BEST PRACTICES 2010

CSU Chico Yolo Hall Monitoring-Based Commissioning

Retro-commissioning measures improved building energy performance at Yolo Hall by focusing primarily on HVAC control strategies, resulting in an annual reduction of 23 percent in natural gas consumption, and a 13 percent reduction in total building electricity use.

Award Category

Monitoring-Based Commissioning

Opportunities Identified from MBCx

Re-calibrated air handler unit sensors

Updated EMCS programming for outside air dampers

Modulated outside air dampers based on VFD speed

Updated programming for economizer display readings

Size

71,000 ft^2

Cost

$15,700 (in-house fees)

$37,100 (consultant fees)

Annual Energy Savings

Electricity (excluding space cooling): 11%
59 mWh

Space heating: 23%
7800 therms

Space cooling: 2%
2150 ton-hours

Completion Date

December 2009

Sometimes improving the energy efficiency of newer buildings primarily requires fine tuning and reprogramming building operational software. Such was the case with a retro-commissioning effort that was undertaken at Yolo Hall at California State University, Chico. Monitoring-based commissioning (MBCx) utilizes permanent utility metering and computing analytics to identify ways to reduce energy use in new and existing buildings. MBCx-E is an "express" program based on an approach which utilizes a few months' worth of data to understand a building's performance record, rather than a full year of data frequently used in retro-commissioning projects.

The selection process for the MBCx-E program began with a solicitation issued to multiple CSU campuses. Six campuses responded and 30 buildings were selected. Yolo Hall was selected because it had not been upgraded or fully commissioned, it had a relatively new energy management control system (EMCS), and preliminary evidence suggested that its energy performance could be improved.

Compared to older buildings, Yolo's controls would be relatively easy to change in order to create a more energy-efficient building.

While MBCx-E can include commissioning of lighting and other systems, the focus at Yolo Hall was primarily HVAC equipment — air handling units, VAV terminal units, and exhaust fans. The primary objectives of the MBCx-E project at Yolo Hall were to:

- Obtain cost-effective energy savings from implementing low-cost measures, and optimizing how the building's energy systems are operated and maintained.
- Identify previously unrecognized inefficiencies in the building and plant system operations.
- Enhance building system performance and occupant comfort.
- Measure and document energy savings from resulting operational improvements.
- Facilitate ongoing recommissioning of systems to ensure persistence of savings.

Yolo Hall. Photo: CSU Chico.

In 2009 CSU retained EnerNOC to conduct the metering, telemetry, and computing analytics portion of the MBCx-E effort. EnerNOC's commissioning process is a multi-tier investigation that starts with a planning phase and leads to three levels of testing: (1) pre-functional testing; (2) functional testing; and (3) verification. The primary objective of the pre-functional testing is to verify and correct the operation of the systems controlled by the EMCS, and to ensure that the system is measuring and relaying the information correctly. The purpose of the functional testing is to confirm that sequences of operation are properly implemented and achieving the results of the design intent.

Measuring ongoing performance is a key aspect of MBCx-E. While the EMCS was available for monitoring performance at Yolo Hall prior to the MBCx-E process, the system's monitoring capability could be improved. Prior to the project, the EMCS trended electricity, chilled water, and hot water at various time intervals; a separate system measured lighting performance. Chilled water and hot

Contacts

Wesley R. Morgan
562.951.4121
wmorgan@calstate.edu

Project Team

Campus Project Manager: Neil Nunn

Campus Controls Specialist: Dan Hayden

Retro-commissioning Lead: Prakash Rapolu
EnerNOC

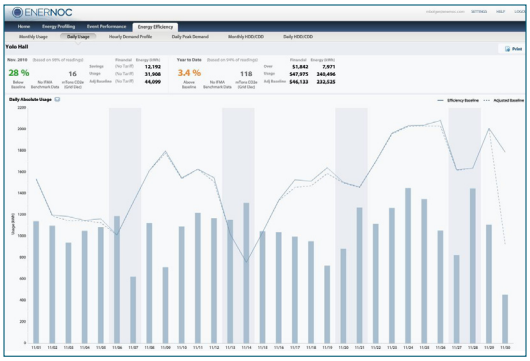
More Information

http://www.uccsuiouee.org/mbc.html

http://cx.lbl.gov/MBCx.html

water data were collected using permanent flow meters, hydronic supply, and return temperature sensors. After the MBCx-E process, the trended utility and equipment information was made available on the EMCS and also in real-time on EnerNOC's SiteSMART platform.

During the MBCx-E process, the SiteSMART program collected and analyzed data. For an initial period of two months and then continuously thereafter, utility data was collected and put into an energy simulation model to create a building performance baseline, corrected for weather and occupancy. EnerNOC provided monthly summary reports which they reviewed with Yolo controls staff. These building "scorecards" included comparisons of utility performance relative to the pre-MBCx baseline, and also future equipment retrofit opportunities.



View of SiteSMART dashboard showing 28 percent reduction from baseline. Image: EnerNOC.

Facilities staff continues to use Yolo Hall's original EMCS, however meter data is now continuously fed to the EnerNOC SiteSMART platform and can be viewed in a dashboard display. Instead of CSU staff spending precious time studying detailed information on a daily basis, a commissioning agent and campus staff can use it on an annual, quarterly or as-needed basis to identify necessary adjustments, continuously fine-tuning the building and ensuring persistence of energy savings. This approach is cost effective and keeps the building operating in a highly energy-efficient manner, a combination that is important in today's resource-challenged era.

Retro-commissioning control sequences is a highly cost-effective method to capture significant energy reductions.

As previously noted, re-programming building operational software was a primary focus of the MBCx-E program. One programming fix was changing the system status to "unoccupied" instead of "occupied" during early morning start-up. "Through reprogramming the control sequences, fan horsepower and ventilation requirements for VAV boxes were reduced for approximately an hour before occupancy. This minor adjustment, when considered on a cumulative annual basis, led to cost savings that are significant.

Energy savings were primarily related to HVAC, specifically a 23 percent reduction in natural gas consumption, and a 13 percent reduction in total electricity (including electricity consumed at the central plant to produce chilled water). This amounts to an operational cost savings of $17,000 per year for CSU Chico. The project also leveraged over $27,000 in utility incentives from PG&E.

LESSONS LEARNED

Prakash Rapolu of EnerNOC notes the importance of close collaboration between facilities maintenance staff and EnerNOC. For example, both entities identified and tracked issues during the MBCx-E process, and recorded them on a "findings log" compiled by the project team, to document energy savings options. EnerNOC project members referred to this log when they provided recommendations for EMCS programming changes, which were then implemented by campus staff.

Best Practices case studies are coordinated by the Green Building Research Center, at the University of California, Berkeley.

The Best Practices Competition showcases successful projects on UC and CSU campuses to assist campuses in achieving energy efficiency and sustainability goals. Funding for *Best Practices* is provided by the UC/CSU/IOU Energy Efficiency Partnership.