ACC Senior Services LED Lighting Study

ET13SMUD1032

Sacramento Municipal Utility District

November 21, 2014

Prepared by:

ADM Associates, Inc.
3239 Ramos Circle
Sacramento, CA 95827

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 3
2. PROJECT DESCRIPTION.....5
3. RESULTS 8
4. DISCUSSION 10
5. CONCLUSION.....11

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

It is no secret that LED technology is revolutionizing the lighting industry. Today manufacturers offer a wide variety of LED fixtures for just about every possible application. Some of these products offer impressive performance; fully dimmable, efficacies of over 105 lumens per Watt and full ten year warranties. Despite these potential benefits, however, some of these products produce harsh-looking light and excessive levels of glare. This can be a significant problem—especially for senior citizens who tend to require higher light levels yet are very sensitive to glare.

In 2013, ACC Senior Services (formerly Asian Community Center) decided to upgrade their dining room by installing new flooring, new ceiling tiles and a state-of-the-art LED lighting system. Since ACC provides health care services and housing to senior citizens, the project had to meet requirements set by California's Office of Statewide Health Planning and Development (OSHPD). SMUD assisted ACC by providing lighting design and project funding support via a Customer Advanced Technologies program research grant.

The new lighting system includes wall-mounted and suspended LED fixtures with indirect-direct lighting distribution (Figure 1), as well as recessed LED downlights for the countertop areas. All of the new lights are dimmable and controlled by a touch pad screen.

Figure 1: The new lighting system included state-of-the-art suspended LED fixtures with indirect-direct lighting distribution and touchpad controls

Replacing the original surface-mounted fluorescent fixtures with suspended LED fixtures proved to be quite a challenge!

- The original fixtures were mounted to the ceiling in continuous rows. Each of the 4ft. fluorescent fixtures was anchored to the ceiling with four bolts. As expected, when the fixtures were removed, the ceiling tiles were discolored and covered with dozens of holes. Since matching tiles were not available, the tiles needed to be replaced.

- Removal of the old ceiling tiles was a daunting task—since the old tiles were glued to the ceiling, the old glue had to be manually chiseled off (Figure 2).

- The new lighting system required installing new structural supports, electrical conduit, electrical outlet boxes and control wires. All of this work had to be performed above the ceiling in an insulated attic (Figure 3).

Figure 2: Removal of ceiling tiles was a daunting task when it was found they were glued to the ceiling and the old glue had to be chiseled off.

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. Additionally, ADM conducted surveys with ACC residents, their family members, and ACC employees in order to gather their opinions about both the old and new lighting systems.

Although this was a very challenging project, the results were very favorable; lighting energy consumption was reduced by 48% and peak electrical demand was reduced by 55%. Survey participants said that they really liked the overall appearance of the dining room lights and loved the easy-to-use lighting control panel (Figure 4).

Figure 3: The new lighting system required installing new structural supports, electrical conduit, electrical outlet boxes and control wires. All of this work had to be performed above the ceiling in an insulated attic.

Acknowledgments

While many people contributed to the success of this project, we particularly appreciate the efforts and support from the following individuals:

- Melanie Henderson (ACC)
- Jeff Clay (ACC)
- Gary Tinseth (Unger Construction)
- Daniel Buffum (Unger Construction)
- Steve Henning (Shetter Electric)
- Toby Fry (Schetter Electric)
- Obadiah Bartholomy (SMUD)
- Connie Samla (SMUD)
- Vicky Zavattero (SMUD)
- Manny Ramos (Silva Stowell)

Figure 4: Incorporating a user-friendly control panel into an LED lighting system also provides several energy and user experience benefits. Building occupants are able to select from several preset lighting configurations, or "activity settings," that vary in dimming level, lighted area, and level of direct vs. indirect light.

2. Project Description

2.1 Background

The ACC Senior Services health care facility provides assisted living for up to 99 senior citizens. Three meals a day are provided to the residents in a dining room with tables in a formal setting. The dining room is also used as a recreation room, learning, wellness and entertainment centers. An alcove portion of the room has a large screen TV which the residents use as a movie theater.

The original dining room lighting system consisted of 52 three-lamp, surface-mounted fluorescent fixtures mounted in continuous rows. Based upon monitoring data, the lights in the dining room were operated approximately 4,474 hours per year. Although the original system was fairly energy efficient, it was very industrial looking (Figure 5) and could not be dimmed. Because of these limitations, the original system did not provide many options for controlling the lighting during the various activities taking place in the dining room. The original lights also produced a lot of glare on the surface of the tables. This was a significant problem since many senior citizens tend to be very sensitive to glare.

After surveying the site and meeting with ACC staff members, the SMUD team began to explore several design options. ACC wanted to use energy-efficient LED fixtures and improve the look and feel of the dining room. Ultimately, the project team created a new lighting design which included the following:

- Removal of the existing fluorescent fixtures and installing dimmable, suspended LED lighting fixtures with 80% direct light and 20% indirect lighting (reflected off the ceiling). The new fixtures were installed in diagonal rows across the room.
- Installing wall-mounted LED fixtures in the alcove area used for movies and recessed LED downlights over the counter top areas.
- Installing user-friendly, touch screen controls to replace multiple wall switches. The touch screen buttons were labeled for the types of activities taking place in the room. The settings control both the number of fixtures and the dimming levels for each activity.

Figure 5: Although the original lighting system was fairly energy efficient, it was very industrial looking and could not be dimmed. This did not provide many options for controlling the lighting during the various activities taking place in the dining room.

After reviewing manufacturer literature and examining sample products, the team chose to use the following:

- Main dining room: Twenty 8ft. and three 4ft. Philips BoldPlay™ LED suspended fixtures (Figure 6)
  - 46.7 Watts / 4ft.
  - 3747 Total lumens/4ft. (4800 lumen model)
  - 83 CRI, 4000K
  - 80.2 LPW
  - 60,000 hours rated life (L^{80})
  - External LED driver with 0-10V input

- Wall mounted: eight Philips BoldPlay LED fixtures (Figure 7)
  - 41.3 Watts / 4ft.
  - 3384 Total lumens/4ft. (3400 lumen model)
  - 84 CRI, 4000K
  - 81.9 LPW
  - 60,000 hours rated life (L^{80})
  - External LED driver with 0-10V input

- Ceiling recessed downlights: five Philips Calculite™ LED fixtures (Figure 8)
  - 14.6 Watts
  - 1078 lumens
  - 80 minimum CRI, 4100K
  - 73.8 LPW
  - 60,000 hours rated life (L^{70})
  - External LED driver with 0-10V input

- Creston Green Light Controller
  - Touchscreen panels
  - Activity settings
  - Occupancy sensors
  - Daylight harvesting sensors (photo sensors)

Figure 6: Philips BoldPlay indirect/direct LED fixtures (suspended)

Figure 7 Philips BoldPlay indirect/direct LED fixtures (wall mounted)

Figure 8: Calculite LED downlights

2.2 Assessment Objectives

The goal of this study was to understand the performance characteristics of the LED lighting system in the ACC Senior Services dining room. This assessment included monitoring the energy consumption and obtaining feedback from ACC's staff members, residents, and visiting family members.

2.3 Methodology

Lighting power and energy consumption were measured using an Enernet meter recorder (model K20) and high-accuracy, split-core current transducers installed at the electrical breaker panel. The system was set to record energy use in 5-minute intervals. ADM obtained measurements before and after the new lighting system was installed.

Employees, residents, and family members were surveyed before and after the new lights were installed to get their feedback on the lighting systems. Survey topics included:

- Tenure at the facility or visiting family at the facility;
- Uses of the dining room;
- Adequacy of the old and new lighting for various activities;
- 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 evening hours; and
- Overall satisfaction with the old and new lighting systems.

In total, 8 residents, 10 resident family members, and 18 employees responded to the pre-retrofit questionnaire, while 9 family members, 10 residents, and 18 employees completed the post-retrofit questionnaire.

3. Results

3.1 Energy Monitoring Results

The original lighting system was monitored between 1/25/14 and 4/14/14 (baseline monitoring period). Monitoring of the new LED lighting system took place between 5/15/14 and 6/18/14. Based upon the data, typical day load profiles were created for weekdays and weekends. The average weekday profiles are shown in Figure 9, and the average weekend profiles are shown in Figure 10. These monitored average load profiles were used to determine normalized savings for a typical year consisting of 261 weekdays and 104 weekend days. Holidays were counted as weekdays.

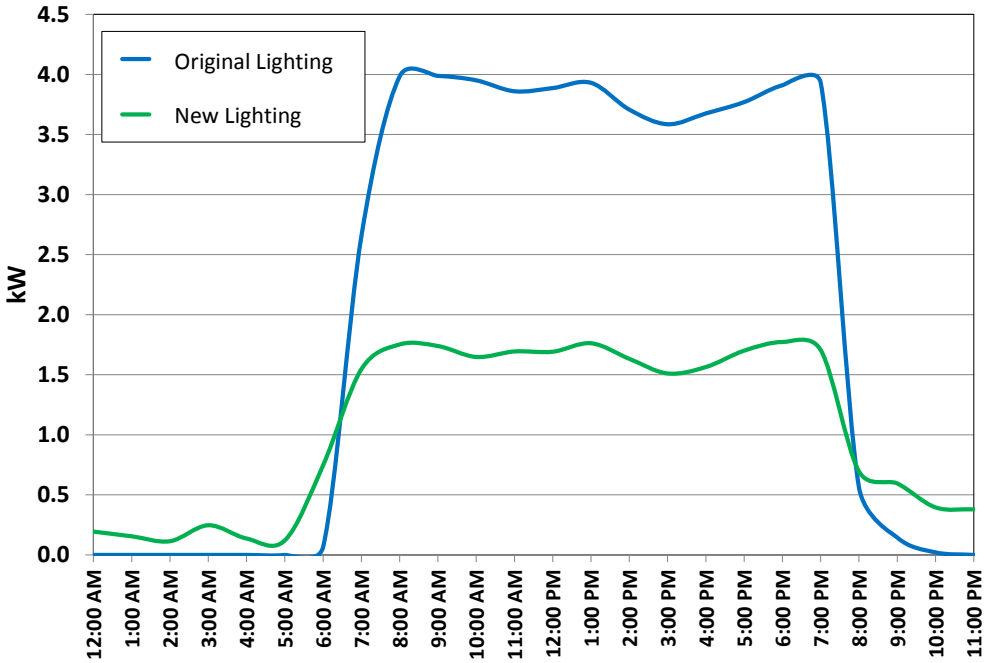

Figure 9: Typical Weekday Lighting Load Profile

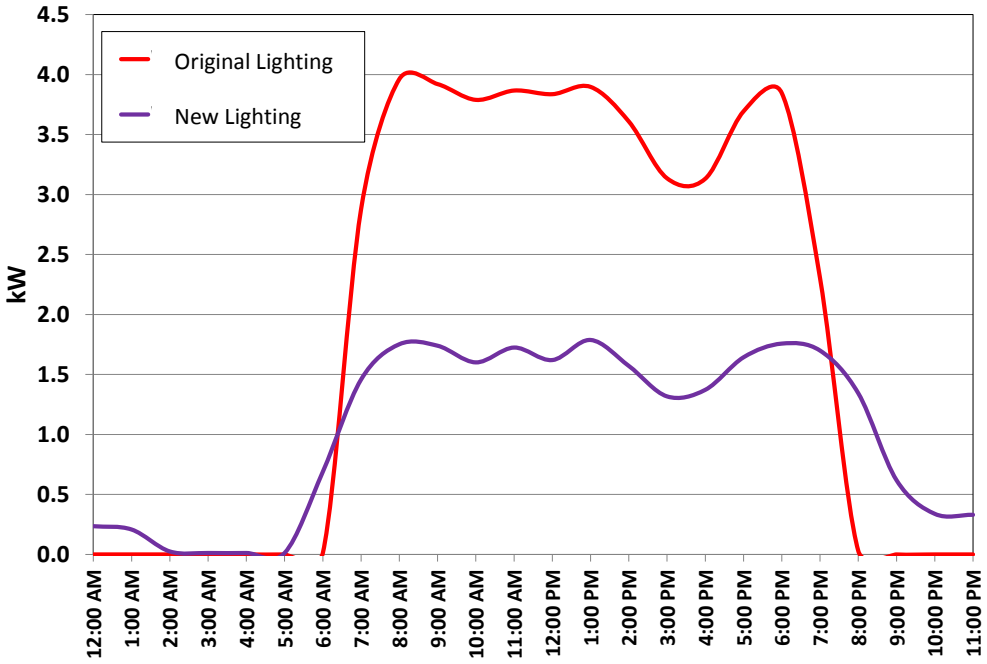

Figure 10: Typical Weekend Day Lighting Load Profile

The results of the study show a 48% reduction in annual lighting energy consumption, as well as a 55% reduction in peak demand use (Table 1). Peak period demand savings are defined as the average savings during June through the end of September between 4:00PM and 7:00PM. The peak savings were assumed to be the average difference between pre and post monitoring points recorded on weekdays between 4:00PM and 7:00PM.

	Annual Energy, kWh	Peak Period Demand, kW
Original Lighting	17,697	3.93
New Lighting	9,237	1.77
Savings	8,461	2.16
Percent Savings	48%	55%

Table 1: Project Results

3.2 Survey Results

In terms of qualitative assessment of the lighting retrofit, the resident, employee, and resident family member 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.
- All of the people who took the survey both before and after the new lighting was installed said that the brightness of the dining room was better with the new lighting system.
- Some people had noticed glare, flickering, and buzzing sounds from the old lights, but none of the surveyed residents, employees, or resident family members reported these problems with the new lights.
- Survey participants identified other specific benefits of the new lighting, including the dimming capability, the easy-to-use control panel, and the overall appearance of the dining room lights.

Figure 11 shows how satisfied the different groups were with the new and old lighting systems. Satisfaction with the lighting increased from an average of 53% to 94% after the installation of the new lighting system.

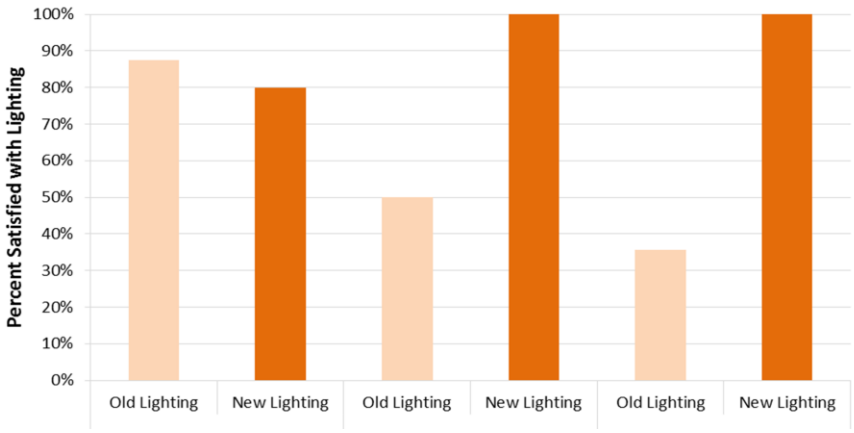

Figure 11: Satisfaction survey results for ACC employees, residents and their family members.

4. Discussion

Although the lighting retrofit experienced delays due to OSHPD engineering and inspection requirements, the result has been very well-received and can be considered a success. Overall satisfaction levels increased from an average of 53% to 94% after the installation of the new lighting system.

Nearly all interviewed individuals thought that the pleasantness, brightness of the room, and the amount of glare was better with the new lighting than the old. 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 indicated that the new lighting system was a significant improvement that enhanced the attractiveness and usability of the room. Additionally, many of the comments referenced the fact that with the new system, the lighting levels can be adjusted easily via the user-friendly touch pad controls.

The occupancy and photosensors, combined with the programmable control panel have substantially decreased annual energy consumption. ACC staff members appear to be receptive of the retrofit, and their active use of the control panel has likely contributed to the effectiveness of the new system.

5. Conclusion

Retrofits of fluorescent lighting with LED lighting systems in health care and other commercial facilities may be an effective way to improve the user experience while generating substantial energy savings. Installation of a lighting control panel is appealing, as it provides a simplified point of interaction for building occupants and allows for energy usage reduction through pre-set "activity modes." Facility managers may find it useful to seek advice and guidance from their utility company in the best way to approach this type of project.

LED retrofits and controls are currently eligible for commercial energy efficiency incentives. For more information, please visit www.SMUD.org.