



Award Category

Lighting Design/Retrofit

Green Features

40-70% reduction in lighting energy use

Lowered standard illumination levels

Wireless lighting control based on open protocols

Dimmable ballasts

Occupancy and daylight sensors

Recessed downlights retrofitted with 6-inch LED lamps

Size

140,000 ft²

Annual Energy and Cost Savings

255,700 kWh

\$34,520

36 kW peak demand reduction

Cost

\$208,000

4.2 year simple payback (with \$61,375 incentive)

Completion Date

March 2014

UC Santa Cruz Laboratory Lighting Conversion Project

A lighting and controls retrofit at UC Santa Cruz is expected to provide energy savings of 40 to 70 percent, while meeting the safety and control needs of the lab users. The work involved detailed evaluation of control technologies and computer simulations to provide suitable illumination levels and distribution.

Lighting control upgrades offer opportunities for cost-effective energy savings in research laboratories, however installations in existing labs hold special challenges. Energy managers at UC Santa Cruz completed a lighting controls and fixture retrofit, working in close collaboration with researchers, to reduce interruptions and while producing impressive energy savings.

Lighting quality and control is of great concern to biological science researchers because experiments may be sensitive to lighting levels and schedules, and conventional occupancy sensors could very easily disturb experiments. The project team identified the Physical Science Building as a good candidate for a lighting retrofit, as it included a diversity of spaces, opportunities for daylight harvesting, and 30 wet labs.

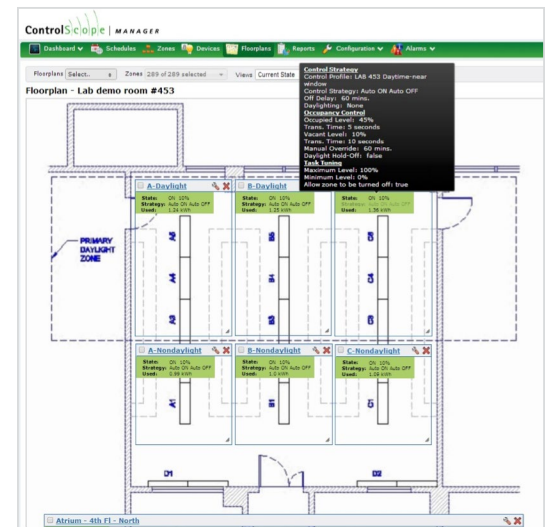
The team developed a scope of work in conjunction with building facilities personnel so that the technologies and solutions would meet the needs of both groups. The team focused on controls and the overhead lighting in labs, hallways, stairs and in the atrium.

The success of this process relied on a critical evaluation of available lighting control technologies and thorough coordination with stakeholders.

One of the important first steps was the evaluation of prospective control systems. UCSC Energy Analyst Sarah Gilchrist explains that the team reviewed four leading control products, including both wireless and wired systems, with respect to energy savings, cost, flexibility, safety, and the ability to be integrated with the Tridium Niagara building management systems used in most major buildings on campus. The team also placed a high value on using non-proprietary systems, and consequently selected the ControlScope system from Daintree Networks, as it is based

on open source standards such as BACnet and ZigBee, it communicates wirelessly, and it does not require the use of proprietary hardware, allowing a wide range of ballasts and sensors to be used.

As part of the retrofit, the team also considered the illumination levels and found that the levels were significantly higher than industry recommendations, a situation all too common in campus buildings. The team extensively modeled the retrofit zones using DIALux, a free lighting simulation tool, to optimize control strategies and lighting levels using various



Daintree controls provide a web-based interface that allows staff to make changes. Image: UCSC.

fixture combinations. The maximum illumination levels were reduced from the previous level of 110 footcandles down to 50 in the labs, and from 25 to 10 FC in hallways.

By tuning lighting levels using the new control system, with new fully dimmable ballasts, the team was able to set more appropriate levels and make significant energy savings. The retrofit is expected to yield energy savings of 40 to 70 percent from dimming and occupancy control alone. Sarah Gilchrist says that

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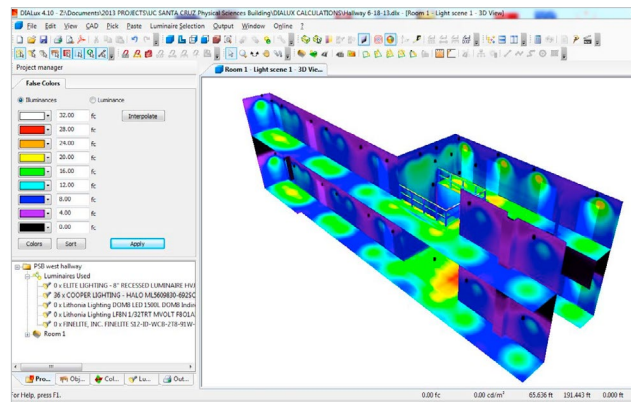
More Information

<http://projectclearinghouse.ucsc.edu/green-labs-program>

<http://www.daintree.net/products/lighting-controls/>

energy savings as high as 78 percent have been measured, however this may be lower as daylight access is reduced in winter.

To minimize disruption to the labs during both installation and future operations, the project team coordinated closely with laboratory users. The team devised an innovative method of installing the dimming ballasts and control hardware in the light fixtures outside



Screen showing “pseudo color” simulation of hallway illumination levels using DIALux lighting software. Image: Steve Mesh.

of the lab area, then these wired lights were installed in labs during two-hour time slots early in the morning, avoiding what would otherwise have required more than a full day of installation time.

Annual energy savings from daylight harvesting and occupancy controls are estimated to be 40 to 70 percent, and measured savings have been as high as 78 percent.

Much of the planning and installation was performed by campus staff with a value-added reseller (VAR) certified with Daintree. Campus staff members also took the VAR training so that they will be able to program system changes as needed, reducing maintenance costs. The Daintree system has a

web-based graphical interface that allows the lighting staff to easily implement additional demand reduction and other changes from anywhere on campus.

The team also replaced recessed 34-watt fluorescent downlights with 9-watt LED retrofit kits, using “goof rings” to accommodate the difference between the existing 8-inch diameter fixtures and the 6-inch LED lights. This change yielded approximately five kW in permanent electrical demand reduction. The team also collaborated with the student Green Labs program for outreach and education, adding training on the use of the controls to the existing program.

LESSONS LEARNED

Early on the team encountered a problem with false on and off signals, which was diagnosed to be caused from insufficient shielding of the control wiring inside the fixtures. This was simply remedied by installing additional shielding cable wrap inside the fixtures.

Another adjustment was needed when users reported that lights turning on automatically were causing problems with experiments. Sarah Gilchrist notes that a primary focus of the control system programming had been on turning off lights to save energy, and the automatic on function was given less consideration. However the control system provided the flexibility to make this change easily, and in some labs the auto-on function has been permanently disabled, and lights are only turned on manually.

The project team reports that once occupants were educated about the increased lighting control capabilities, they were excited to have the upgrade. On rare occasions occupants turned the lights up for fine work, but otherwise most overrides were to turn lights off.

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.

