Spectrally Enhanced Lighting: Sonoma State University 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%.

About an hour north of San Francisco, Sonoma State University is a relatively small public university in California's wine country.

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.

Sonoma State University took advantage of rebates and special financing to retrofit three-quarters of the campus with SEL. In addition to paying almost no out-of-pocket expenses for the energy-efficient upgrade, the university reduced lighting energy consumption in the retrofitted buildings by 42 percent.

In 2007, Sonoma State embarked on a project to retrofit the lighting in about a dozen of its buildings. The retrofit was designed to reduce wattage and energy use, particularly during periods of peak usage. Sonoma State paid no significant out-of-pocket expenses on the $1.25 million upgrade because of a $432,569 rebate from Pacific Gas & Electric Company (PG&E), coupled with positive cash flow financing from Chevron, an energy services company (ESCo), which allowed the university to pay for the upgrade through energy savings.

The Upgrade

About 75 percent of Sonoma State's buildings, or 864,900 square feet, were retrofitted with SEL technology. The original lighting was mostly basic-grade T8s, but also included U-bend basic-grade T8s, CW T12s, and T5HOs. For the most part, the original lamps had a CCT of 3500K and a CRI of 75. Where possible and convenient, the lighting was upgraded to high-performance T8s with a CCT of 5000K and a CRI of 85.

The $1.25 million retrofit, when coupled with the PG&E rebate, will pay for itself in three years. Lighting Wizards, a California-based energy solutions company, performed energy audits on the buildings, and Chevron, the ESCo, managed the lighting work.

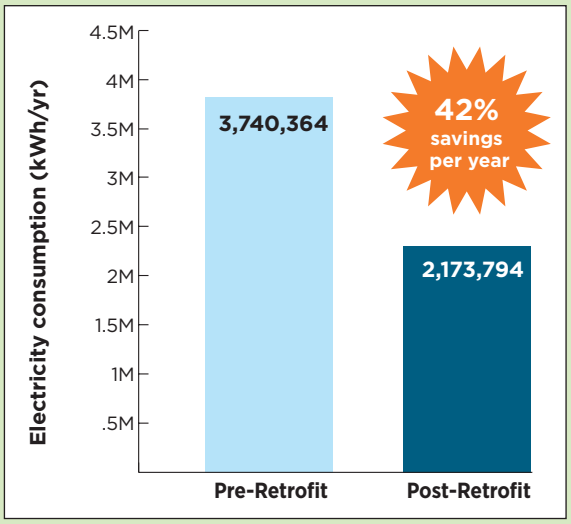
Conclusions

SEL technology reduced lighting energy consumption at Sonoma State University by nearly 1.6 million kWh each year, reducing lighting energy use by 42 percent in the retrofitted buildings. The improvements save Sonoma State $270,000 annually.

The university is pleased with the retrofit and plans to upgrade more lighting.

> "We will continue to change more (buildings) to increase energy savings, increase uniformity of lighting-type and Kelvin, and to add controls to many areas not included in the original work."
>
> Craig Dawson, Director
> Energy/Environmental Health & Safety, Sonoma State University

Specifications (for the majority of the fixtures)



Total installed cost	$1,250,000*
Annual savings from retrofit	**$270,000**
Payback (years)	3.0**
Rate of return	21.6%

	Pre-Retrofit	Post-Retrofit
Lamp	Basic grade F32T8s; 2', 3', and U-bend basic grade T8s; 4'–8' CW T12s, and some T5HOs	High-performance T8s
Nominal lamp wattage	32 for F32T8s	32 for F32T8s
Temperature (Kelvin)	3500	5000
CRI	75–78	80–85
Lamp color	735 for T8 lamps; 835 for T12 lamps	850
Rated photoptic lumens (P)	2800 for F32T8s	3100 for F32T8s
Ballast factor (BF)	0.88–1.10 for T8s	0.77, 0.88, 1.00 and 1.15 for T8s

Note: Ballast factor reflects dimmed lighting.

* *Sonoma State University paid insignificant out-of-pocket expenses because it earned rebates and ESCo financing.*

** *Includes a $432,569 rebate*

LIGHTING TERMS

Sonoma State University selected T8 fluorescent lamps with a temperature of 5000K and CRI in the 80s—also known as 850 lamps—to retrofit the majority of its buildings.

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 735 lamp would have a CRI in the 70s and a CCT of 3500K.

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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