

## Spectrally Enhanced Lighting: Port Hueneme 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



The U.S. Navy cut electricity consumption at Port Hueneme more than 20 percent by retrofitting an office building on the California naval base with spectrally enhanced lighting. The project paid for itself in less than four years. The port in Ventura County is home to the Naval Construction Battalion Center and the U.S. Navy Seabee Museum.

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.

Port Hueneme in Oxnard, California, has a 67,000-square-foot, two-story office building called Building 1000. A DOE Economics Validation Study gave Port Hueneme the opportunity to gather in-depth data while retrofitting the lighting in Building 1000 with SEL technology in 2005. The Navy paid for the labor to do

the installation, while DOE paid for the monitoring. The materials were donated.

### The Upgrade

The pre-retrofit lighting system at Building 1000 consisted primarily of 2x4-foot, three-lamp fixtures fitted with T8 lamps that had a 741 lamp color. Approximately 2,300 overhead lamps with electronic instant-start ballasts were replaced in the building, which houses 57 enclosed offices, 168 cubicles, and several conference rooms. The retrofit was performed between October and November 2005. 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 Sylvania F030/850XP/SS/ECO lamps and the ballasts were replaced with electronic programmed-start ballasts. Light level measurements taken in a sample of workstations following the retrofit indicated that horizontal photopic light levels decreased by 15 percent and horizontal scotopic light levels did not change.

Occupants were surveyed 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.

### LIGHTING TERMS

*For the most part, the Navy selected T8 fluorescent lamps with a temperature of 5000K and CRI of 85—also known as 850 lamps—for the retrofit of Port Hueneme's Building 1000.*

**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.

## Results

Pre-Retrofit



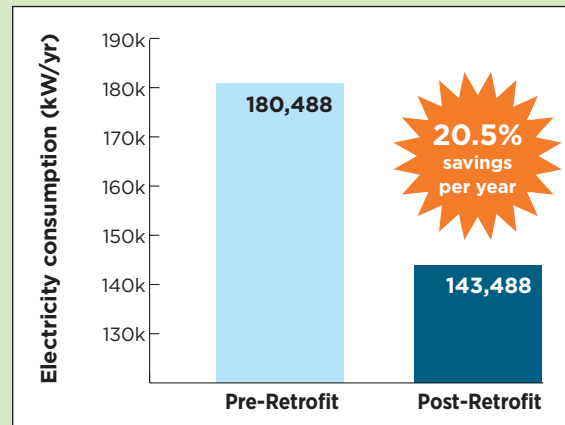
Post-Retrofit



## Specifications (for the majority of the fixtures)

	Pre-Retrofit	Post-Retrofit
Lamp	F032/741/ECO	F030/850XP SS/ECO
Nominal lamp wattage	32	30
Temperature (Kelvin)	4100	5000
CRI	75	85
Lamp color	741	850
Rated photopic lumens (P)	2800	2800
Ballast factor (BF)	0.88	0.71
Lumen output (PxBF)	2464	1988
S/P ratio	1.56	1.85
Visually effective lumens (PxBF) x (S/P) <sup>78</sup>	3486	3212
Measured connected load	27.11 W/lamp	21.56 W/lamp

Note: Ballast factor reflects dimmed lighting.



Total installed cost	\$32,354
<b>Annual savings from retrofit</b>	<b>\$9,276</b>
Payback* (years)	3.49
Rate of return	29%

\*Payback analysis was performed using the life-cycle cost-benefit analysis in accordance with the IESNA Handbook.

## Conclusions

SEL technology reduced lighting electricity consumption in Port Hueneme Naval Base's Building 1000 by 20.5 percent and decreased annual lighting costs by more than \$9,250, meaning the retrofit paid for itself in 3.49 years. The retrofit did not disrupt business or productivity and occupants were satisfied with the results.

### 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](http://www.eere.energy.gov/buildings/spectrally_enhanced.html).

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