Spectrally Enhanced Lighting: Santa Rosa Business Office Case Study

Spectrally enhanced lighting (SEL) is a lighting design technique that saves energy by changing the color of light to be closer to daylight. Buildings that are retrofitted with SEL can reduce their energy costs by 25–50%.

DOE research studies show that by simply shifting the color in fluorescent lamps from the warmer yellow end of the color spectrum to the cooler blue end of the spectrum, we can see things more clearly and spaces appear brighter. Therefore, when we change the color of light to be more like daylight, lighting levels can be reduced to save energy while still achieving the same visual acuity. In T8s with electronically ballasted fluorescent lighting systems, this translates to a 20 percent energy savings, and in T12s with magnetically ballasted systems, SEL can achieve a 50 percent savings.

After the 2001 California brownouts, PG&E sought out new ways to reduce electricity consumption and gave SEL a try in several California office buildings. The company was pleased with the results. A DOE Economics Validation Study gave PG&E the opportunity to gather more in-depth data while retrofitting the Santa Rosa business office in 2006.

Pacific Gas & Electric Company (PG&E) nearly cut in half the lighting electricity consumption at its Santa Rosa business office in California by retrofitting the 57,800-square-foot, one-story building with spectrally enhanced lighting. The project paid for itself in less than two years and occupants were pleased with the results.

The Upgrade

The Santa Rosa business office had a pre-retrofit lighting system that consisted primarily of 2x4-foot, three-lamp, 18-cell parabolic luminaires fitted with T12s that had a 735 lamp color. Approximately 1,700 overhead lamps with magnetic rapid-start ballasts were replaced in the business office, which houses 30 enclosed offices, 103 cubicles, and several conference rooms. All of the work was completed outside of business hours, with no disruption of office activity or productivity.

The lamps in all the fixtures were replaced with new Philips F32T8/ADV850/XEW lamps and the ballasts were replaced with electronic instant-start ballasts. Light-level measurements taken in a sample of workstations following the retrofit indicated that horizontal photopic light levels decreased by 20 percent.

Occupants were surveyed before and after the retrofit and there was no significant change in their satisfaction with the lighting. Furthermore, the use of task lighting did not change following the retrofit.

Conclusions

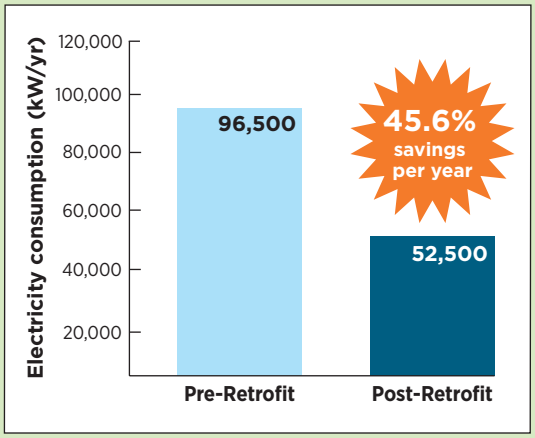
SEL technology reduced lighting energy consumption in the Santa Rosa business office by 45.6 percent and decreased annual lighting costs by nearly $18,000, meaning the retrofit paid for itself in 17 months. The retrofit did not disrupt business or productivity and occupants were satisfied with the results.

PG&E Superintendent Jack Rust recalls a brief period of adjustment to the new light, “but after about a week or so, I was pleased.”

Specifications (for the majority of fixtures)

	Pre-Retrofit	Post-Retrofit
Lamp	F34T12/SPEC35/RS/EW	F32T8/ADV850/XEW
Nominal lamp wattage	34	25
Temperature (Kelvin)	3500	5000
CRI	75	85
Lamp color	735	850
Rated photoptic lumens (P)	2800	2400
Ballast factor (BF)	0.88	0.77
Lumen output (PxBF)	2464	1848
S/P ratio	1.32	1.87
Visually effective lumens (PxBF) x (S/P).78	3060	3011
Measured connected load	37.7 W/lamp	20.5 W/lamp

Note: Ballast factor reflects dimmed lighting.



Total installed cost	$25,210
Annual savings from retrofit	**$17,921**
Payback (years)	1.41
Rate of return	71%

LIGHTING TERMS

For the most part, PG&E selected T8 fluorescent lamps with a temperature of 5000K and CRI in the 80s—also known as 850 lamps—for its retrofit of the Santa Rosa business office.

Correlated color temperature (CCT)—A measure of the color appearance of a white light source. It is measured on the Kelvin absolute temperature scale and commonly ranges from 2700K (warm white) to 8000K (sky white).

Color rendering index (CRI)—A measure of how a light source renders the colors of objects. CRI is given as a number from 0 to 100, with 80 being the minimum CRI recommended for interior lighting.

Electronic ballast and ballast factor (BF)—To improve energy efficiency, SEL technology usually includes Premium electronic ballasts designed to work with the new T8 or T5HO fluorescent lamps. Ballast factor (BF) is the factor applied to the rated lumens of the lamps and is a function of the lamp/ballast combination employed. When dimming ballasts are used, the dimmed BF should be used in all calculations.

T8—A type of fluorescent lamp. The "T" means it is tubular in shape and the "8" means the diameter is eight-eighths of an inch, or 1 inch. A T12 lamp is twelve-eighths of an inch, or 1.5 inches thick. T8 lamps have a better CRI and are more efficient than T12 lamps.

850—A number that combines the CCT and CRI into one number. The "8" in 850 references a CRI in the 80s and the "50" refers to a CCT of 5000K. A 741 lamp would have a CRI in the 70s and a CCT of 4100K.

For More Information

For more information about spectrally enhanced lighting, or to download complete technical reports about its feasibility and economics, visit www.eere.energy.gov/buildings/spectrally_enhanced.html.

EERE Information Center

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