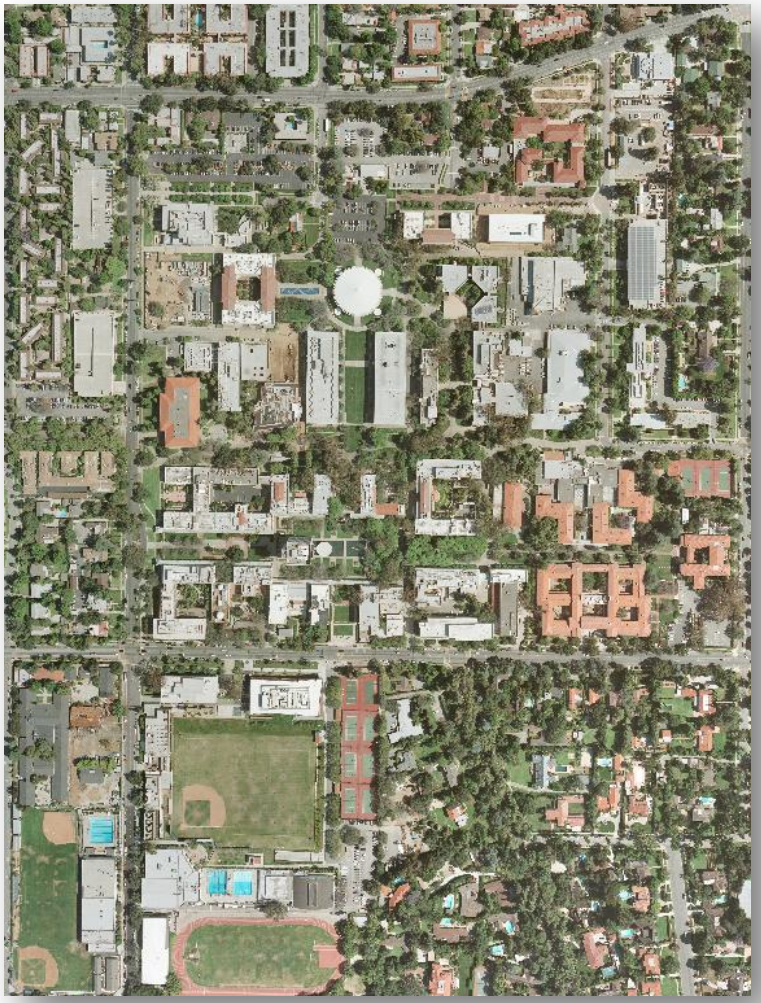
Campus Development Summit

Matthew Berbée – Caltech, Energy Manager

(April 3, 2012)

Caltech Overview

- Private research university in Pasadena, CA
- Campus population roughly 5,000
- 120+ GWH electricity annually
- 85% Generated onsite
- Energy Intensity ~285 MBTU/SF
  - Average UC Campus ~ 180 MBTU/SF
- $16M+ annual utility bill
- 4.2 Million SF of buildings
- 125 acres in urban setting



Green Revolving Funds

CECIP PROGRAM ANNUAL REPORT FY2011

April 2012

CALTECH JOINS THE BILLION DOLLAR GREEN CHALLENGE

In a collaborative effort with 32 other leading U.S. institutions, Caltech helped launch the Billion Dollar Green Challenge, an initiative to invest a cumulative total of one billion dollars to fund energy-efficiency upgrades on campuses across the country.

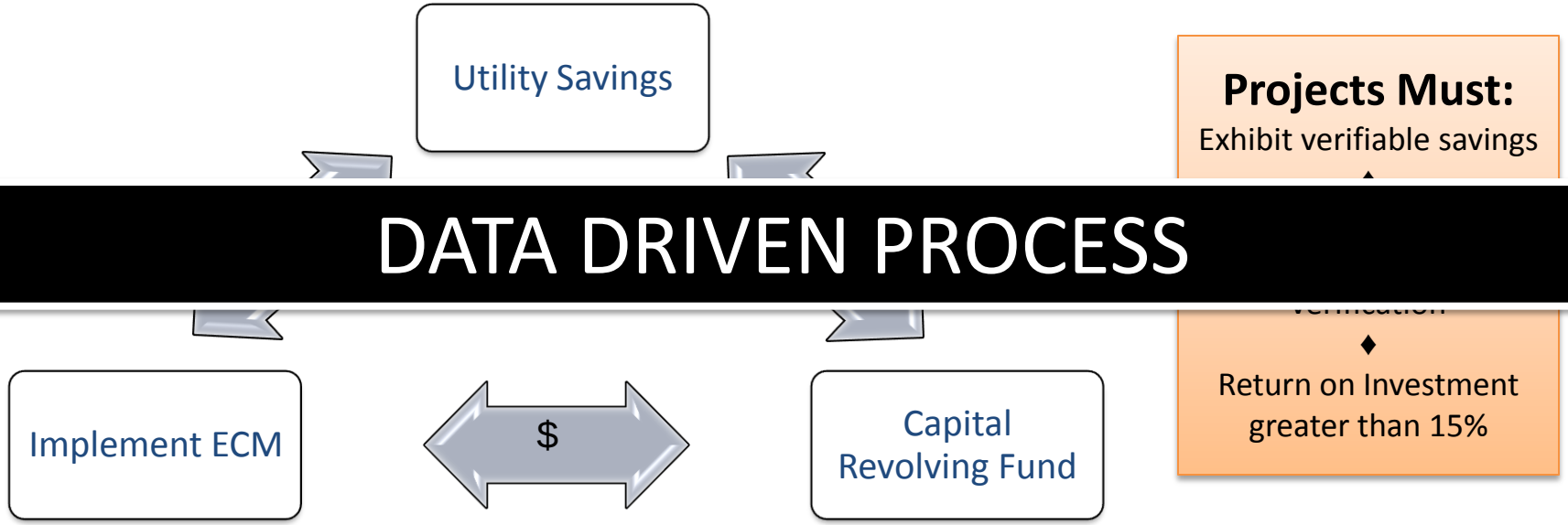
Caltech was the first institution to make the commitment to use a self-managed green revolving funds for sustainability improvements as part of the challenge. These profitable investments help create green jobs in campus communities while lowering operating costs on college and university campuses.

The Billion Dollar Green Challenge is transforming energy efficiency upgrades from perceived expenses to high-return investment opportunities.

Source: http://greenbillion.org

Caltech Energy Conservation Investment Program

Caltech Energy Conservation Investment Program (CECIP) is a capital revolving fund, financed by the Institute's endowment, used to finance energy conservation projects. The fund is then reimbursed from avoided utility costs that result from the implementation of the projects.

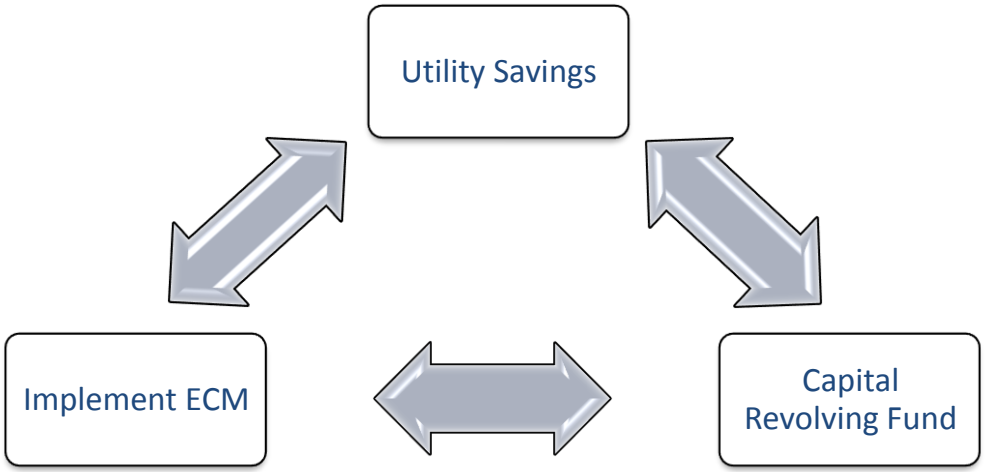


	FY09	FY10	FY11	FY12 (projected)
Energy Project Investment	$970K	$3.8M	$3.5M	$3.7M
Utility Rebates/Incentives	$350K	$500K	$600K	$600K
Reduced Utility Cost	$410K	$930K	$990K	$550K
Percent Annual Utility Cost	2%	6%	6%	4%

Questions to ask yourself and your integrator

- Are you looking to optimize your system (Save money)?
- Are you looking reduce reactive maintenance ?
- What is the application?
- Long term or mid-term solution?

Clear sense of bigger purpose



Projects

Three WPT Installations at Caltech

Laboratory

Office

Library

Pneumatic to Digital Building Control

Before

- Local control
- No data available for optimization

- Local control
- Data available for optimization
- Uses existing infrastructure

Lab Building

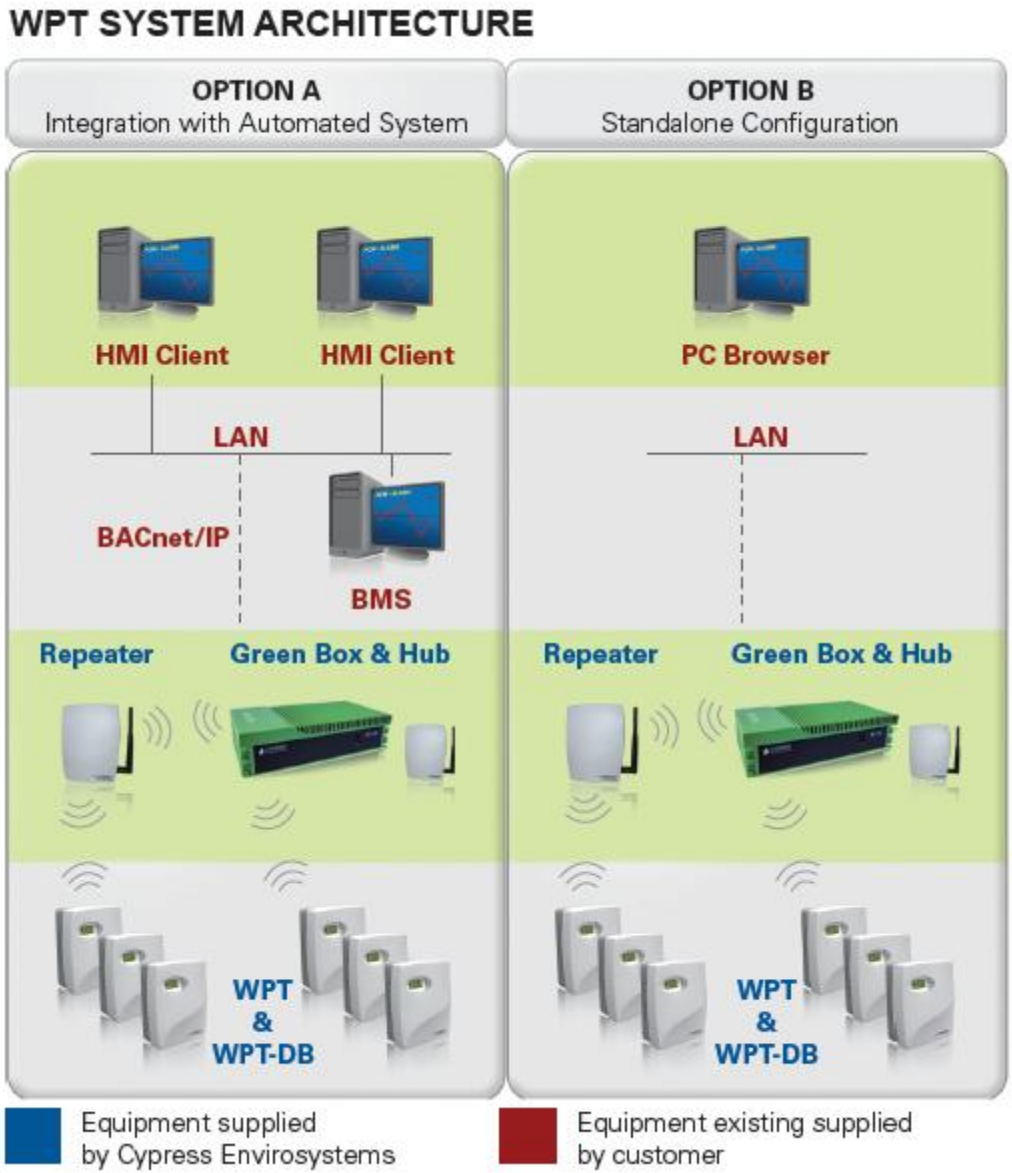
North Mudd- Built 1938
51K SQFT

Before

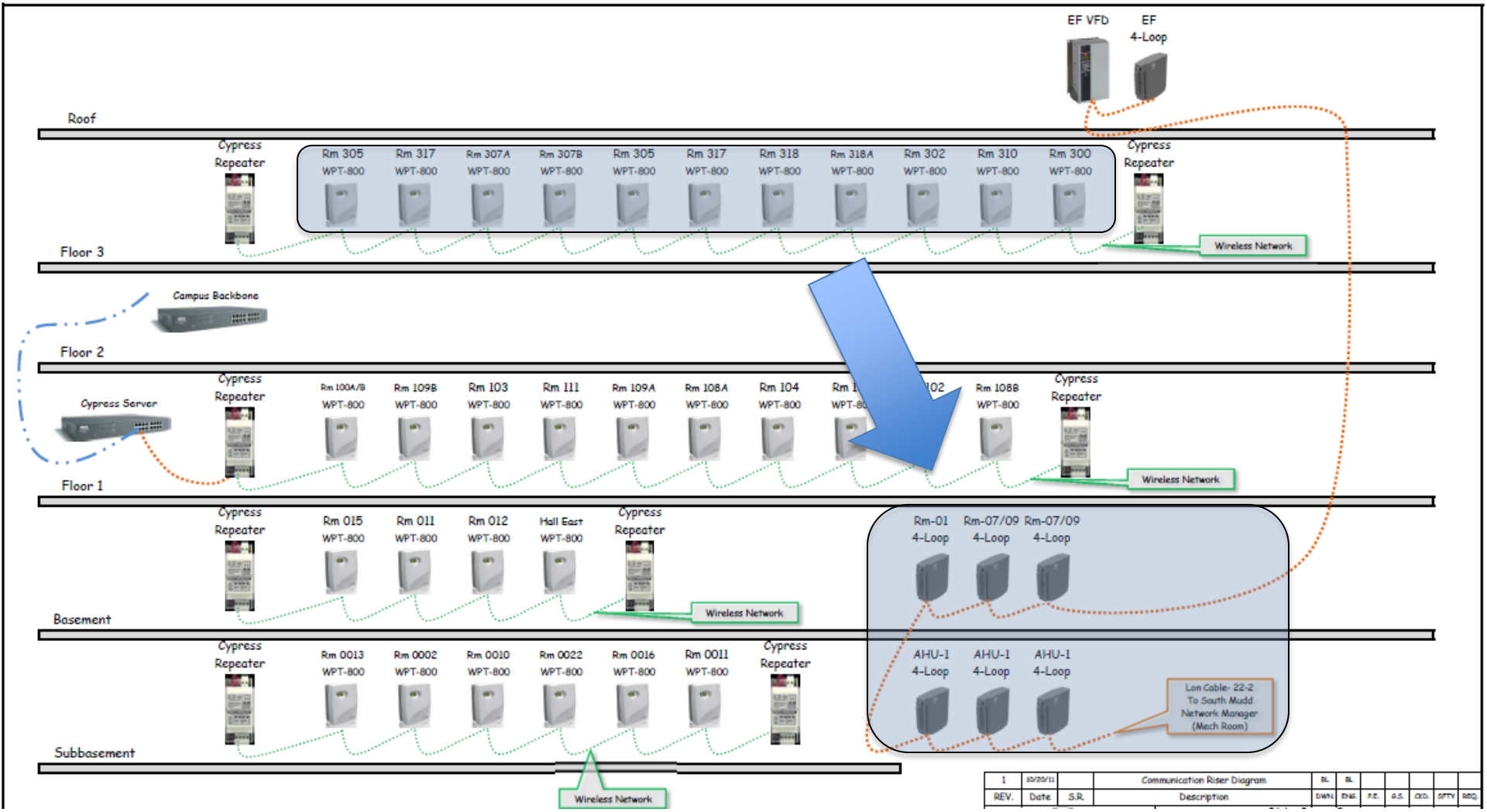
HVAC SYSTEM

- 3 Above Ground Floors
- 2 Basement Levels
- 51,000 Sqft
- 2 Constant volume supply fans (25,000 CFM ea)
- Variable speed exhaust fan
- 100% Out-Side-Air Bldg
  - single cooling coil
  - two down-stream steam coils
- HW Radiators
- HW Reheat-Zones
- Chilled Water Fan-coils

Conceptual System Architecture



Fully Integrated with building automation system



Device Commissioning & Building Retro-Commissioning

Before

CYPRESS ZONE COMMISSIONING- CALTECH- N. MUDD

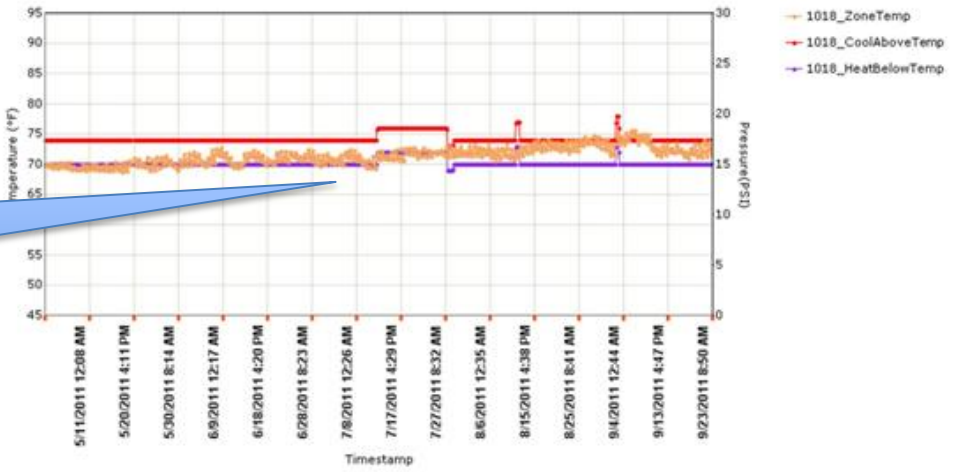
Thermostat Part #	WPT021008 Dead Band Wireless (Reverse Acting)
	108B
	018
Equipment Controlled	FAN COIL/CHW VALVE-HW Re-Heat
Condition of Valve	Operational-Valve Stroked Open & Closed
	FM
	108A & Heat is operational.
Repairs Made	None
Pending Repairs	None

Node ID 1018 — 1018 (Node IDs (1001,1002))

Start Date — End Date 9/23/2011 9:00 AM — Tooltip

Export — Pressure — Setpoint Temp — Cool above Temp — Heat below Temp

WPT Temperature,Pressure Graph



Fan coil operational. Reheat operational, no pending repairs.

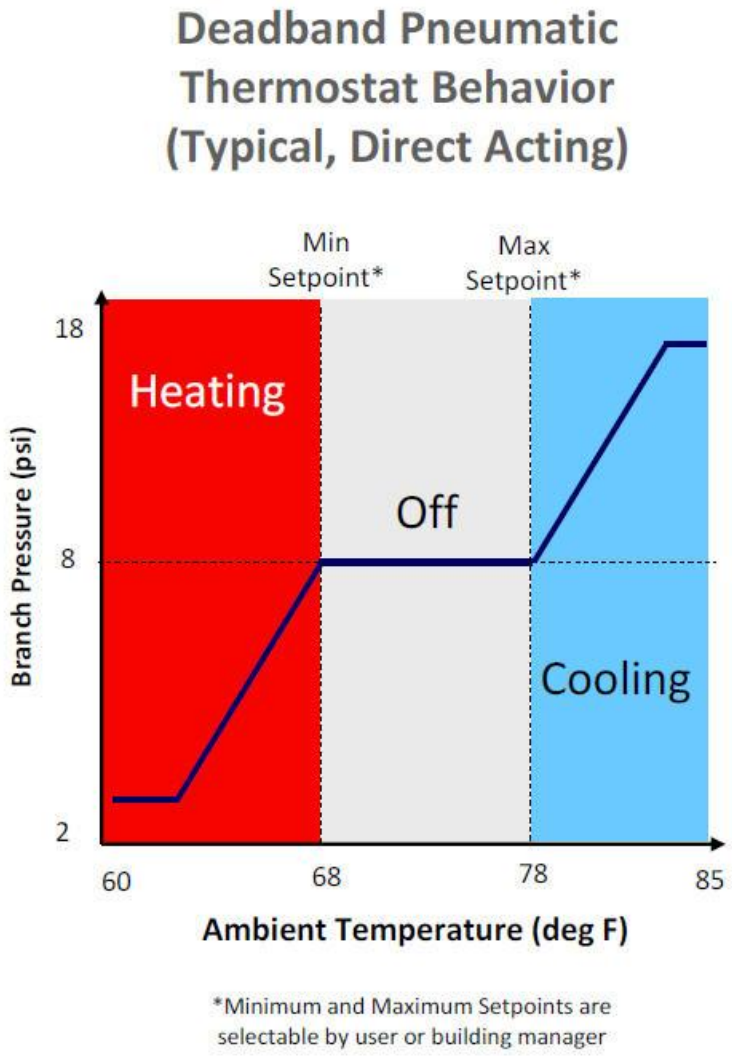
Link the DEVICE

To the Control DEVICE

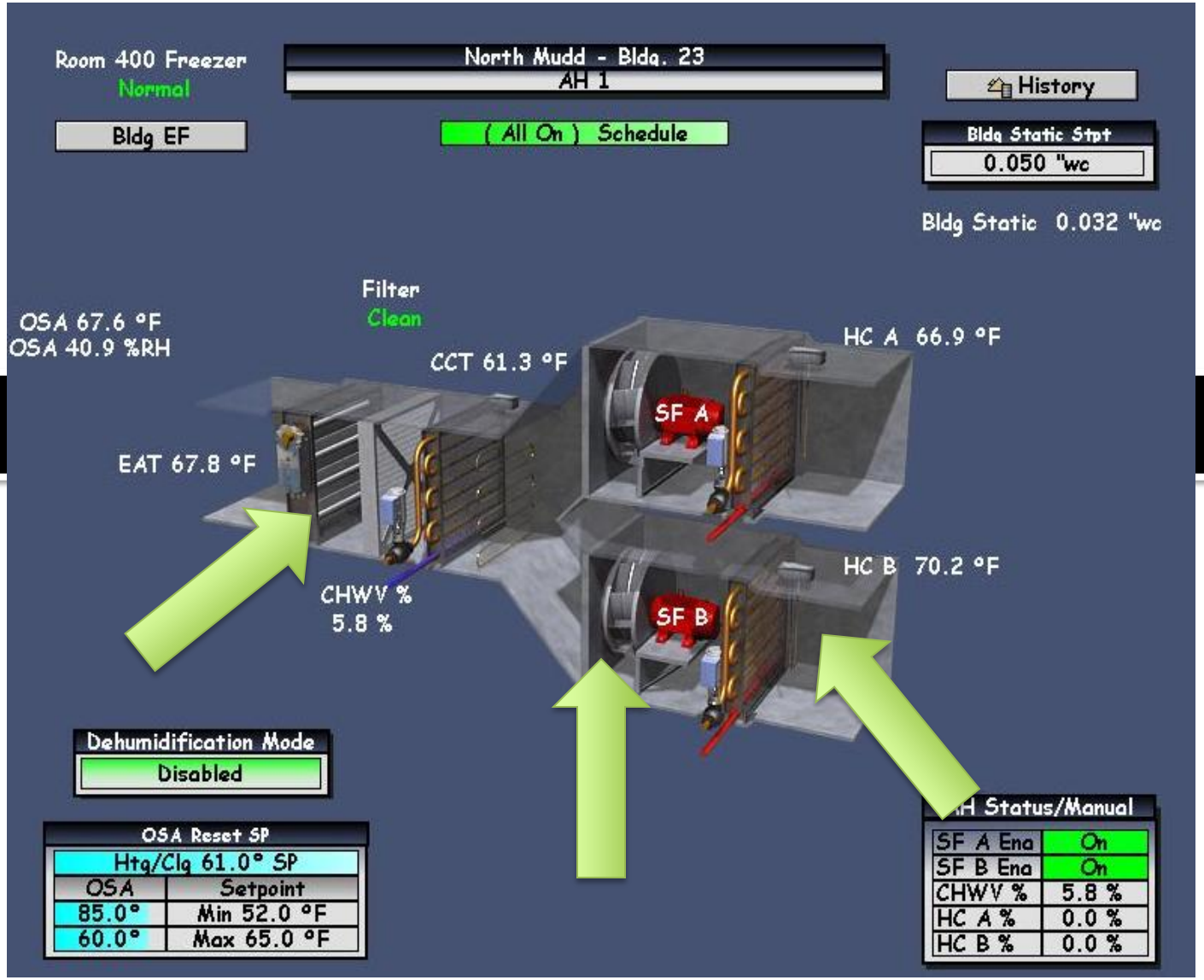
Prove Function

Codify for training and O/M

Feedback used to Optimize Air-Handling System



Feedback used to Optimize Air-Handling System



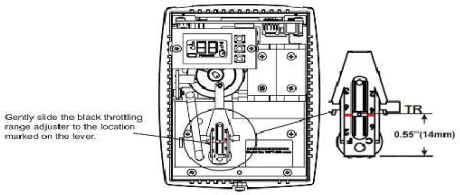
Training: The WPT is a modern interface to a legacy technology

Before

Wireless Pneumatic Thermostat (WPT)
Training Program

www.CypressEnvirosystems.com

Calibrating the WPT – Step 1

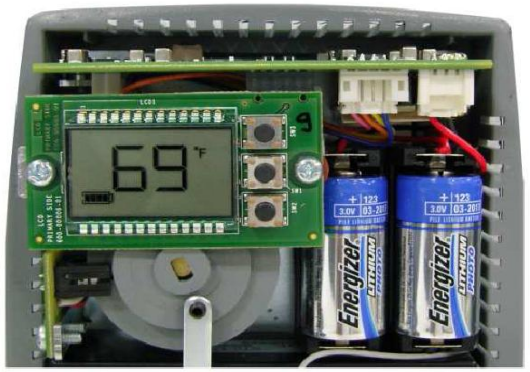


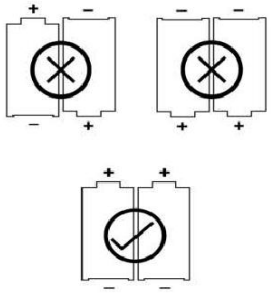
- Remove the front cover of WPT
- Make sure that the WPT is acclimatized to the ambient temperature
- Verify that the black throttling range adjuster is set to the location marked on the lever

Warning!

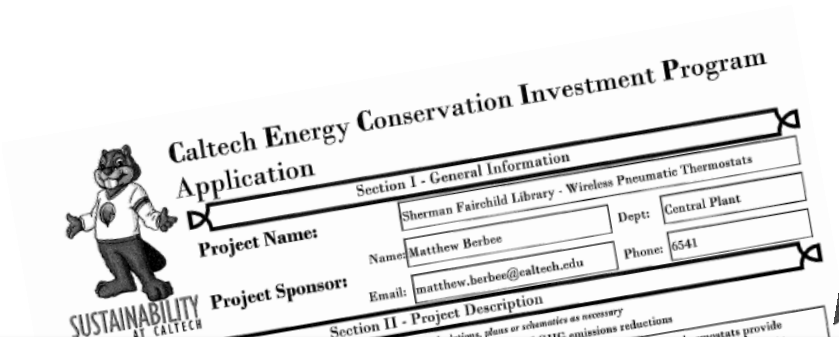
- WPT is factory adjusted for about 4°F throttling range
- It is highly recommended to avoid touching or adjusting the throttle range
- The bi-metallic strip can be damaged if enough care is not taken while moving the throttling range adjuster
- Use a gentle nudging motion on the throttling range adjuster, without exerting force on the bi-metal strip as this type of force will likely damage the bi-metallic strip

Changing Batteries in the WPT





Rebates: WPT is an emerging technology, rebates are substantial



Caltech Energy Conservation Investment Program Application

Section I - General Information

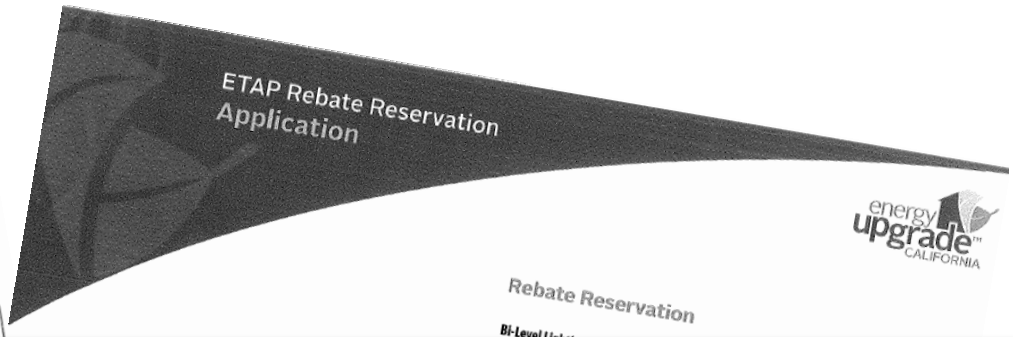
Project Name: Sherman Fairchild Library - Wireless Pneumatic Thermostats

Project Sponsor: Name: Matthew Berbee Dept: Central Plant

Email: matthew.berbee@caltech.edu Phone: 6541

Section II - Project Description

SUSTAINABILITY AT CALTECH

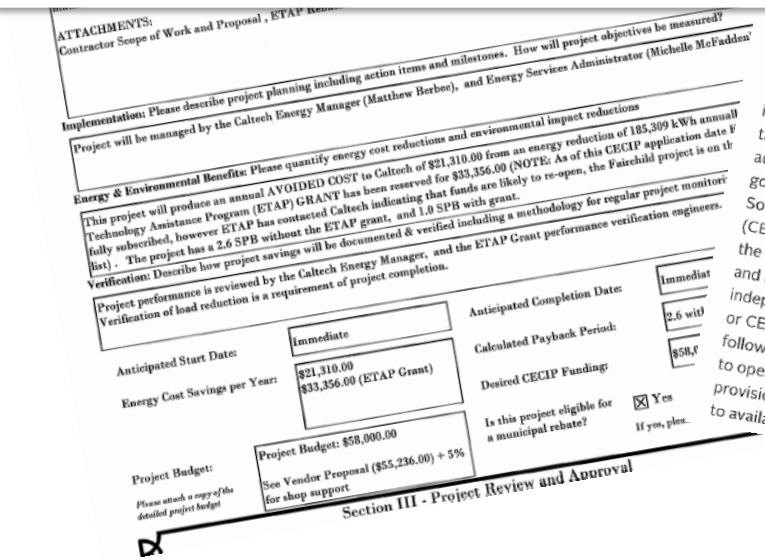


ETAP Rebate Reservation Application

energy upgrade CALIFORNIA

Rebate Reservation

$55K Project Cost / $33K Rebate / $21K Avoided Cost



ATTACHMENTS:

Contractor Scope of Work and Proposal , ETAP Rebate

Implementation: Please describe project planning including action items and milestones. How will project objectives be measured?

Project will be managed by the Caltech Energy Manager (Matthew Berbee), and Energy Services Administrator (Michelle McFadden)

Energy & Environmental Benefits: Please quantify energy cost reductions and environmental impact reductions

This project will produce an annual AVOIDED COST to Caltech of $21,310.00 from an energy reduction of 185,309 kWh annuall

Technology Assistance Program (ETAP) GRANT has been reserved for $33,356.00 (NOTE: As of this CECIP application date F

fully subscribed, however ETAP has contacted Caltech indicating that funds are likely to re-open, the Fairchild project is on th

list) . The project has a 2.6 SPB without the ETAP grant, and 1.0 SPB with grant.

Verification: Describe how project savings will be documented & verified including a methodology for regular project monitori

Project performance is reviewed by the Caltech Energy Manager, and the ETAP Grant performance verification engineers.

Verification of load reduction is a requirement of project completion.

Anticipated Start Date: Immediate

Anticipated Completion Date: Immediat

Energy Cost Savings per Year: $21,310.00 $33,356.00 (ETAP Grant)

Calculated Payback Period: 2.6 wit

Desired CECIP Funding: $58,0

Is this project eligible for a municipal rebate? ☒ Yes

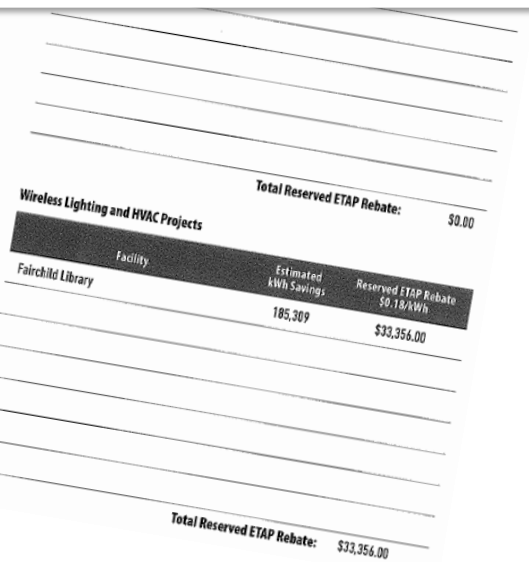
If yes, plea

Project Budget: Project Budget: $58,000.00

Please attach a copy of the detailed project budget

See Vendor Proposal ($55,236.00) + 5% for shop support

Section III - Project Review and Approval



ASSISTANCE PROGRAM

The Energy Technology Assistance Program (ETAP) is a statewide program that provides technical assistance and financial rebates to accelerate the uptake of advanced energy efficiency technologies in the local government market. ETAP is administered by Energy Solutions as part of the California Energy Commission's (CEC) Energy Upgrade California initiative. Funding for the program is provided by the American Recovery and Reinvestment Act of 2009 (ARRA). To provide an independent analysis of the impacts of ETAP, CEC staff or CEC subcontractor staff may conduct site visits following project implementation. ETAP is expected to operate from September 2010 – March 2012. The provision of ETAP services and rebates is subject to availability.

Total Reserved ETAP Rebate: $0.00

Wireless Lighting and HVAC Projects

Facility	Estimated kWh Savings	Reserved ETAP Rebate $0.18/kWh
Fairchild Library	185,309	$33,356.00

Total Reserved ETAP Rebate: $33,356.00

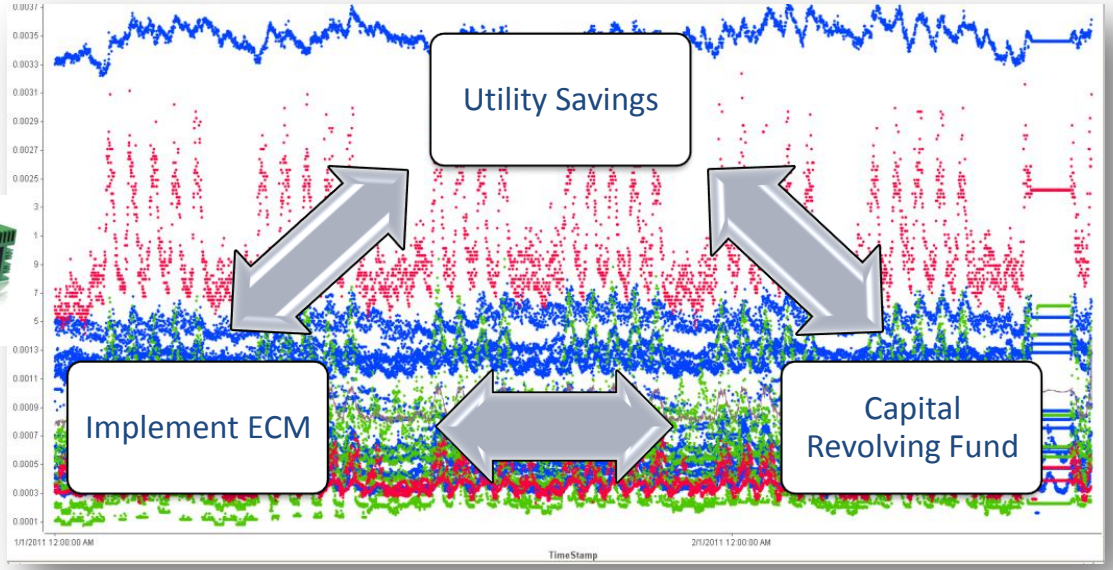
CALIFORNIA INSTITUTE OF TECHNOLOGY 1891

Active Energy Management

"Building energy usage creeps up 3% per year"
in a post-retrofit period.

California Energy Commission – Public Interest Energy Research Program, 2003

Put it all together with Active Energy Management



Summary / Questions

INTEGRATE

Matthew.Berbee@caltech.edu