Spectrally Enhanced Lighting: Alameda County 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%.

An energy audit revealed to officials in the California Bay Area's Alameda County that they could retrofit the lighting systems in nearly all of their government buildings with energy-efficient spectrally enhanced lighting and have the initial investment pay off in less than four years, saving electricity costs. The retrofit included the 1920s-era county courthouse.

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.

Alameda County's green motto is to strive for "a small impact on the environment and a huge impact on the quality of life for its citizens." Its 52-building lighting retrofit, completed in 2008, is doing just that. By changing to SEL technology, the county has reduced its carbon footprint, improved the quality of its lighting, and reduced electricity costs for its citizens. The lighting retrofit, which covered more than 3 million square feet and involved nearly 68,000 lamps, originated from an audit performed by Oakland, California-based energy-efficiency company Energy Solutions and was completed by Fluoresco, a lighting company headquartered in Tucson, Arizona.

The Upgrade

Alameda County's lighting retrofit involved a great many fixtures of varying type in a wide variety of different spaces with unique lighting needs. This meant the retrofit could not be simply one type of lamp, ballast, and fixture. For the most part, the county changed T8 fluorescent lamps with a 3500K CCT, which were installed in the 1990s, to T8s with a 5000K CCT (850 lamps). Where necessary, it retrofitted with third-generation Premium electronic ballasts.

Before retrofitting all of its buildings, Alameda County tested the SEL technology in its technical services department, the department that was managing the retrofit.

"We did one of the floors in our building, just to see what the effects were," said Matthew Muniz, P.E., Alameda County Energy Program Manager. "We found that they seemed brighter, and we liked it brighter. In fact, some people said the fixtures were too bright, so we unscrewed a few lamps. All in all, people really liked them once they got used to them."

The county moved forward with the retrofit, beginning in March 2008 and concluding at the end of the year. It even made sense to retrofit buildings the county leases, since it pays the electric bill.

LIGHTING TERMS

For the most part, Alameda County selected T8 fluorescent lamps with a temperature of 5000K and CRI of 85—also known as 850 lamps—for its retrofits.

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.

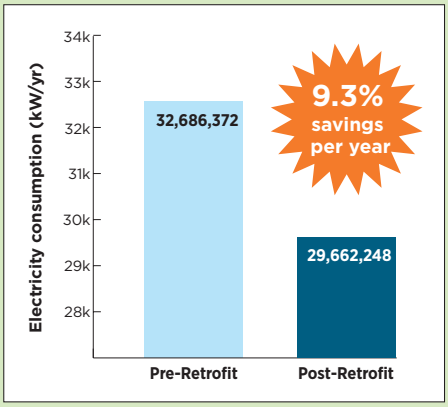
850—A number that combines the CCT and CRI into one number. The "8" in 850 refers to a CCT of 5000K. A 735 lamp would have a CRI in the 70s and a CCT of 3500K.

Results

Pre-Retrofit

Post-Retrofit

Specifications (for the majority of fixtures)



	Pre-Retrofit	Post-Retrofit
Lamp	T8	T8 (F032/850)
Temperature (Kelvin)	3500	5000
CRI	75*	82
Lamp color	735	850
Lighting level (foot-candles)	50	30

Approximate

Total installed cost	$1,792,446
Annual savings from retrofit	**$409,953**
Payback* (years)	3.56
Rate of return	23%

Includes one-time Energy Watch incentive of $332,459

Conclusions

Alameda County found that even though it had replaced the lighting in its county buildings with more efficient lamps in the 1990s, it made sense to retrofit with SEL technology in 2008. The county expects to recoup the cost of its $1.79 million lighting retrofit in less than four years.

The county's 9,000 employees have been pleased with the results of the retrofit. The few complaints to the energy programs department amounted to less than half a percent of the county's staff.

"I'm a convert to the 5000 Kelvin lamps. I was a little unsure at first, thinking they would be too industrial, but they've worked out well," Muniz said.

Santa Rita Jail

In addition to its 52-building lighting retrofit, Alameda County also tackled the lighting at its jail—the largest building the county is responsible for. By retrofitting 12,000 lighting fixtures in the Santa Rita Jail with SEL technology in 2008, the county saves more than 560,000 kWh of electricity every year. That translates to more than $60,000 in annual savings.

In June 2010, the county took its jail lighting retrofit a step further and replaced 860 high-intensity discharge lamps in the housing unit's day rooms with 5000K, 120 W induction lighting. The 1,550,319 kWh annual energy savings, coupled with a $99,255 rebate, means that the $278,767 project will pay for itself in less than a year.

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

1-877-EERE-INF (1-877-337-3463)
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