Spectrally Enhanced Lighting: Fort Wainwright 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%.

Fort Wainwright, near Fairbanks, Alaska, is "Home of the Arctic Warriors." It employs 7,700 soldiers who are prepared to rapidly deploy worldwide in defense of U.S. interests or on humanitarian missions.

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.

In 2000, the U.S. Army awarded a Super Energy Savings Contract (ESPC) to have the lighting at Fort Wainwright near Fairbanks, Alaska, retrofitted with SEL technology. A wide variety of buildings, including hangars, maintenance facilities, barracks, administrative buildings, the dining facility, child development center, fire station, and chapel were retrofitted from mainly cool white T12s to energy-efficient 850 T8s. The new lighting saves nearly $375,000 in energy costs every year and was so well received that the Army has undertaken several similar projects.

The upgrade reduced lighting energy consumption by more than 3 million kWh annually and the Army was pleased with the results, while employees hardly noticed the difference.

The Upgrade

A total of 91 buildings, or 2,193,122 square feet, were retrofitted with SEL technology at Fort Wainwright. A wide variety of lighting existed pre-retrofit, including incandescent lamps, T12s with magnetic ballasts, high-pressure sodium, low-pressure sodium, and mercury vapor lamps. Where possible, the lamps were changed out to Sylvania T8 800 series lamps, though some LEDs and compact fluorescent lamps were used where it was more efficient. The magnetic ballasts were changed to electronic ballasts.

The project cost $2,169,094 and was completed over eight months, mainly in 2000. Honeywell was the contractor that performed the retrofit.

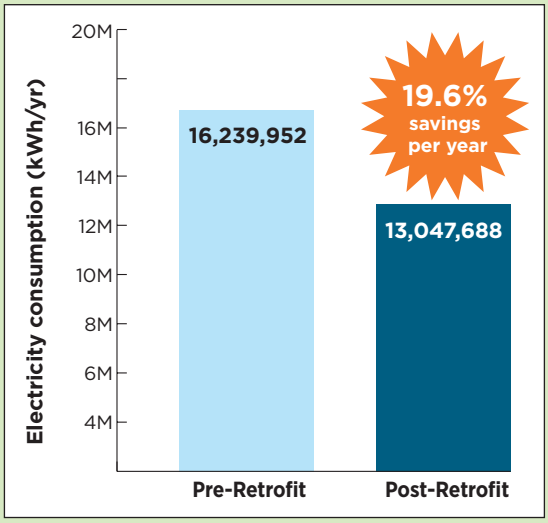
Aside from the temporary inconvenience while lamps were changed out, there were few complaints and most of the staff did not perceive a significant change. Maintenance of the new lighting is less or equal to the costs of maintaining the old lighting.

Conclusions

SEL technology reduced lighting energy consumption at Fort Wainwright by 3,192,264 kWh annually, or 19.6 percent. The lighting retrofit paid for itself in 5.8 years and saves the U.S. Army $374,246 each year. The Army has since undertaken several other similar lighting projects.

"Overall, the lighting was received very well," said Ashish Agrawal, an energy management consultant who had worked in the U.S. Army Installation Management Command during the retrofit. "The lighting quality improved compared to the older lights."

Specifications (for the majority of the fixtures)



	Pre-Retrofit	Post-Retrofit
Lamp	T12	T8
Nominal Lamp Wattage	34	32
Temperature (Kelvin)	4100	5000
CRI	62	82
Lamp Color	Cool White	850
Rated Photoptic Lumens (P)	2650	2950

Total installed cost	$2,169,094
Annual savings from retrofit	**$374,246**
Payback (years)	5.8
Rate of return	17.3%

Note: Electricity and cost savings are estimated.

Results

Pre-Retrofit

Post-Retrofit

The U.S. Army was so pleased with the large-scale SEL retrofit of Fort Wainwright completed a decade ago that it recently performed some in-house retrofits of a few more buildings, including this hangar.

LIGHTING TERMS

The U.S. Army selected T8 fluorescent lamps with a temperature of 5000K and CRI in the 80s—also known as 850 lamps—for its retrofit of Fort Wainwright.

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 730 lamp would have a CRI in the 70s and a CCT of 3000K.

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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