BEST PRACTICES 2009

UC San Francisco, Mount Zion Research Center MBCx Project

Monitoring Based Commissioning (MBCx) reduced energy use at the Mount Zion Research Center by approximately 35%, bringing it in line with the energy use of UCSF's other lab facilities.

Award Category

Best HVAC Retrofit

Green Features

Variable speed drives and airflow measuring stations to reduce airflow rates

Permanant metering and monitoring equipment

Annual Energy Savings

Estimated annual energy savings: 1,917 mWh, 100,494 therms

Estimated annual energy cost savings: $344 thousand

Size

109,000 ft^2

Cost

$700 thousand

Completion Date

November 2008

The Monitoring Based Commissioning (MBCx) Program funded through the UC/CSU/IOU Partnership helps existing buildings to save energy and improve building performance through retro-commissioning and monitoring. The Mount Zion Research Center at UCSF was a prime candidate for the Partnership MBCx program. This 110,000-square-foot lab facility had the highest energy intensity, at 530 kBtu/sf, of any building in the UCSF system. Mount Zion operations staff also had no method of measuring whole-building electricity and natural gas consumption, heating hot water, chilled water, or process steam production and efficiency.

UCSF Mount Zion Research Center. Photo: Michael Sweeney, Arup

In fall of 2006 UCSF hired Arup to carry out site investigations and spot metering to identify opportunities to decrease energy use. Arup analyzed existing operating conditions and compared their findings to simulations of the building created using Trace 700 software. The analysis revealed that the airflow rates to the north and south towers almost always exceeded that required to meet peak cooling and heating loads. In addition, the building's zone reheat coils were nearly always in a state of heating to prevent overcooling while maintaining comfortable room temperatures.

Arup identified excessive airflow rates in relation to load conditions as the primary opportunity to decrease energy consumption in a cost effective manner.

The typical Mount Zion laboratory space had a constant airflow rate of 24 air changes per hour (ACH), substantially higher than that required to meet heating and cooling loads. This airflow rate was also nearly four times the university's minimum standard of 6 ACH and the NFPA's code-mandated rate of 6 ACH for laboratories with fume hoods. Arup proposed cutting the airflow rate to 12 ACH for north-facing lab spaces and to 15 ACH for south-facing lab spaces (higher solar gains in south-facing spaces merited increased air flow). Furthermore, Arup identified the opportunity to scale back the airflow to 8 ACH at night. Implementing this strategy reduced the daytime supply air volume by approximately 25% and the nighttime supply air by just over 40%.

The major energy saving opportunities for MBCx were issued in a report by Arup in early 2007. The UCSF team, including Sukhi Sandhu, now Director of Engineering and Utilities for the UCSF Medical Center, and project manager Patrick McGee, then worked to secure funding for the project. The UC/CSU/IOU Partnership provided incentives of $.24 per kWh and $1.00 per therm of energy saved, for a total incentive of approximately

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Team

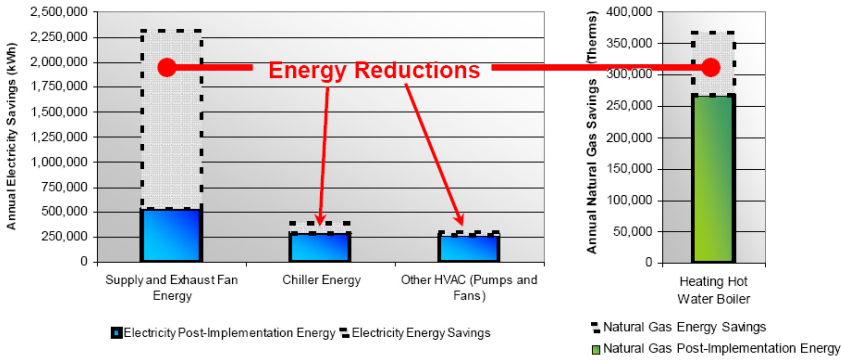
Mechanical Engineering/Cx Agent: Arup

Controls Contractor: Johnson Controls

Test and Balance Contractor: RS Analysis

Energy Data Metering: KW Engineering

$500,000. The university invested an additional $200,000. With an overall cost of about $700,000 and annual savings of $340,000, the MBCx results in an impressive simple payback of under 2 years.



Energy savings at UCSF Mount Zion as a result of MBCx. Image: Arup

In the summer of 2007, Arup was hired to implement the project. To reduce airflow, the team installed eight variable speed drives along with airflow measuring stations to modulate between daytime and nighttime modes. Although the reduction of airflow was the primary energy saving strategy, poor air balancing was also contributing to unnecessary energy consumption. While most zones were being provided with too much cooling, several zones had insufficient airflow and cooling. Therefore, the project team rebalanced the air distribution and decreased airflow overall by approximately 27%. Furthermore, energy consumption was reduced by resetting the temperature from 72°F to 68°F in less intensely occupied spaces such as offices and corridors, saving energy by decreasing the amount of reheat to maintain the zone temperature setting. Monitoring equipment was also updated to verify chilled water, hot water, and steam production and efficiency. New metering equipment was provided, and new reporting capabilities were added to building operation systems to allow operations staff to monitor energy usage trends. The MBCx project was completed in November 2008 and energy use at Mount Zion is now comparable with that at other UCSF labs. Mount Zion Research Center's annual energy consumption was reduced by 16,882 million Btus, a 35% reduction in energy use, resulting from a combination of electric savings of approximately 2,000 mWh and natural gas savings of over 100,000 therms.

LESSONS LEARNED

Michael Sweeney, Associate Principal at Arup, states that a good commissioning study begins with carefully analyzing existing loads and site conditions to identify promising strategies for decreasing energy use. He notes that commissioning teams must think creatively, and consider multiple approaches in order to identify solutions that will be most cost effective for achieving the most substantial energy savings. He also advises that long term energy reductions require permanent metering and monitoring.

Best Practices is written and produced 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.