

2016 Building 78 Lighting Retrofit

Saving energy, improving lighting & building controls, piloting new technology

Project Overview

The B78 Lighting Project implemented an advanced lighting control technology (Daintree) on a small scale, for the purpose of learning the capabilities and limitations of a specific advanced lighting control product, strengthening the partnership between SBL and Facilities, and building energy retrofit knowledge/skills/capacity that can be scaled effectively and cost-efficiently to other LBNL buildings.

Project goals were:

- Retrofitting lighting in Building 78
- Achieving energy savings
- Integration, control, & monitoring across all end uses (lighting, HVAC, and plug)
- Informing a strategy for future lighting retrofits

Background and Approach

The Daintree technology included:

- Both retrofit and replacement to fully dimmable, LED fixtures
- Controlling existing fluorescent fixtures at the circuit level
- Daylight and occupancy sensors
- Monitoring & data collection
- Wired and wireless control with Zigbee
- Flexible control using sensors and scheduling software
- Testing of plug load monitoring and control at the receptacle or circuit level
- Integration of a wireless thermostat for HVAC control



LED Light Retrofit

The Scope

Building 78 is a small, 4,900 square foot building with three interconnected sections.

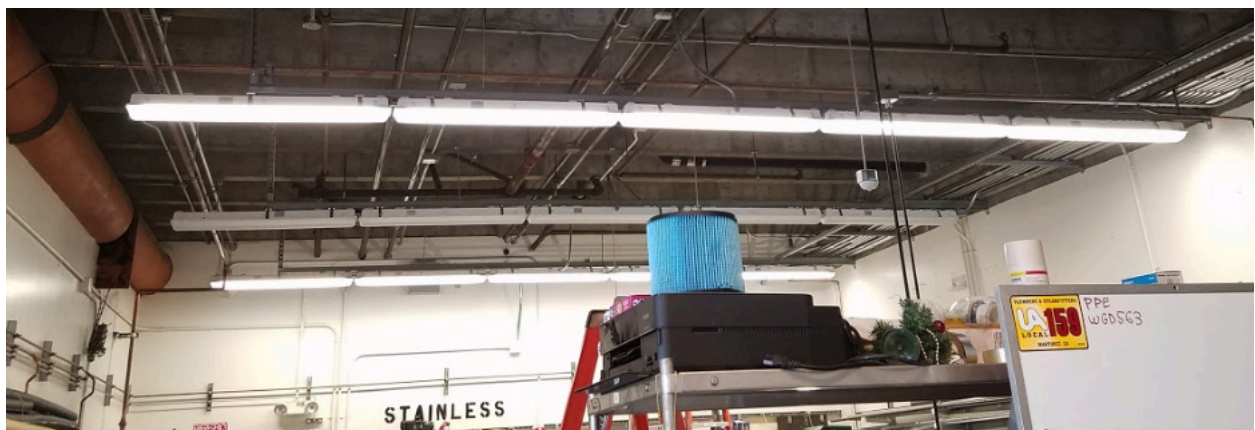
HVAC

Each building section was managed by a separate thermostat, all of which were replaced with wireless units, allowing them to be managed via the central Daintree control software. User input on staff schedules and comfort, as well as readings from CO2 sensors were used to develop strategies for stabilizing temperature in the space, through optimizing the heating schedule, use of natural ventilation, and an outside-air economizer.

Lighting

Existing sensors were replaced so that lighting could be controlled through Daintree across the entire building, using different strategies in each space. Light switches were replaced with wireless wall switches in all three areas. Emergency lighting was out of scope and not changed.

- **EHS Offices (101) - Lighting retrofit** - existing fluorescent light fixtures were retrofit with LED strips. Fluorescent light tubes were removed, lighting ballasts replaced, and the metal back panels were removed and fit with strips of LED lights. Sensors, user input, and software programming to make use of the extensive daylight in the space, as well as to address dark areas away from windows.
- **Plumbing Shop (103) - Lighting replacement** - existing fluorescent light fixtures were replaced with fully enclosed LED light fixtures, designed to handle a shop environment.
- **Carpentry Shop (119) - Lighting controls only** - no changes were made to the light fixtures.



New LED light fixtures in the Plumbing Shop

Plug Loads

Plug load monitoring/controls were used in the Office spaces only.

Results

- **Energy Savings** estimated at 30% based on [9 months of utility data](#)
- Established a working system that can be used by Lab Researchers for testing Demand Response protocols
- Favorable reception by occupants
- Improved visibility into and finer control of building operations, temperature profile, etc.
- Improved light quality in the two buildings segments with LED
- **Successful implementation and proof of concept** for three types of retrofits:
 - LED strip retrofit of pendant fluorescent light fixtures, with upgraded controls (lighting & HVAC)
 - Full LED light fixture replacement, with upgraded controls
 - Upgraded controls only (no light fixture changes)



Wireless light switches below the old switch plate

Technical Plan

EHS Offices (Area 101)

This area is office space. It has extensive daylight against the windows, where it tends to be overlit, while the office spaces are much less well-lit in the back. The existing overhead fluorescent light fixtures will be retrofit with dimmable LEDs that will be zoned so they can be dimmed to different levels in response to (newly installed) daylight and occupancy sensors. This is the only area where plug load monitoring/controls will be tested.

Details:

1. The 25 fixtures will be retrofitted with LG FRR629D3HZZ (4000K) kits. The process for this is as follows:
 - a. The reflectors panels for all fixtures will be removed by LBNL.
 - b. The reflectors will be picked up by Glued Solutions and they will be retrofitted with LED Panels.
 - i. Total Wattage: 35W (Direct: 28W / Indirect: 7W).
 - ii. A lens will be installed on the indirect strip portion to aid long-term maintenance (minimizes dust collection on upward-facing LEDs)
 - c. The modified reflectors, along with LED drivers, will then be delivered to building 78.
 - d. LBNL will then install the panels and drivers in the existing fixtures. Glued Solutions will provide onsite training to go over the installation with LBNL/installers.
2. The current installed control devices will be removed or disabled (occupancy sensors, photo sensors, relays, and line voltage switches). This will be performed by LBNL.
3. New wireless Daintree control devices will be installed:
 - a. 10 x WOS2 (Wireless Occupancy Sensors) -Additional hardware will be required to position the sensors closer to the height of the fixtures. See the current installed sensors for more details.
 - b. 5 x WWD1 (Wireless Wall Dimmer Switches) -The old line voltage switches will be removed and the wall boxes will need to be covered with blank plates. The WWD1 switches can be mounted using industrial grade double sided tape.
 - c. 1 x WAPM (WA100-PM Wireless Adapter) -To be installed where the BZ50/BZ150 (power pack for the existing occupancy sensors) is currently installed. Remove the BZ and install the WAPM, but do not use the WAPM's relay to control the circuit. We are just getting power (277AC) for the WAPM. The WAPM will be used to power a Wireless Sensor Adapter (WSA) and used to wirelessly adapt the photo sensor (RPL-CES)
 - i. 1 x WSA (Wireless Sensor Adapter) -See WSA100 installation guide
 - ii. 1 x RPL-CES/A-24-0-10 (Photo Sensor) - See WA100-PM installation guide

- d. 11 x WAPM (WA100-PM Wireless Adapter) -To be installed on J-boxes to control/monitor the 110AC outlets. Actual locations may change depending on access to circuits.
- e. 1 x Tstat (WTS Wireless Thermostat) -Will replace the current Thermostat and will be powered by the same 10-30 VAC.

Plumbing Shop (Area 103)

This area consists of a small, semi-enclosed office space and a large, open, plumbing workshop. There is minimal daylighting in the space, and the office space is rather dark with very poor lighting. The lighting fixtures will be replaced with LED fixtures, and the office space will have a separate lighting fixture zone.

Details

- 1. The 24 fixtures will be replaced with Deco Lighting DWH-LED-W-35-40-UNV-DIFF-LENS-CSC fixture. ([Spec sheet](#))
 - a. 35W / 3450 lumens per Each fixture has a gasket seal, which should promote long-term performance in a workshop environment
- 2. The current installed control devices must be removed or disabled (occupancy sensors, photo sensors, relays, and line voltage switches).
- 3. New wireless Daintree control devices will be installed:
 - a. 4 x WOS2 (Occupancy Sensors) -Additional hardware will be required to position the sensors closer to the height of the fixtures. See the current installed sensors for more details.
 - b. 2 x WWD1 (Dimmer Switches) -The old line voltage switches will be removed and the wall boxes will need to be covered with blank plates. The WWD1 switches can be mounted using industrial grade double sided tape. One switch will control 4 rows of fixtures while the other controls just one row.
 - c. 1 x Tstat (WTS Wireless Thermostat) -Will replace the current Thermostat and will be powered by the same 10-30 VAC.

Carpentry Shop (Area 119)

This area is a rather large, open carpentry shop with significant machinery, materials, etc. It has virtually no daylight. There is also very small office space. Light fixtures will remain - they will not be replaced or retrofit.

- 1. No fixture replacements
- 2. The current installed control devices must be removed or disabled (occupancy sensors, photo sensors, relays, and line voltage switches).
- 3. New wireless Daintree control devices will be installed:

- a. 2 x WWD1 (Dimmer Switches) -The old line voltage switches will be removed and the wall boxes will need to be covered with blank plates. The WWD1 switches can be mounted using industrial grade double sided tape.
- b. 2 x Tstats (WTS Wireless Thermostat) -Will replace the current Thermostats and will be powered by the same 10-30 VAC.
- c. 2 x WAPM (WA100-PM Wireless Adapter) -To be installed on J-boxes to control/monitor the two lighting circuits. Note there will be no dimming, just on/off control.