Higher Education Buildings Recognized for Integrated Controls for HVAC and Lighting Systems

CASE STUDY: California State University Dominguez Hills and University of Minnesota

About the Project

With a large portfolio of buildings, college campuses present a unique opportunity to adopt connected lighting systems for the benefit of the students, professors, administrative staff, and the public. And that's just what both California State University, Dominguez Hills (Cal State Dominguez Hills) and the University of Minnesota did. Cal State Dominguez Hills wanted to decrease energy costs at James L. Welch Hall (Cal State), a four-story building housing multiple functions, including administrative and admission offices, classrooms, tech support, server rooms, and a police station. The University of Minnesota had similar goals for Jones Hall (UMN), one of their mixed-use buildings on campus with a combination of offices, classrooms, and public space.

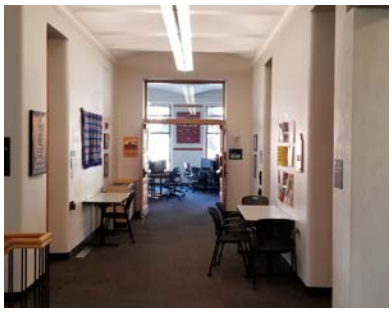
Project Goals

Cal State Dominguez Hills:

- **FUTURE PROOFING.** The facilities team at Cal State Dominguez Hills is a big proponent of thinking ahead and being prepared. One of the main goals for the project was to install digital infrastructure to accommodate emerging technology. They also wanted to be ready for new building energy codes.
- **PERSONALIZATION.** Staff often complained about the brightness of fluorescent lamps. So, it was a top priority to give university employees granular control over their light level and the ability to set their preferences.

University of Minnesota:

- **ENERGY SAVINGS.** Lighting and controls were upgraded at Jones Hall (UMN) as part of the university's aggressive sustainability initiatives.



James L. Welch Hall at Cal State Dominguez Hills

PROJECT QUICK FACTS

Cal State Dominguez Hills:

- **Location:** Carson, California
- **Size:** 183,000 sq. ft.
- **Year Built:** 2001

University of Minnesota:

- **Location:** Minneapolis, Minnesota
- **Size:** 25,000 sq. ft.
- **Year Built:** 1901

KEY STRATEGIES AND OUTCOMES

- The universities employed the following **advanced lighting strategies:**
  - Advanced sensors
  - HVAC integration
  - Plug load control
- Advanced lighting and integration strategies led to several **positive outcomes** for both universities:
  - Energy savings
  - Occupant satisfaction

Lighting and Integration Strategies

- **ADVANCED SENSORS.** Both universities installed advanced sensors on every luminaire in their respective building. The sensors track occupancy within the building and include photo-sensing for daylighting; temperature-sensing capabilities for heating and cooling regulation; and motion-sensing to track occupancy. The sensors enable energy-saving actions by responding to environmental signals and adjusting conditions accordingly, such as powering or dimming lights, adjusting room temperature, or lowering window blinds. Luminaire-based sensors also facilitate personalization by allowing each user to select light levels that are comfortable for them.
- **HVAC INTEGRATION.** In both universities, HVAC sequences were programmed using occupancy data from the network of lighting sensors. At Welch Hall (Cal State), the damper was shut off in over 90 percent of the spaces when no one is present. In the southwest corner of the building, which receives direct sunlight, the room is set back four degrees to prevent the room from getting too hot. Similar thermostat setback strategies were used at University of Minnesota.
- **PLUG LOAD CONTROL.** To cut out energy waste, the University of Minnesota installed electrical outlets with wireless plug load controls in common areas such as printing and charging stations. The controls allow occupants to use outlets that shut off when not in use, reducing standby power.

Jones Hall at the University of Minnesota

Outcomes

- **ENERGY SAVINGS.** In a year, lighting and fan energy use was reduced at Welch Hall (Cal State) by 34 percent, resulting in savings of 0.9 kWh per sq. ft. They reduced heating and cooling by 27 percent and saved nearly 0.16 therm per sq. ft. The savings at Jones Hall (UMN) were just as impressive. With lighting alone, they saved 0.9 kWh per sq. ft. The HVAC integration allowed them to save an additional 2.8 kWh per sq. ft. and 0.06 therm per sq. ft. In total, they saved $0.45 per sq. ft.
- **OCCUPANT SATISFACTION.** At Welch Hall (Cal State), the average set-point based on occupant preference was 40 percent of full light output. An informal survey of building occupants showed that people loved the customizable light levels.

Lessons Learned

Both connected lighting projects at Welch (Cal State) and Jones Hall (UMN) yielded a wealth of insights and lessons learned that can be applied to similar lighting retrofit projects.

- Use good engineering practices when running communication cables between the light switch and the devices plugged into the switch.
- Do not wait long to adjust light levels to occupant preferences. New lights are almost always too bright.
- Test out light performance and settings on a small batch of luminaires before purchasing a large number of lights. Test them in a variety of scenarios and use cases. This will mitigate the risk of making a large investment, only to find out later that something doesn't work.
- Make sure the project is commissioned properly before any work starts. It might take a little longer at the start of the project but reworking and scope creep will be avoided as the project progresses.
- Involve information technology staff early on to minimize failures and disruptions while connecting controls to the internet.

- Having clearly documented roles and responsibilities outlined at the beginning of the project will make everything go much smoother, as will upfront communication on requirements.
- Coordination with internal stakeholders is key while mapping control points between lighting and HVAC. Lighting and HVAC zones should be planned in advance.
- Training is key to project success, for both facilities staff and building occupants. Train occupants on proper operation of lighting and outlet controls and color-code the outlets for ease of use. Train a dedicated member of the facilities team during commissioning, so there is someone on staff who can make necessary adjustments and troubleshoot when necessary.

About the ILC

The Integrated Lighting Campaign (ILC) is a program designed to help facility owners and managers take advantage of savings opportunities and benefits of advanced lighting controls and of integrating lighting systems with other building or business systems in their facilities. The ILC serves as a resource for relevant research regarding new advanced lighting controls and integrated lighting systems and provides a platform to recognize exemplary projects shared by ILC participants and supporters.

For More Information

- On the ILC and how to join, visit: https://integratedlightingcampaign.energy.gov/
- To learn about Better Buildings Technology Campaigns visit: https://betterbuildingssolutioncenter.energy.gov/alliance/tech-campaigns

ILC Organizing Partners

This effort is a collaboration between the DesignLights Consortium® (DLC), Illuminating Engineering Society (IES), the International Facility Management Association (IFMA), interNational Association of Lighting Management Companies (NALMCO), the Lighting Controls Association (LCA), U.S. General Services Administration (GSA), and the U.S. Department of Energy.