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ENLIGHTEN AND INSPIRE

THE POWER OF LIGHT:

Why TLEDs have been the lighting choice of the U.S. Navy since 2012

Making the Switch to LED

Lighting accounts for roughly 20% of all electricity used in a facility. With the ability to reduce lighting energy consumption by up to 60% when compared with fluorescent lighting, Tubular LEDs (TLEDs) are revolutionizing the world of lighting by providing energy managers and public works officers a profound energy conservation measure (ECM).[5] Retrofitting fluorescent lights with LED tubes nearly eliminates the need for maintenance – saving time, reducing costs, and providing a safer work environment. The power of TLEDs has never been higher and the need has never been greater.

Retrofitting fluorescent lamps with TLEDs offers a unique ECM option, with minimal upfront costs and simple installation Depending on the installation method chosen, a tube-based light fixture can be upgraded in 5–15 minutes, which immediately cuts that fixture's energy consumption by up to 60%. With an average life expectancy of more than 50,000 hours, the maintenance savings are also significant. At normal usage rates, 50,000 hours equates to 16 years. Imagine not having to change another light bulb for the next 16 years.

The U.S. Navy is reaping the benefits of these energy and maintenance savings today in the surface fleet. As of January 2016, 30% of U.S. Navy ships have been retrofitted with TLEDs. Simply by changing their light bulbs, they are saving $50.7 million each year in reduced fuel and maintenance. This same technology is now available for shore-based facilities.

What are Your Options?

Direct Wire

TLEDs incorporate an LED driver into the lamp and operate from the electrical mains. They do not require a ballast to operate therefore it must be removed for proper operation. Removing the ballast provides additional energy savings while making the fixture virtually maintenance free. Direct wire TLEDs reduce energy consumption by up to 60% and total cost of ownership is typically the lowest of all retrofit options with the shortest payback period. Although the cost of the retrofit during installation is somewhat more expensive, the higher energy savings and nearly non-existent maintenance expense quickly off-set the higher upfront cost.

It is important to note that direct wire TLEDs often require replacing the lamp sockets in an existing fixture during ballast removal, so it is always best to have a licensed electrician perform the retrofit installation.

Direct Fit

TLEDs are "plug-and-play" replacements for fluorescents and require a fluorescent ballast to operate. They provide a 30% reduction in energy consumption compared to fluorescent technology, and have the benefit of being the simplest and lowest cost retrofit.

Although direct fit applications have the lowest initial cost, they do have some drawbacks as an ECM. Direct fit TLEDs have the highest total cost of ownership of all the TLED retrofit options. Because the ballast is not removed, ballast power losses combined with higher ballast maintenance costs reduce overall savings and lengthen the payback period. With Direct fit TLEDs, if you wish to remove the ballast at a later date to further reduce energy consumption and eliminate ballast maintenance, a completely new TLED will have to be purchased. For these reasons, if your budget allows for moderate installation costs, direct wire TLEDs are recommended over direct fit TLEDs in order to maximize both energy and maintenance savings.

External Driver

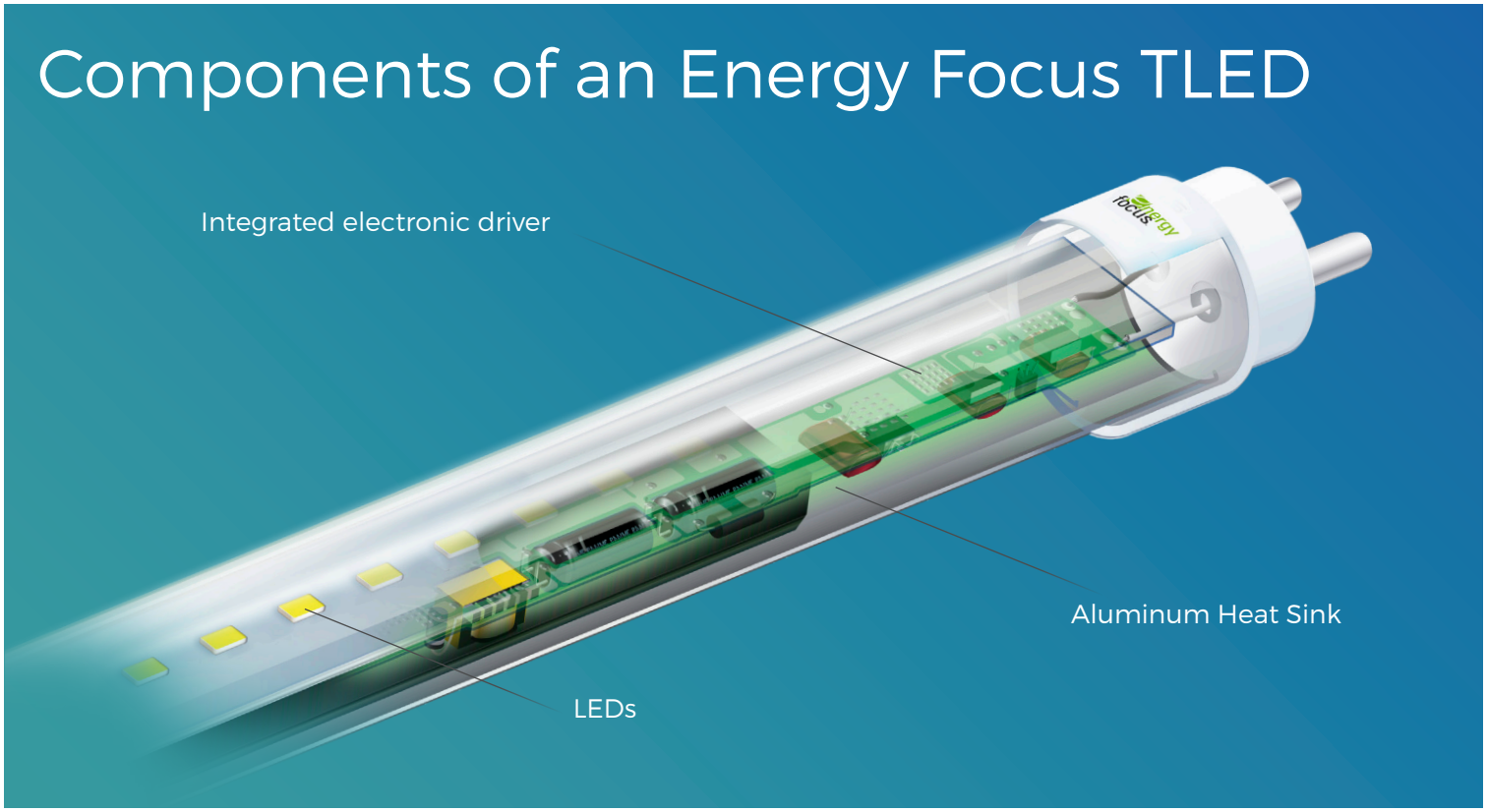
External driver TLEDs replace a fluorescent ballast with a similar “black box” to drive multiple LED tubes, with performance similar to direct wire TLEDs. These are often dimmable, making them preferred when dimming controls are in place.

External driver TLEDs have a retrofit similar to direct wire TLEDs, with the additional wiring of the new driver in place of the ballast. Be aware: this style of TLED can complicate your retrofit options. A given driver will work only with a certain type and number of tubes per fixture. In most cases, drivers or tubes are not compatible with other brands. Mixing and matching components can overload the system, increasing the risk of fire and damage to the system. For these reasons, this option is not recommended by most lighting professionals.

Dual Mode

Dual-mode TLEDs combine direct fit and direct wire into one tube, and can work with or without a ballast. Dual-mode TLED solutions offer energy managers a compromise between direct fit and direct wire options. With installation costs of virtually zero in direct fit or “plug-and-play” mode, 30% energy savings can be reached immediately. When a ballast fails, it can be removed during normal maintenance and the fixture becomes a ballast-free, direct wire; the lamps will continue to operate and achieve the maximum 50% energy savings at the same time.

The U.S. Navy selected dual-mode TLEDs for the surface fleet for the versatility of operation. Sailors are able to replace lamps in direct fit mode while they are deployed or stationed. Electricians can remove ballasts and switch to direct wire mode when ships are in port, on station, or when a ballast fails before docking.



When Specifying TLEDs:

> "The U.S. Department of Defense is the nation's largest energy user...Facility energy is the single-largest threat to energy resiliency"

Consider the following when specifying TLEDs[16]

- Select only DLC listed products for minimum standards in performance. Visit www.designlights.org or ask the manufacturer for their DLC QPL listing.
- Select only UL marked products for safety and UL qualified products. Visit UL's online database or ask the manufacturer for their UL CoA.
- Choose "Buy American" qualified or "Made in America" products when possible.
- Look for L70 lumen depreciation of 50,000 hours. Beware of 36,000 hour listings, as this represents legacy standards. Ask the manufacturer for their LM-80 and TM-21 reports. A reputable manufacturer will have test data to support their claims.
- The CRI should be a minimum of 80 to ensure vivid colors in the illuminated space.
- Select only TLEDs possessing a full aluminum heat sink, ensuring proper thermal management. Good heat dissipation improves performance and increases the lifetime of a TLED.
- Insist on a product warranty of at least five years.

Cost, Energy and Maintenance Savings

The U.S. Department of Defense is the nation's largest energy user.[17] Energy dependency of the DoD and the subsequent impact on the environment and federal budget has led to a massive top to bottom renovation of energy reducing strategies.

With 2.2 billion square feet of facilities in the DoD, facilities energy is the single largest threat to energy resiliency, consuming 26% of the FY10 energy budget totaling over $4B.[18] Based on these numbers, switching from fluorescent lamps to TLEDs could save the DoD upwards of $800M a year in electricity costs alone.

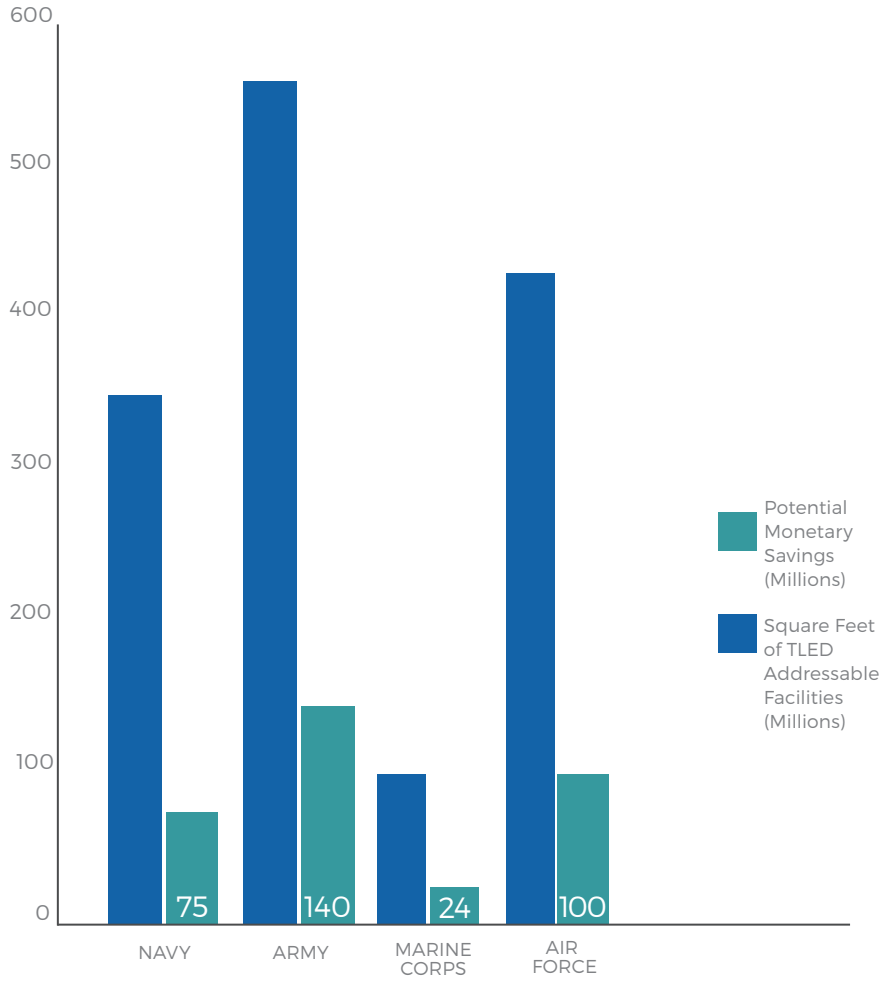
Due to their exceptional energy savings, low cost, and quick payback, TLEDs provide energy managers an excellent material solution for achieving their installation energy goals. In commercial facilities, retrofitting existing fluorescents with TLEDs as an ECM can cut the amount of energy consumed by lighting in half, saving an average of $0.22 per square foot in direct operating costs. *This cost savings only takes electricity costs into account; maintenance and fluorescent disposal costs are not included.*

Substantial Savings

TLEDs have an average life span of 50,000 hours, and last about three times longer than fluorescent bulbs. If a ballast bypass TLED is selected, such as a direct wire TLED, your overhead lighting becomes virtually maintenance free. These maintenance savings, when combined with the money saved on electricity, provide for a payback period of less than three years in most cases. If rebate programs are available, this payback period can often be reduced to less than 24 months. Check with your local utility when making lighting retrofit decisions to find rebate options. Table 2 shows potential direct savings – energy savings only – by branch of the service.[2]

Table 1 — Lighting Retrofit Opportunity, by Service

POTENTIAL MILITARY SAVINGS BASED ON AVAILABLE SQUARE FOOTAGE - IN MILLIONS



Potential Reduction in Total kWh Used Per Year: 15% Per Branch

Conservative estimate, derived by including only spaces lit or potentially lit by TLEDs, at a rate of 1 TLED per 30ft², operating 4200 hrs per year (11.5 hrs/day, 365 days/yr), at the national average of $.11/kWh.[5]

The resultant energy security from converting fluorescent lighting to TLEDs decreases non-tactical energy, allowing funds and precious energy to be prioritized for mission essential requirements. TLED retrofitting is the fastest, easiest way for the DoD to reach their goals of continuing energy reduction.

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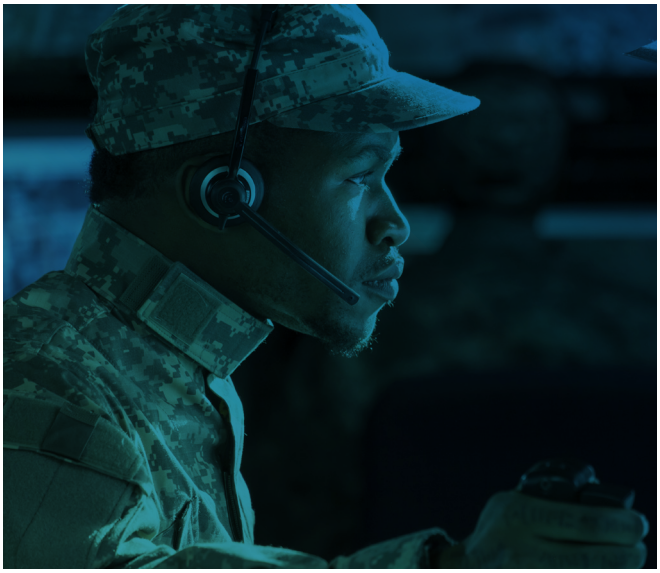
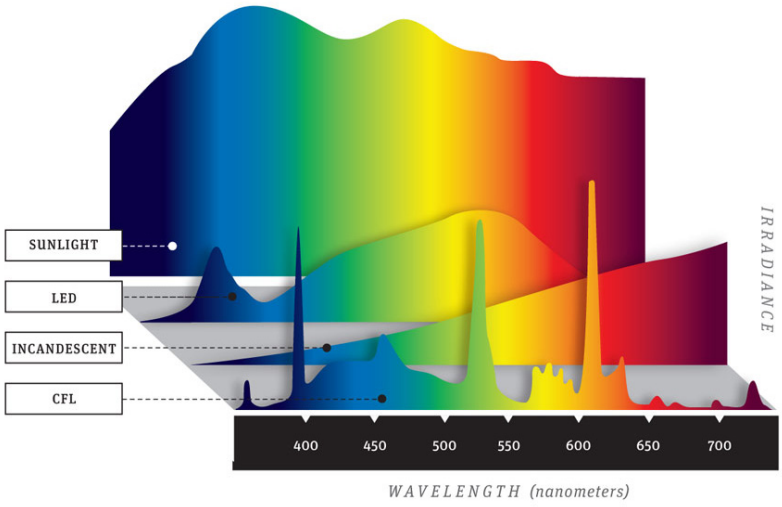
Healthier, Less Stressful Lighting

LED lighting has critical benefits to our mental and emotional wellbeing. Our body's natural circadian rhythm is triggered only by full spectrum light sources like that from LEDs and sunlight, not fluorescent or metal halides. The light of wavelength 450–480nm, given off by LEDs, activates melanopsin receptors in the retina of the eye, triggering the suppression of melatonin, the natural hormone that triggers drowsiness.[11,14] When spaces are lit with LEDs, attention, productivity and alertness are increased, as shown by Case Western Reserve University, Tufts University, and the U.S. Army.[12,13] The activation or suppression of other hormones by full spectrum lighting has been shown to yield happy, less-stressed, productive people.[15]

As more research is being done to characterize how LEDs promote these responses, the already clear choice of LED lighting for facilities will only be supported further.



> "LED technology is proven to create the most comfortable environment for the eyes, with better visibility and less eyestrain than any other form of lighting.[7]"



Safety

TLEDs are a much safer lighting solution for your spaces for a number of reasons. Fluorescent lighting – unlike TLEDs – emits UV radiation with irradiance in the UV-A range similar to the rays from sunlight that we avoid with protective outdoor wear. The sensitivity of the eye to these short electromagnetic wavelengths that are not perceived as visible light is important and possibly detrimental. Absorption of too much short-wavelength UV light can damage ocular tissues in the lens and retina by changing the chemical structure of biomolecules. UV wavelengths are capable of potentially irreparable damage to the eye.

The hazards of fluorescent lamps go much further than UV exposure. Due to the mercury content of fluorescent lamps, chemical exposure and contamination are also of great concern. Converting from fluorescent lamps to TLEDs completely eliminates these risks because TLEDs contain no hazardous chemicals; therefore, they require no special handling or disposal. The special handling and disposal requirements for fluorescent lamps are expensive and add to the detriment of the environment. Reliable TLEDs use recyclable materials and do not contain mercury.[4]

When selecting a TLED for your project or facility, it is important to note that not all TLEDs are created equal. Therefore, when choosing a TLED for a retrofit, it is imperative to be an educated customer and find a reputable manufacturer with a dependable product and consistent record of high quality light and responsible safety specifications. And finally, as with any electrical project, be sure to consult a qualified licensed professional to assist with your lighting retrofit.

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