BEST PRACTICES 2010

UCSD Sustainability Resource Center DC-DC Lighting Project

This project is the first installation of a DC lighting system to use photovoltaic cells as the primary power source. With advanced controls, LED lighting, an energy dashboard, and a flexible plug-and-play platform, the SRC provides opportunities for students to explore renewable and low-energy technologies.

Award Category
Lighting Design/Retrofit

Green Features
800W photovoltaic system
DC ceiling "microgrid"
DC fluorescent lighting and LED task lighting
Motion and light sensors
Energy dashboard

Size
986 ft^2

Cost
$318,000 (including value of donations)

Annual Energy and Cost Savings
15% lighting energy reduction
$345 ($0.35/ft^2)

Completion Date
December 2009

The Sustainability Resource Center at UC San Diego was founded through student funding initiatives to create a collaborative workspace on campus for students to work on issues related to sustainability, and to reduce the campus' environmental impacts. In spite of the center's modest size of just under 1000 ft^2, the project demonstrats a wide range of green building strategies and products.

One of the goals set out by the project team was to make a space that was both attractive and at the same time to showcase new sustainable products and systems. One of the most unique and cutting edge systems implemented in the center is a DC lighting system powered primarily by four rooftop photovoltaic (PV) panels that can provide up to 800W of electrical power. The system uses a low-voltage DC electrified ceiling grid and LED lighting, all of which are based on new industry standards developed by the industry association EMerge Alliance. Because the center's low-voltage lighting is mostly powered directly by DC current from the PV panels, the system avoids energy losses that are inherent when converting DC to AC current. In addition, LED lighting can be 10-15 percent more efficient when using DC current, according to reports by EMerge Alliance.

View of the lighting system, with electrified grid, and clear view panel. Photo: UC Regents/Rhett S. Miller.

Campus staff and students partnered with local and national vendors and manufacturers to create a demonstration site for new lighting technologies.

Due to the project's limited budget, students and project team members looked to the building community for donations for many materials and products. Suppliers were swayed by the compelling goals of the project, including the innovative lighting system and the center's outreach potential, and in the end more than 30 companies donated products or services. Many of the lighting system elements were donated—for example, the DC ceiling microgrid from Armstrong; fluorescent ceiling lights, ballasts and LED task lights from Finelite; light and motion sensors from Wattstopper; solar panels from Kyocera, and the power supply, ballasts, and engineering services by Nextek Power. Borrego Solar donated the installation of the PV panels, and Tyco Electronic donated DC cabling and connectors to finish out the installation. In recognition of these many contributions, the project includes a donor wall to provide acknowledgment for these companies.

Emerge Alliance was instrumental in reaching out to the members of its consortium, many of whom provided products and services for the project, and who assisted the project team in the design and the specification of the DC system. Nextek Power supported the engineering of the project on a *pro bono* basis, and provided valuable assistance trouble-shooting the initial installation.

2010 BEST PRACTICES

Additional Awards

LEED CI Gold (pending as of January 2011)

Runner-up for Special Achievement by a Government or Institutional Agency, San Diego Excellence in Energy (SANDEE) Award, 2010

Contacts

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Project Team

Architect:
CitiZen Design Group

Contractor:
Folton Enterprises

Electrical Engineer:
UCSD Facilities Design and Construction

Electrician: MKR Electric

More Information

http://ucsdnews.ucsd.edu/newsrel/events/11-09SRC.asp

http://www.emergealliance.org/

Kevin Norris, who works on UCSD's commissioning and sustainability efforts, explains that many of the companies involved viewed the SRC as an outlet for demonstrating their products. He also explains that the 24V grid provides plug-and-play flexibility, allowing

Faculty, staff, and students at the opening of the resource center. Photo: UC Regents/Rhett S. Miller.

lights to be relocated easily. He notes that the systems can also be cost effective by taking advantage of low-voltage wiring which reduces the need for conduit.

Ongoing involvement from key product manufacturers was critical to the successful commissioning of the system.

The project includes a number of control strategies to reduce lighting energy consumption. Light-level and occupancy sensors that are integral to the DC grid turn off lighting when it's not needed. An advanced monitoring system allows the power generated by the PVs, and the lighting power consumption, to be viewed on a flat-screen monitor. The system's power supply unit includes both AC and DC input, so when sunlight is not sufficient to meet the center's demand, power from the campus grid is converted to DC to supply the system. This power supply unit is connected to the Internet via a ZigBee wireless connection, which allows the manufacturer to remotely control and update the device. The project team now plans to collect data for one year to see whether the system is meeting its energy estimates. Center staff reports that during the day the lighting is frequently powered entirely by the PV system.

Kirstin Hansen, a UCSD sustainability analyst who works in the center, reports that the project benefitted from the early involvement of students, who assisted with researching products for the center, estimating the lighting system's energy savings, and assembling materials that earned the project a LEED-CI Gold certification. She explains that the center has been successful in its outreach goals, and that students are using it as a living laboratory. Center staff members have also hosted many visitors from the local area as well as from abroad.

LESSONS LEARNED

During the first year, the project team encountered several challenges commissioning the lighting system. When the system switched between AC and DC current, the power would go off, requiring a reboot of the system. There were also problems with the energy dashboard display, which also required frequent restarts. Wayne Gutschow of Nextek explains that the power supply unit that was installed did not have an integral PV regulator, and the one that was installed (from another company) did not work properly. Nextek Power subsequently built and installed a custom PV regulator, and is now developing a new product that will work in any future PV-powered system. While these problems have been successfully resolved, Kirstin Hansen says that even in hindsight there is nothing that she feels the team could have done better. "This is the first-of-a-kind project, and some issues like this are inevitable." Future goals for the project include setting up controls for the LED task lights, and powering one of the center's desktop computers from the DC power supply.

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.