CALTECH ENERGY CONSERVATION ENERGY INVESTMENT PROGRAM

CECIP

2015
CECIP has been reducing the Institute’s energy usage by ~2% annually. In FY15, Caltech consumed approximately 118 GWH of electricity. Without CECIP, Caltech would have consumed an additional 22 GWH over the past six years, as result of the addition of 146 fume hoods and a 3% increase in campus square footage.

CECIP FY15
- $2M invested
- $2M avoided utility costs
- 118 GWH electricity used
- 2% energy reduction from FY14

CECIP Gets Refinanced: CECIP vs CECIP 2

Within the first six years of the program, Caltech invested approximately $20 million, and acquired $3 million in rebates for CECIP, which resulted in $9 million in avoided utility costs.

In FY 15, Caltech opted to harvest the savings from CECIP, by paying the remaining CECIP loan.

Previously, CECIP 1 would have been paid back by 2018. With its cashflow restarted, CECIP 2 is expected to breakeven in 2022.

More information about CECIP: www.sustainability.caltech.edu/CECIP
### Project Highlights

**Diversifying Campus Energy Sources**

In collaboration with Bloom Energy, Caltech added an additional 1MW of fuel cells to campus. The Institute now generates **85 percent** of its own power via 3MW of fuel cells, 2MW of solar PV, a 10 MW gas turbine generator (GTG) and a 2.5 MW steam turbine generator (STG).

**Chilled Water (CHW) Loop Expansion**

The CHW loop expansion involves the addition of a 24” CHW connection to the southeast section of Caltech’s campus. Caltech produces CHW mainly from its Central Plant, and Satellite Plant. This addition will allow us shutdown the Satellite Plant, and lower CHW pumping energy.

**Lighting Upgrades**

With little upfront investment and attractive returns, lighting upgrades continue to be valued CECIP projects. Approximately **75%** of Caltech’s campus lighting has been upgraded to high-efficiency lamps and LEDs.

In FY15, Caltech also cemented lighting standards, which will be implemented for all CECIP projects moving forward. Additional advantages include a reduction in velocities, and undesired pressure drops within the pipes.

To leverage these benefits and achieve further energy and cost savings, Central Plant Optimization is scheduled as CECIP project for FY2016.
OPTIMIZING ENERGY MANAGEMENT TOOLS: INCREASING AUTOMATION

The strength of CECIP lies within its rigorous measurement and verification. In FY15, much of the focus of CECIP was spent optimizing its energy management tools.

METERING

Jorge Guerrero, Caltech plumber, records domestic water meter readings on an iPad. The data syncs automatically within Caltech’s Sharepoint. A temporary solution until all water meters are integrated into the BMS.

Before CECIP projects begin, baseline energy loads are established through data from chilled water (CHW), heating hot water (HHW), hot water (HW), steam, and power meters.

In FY15, Caltech Facilities began a campaign to integrate all of its power and domestic water meters into the BMS. Expected completion date of this project is FY16 for power meters and FY17 for water meters.

![Image](opt-ener-con.jpg)

**Above**

Caltech uses Tridium’s Niagara software to provide comprehensive control and monitoring of its facilities.

AUTOMATED DIAGNOSTICS: CONNECTED BUILDING COMMISSIONING

*Custom fault detection rules shown in the Skyspark graphic above can quickly identify equipment/zone failures across an entire building.*

As Caltech adds more complex buildings to campus, the need for more sophisticated controls and data analytics increases.

Caltech Facilities, in collaboration with its strategic business partners, is implementing automated whole building diagnostics using Skyspark software. This is an aggressive approach to combat potential energy losses that occur naturally through building drift, estimated at 3% per year in a post-retrofit period*.

Connected building commissioning (CBCx), otherwise known as smart commissioning, increases not only the speed at which operational risks and energy inefficiencies can be identified but also allows operations staff to make better informed decisions by presenting a complete profile of a building’s performance. This results in more energy savings and also reduced labor as less time is spent in the field searching for the problem. In FY15, CBCx was implemented within a major laboratory renovation at the Gates-Thomas building (57,000 sq ft), as well as at the Beckman Institute, where 27 labs were retrofitted from analog to digital controls, with approximately 111 data points per lab.

*California energy cession, Public Interest Energy Program 2003
FUTURE OUTLOOK: 2016

ASSET MANAGEMENT

In 2016, Caltech will implement a new Integrated Work Management System (IWMS) which will optimize the management of infrastructure assets.

Part of the process includes the marriage of automated diagnostics and building information modeling (BIM) with asset management. This affords Caltech Facilities a powerful tool to seamlessly integrate thousands of data points per building into one source. The resulting multiple benefits including faster access to more accurate, high-quality data, more streamlined operational procedures, and cost savings.

ENERGY RESOURCE PLAN

Caltech Facilities is faced with the challenge of obtaining ~120GWH of electricity from affordable, reliable and clean sources of energy for Caltech’s evolving operations.

As a result, Caltech Facilities assembled a multidisciplinary team of faculty, staff, and external advisors to develop an Energy Resource Plan. The goal is to model future demand and campus growth in order to determine the appropriate technologies and energy investments for both short-term and long-term solutions.

2016 PROJECTS

Connected Building Commissioning (CBCx) - campus deployment

Central Plant Optimization

Smart Metering

Data Center Upgrades

Conversion of Pneumatic Controls Systems to Direct Digital Controls

Chilled Water Pipeline Extension & Optimization

Exterior Campus Lighting Upgrades

AWARDS & PRESENTATIONS 2015

AWARDS

AEE International Award, 2015

(pictured to the right, Caltech Energy Manager, Thomas Shaffer, accepts the award at the 2015 AEE International Conference in Orlando, FL)

PRESENTATIONS

Construction Owners Association of America (COAA):

Regional Meeting
National Meeting
Summer Workshop
Fall Owners Conference

Intermountain Power Association

California Commissioning Collaborative