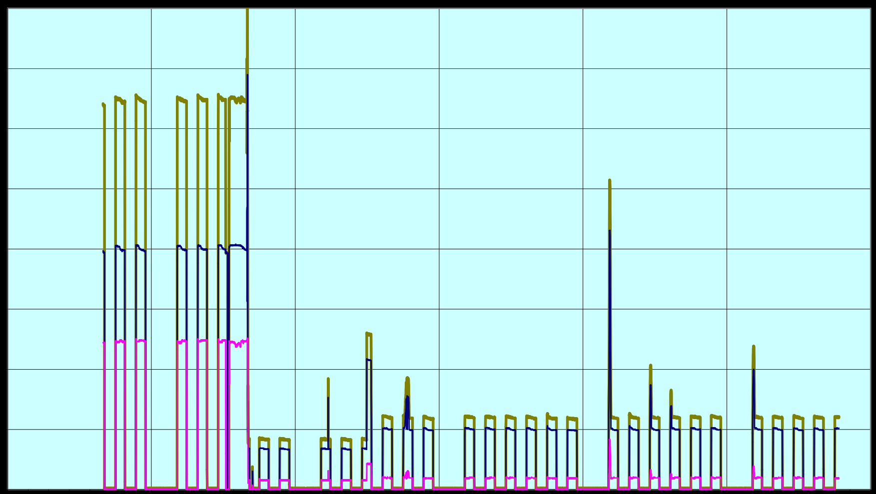
Results:

- Reduced fan energy by 52-72%
- Reduced heating energy by 24-31%
- No hot/cold complaints
- No air quality complaints
- Cost approximately $60K (less than half the cost of full DDC)
- Energy savings $15K/yr
- Payback 3 years after incentives

Daily Fan Demand Profile:



Fan Energy Before/After:



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Lessons Learned:

- Before installing VFD's, replace motors with NEMA Premium Efficiency, inverter duty rated motors.
- Check grounding system in older buildings before installing VFD's.
- Consider options for integration with your DDC system, or can be installed as a standalone system.
- Involve O&M staff during installation, start up and commissioning to make use of training opportunity.
- Achieves about 80% of the energy savings of full DDC VAV controls, for half the cost.

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Kitchen Hood Demand Ventilation

Central Campus Dining Facility

Problem:

- Kitchen hoods run full speed from 6 am to midnight – 3 fans, 9 hp total
- Cooking activities are intermittent
- Fan energy and conditioned air are wasted

- Solution:

Kitchen Hood Demand Ventilation Controls

- Slow fans down when no cooking is taking place, ramp up to full speed only when needed

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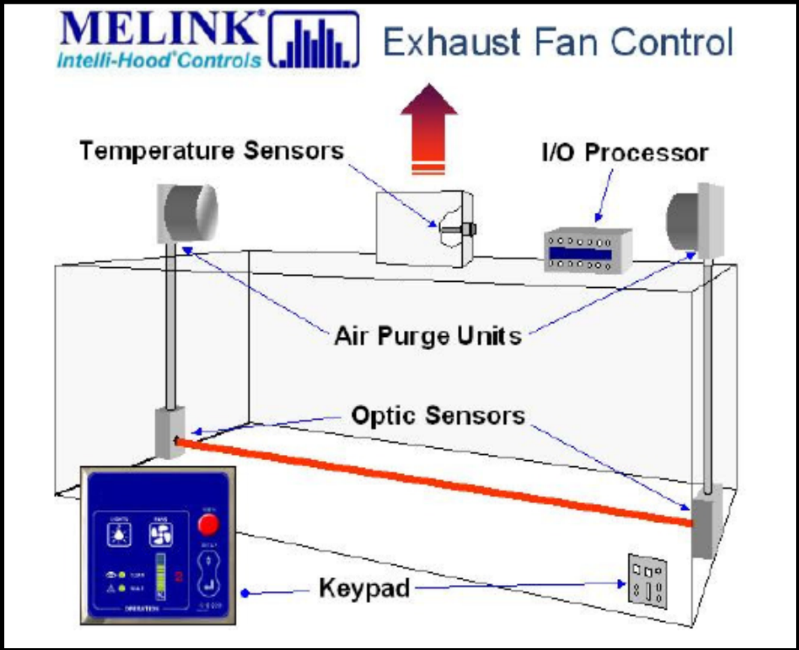
Melink Intelli-Hood Control System

- VFD's installed on hood exhaust fans
- Temperature sensors installed in each exhaust duct to detect heat
- Optical light beam across hood opening detects steam or smoke
- If exhaust temperatures rise, fan speed is increased
- If smoke or steam is detected, fans ramp up to 100% speed
- If no cooking is taking place, fans slow down to 50% speed



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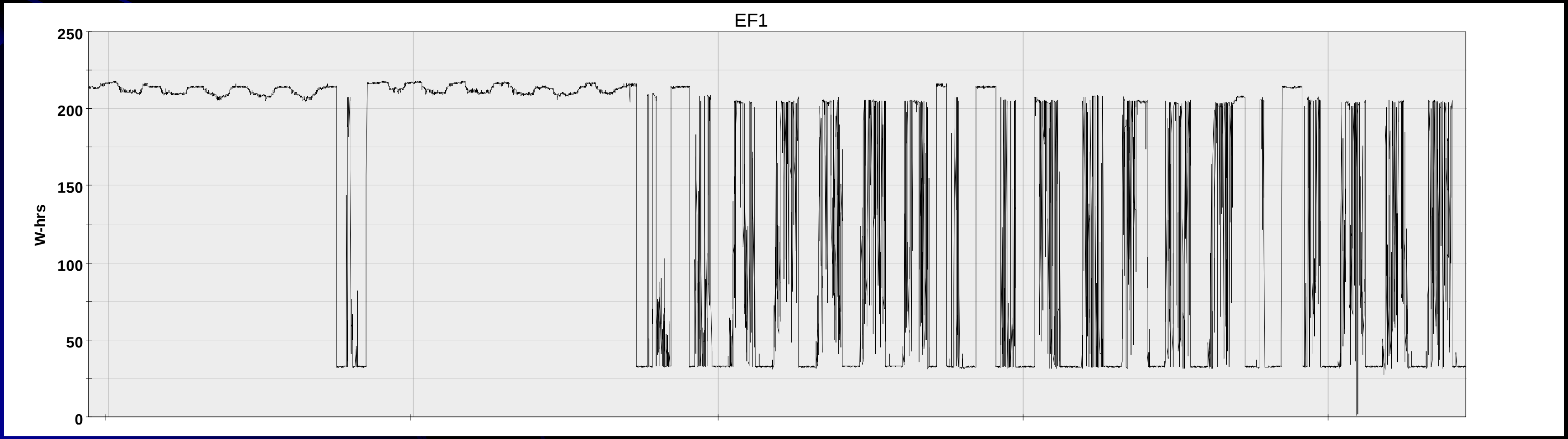
Kitchen Hood Demand Ventilation

Results:

- ➢Reduced fan energy by 54%
- ➢Reduced heating energy by 34%
- ➢Cost $52,700 (included replacement of 3 exhaust fans)
- ➢Energy savings $9,600/yr
- ➢4 yr payback after incentives



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Kitchen Hood Demand Ventilation

Lessons Learned

- Must involve and train kitchen staff to understand usage and monitor operation.
- Be sure to properly interface controls with existing fire suppression system.
- Melink control system is stand-alone, but consider remote monitoring from campus DDC system.

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Contacts:

Dennis Elliot, Sustainability Manager, Cal Poly, SLO

PIER Program

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