UC Davis McLaughlin Reserve ZNE Lighting Retrofit

UC DAVIS PROGRAM FOR INTERNATIONAL ENERGY TECHNOLOGIES

UC DAVIS FACILITIES MANAGEMENT

Purpose

We were requested to provide our client (McLaughlin Reserve management) with a report on current lighting fixture technologies and sufficient information on upgrading lights that are compatible with the current system.

To satisfy our clients' needs, a low range, mid range, and high range cost option for upgraded lighting systems will be explored. Emphasis will be set on researching various control systems which include integrated occupancy and light sensors. A cost analysis will be provided which includes the effect of potential PG&E rebates awarded to replacing energy inefficient fixtures. The goal is to provide our client with sufficient information to take actions to replace the lights (i.e. providing them with a quote for new lights from a lighting rep).

Some of the benefits through the realization of our efforts include providing on site energy savings, improving on site occupant comfort level, protecting on site environmental stewardship, and reaching UC commitment towards carbon neutrality initiative in 2025.

Methodology

- **Preliminary Research on Light Technology**

Our approach to this project is first through extensive lighting technology research. We accomplished this task through communicating with field experts from the California Lighting Technology Center, energy data analysts from the Energy Conservation Office, and technology director from the Program for International Energy Technologies. Through meeting with them, we learned how to identify different types of ballasts (magnetic or electronic), PG&E rebate options (for cost analysis), case studies of similar lighting retrofit projects, and pros and cons of different lighting design and zoning options.

Their advice on our project scoping and their networks from the lighting industry paved our way to completing this project.

- **Site Visit & Data Collection**

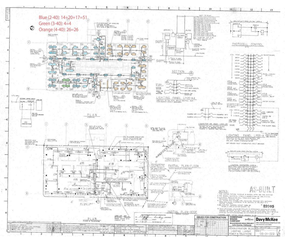
After gaining a sufficient understanding of various lighting technologies, we visited the site and met our client in person. We identified our clients' lighting usage needs (functional needs for different types of lighting) and operating patterns (use of lights in a typical day). Through walking the facility and examining existing lighting lamps and fixtures (make and model, distribution count, performance), we got a hold of the existing on site situation.

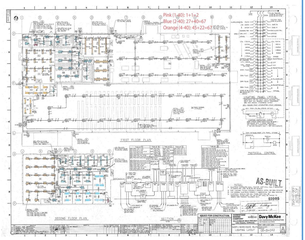
- **Further Research**

We furthered our findings on existing lighting distribution through looking closely into facility lighting fixture drawings. Using specs from the manufacturer's website (General Electric), we then calculated the total energy usage with the lumen and wattage data and occupancy pattern data.

- **Contact Reps**

To provide our client with a realistic quote towards a lighting retrofit for the facility, we contacted multiple lighting representatives in the Sacramento region. Using proper lighting language (such as "2x4 recessed fluorescent troffer with 4 lamps"), we were able to quickly receive replacements of LED lighting suggestions from the reps. Their recommendations were extremely beneficial for our understandings.





Findings

The Current State of the Lighting System

Fluorescent Lighting

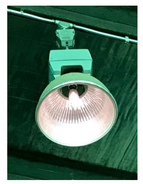
GE Cool White Watt-Miser® T12

Lumens: 2,280/ bulb

Watts: 34W per bulb (theoretical)

Controls: on/off

Industrial Sodium Vapor Lamps



GE Ecolux® Lucalox® High Pressure Sodium ED18

Lumens: 26,100

Watts: 250W

Controls: 0%, 50%, 100% on/off capabilities

Current System Energy Audit

Item	Location	Count	Power per Appliance (W)	Annual Usage Hours	Annual Energy Use (kWh)
Field Station					
AV8 - 4 - 132	Bathrooms	6	32	446	85.632
PVSL60 Shower Light	Bathrooms	4	26	116.5	12.116
2 - T12 - 34	Entryway	5	72	466	167.76
2 - T12 - 34	Hallways	17	72	466	570.384
2 - T12 - 34	Offices/Misc	8	72	116.5	67.104
3 - T12 - 34	Offices/Misc	4	115	116.5	53.59
4 - T12 - 34	Offices/Misc	8	144	116.5	134.208
2 - T12 - 34	Kitchen	3	72	699	150.984
4 - T12 - 34	Living Room	7	144	466	469.728
2 - T12 - 34	Living Room	8	72	466	268.416
4 - T12 - 34	Bedrooms	11	144	185	293.04
2 - T12 - 34	Bedrooms	10	72	185	133.2
Warehouse					
4 - T12 - 34	Mining Gym	14	144	125	252
2 - T12 - 34	Mining Hallway	8	72	280	161.28
1 - T12 - 34	Mining Hallway	1	43	280	12.04
2 - T12 - 34	Mining Locker Room	27	72	96	186.624
1 - T12 - 34	Mining Locker Room	1	43	96	4.128
4 - T12 - 34	Mining Office 1st floor	6	4	500	12
2 - T12 - 34	Mining Office 2nd floor	29	72	1500	3132
Sodium Lights	Mining Storage Room	23	250	384	2208
2 - T12 - 34	Shared bathroom 2nd floor	2	72	375	54
2 - T12 - 34	UC Bathroom	1	72	125	9
4 - T12 - 34	UC Common Room	15	144	200	432
2 - T12 - 34	UC Hallway	1	72	250	18
4 - T12 - 34	UC Office 2nd floor	32	144	500	2304
Sodium Lights	UC Storage Room	23	250	140	805
				TOTAL kWh:	11996.234
				Price per kWh:	0.21
				TOTAL COST:	2,519.21

Results

Lighting Control Technology

nLight® AIR rPODB: Battery powered, Wall Switch

- Powered with three AAA Lithium size batteries and rated for 10 years of normal use
- Communicates with nLight® AIR devices via radio frequency
- Wireless multi location dimming
- **Cost**: $53.30

nLight® AIR rCMS Ceiling Mounted Smart Sensor

- nLight AIR-enabled wireless ceiling/surface mount occupancy sensors provide a range of sensor solutions for applications with finished ceilings
- Digital PIR detection
- Control of fixtures individually or in groups.
- **Cost**: $173.35

Results (cont'd)

LED Technology from Lithonia Lighting Quoted from CJS Lighting May 2018

LED Troffers

Lumens: 4,529
Watts: 32W
Cost per Fixture: $190
Controls: nLight compatible, Motion Sensor Compatible
Description: The BLTR LED Relight Assembly is a cost effective solution for renovating existing fluorescent troffer and parabolic fixtures while providing upgraded aesthetics and outstanding performance. The wide range of lumen packages and control and driver options make the BLTR a great choice for many applications including offices, schools, hospitals, retail spaces and other general lighting applications.

Lumens: 4,500
Watts: 33.2Wh
Cost per Fixture: $272
Controls: nLight compatible, Motion Sensor Compatible
Description: — The VT Series Volumetric LED Troffer (VTL) combines the aesthetics and high performance with intelligent LED engines for applications such as offices, schools, retail locations and hospitals. High-efficacy light engines deliver long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable.

Lumens: 4,000
Watts: 32.4W
Cost per Fixture: $172
Controls: Generic Dimming Controls, Motion Sensor Compatible
Description: LBL LED wraparound provides a digital lighting platform to deliver general ambient lighting for surface-mount applications. The LED system delivers long life and excellent color to ensure a quality, low-maintenance lighting installation. Ideal for closets, storage rooms, hallways, stairwells and offices.

LED High Bays

Lumens: 22,000
Watts: 166W
Cost per Fixture: $212
Controls: Motion Sensor Compatible
Description: Ideal one-for-one replacement of conventional lighting systems such as HID and fluorescent. For use in light Industrial applications such as, warehousing and other large indoor spaces with mounting heights ranging from 10' LSXR Sensor option provides increased energy savings.

Lumens: 24,000
Watts: 172W
Cost per Fixture: $370
Controls: 0-100% Dimming, Zone Control, Bluetooth
Description: Ideal one-for-one replacement of conventional HID and fluorescent high bay systems. Applications include warehousing, manufacturing, gymnasiums, and other large indoor spaces with mounting heights up to 60'.
XPointTM Wireless technology creates a mesh network to ensure communication between fixtures, sensors and wall stations facility-wide. This option provides superior lighting management capabilities including granular control, configuration and custom grouping for increased energy savings.

Projected Energy Audit with New Lighting Technology

Item	Location	Count	Power per Appliance (W)	Annual Usage Hours	Annual Energy Use (kWh)
Field Station					
AV8 - 4 - 132	Bathrooms	6	32	446	85.632
PVSL60 Shower Light	Bathrooms	4	26	116.5	12.116
New LED's	Entryway	5	32	466	74.56
New LED's	Hallways	17	32	466	253.504
New LED's	Offices/Misc	8	32	116.5	29.824
New LED's	Offices/Misc	4	32	116.5	14.912
New LED's	Offices/Misc	8	32	116.5	29.824
New LED's	Kitchen	3	32	699	67.104
New LED's	Living Room	7	32	466	104.384
New LED's	Living Room	8	32	466	119.296
New LED's	Bedrooms	11	32	185	65.12
New LED's	Bedrooms	10	32	185	59.2
Warehouse					
New LED's	Mining Gym	14	32	125	56
New LED's	Mining Hallway	8	32	280	71.68
New LED's	Mining Hallway	1	32	280	8.96
New LED's	Mining Locker Room	27	32	96	82.944
New LED's	Mining Locker Room	1	32	96	3.072
New LED's	Mining Office 1st floor	6	32	500	96
New LED's	Mining Office 2nd floor	29	32	1500	1392
LED High Bays	Mining Storage Room	23	170	384	1501.44
New LED's	Shared bathroom 2nd floor	2	32	375	24
New LED's	UC Bathroom	1	32	125	4
New LED's	UC Common Room	15	32	200	96
New LED's	UC Hallway	1	32	250	8
New LED's	UC Office 2nd floor	32	32	500	512
LED High Bays	UC Storage Room	23	170	140	547.4
				TOTAL kWh:	5318.972
				Price per kWh:	0.21
				TOTAL COST:	1,116.98
				POTENTIAL SAVINGS	$1,402.23 per year

Lighting Option	Hourly Usage	Count	Up front Cost	Pge Rebate	Yearly Energy Savings*	Payback**
IBE High Bay	Occupancy Data	46	$10,017	$55/fixture	$202.00	37 years
IBG High Bay	Occupancy Data	46	$17,401	$55/fixture	$202.00	74 years
LBL4 Troffer	Occupancy Data	137	$23,048	$21.265/fixture	$887.00	23 years
2BLTR Troffer	Occupancy Data	81	$15,390	$21.295/fixture	$887.00	16 years
2VTL Troffer	Occupancy Data	81	$22,032	$22.50/fixture	$887.00	23 years

* Yearly Energy Savings assume an average LED troffer wattage of 32W and LED High Bay wattage of 170W
**Payback time does not include installation fees and cost of lighting technology. PGE Rebates, price per kWh, and occupancy patterns are subject to change and impact final savings

Conclusion

Based on our findings, this retrofit has the potential to produce positive annual energy savings. Although the payback period isn't ideal, it can be shortened by using lighting options that do not have occupancy sensing capabilities integrated into the fixture. In other words, getting cheaper fixtures would lower the payback period. Due to the limited timeframe that we were given, the lighting retrofit we conducted is limited in vendor options, so we suggest contacting more vendors and looking at what other vendors (besides CJS) have to offer. Additional cost, such as installation fees, were not taken into account for this retrofit and may also significantly impact the payback period, so we suggest taking these factors into account as well in the future.

References

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