Design & Engineering Services

Demand Reduction and Energy Savings Potential of Integrated Dimming Ballast Controls in Mid-Size Retail Facilities: PetSmart Stores

Customer Report

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What's Inside...

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Acknowledgements

Southern California Edison's Design & Engineering Services (D&ES) group is responsible for this project in collaboration with the Tariff & Program Services (T&PS) group. It was developed as part of Southern California Edison's Demand Response, Emerging Markets and Technologies program under internal project number DR 08.01. D&ES project manager Doug Avery conducted this technology evaluation with overall guidance and management from Carlos Haiad of D&ES and Ishtiaq Chisti of T&PS. For more information on this project, contact doug.avery@sce.com.

ABBREVIATIONS AND ACRONYMS

EMS	Energy Management System
FC	Foot-Candles
kW	Kilowatt
kWh	Kilowatt-hour

EXECUTIVE SUMMARY

This project attempts to quantify the demand reduction and energy savings associated with continuous dimming ballasts with daylighting controls when deployed in mid-size retail facilities. A daylighting control system was installed at a recently opened PetSmart store to provide control in the retail portion of the store containing skylights. The daylighting system was integrated with the store energy management system (EMS) to provide greater energy savings and demand reduction capabilities from the continuous dimming ballasts.

There are 77 fluorescent lighting fixtures in the main retail area of the store. Of those, 25 fixtures form a line around the inside perimeter and are not controlled by the daylighting system. There are 52 six-lamp fluorescent fixtures that are controlled by the daylighting system which uses a single photocell as input. PetSmart can control the lighting schedule, and enable or disable the daylighting controls remotely from their headquarters in Phoenix, AZ.

The baseline electricity demand of the 52 fixtures is 9.2 kW. However, by leveraging the integration of the dimmable ballasts and the EMS controls the ballasts were dimmed to 90% of their full light output, which provided a demand reduction of 0.8 kW when no daylighting is available. The load profiles for the baseline and daylight controlled periods for a typical weekday are shown in Figure ES-1. The profile shows the daylighting system is working to reduce lighting load during the day. The monitored data shows a daily pattern that the lighting turns on just before 5:00 PM for about an hour and turns back off. This pattern is the result of an override of the EMS to bring the lights on. This temporary override has since been corrected. The results of the analysis of the load profiles provide annual energy savings of 28,780 kWh.

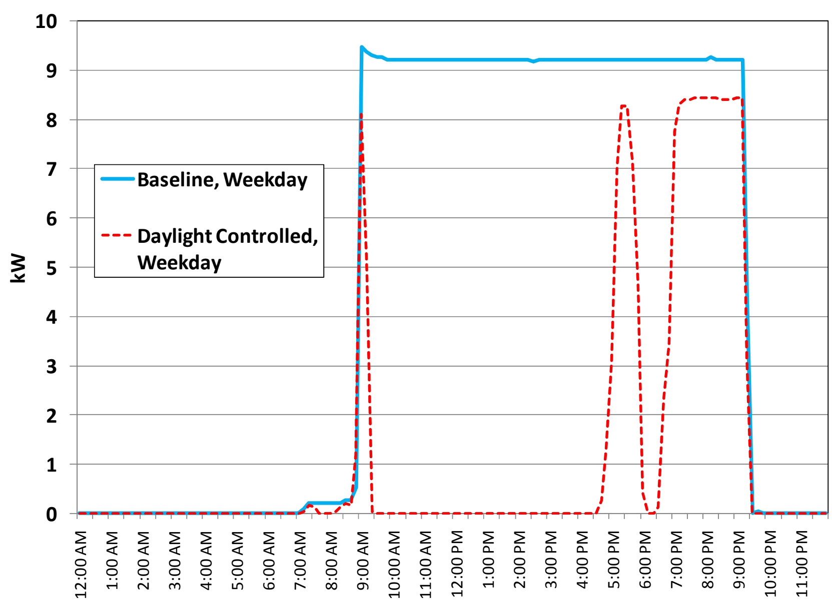

FIGURE ES-1 – LOAD PROFILE OF DAYLIGHT CONTROLLED FIXTURES FOR BASELINE AND CONTROLLED WEEKDAYS

1.0 ADDITIONAL INFORMATION

The test building for this project was a new construction site for PetSmart, located at 3900 Sisk Road, Modesto, CA, which was opened to the public in July of 2008. Typical store hours are Monday-Saturday 9am-9pm and Sunday 10am-6pm. The building is a one-story retail store with approximately 23,500 square feet. The sales area has 42, 4’x4’ skylights. There are 25 interior perimeter suspended seven-lamp fixtures and 52 six-lamp fixtures in the main sales area. The four-foot fluorescent lamps are 32 Watts and the dimming ballasts are electronic (Advance Mark 7, 0-10V, continuous dimming ballasts). The lighting fixtures are on 277 Volt circuits. PetSmart encountered some issues integrating the dimming ballasts into their energy management system (EMS), a Novar Savvy system, but the problems were resolved. Figures 1-1 and 1-2 show samples of the lighting system.

FIGURE 2-1 – LIGHTING TOWARDS THE FRONT OF THE STORE

FIGURE 2-2 – CLOSER VIEW OF LIGHTING AND SKYLIGHTS

On-site verification and monitoring of the loads verified the daylighting controls of the lighting worked. The power for several lighting breakers was monitored. PetSmart disabled the controls for a week so baseline lighting load energy use profiles could be collected. The baseline period used in the following analysis was from 8/22/08 to 8/28/08. The daylighting control period used in the analysis was from 9/4/08 to 9/10/08.

Figure 2-3 shows the EMS module, which also controls the lighting system, in the back electrical room. Figure 2-4 shows the monitoring equipment in lighting panel HA.

FIGURE 2-3 – ENERGY MANAGEMENT SYSTEM

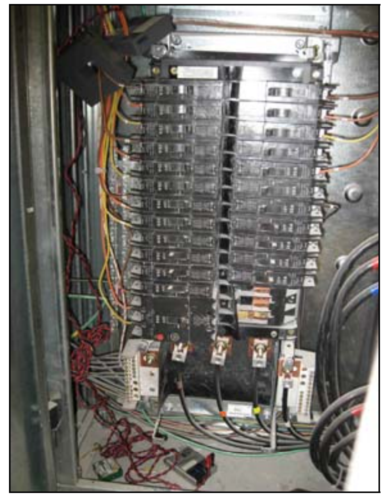

FIGURE 2-4 – LIGHTING PANEL HA WITH MONITORING EQUIPMENT

Lighting levels were measured with a hand held light meter. These measurements were taken at nine different locations in the sales area during mid morning and repeated for the three conditions reported in Table 1. The measurements were made at 4 feet above the floor. There were only two measurements that were below 50 foot-candle, which is the minimum level recommended by the Illuminating Engineering Society for reading small font. Both were toward the northwest side at the end of aisles. The store manager commented that there are dark spots in the showroom corners.

TABLE 1. LIGHTING LEVEL MEASUREMENTS.

Light Level	Daylight + 100% On	Daylight + 50% Dimmed	Daylight + Lights Off
Minimum	62 fc	66 fc	25 fc
Maximum	140 fc	118 fc	84 fc
Average	112 fc	98 fc	61 fc

The analysis of the average lighting load profiles, shown in Figure 1, indicated that the daylight fixtures would use 114.8 kWh of energy on weekdays (Monday through Saturday) for baseline comparison, while the average lighting load profiles for daylight controlled fixtures would use 30.3 kWh of energy on weekdays resulting in a savings of 84.5 kWh per day (74% reduction). On Sundays the energy use declined from 77.9 to 5.9kWh, a savings of 72.1 kWh per Sunday (93% reduction).

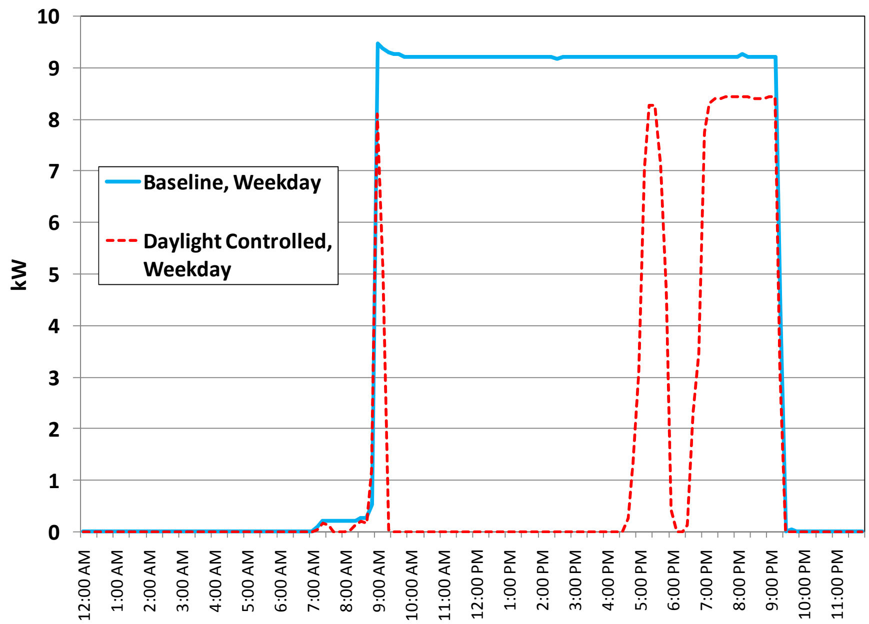

FIGURE 1 – LOAD PROFILE OF DAYLIGHT CONTROLLED FIXTURES FOR BASELINE AND CONTROLLED WEEKDAYS

The annual savings calculation also incorporated several corrections. The daylighting control monitoring period occurred in September approximately three weeks before the autumnal equinox. This necessitated a minor correction; estimating one hour of daylight that would not be utilized during two months in the summer resulted in a reduction of 550 kWh in annual savings. A weather correction based on 5% of the days reducing the daylighting available resulted in a reduction of 770 kWh of annual savings. The final calculation shows a system savings of 28,780 kWh per year. Additional savings may be obtained if a portion of the interior perimeter also is controlled by the daylighting system. The monitored data shows a daily pattern that the lighting turns on just before 5:00 PM for about an hour and turns back off. This pattern is the result of an override of the EMS to bring the lights on. This temporary override has since been corrected and is expected to result in an additional 2,400 kWh savings per year.

The integration of the dimmable ballasts with the EMS resulted in a 10% demand reduction from 9.2 kW to 8.3 kW as shown in Figure 1 for the hours when the lights are no being controlled by the daylighting controls.

2.0 CONCLUSION

The dimming ballasts and daylighting control system are working and providing significant energy and demand savings. The skylights provide a significant level of natural lighting. The estimated energy savings is 28,780 kWh per year, a 0.8 kW demand reduction when the lights are on and a 9.2 kW demand reduction during daylight hours.