DLC Advanced Lighting Technology Demonstration: Philips SpaceWise

This demonstration is one in a series of advanced lighting demonstration projects being completed through a joint initiative between the DesignLights™ Consortium (DLC) and the U.S. Department of Energy. Additional partners for this site included National Grid plc, Philips, and Rise Engineering.

Demonstration Site

The Rhode Island Public Utility Commission (RIPUC) occupies a multi-story 19,400 ft^2 office building constructed in 1980 in Warwick, Rhode Island. Although the facilities were lighted with standard T8 fluorescent technology, the LED lighting and intelligent controls retrofit completed in 2016 offered additional savings and better quality lighting and control. The RIPUC installed the new LED lighting and intelligent control system. The advanced software options allow for customization of light levels to meet application and occupant needs.

Demonstration Technology

The Philips SpaceWise technology is a fully integrated wireless control system applied at the luminaire level that provides plug and play lighting energy savings. It has application modes for open plan offices, private offices, meeting rooms, corridors, and emergency egress; on-board technology provides dimming in response to both occupancy sensing and daylight harvesting. Full light output is delivered only to occupied workstations with background settings typically at only 1/3 of full output. In addition, the system allows for task tuning to adjust lighting to desired levels and daylighting control requires no separate zoning or configuration. For this demonstration, the scope of the project included replacement of the existing luminaires with new Philips DuaLED luminaires with on-board controls.

Project Savings

The Cadmus company measured the lighting system energy use before and after the upgrade with and without lighting controls. The results of the measurements show that replacement of older fluorescents with LEDs alone saved 64% of the estimated annual lighting energy use. Along with this savings was a modest reduction in excessive pre-retrofit light levels in many areas. With advanced occupancy sensing and daylighting controls, an additional 3% of the baseline energy use was saved for a total of 67% estimated to be 39,500 kWh. The corresponding reduction in facility energy cost is approximately $4,700 annually. The total project cost is $110,900 and will pay for itself in just under 15 years after $41,000 in utility rebates from National Grid. A more basic fixture from the manufacturer with similar capabilities could have been applied at $83,300 for a payback of just over 9 years with the rebate.

The low energy savings (3%) from controls at this site are because of limited occupancy sensor savings. This includes enclosed offices and restrooms that already had occupancy sensors. The new embedded occupancy sensors were also set to "automatic-on" and gradually dim to off after the space is unoccupied for 25 minutes. While this configuration may provide occupant satisfaction benefits, it may increase energy use vs. traditional occupancy sensors that automatically turn lights off when unoccupied and use a "vacancy" control strategy requiring a manual switch to turn lights on.

Installation and Operation

RIPUC office hours are from 8 AM to 4 PM, 5 days a week. Pre-retrofit lighting controls were a combination of wall switches and some on-off occupancy sensors. The variety of departments with differing functions in the facility provide some occupancy variance creating energy harvesting opportunities for advanced controls.

RHODE ISLAND PUBLIC UTILITIES COMMISSION

Rhode Island Public Utility Commission building located in Warwick, RI updated their lighting for energy savings and improved lighting quality. *Photo courtesy of Google Earth.*

Philips DuaLED with integrated SpaceWise on-board controls

Photo courtesy of Philips.

Advanced lighting control systems can incorporate a variety of options. The SpaceWise system offers the following:

- Occupancy Sensing
- Daylight Harvesting
- High-End Trim / Task Tuning

Occupant Lighting Satisfaction

BEFORE THE LED RETROFIT*

A staff survey of 38 occupants found the following:

- **89%** Between Neutral and Very Satisfied with Overall Lighting Conditions
- **22%** Lighting Too Bright At Times
- **78%** Occupancy Sensor Control of Lighting is Acceptable or Satisfying

AFTER THE LED RETROFIT*

A staff survey of 13 occupants found the following:

- **100%** Very Satisfied or Neutral with Overall Lighting Conditions
- **15%** Lighting Too Bright At Times
- **77%** Occupancy Sensor Control of Lighting is Acceptable or Satisfying
- **62%** Daylighting Controls of Lighting is Acceptable or Satisfying

*Before and after the retrofit 1 respondent found the light too dim.

PROJECT ENERGY SAVINGS

Total Lighting System Savings

New LED Fixtures Only*	New LED Fixtures with Controls
64%	67%

Lighting Control Savings**

Occupancy Sensor Shutoff	Daylighting Reduction**	High End Trim / Task Tuning***
-5%	16%	(~12%)

*The 64% energy savings came from installing the more efficient LED fixtures. The remainder of this site's savings came from advanced control of these new LED lights.
**The data also shows that if the control savings were based only on the lower wattage new LED lighting, the daylighting part of the advanced controls would reduce the lighting energy use by 16%. However, this savings was offset by an increase in energy use due to the new occupancy sensing configuration. The new control system used an auto-on and dim-when-unoccupied approach rather than a manual-on and turn-off-when-unoccupied approach of the previous occupancy controls. NOTE: Applications with a different mix of activities and/or existing controls could see higher or lower overall control savings.
***High End Trim / task tuning was not a part of field adjustments for this system. LED luminaires were shipped to the site with drivers set at 88% of full power to accommodate the specific light level needs at the site. Compared to more common static output products, this could be considered a potential 12% savings.

Facility Acceptance

The installation contractor who installed the LED lighting found the process to be straightforward and generally similar to installing standard fluorescent fixtures. System controls commissioning was provided by the manufacturer and was relatively quick to implement in this mostly standard office facility. Facility operations staff reported that the system software required a learning curve, but found the system made it very easy to check the occupancy sensor operation (typically a cumbersome task). This system when initially installed did experience issues with proper programming and fixture operation. After exploring the issues, the system provider determined there was a manufacturing issue with the LED drivers. After the replacement of the drivers, the system is functioning as designed and operating well to meet the needs of the occupants.

Lighting System Performance

Pacific Northwest National Laboratory took measurements in selected open areas to compare lighting performance before and after the retrofit. These open areas provided clean comparison relative to typical office areas.

Location	Before (fc)	After (fc)	% Change
Open Hallway	47	38	-18%
Elevator Lobby	36	30	-18%
Open Hallway	38	32	-16%
Enclosed Hallway	11	26	147%
Lobby	19	36	85%

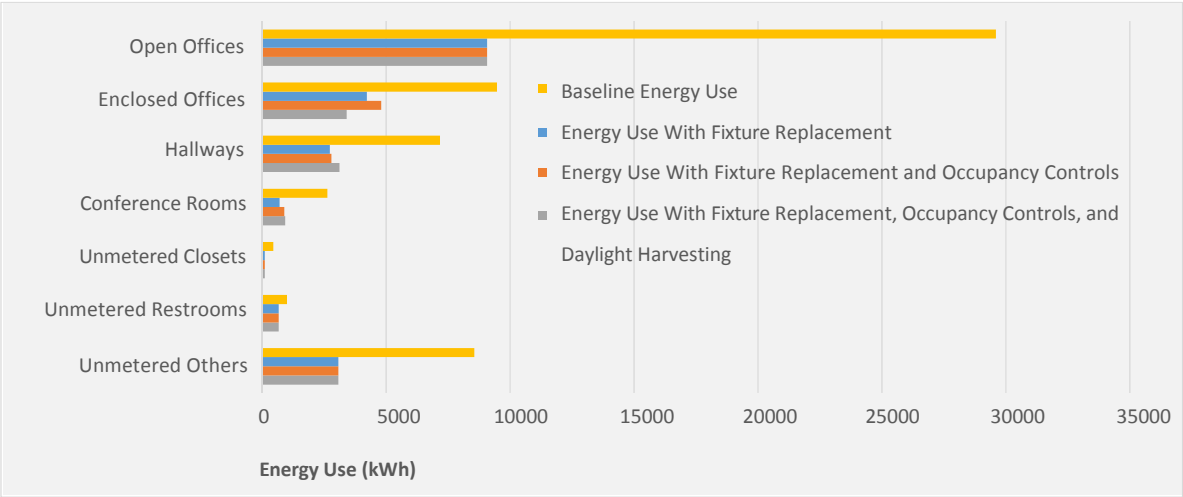
* measurements taken at floor level before and after retrofit

Light levels before the retrofit were mixed with some higher and some lower than Illuminating Engineering Society (IES) recommendations. The post-retrofit light levels in these areas all generally meet or exceed IES recommendations and the changes ranged from approximately 16% lower to almost 150% higher.

Application Determines Savings

In most areas, the technology change from fluorescent to LED fixtures provided the majority of savings. Controls offered additional savings when they were not present before. Control savings can vary widely depending upon the type of activity and facility function.

Annual Extrapolated Energy Consumption by Space Type



These results represent potential savings for one building type with representative space types and activities. It is important when choosing a lighting system and controls to determine the best fit for the given mix of space types and activities.

This technology demonstration is supported through a partnership of multiple organizations including:

Better Buildings U.S. DEPARTMENT OF ENERGY
DLC
PHILIPS
nationalgrid
RHODE ISLAND DIVISION OF PUBLIC UTILITIES
Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965
RISE ENGINEERING