



### Award Category

Monitoring-Based Commissioning

### Opportunities

#### Identified with MBCx

Pressure-independent chilled water valves

Supply air temperature reset sequence

Programming to prevent simultaneous heating and cooling

Replaced leaking reheat valves

Repairs to optimize economizer operation

### Size

122,845 ft<sup>2</sup>

### Annual Energy and Cost Savings

Electricity: 172 MWh

Chilled water: 11,000 MMBtu

Hot water: 12,700 MMBtu

\$221,000

### Cost

EnerNOC fee \$133,800

Campus labor and subcontractor \$541,200

Incentive \$379,400

### Completion Date

2012

# MBCx at UC San Diego Clinical Teaching Facility

A thorough monitoring-based commissioning (MBCx) program reduced energy use in a multi-purpose teaching and research facility by 33 percent, leading to annual savings of over \$200,000. Corrective actions included correcting BMS overrides and repair and replacement of faulty equipment.

Housing a wide variety of laboratories, classrooms, and offices, the Clinical Teaching Facility (CTF) at the University of California, San Diego (UCSD) is part of the acclaimed healthcare complex at the Hillcrest Medical Center. The building is comprised of three separate wings with four stories above grade, connected by exterior corridors. Built in 1978, and renovated in 1996, the building serves a complex set of research and teaching needs, with 14 air-handling units, 53 fume hoods, and 26 exhaust fans. With such intensive equipment demands, the building had an annual energy bill of \$670,000 before commissioning. In recent years the operation of the building was not optimal, with frequent hot and cold complaints as an indicator of problems.



The Clinical Teaching Facility at Hillcrest Medical Center consists of three wings connected by open-air corridors. Image: UCSD

Operators of medical buildings are naturally wary of any changes to building controls, given the critical nature of temperature and airflow control in those environments, says Anna Levitt, UCSD's assistant campus energy manager. It requires an extremely conscientious and knowledgeable team to implement changes that will save both energy and adhere to strict safety and research requirements. While the CTF does not house patient

care functions, it is managed by UCSD's Medical Center, and was seen as a good way to introduce medical operations staff to monitoring-based commissioning.

In 2011, facilities staff at the CTF initiated an MBCx project with support from the UC/CSU/IOU Partnership Program. This was the first time a building at the Hillcrest Medical Center has taken advantage of the program, and it was hoped that a successful outcome would be useful for encouraging further implementation of the MBCx process at other medical center buildings.

### Prior to commissioning, building operations staff lacked granular energy performance data. New sub-meters alert operators of increases in energy use, and are improving diagnostics.

The entire medical center had been equipped with only one electricity meter, with no metering for chilled and hot water, a situation that prevented operators from accurately monitoring and controlling buildings. As part of the MBCx project, additional meters were added, including three electricity meters, three chilled water BTU meters, and two hot water BTU meters. These meters were tied into the existing energy data management system that monitors energy use across campus.

The MBCx investigations found that the chilled water loop pressure from the central plant had been increased to serve needs in another Hillcrest Medical Center building. This increase in pressure caused "leaking-by" in chilled water valves at the CTF, causing frequent simultaneous heating and cooling. The investigation also found system overrides to the building management system (BMS) that were leading to excessive energy use, such as fixed supply air temperatures, regardless of zone heating and cooling demands. Also, all of the economizer dampers had been fixed fully open,

# BEST PRACTICES

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## Project Team

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## More Information

<https://rmp.ucsd.edu/fdc/sustainability/index.html>

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

increasing cooling energy consumption during the summer and heating energy during the winter.

The commissioning team reset the supply air temperature at the CTF to a range from 55 °F to 65 °F based on actual heating and cooling loads. Numerous energy saving changes were made to the sequences of operations, including resetting the hot water differential pressure based on heating load, and resetting the heating hot water supply temperature based on the number of zones requiring heat. To ensure that economizer operation is

included operator training, and the development of an Operations and Maintenance Plan, that provided a process for monitoring and continuous commissioning.

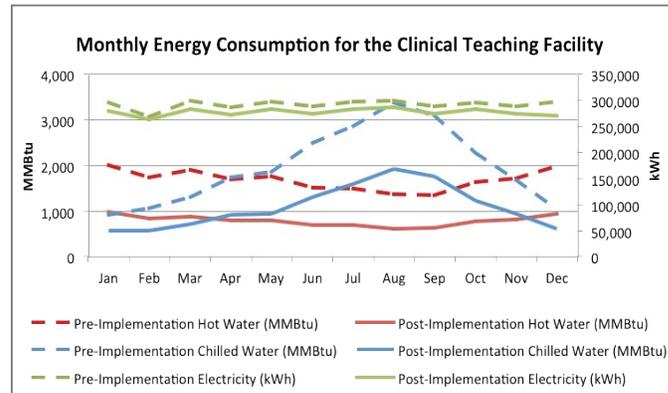
**Changes at the central plant affect all buildings on campus. A commissioning agent working closely with the central plant staff can provide new and better ways to handle future problems.**

The MBCx project at the Clinical Teaching Facility has achieved savings of \$221,000 per year, equivalent to a 33 percent savings. The simple payback is three years, or 1.5 years including the utility incentives.

## LESSONS LEARNED

A significant lesson was learned from documenting the unforeseen issues that resulted from changes at the central plant. Increasing pressures to serve one building on caused a significant waste of energy at other buildings.

An additional lesson learned is the importance of “buy-in” from the central plant staff, says Tavis Werts, the EnerNOC project engineer. EnerNOC worked very closely with the central plant staff to ensure that they were involved with the decision-making process. This collaboration ensured that the central plant staff understood and agreed with changes made to the system, such as new sequence of operations and early leak detection procedures. This coordination will ensure that the central plant staff will work to maintain the savings achieved by the MBCx project at the building level. This process also helped to demonstrate the value of the MBCx process to the staff, and hopefully will encourage adopting the process at other Hillcrest Medical Center facilities.



Annual energy consumption during pre- and post-commissioning periods. Image: EnerNOC.

appropriate for a given outdoor air temperature, EnerNOC repaired and replaced wiring from the controller to the outside air damper actuator. Programming new sequences of operations to better coordinate HVAC equipment (fans, pumps, and valves) is a laborious undertaking, however the work represents a significant contribution on EnerNOC’s part, and yields substantial and persistent energy cost savings.

The MBCx process and the documented findings have given the campus facility staff numerous insights into the operation of the CTF’s systems, and have improved the operators’ monitoring capabilities. The final phase

*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.

