Donahue Schriber SmartCast™ Lighting Project

ET14SMUD1045

Sacramento Municipal Utility District

SMUD™

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About the Customer Advanced Technologies Program…

SMUD's Customer Advanced Technologies (C.A.T.) program works with customers to encourage the use and evaluation of new or underutilized technologies. The program provides funding for customers in exchange for monitoring rights. Completed demonstration projects include lighting technologies, light emitting diodes (LEDs), indirect/direct evaporative cooling, non-chemical water treatment systems, daylighting and a variety of other technologies.

For more program information, please visit:
https://www.smud.org/en/business/save-energy/rebates-incentives-financing/customer-advanced-technologies.htm

1. Executive Summary

Last July, the latest version of California Title 24 Energy Standards went into effect. These new standards include some tough new requirements for interior commercial lighting applications (e.g. dimming), which may encourage more people to choose LED troffers instead of fluorescent for office applications. Fortunately, manufacturers now offer a wide variety of LED fixtures with impressive features; they're fully dimmable, have efficacies of over 105 lumens per Watt and up to ten year warranties.

Recently Cree© introduced LED fixtures with an integrated wireless control system known as SmartCast™. The SmartCast system includes motion sensors, daylight harvesting sensors and wireless communication already built into the fixtures. Unlike many other wireless control systems, SmartCast does not require the installation of computer software, routers, or gateways. Instead, all of the programming is completed via a user-friendly remote control (Figure 1). Users can use the remote to set up control groups, set task tuning levels, adjust the sensitivity and time delays for the motion sensors. Unfortunately, SmartCast does not currently have energy monitoring or automatic demand response (ADR) capabilities.

Figure 1: Cree SmartCast fixtures include integrated motion sensors, daylight harvesting sensors and wireless communication.

During 2014, SMUD worked with Donahue Schriber, a real estate acquisition and development firm, to test the SmartCast system. The project included replacing the existing fluorescent lighting with SmartCast LED fixtures. SMUD hired ADM Associates Inc. to monitor the energy consumption before and after the lighting retrofit and evaluate the overall performance of the new lighting system. ADM also conducted surveys with installers and employees in order to gather their opinions regarding the new LED lighting system. Overall, the results of this project were very favorable:

- Lighting energy consumption was reduced by 59%.
- Peak electrical demand was reduced by 61%.
- Feedback obtained from the surveys was also very favorable towards the new lighting. *Employees said they liked the more natural-looking color of the new lighting and the reduced glare.*
- The installers said the lighting fixtures were very simple to install and programming the controls took much less time than anticipated.

However, one major roadblock was identified—high first cost. Replacing fluorescent troffers with LED fixtures in an occupied office is a labor intensive, expensive process. Although Donahue Schriber received a generous research grant that resulted in a simple payback of 3.5 years, the simple payback without the grant would have been totally unacceptable for most commercial customers (over 26 years). Fortunately, Cree now offers much lower priced options than the fixtures chosen for this particular project.

2. Project Description

2.1 Background

Donahue Schriber's Sacramento office is occupied by 17 employees. The majority of the employees work in cubicles in the open office area. The remaining employees have private offices surrounding the cubicle area. There are also two hallways and a front lobby. This project included replacing the light fixtures in the cubicle area and the adjacent hallway.

The original lighting system for the cubicle areas and the hallway consisted of twenty-five, 2 ft. x 4 ft. fluorescent troffers (Figure 2). The lights operated approximately 3,170 hours per year. After reviewing several product options, Donahue Schriber hired Century Lighting & Electric to install Cree's CR Series LED Architectural Troffers equipped with SmartCast controls (Figures 3 and 4). Manufacturer's information is listed below.

- Model: CR24HE LED
- 32 Watts @ 100% output
- 4000 lumens (initial)
- CRI: 90
- CCT: 4000K
- 120 LPW
- 100,000 hours rated life (L70)

Figure 2: Original Fluorescent Lighting Fixtures

Figure 3: LED Architectural Troffers

Figure 4: New LED Lighting Fixtures

2.2 Assessment Objectives

SMUD hired ADM Associates Inc. to monitor the energy consumption before and after the lighting retrofit and evaluate the overall performance of the new lighting system.

2.3 Methodology

ADM monitored the common area energy use at the electrical panel before and after the lighting retrofit. Some of the circuits also had other loads on them which were subtracted out prior to the analysis. There were four components of the study.

1. Lighting power consumption was measured at the breaker panel using WattNode Watt-hour transducers and high accuracy split-core current transducers (CTs) placed inside the panel (Figure 5). The system was set to record energy use in 5-minute intervals for a month of baseline (original lighting) and two months with the new lighting.

2. Light level measurements at various locations in the office to compare before and after conditions.

3. Employees were surveyed after the new lights were installed to get their feedback on the lighting systems. In total, 10 of the 17 employees in the building completed the post-retrofit survey. The survey topics included:
    - Position and tenure at the company;
    - Time spent in cubicle area;
    - Adequacy of the old and new lighting for performance of job duties;
    - Perceptions of flickering, glare, and noise from the old and new lights;
    - Perceptions of brightness and pleasantness of the old and new lighting during daytime; and
    - Overall satisfaction with the old and new lighting systems.

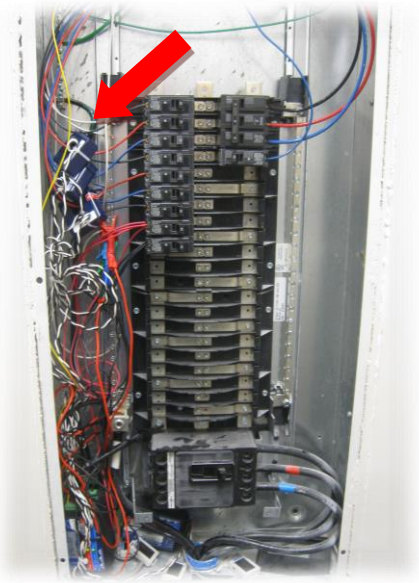

Figure 5: Split-core Transducers Placed in the Breaker Panel

4. Lighting installers were interviewed after retrofit to ask about ease of installation and any problems that may have occurred (see Section 3.4 for more information).

3. Results

3.1 Energy Monitoring Results

The baseline monitoring period (original lighting) took place between 6/26/14 and 7/29/14 and the new LED lighting monitoring period took place between 8/4/14 and 10/3/14. Based upon the monitoring data, typical day load profiles were created for weekdays and weekends. The average weekday profiles are shown in Figure 6. These monitored average load profiles were used to determine normalized savings for a typical year consisting of 253 weekdays. Holidays were counted as weekends. The results of the study show a 59% reduction in annual lighting energy consumption, as well as a 61% reduction in peak demand use (see Table 1).

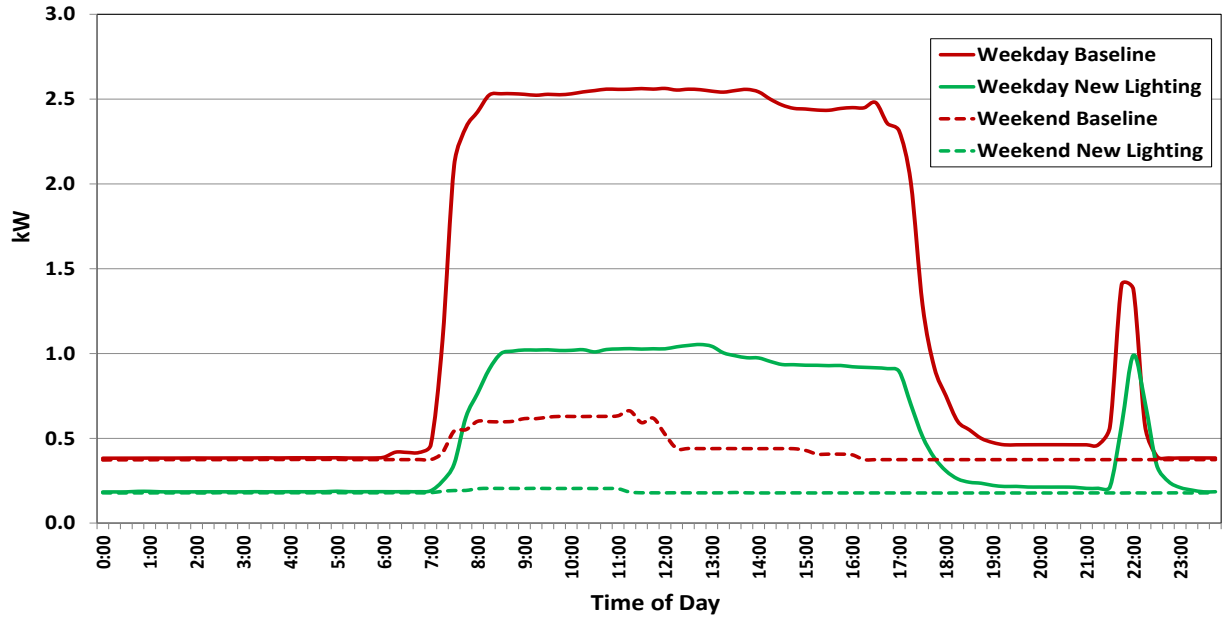

Figure 6: Typical Weekday and Weekend Day Lighting Load Profiles

Table 1: Results

	Annual Energy, kWh	Peak Period Demand, kW
Original Lighting	9,192	1.39
New Lighting	3,742	0.54
Savings	5,449	0.85
Percent Savings	59%	61%

Peak period demand savings are calculated as the average savings during June through the end of September between 4:00PM and 7:00PM. The peak savings were taken to be the average difference between baseline and new lighting monitoring periods recorded on non-holiday weekdays between 4:00PM and 7:00PM. The results are shown in Figure 7.

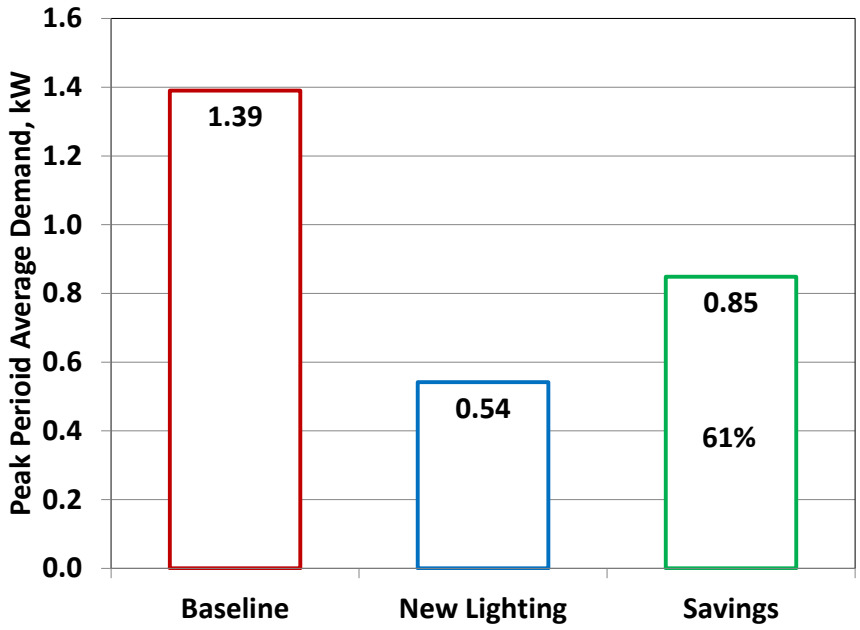

Figure 7: Average Peak Period Demand

3.2 Lighting Level Measurements

Light level measurements were made in eleven locations around the office with the original lighting on and after the new lighting were in place and adjusted for normal operation. The baseline lighting level measurements ranged from 27 to 59 foot-candles (fc) and averaged 44 fc. The new lighting level measurements ranged from 19 to 45 fc and averaged 31 fc. Although the lighting level was less with the new lighting it was because the lighting had been dimmed to meet the needs of the occupants.

3.3 Survey Results

In terms of qualitative assessment of the lighting retrofit the employee survey results were very positive. Key findings from the surveys include:

- Overall, people found the new lighting system to be more pleasant than the old lighting system.

- All of the people who took the survey both before and after the new lighting was installed said that the brightness of the cubicle area was better with the new lighting system.

- Employees were asked if the new lighting is better, about the same, or worse than the old lighting in three categories: the amount of glare, the brightness, and the pleasantness. Seventy-five percent of surveyed employees said the new lighting was better while 25% said the new lighting was about the same as the old lighting (Figure 8).

- Survey participants identified other specific benefits of the new lighting, including the natural color of the lighting and less glare.

- When asked overall, how satisfied were they with the lighting in the cubicle area, seven of the ten employees surveyed said they were very satisfied while three said they were neither satisfied nor dissatisfied (Figure 9).

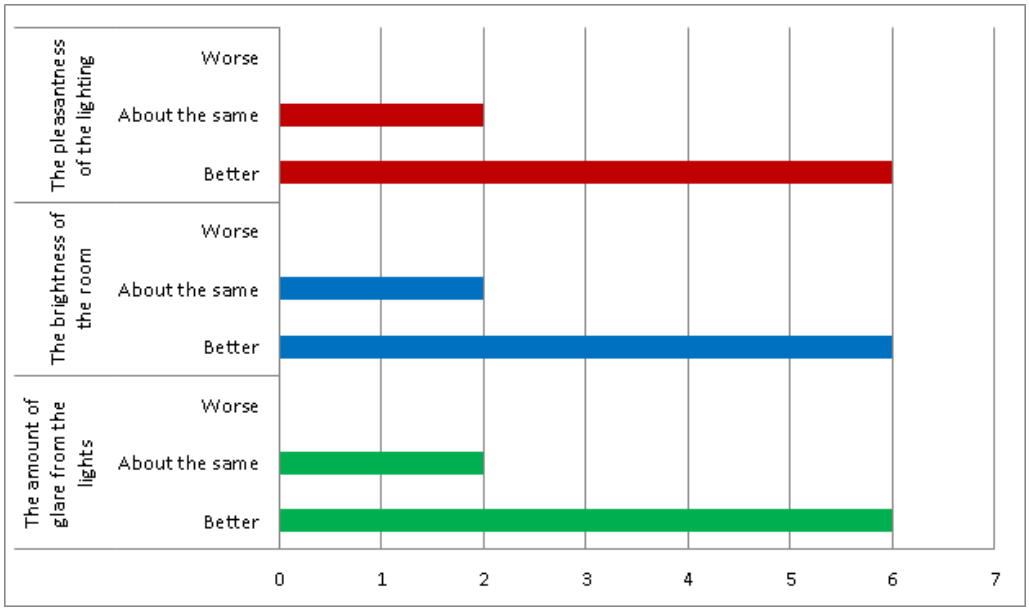

Figure 8: Employees' Perception of the New Lighting

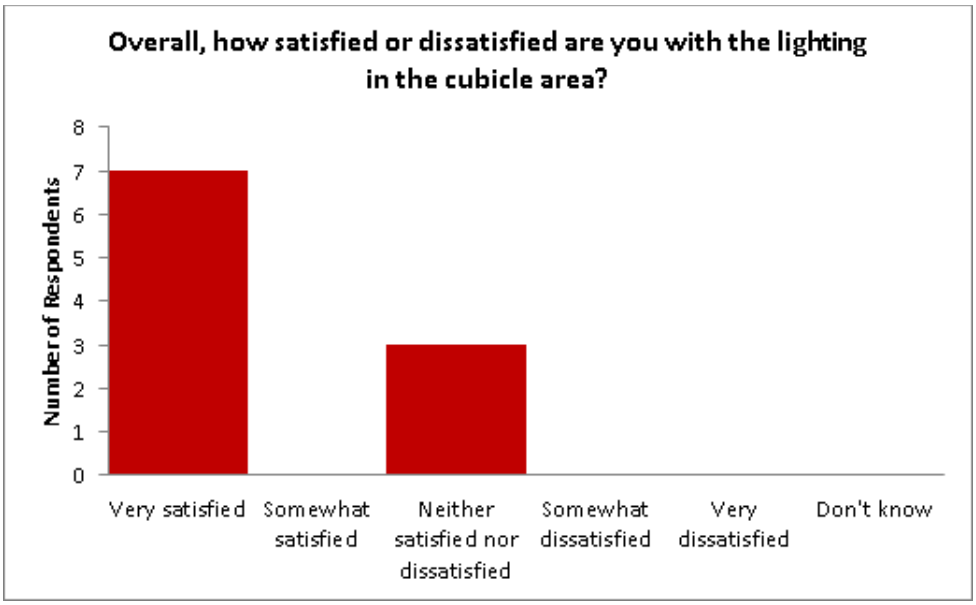

Figure 9: Satisfaction Level of Employees

Donahue Schriber employees were more satisfied with the new lighting than the old. Nearly all interviewed individuals thought that the pleasantness, brightness of the room, and the amount of glare was better with the new lighting as well. At various points during the survey, participants were asked to provide open-ended comments about the new lighting that was installed. These comments were overwhelmingly positive and indicate that the new lighting was a significant improvement that enhanced the attractiveness and usability of the room.

Additionally, many of the comments referenced the fact that the new lighting makes the office appear to be naturally lit. Some of the comments are as follows:

> *"I like the lighting as there is less glare than the old lighting. I also like the look of the new fixtures, they're more modern looking."*
>
> *"I can't wait for the same installation of lighting in my office!"*
>
> *"Color is more natural."*

3.4 Installer Interview Results

The results from the lighting installer (Century Lighting & Electric) interviews were very favorable. Installers said the lighting was very simple to install, took less time than anticipated, and was easy to explain to Donahue Schriber's employees. Century's electricians did have to contact Cree for technical support because there was an issue adding a fixture to the existing network, but it was easily resolved. The installer did offer a suggestion for how Cree could improve the product and installation. They suggested that Cree produce a quick clip system for existing seismic wire connections. Overall, the lighting installer responses were very positive.

3.5 Economics

The cost of lighting systems using new technology is often expensive, sometimes simply because the economics of volume manufacturing have not kicked in. The cost of material and installation for this case study was $17,260. The customer received a grant for participating in the study and their cost was $2,260. Using an average of $0.12/kWh the 5,449 kWh in annual energy savings translates to $654 per year. The customer's simple payback is 3.5 years. Unfortunately, without the SMUD grant the payback period would have been completely unacceptable (over 26 years).

4. Conclusion

Retrofits of fluorescent lighting with LED lighting systems in office buildings and other commercial facilities may be an effective way to improve the user experience while generating substantial energy savings. The results of this study show a 59% reduction in annual lighting energy consumption, as well as a 61% reduction in peak demand use. Additionally, feedback from end users and the installers was very favorable.

On the downside however, high first cost continues to be a major barrier to widespread market adoption—at least for retrofit applications. The economics would likely be much more favorable for new installations since it would be much easier to justify the incremental costs between dimmable fluorescent lighting and the Cree SmartCast system rather than the entire cost of the project. Furthermore, Cree now offers much lower priced options than the fixtures chosen for this particular project. Please contact your local representative to obtain the latest information.