

**Award Category**

HVAC Retrofit

System Features

Variable frequency drives

Central control system

Occupied/unoccupied and night setback modes

Reduced air change rate

Electrical and thermal metering

Annual Energy Savings

180,000 kWh

13,000 therms

\$29,600

Size55,235 ft²**Cost**

\$150,000

Completion Date

March 2006

University of California, San Diego Cognitive Science HVAC Retrofit

Laboratory space in the Cognitive Science building has been incrementally converted into offices over the last thirty years. The change in space utilization has reduced the building's ventilation requirements and allowed UC San Diego to perform energy-efficiency upgrades on the entire air delivery system.

Built in 1976, the Cognitive Science building at UC San Diego served as a research laboratory for the first Department of Cognitive Science in the world. When UCSD's Facilities Management began a deferred maintenance project to replace the building's worn air handling units (AHU), staff discovered that significant changes in space utilization had occurred since it was first occupied. These changes made the building an ideal candidate for sweeping energy-efficiency upgrades to the entire air delivery system.

The Cognitive Science building was originally constructed with several wet laboratories and contained twelve fume hoods with dedicated exhaust fans. As time passed the labs were incrementally converted into offices and a computer resource center. In fact, staff discovered during design review that the Department of Cognitive Science had moved out completely, and a new humanities tenant had moved in.

One of the most energy-intensive pieces of equipment in a wet lab is the fume hood. A typical laboratory uses roughly five times more energy per unit area than a typical office building, which can be largely attributed to fume hoods.

Major renovations had been performed to accommodate the new department, however much of the remnants of the original labs remained. Cubicles and office furniture had replaced lab benches but not all of the fume hoods had been removed. Staff found some hoods still turned on and sucking in air, and others that were blocked off and forgotten.

Office space has lower ventilation requirements than laboratories which reduces its energy-intensity. At the time, UCSD required 15-20 air changes per hour for labs and only 4-6 changes per hour for offices. The remodeled space in the Cognitive Science build-

ing presented Facilities Management with substantial opportunities to upgrade the old system, lower the air volumes, and reap large energy savings. The original deferred maintenance plan was abandoned, and a new project was launched to bring the HVAC system in line with the building's true energy requirements.



HVAC upgrades have cut the Cognitive Science building's energy use in half. Photo: John Dillio.

UCSD installed electrical metering prior to the retrofit to gather baseline data for the building's energy consumption. Thermal metering was more complicated, however, because the Cognitive Science building shared a high temperature water pipeline with another facility. The campus had to re-route the pipes and segregate the two buildings before metering could be installed, which left less time to collect reliable baseline data.

Obtaining energy consumption data was necessary to quantify the impact of the upgrades on the building's energy performance. The metering system continues to provide real-time data to Facilities Management, enabling staff to maintain a record of consumption, identify problems more easily, and analyze the effectiveness of conservation measures.

After a six-month period of data collection, the campus installed variable air volume boxes at the zone level on the existing 100% outside-air

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More Information

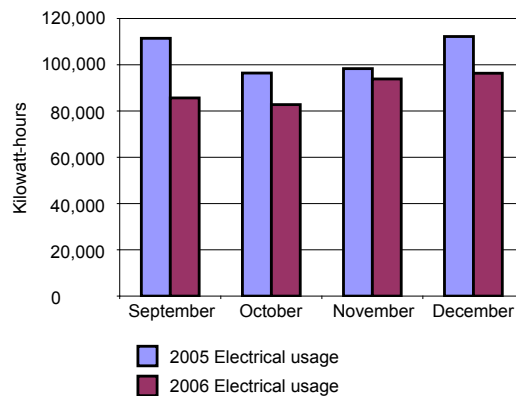
Fume hoods used at
UCSD: [blink.ucsd.edu/
Blink/External/Topics/
Policy/0,1162,13398,
00.html](http://blink.ucsd.edu/Blink/External/Topics/Policy/0,1162,13398,00.html)

Current laboratory
ventilation and safety
standards at UCSD:
[blink.ucsd.edu/Blink/
External/Topics/Policy/
0,1162,13531,00.html](http://blink.ucsd.edu/Blink/External/Topics/Policy/0,1162,13531,00.html)

Room temperature
settings at UCSD:
[blink.ucsd.edu/Blink/
External/Topics/Policy/
0,1162,16614,00.html](http://blink.ucsd.edu/Blink/External/Topics/Policy/0,1162,16614,00.html)

constant-volume HVAC system. The two 25,000 cfm AHUs serving the building were removed and a single 30,000 cfm AHU was installed. All twelve fume hoods and their dedicated exhaust fans were decommissioned and removed, and the remaining four fans were replaced.

In addition to these changes, variable frequency drives were installed on all return and supply fans. The fans are now controlled by a central control system from Johnson Controls. The thermostat settings are reprogrammed to permit a wider range of temperatures which will reduce fan run time. The HVAC system is programmed for occupied mode during working hours Monday through Friday, and unoccupied mode on nights and weekends. A night setback lowers the static pressure setpoint on the AHU and lowers the setpoint for the building's medium temperature water system.



Comparison of metered electricity use: Metering data collected for the Cognitive Science building shows the effect of the retrofit on electricity consumption.

The upgrades performed on the Cognitive Science building have cut its overall energy use by roughly 50 percent. This translates into nearly \$30,000 in annual cost-savings. In addition to increasing the building's operating efficiency, the retrofit has improved the quality

of the indoor environment. The building is now quieter and less drafty. Occupants also enjoy a higher level of thermal comfort since the building is operating under campus temperature settings designed specifically for office space.



View of the interconnected ductwork and new exhaust fans. Photo: John Dillriott.

The Cognitive Science building is one of 66 facilities integrated into the campus's load-shedded programming. This program automatically reduces the university's electrical demand during peak summer hours. With this program in place the campus can respond quickly to grid emergencies and avoid costs associated with purchasing utility-provided power during peak times. UCSD received a 2005 Best Practice Award for implementing this important energy reduction strategy.

LESSONS LEARNED

Energy Manager John Dillriott suggests that campuses look for links to energy efficiency when ranking the urgency of deferred maintenance projects. Combining the two can save campuses time and provide long term cost savings. He also recommends that campuses be vigilant and keep track of changes in space utilization. Wet labs that have been converted into offices offer significant energy saving opportunities, especially when constant volume HVAC systems can be upgraded to incorporate variable air volume technology.

Best Practices is written and produced by the Green Building Research Center, at the University of California, Berkeley.

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