LED LIGHTING
TECHNOLOGY TRIAL

Product Performance Result Report
March 2012

Prepared for:

NV Energy™

Prepared by:

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Sacramento, CA 95827
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</tbody>
</table>
1. EXECUTIVE SUMMARY

This report provides the results of a LED lighting technology trial. Conventional lighting was replaced with LED lighting in a small sample of fixtures around State of Nevada facilities. The primary location in the technology trial was the Legislative Building in Carson City, Nevada.

The study included replacement of linear fluorescent lights, compact fluorescent lights (CFL), recessed metal halide (MH), and exterior high intensity discharge (HID) as baseline lighting. All were replaced with LED lighting that was designed for the appropriate application of the original fixtures.

A total of 67 fixtures were part of the trial. Some fixtures were retrofitted and others were replaced. The total baseline connected capacity of the lighting was 6.90 kW while the installed LED lighting capacity was 1.59 kW. The technology trial started in September 2010 and ended in December 2011. Implementation occurred at various times but was primarily conducted in September 2010, November 2010, and September 2011. The state legislature was in-session from February 2011 to June 2011, during which no trial-related activity could be conducted on site.

The lighting was monitored to document the hours of operation and energy usage. Monitoring equipment was in place for over a year. Monitoring occurred during legislative in-session periods and out-of-session periods. Light levels were measured in a sample of locations.

The savings analysis was based on the monitored data and rated watts of the baseline and newly installed lighting. The total savings for the LED lighting technology trial is 12,439 kWh per year when the legislature is in-session and about 1,000 kWh less for years when it is not in-session. This represents 79% energy savings. The maximum critical peak demand savings is 2.53 kW and occurs in March, which is a shoulder month during which the legislature is in-session. As a comparison the critical peak demand savings in July is 1.14 kW. Table 1-1 summarizes the energy impacts for the program for a year that the legislature is in-session. Lighting levels were reduced as result of the installation of LEDs but still within recommended levels.

<table>
<thead>
<tr>
<th>Area Type</th>
<th>Pre Energy Use, kWh/yr</th>
<th>Post Energy Use, kWh/yr</th>
<th>Energy Savings, kWh/yr</th>
<th>Percent Energy Savings, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>7,824</td>
<td>1,400</td>
<td>6,424</td>
<td>82.1%</td>
</tr>
<tr>
<td>Interior</td>
<td>7,541</td>
<td>1,811</td>
<td>5,729</td>
<td>76.0%</td>
</tr>
<tr>
<td>Office</td>
<td>415</td>
<td>130</td>
<td>286</td>
<td>68.8%</td>
</tr>
<tr>
<td>Total</td>
<td>15,780</td>
<td>3,341</td>
<td>12,439</td>
<td>78.8%</td>
</tr>
</tbody>
</table>

ADM’s recommendation is to conduct trials in locations that have typical schedules of operation for a majority of potential applications of the measure.
2. PROJECT BACKGROUND

This project provides a public display of LED lighting technology supported by NV Energy. The Nevada State Legislative Building shown in Figure 1 is an appropriate setting to demonstrate the state’s commitment to energy conservation. Most of the project was implemented near the West entrance of the building; the floor plan is shown in Figure 2. International Energy Conservation and Deco Lights, Inc. were instrumental in the implementation of the lighting measures for this project.

![Figure 1. Nevada State Legislative Building.](image1)

![Figure 2. Legislative Building Floor Plan.](image2)

The original (left) and new exterior lighting (right) for the flagpole and building dome are shown in Figure 3.

![Figure 3. Original (left) HID and New (right) LED Flagpole and Dome Lighting.](image3)
Lighting over the foyer stairway, as shown in Figure 4, was one of the areas chosen as part of the lighting trials. Figure 5 shows the old and new lighting for the ceiling above the stairway.

![Figure 4. Foyer Stairway Lighting.](image)

Lighting in the back of the foyer on the first floor shown in Figure 6 was also included in the lighting trials. Figure 7 shows the new LED lighting for the 2’x2’ fixtures and a close up of the LEDs. Figure 8 shows another pre-retrofit ceiling mounted recessed can fixture with a CFL.

![Figure 5. Original (left) MH and New (right) LED Stairway Lighting.](image)

![Figure 6. Original 2’ x 2’ fluorescent fixtures at back of Foyer (left) and up close (right).](image)
Standard office lighting fixtures were converted to LED T8 lamps. Figure 9 shows the original 4’x2’ fluorescent fixtures and LED lamps.

The project started in September of 2010 and was not completed until October 2011. One factor affecting this timeline was that when the legislature is in-session (February 2011 to June 2011) no non-emergency work can be conducted in the building.
3. M&V METHODOLOGY

This chapter provides a description of the M&V methodologies applied by ADM in the evaluation of the LED performance. The M&V approach for the project is aimed at the following:

- Site Selection
- Monitoring Equipment
- Summary of Data and Analysis Approach

In August 2010, ADM investigated an M&V approach that would measure the trial savings.

3.1 SITE SELECTION

The site was selected to provide a showcase as well as a demonstration site of new LED lighting. The main building selected is the Nevada Legislative Building at 401 South Carson Street in Carson City. Exterior lighting, foyer and atrium areas open to the public were targeted.

In addition, an office for the Director of the Nevada State Office of Energy was also included in the demonstration. That office is located near to the Nevada Legislative Building at 755 North Roop Street, Suite 202 in Carson City.

Some modifications were made to the initially planned fixture selection. Table 3-1 lists the final selections.

<table>
<thead>
<tr>
<th>Qty</th>
<th>Area</th>
<th>Pre Retrofit Description</th>
<th>LED Post Description</th>
<th>Pre Fixture Watts</th>
<th>Post Fixture Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Rear of Foyer and Meeting Rooms</td>
<td>2’x2’ T8 30W Fluorescent U-Tubes, 3 lamps/fixture</td>
<td>SIMKAR RFL223T8/W RETROFIT KIT</td>
<td>90</td>
<td>24</td>
</tr>
<tr>
<td>18</td>
<td>Over Foyer Stairs &amp; Atrium</td>
<td>Recessed Can with 100W MH</td>
<td>EARTHLED Lumiselect PAR38 4K 277V</td>
<td>125</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>Foyer Catwalk</td>
<td>Recessed Can with 32W CFL</td>
<td>LITON LRCLD821W-B45</td>
<td>32</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>Flag Pole &amp; Dome Lights</td>
<td>100W HID</td>
<td>ENERGY FOCUS LEDLS-765-NSP-26-HWC-AB FIXTURE</td>
<td>140</td>
<td>26</td>
</tr>
<tr>
<td>6</td>
<td>Exterior Coach Sidewalk Poles</td>
<td>Walkway lights 70W HID</td>
<td>Elumenus 15W PLTLR 277V</td>
<td>95</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Private Office</td>
<td>4’x2’ T12 40W 3 lamp Fluorescent</td>
<td>EARTH LED ELED DFLT8 120CM WW 18W</td>
<td>144</td>
<td>45</td>
</tr>
</tbody>
</table>
The total baseline connected lighting capacity is 6.90 kW, inclusive of 4.63 kW for foyer and related lighting, 1.69 kW for exterior lighting and 0.58 kW for the office lighting. The total LED connected lighting capacity for these fixtures is 1.59 kW, inclusive of 1.11 kW for foyer and related lighting, 0.30 kW for exterior lighting and 0.18 kW for the office lighting. The reduction in total connected capacity is 5.31 kW. Appendix A contains manufacturer’s specification sheets for the LED lighting used for this project.

### 3.2 MONITORING EQUIPMENT

ADM used two types of data loggers for this project: Hobo external channel loggers, used to record lighting circuit breaker current, and Hobo light On/Off loggers. Current transformers (CT) were used to measure lighting circuit breaker current as input to the Hobo U12-006 loggers. The CTs have an accuracy of ± 1% from 10% to 100% of full scale, ± 3% at 5% of full scale, and ±5% at 2% of full scale. For the baseline period, three 30 Amp rated CTs were installed in the Legislative Building and 5 and 20 Amp CTs were used for the post-retrofit period. They monitored circuit breakers 4, 8, & 10 in Panel 1HB. The logger was initially set to record data on 5-minute intervals. The interval was increased to 15-minutes during a follow-up visit so that the logger would have memory to last through the majority of the legislative in-session period during which logger access was not permitted. One-time power measurements were made using an AEMC 3910 True rms power meter. One-time readings of Volts, Amps, power and power factor were made on several lighting circuits.

In the Energy Office two Hobo U9-002 Lighting Loggers were used. These loggers record date and time stamps when lighting fixtures are turned on or off. In the monitored office there were two wall switches for bi-level control. One switch controlled two fluorescent four foot fixtures and the other switch controlled two separate fixtures, one of which had already been retrofitted with LED lamps.

Additionally, light level measurements were made using a Davis Light Meter with capability of foot-candle and Lux scales.

### 3.3 SUMMARY OF DATA AND ANALYSIS APPROACH

The current recording Hobo logger was installed on September 9, 2010 and removed on December 27, 2011. Data were downloaded multiple times. Although the lighting circuits that were monitored contained the fixtures originally planned for retrofit, they did not necessarily cover all of the fixtures that were ultimately retrofitted with LED lighting. From the data it was determined that circuit breaker 10 exclusively monitored the eight flag pole and dome lights. As the data was for exterior lights, the profile was also used to represent the exterior walkway pole lights. The data from the other two circuits were combined to represent the profile of other
interior lighting for the Legislative Building. The maximum monitored kW of the combined circuits was normalized to the capacity of the lighting listed in the first three rows of Table 3-1.

The exterior lighting (representing the fourth and fifth rows of other Table 3-1) was charted together as a combined profile. The profile was found not to vary by weekday or weekend or by in-session versus out-of-session for the legislature, but it did have a seasonal dependence.

![Average Exterior Lighting Profiles for the Original Baseline and New LED Lighting](image)

*Figure 10. Average Exterior Lighting Profiles for the Original Baseline and New LED Lighting.*

The interior lighting profiles were separated and averaged into four day type profiles: weekday in-session, weekday out-of-session, weekend in-session, and weekend out-of-session. In-session for the legislature ran from February 7, 2011 to June 7, 2011. The legislature is only in-session during odd years from the first Monday in February and runs for a maximum of 120 days except when a special session is called. Only baseline data for the interior lighting in-session period were monitored. The in-session baseline data was used to generate in-session LED lighting profiles by scaling the rated capacity of the new to the old fixture watts. The baseline and new lighting average profiles are presented in Figure 11 and Figure 12 and respectively. The annual savings analysis is based on a year when the legislature is in-session. Savings will be less on even years. The average lighting profiles for the original baseline and new were developed using data from September 2010 through June 2011.
Figure 11. Average Interior Lighting Profiles for the Original Baseline for All Four Day Types.

Figure 12. Average Interior Lighting Profiles for the New LED for All Four Day Types.
The last row of Table 3-1 is for the Director’s office of the Nevada State Office of Energy. This office has two wall switches and is considered bi-level lighting which is an energy conservation feature. This office is not in the legislature building and is in operation like a typical office, year round. The initial monitoring of this office was conducted after only one fixture was retrofitted with LED lighting. The savings was based on all four fixtures being retrofitted with LED lighting. On/Off lighting loggers were used to monitor the fixtures, one on each switch. The data are then used to illustrate profiles as percent time on as shown in Figure 13. These data suggest that the occupant of the office was energy conscious as he or she generally only turned one switch on and would turn the lights off when leaving the room. Switch 1 is used for 1,333 hours per year and switch 2 is used for 110 hours per year. This conserves energy but actually reduces the savings when factoring in the installation of low wattage light fixtures.

![Figure 13. Average Office Lighting Percent Time On Profiles for Two Day Types and Switches.](image)

Lighting level measurements in footcandles were taken for baseline and post retrofit in the foyer areas. The lighting measurements for the areas involved were compromised by ambient daylight coming in through the windows. Additionally the season and sun angles were also different and added to the discrepancies. The back of the foyer lighting levels fell from 45 footcandles to 20 footcandles and near the front corner of the foyer lighting levels fell from 66 to 25 footcandles.
Twenty footcandles is an acceptable lighting level for lobbies based on Illuminating Engineering Society (IES) recommendations\textsuperscript{1}.

\textsuperscript{1} http://www.facilities.rochester.edu/ppm/designstandards/pdf/16500_new.pdf
4. IMPACT EVALUATION FINDINGS

This chapter provides detailed results pertaining to the energy and demand impacts during a legislative session year.

4.1 ENERGY IMPACTS

Table 4-1 below presents the energy savings broken down by area type. It should be noted that interior savings are for odd years only (legislature in-session); during even years the savings will be about 1,000 kWh less (out-of-session).

<table>
<thead>
<tr>
<th>Area Type</th>
<th>Pre Energy Use, kWh/yr</th>
<th>Post Energy Use, kWh/yr</th>
<th>Energy Savings, kWh/yr</th>
<th>Percent Energy Savings, %</th>
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<tr>
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<td>15,780</td>
<td>3,341</td>
<td>12,439</td>
<td>78.8%</td>
</tr>
</tbody>
</table>

4.2 CRITICAL PEAK DEMAND REDUCTION

The critical peak demand period per month for SPPC (NV Energy North) is defined as the maximum average hourly demand during a given hour per month shown below in Table 4-2. For example, the critical peak (or on-peak) period during July when kW demand reaches the maximum average hourly demand is the hour ending at 17:00 hours or 5:00 pm.

<table>
<thead>
<tr>
<th>Month</th>
<th>Hour (SPPC)</th>
<th>Ending at:</th>
<th>kW Demand Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>19</td>
<td>19:00</td>
<td>1.65</td>
</tr>
<tr>
<td>February</td>
<td>19</td>
<td>19:00</td>
<td>2.26</td>
</tr>
<tr>
<td>March</td>
<td>20</td>
<td>20:00</td>
<td>2.53</td>
</tr>
<tr>
<td>April</td>
<td>21</td>
<td>21:00</td>
<td>2.31</td>
</tr>
<tr>
<td>May</td>
<td>17</td>
<td>17:00</td>
<td>1.53</td>
</tr>
<tr>
<td>June</td>
<td>17</td>
<td>17:00</td>
<td>1.53</td>
</tr>
<tr>
<td>July</td>
<td>17</td>
<td>17:00</td>
<td>1.14</td>
</tr>
<tr>
<td>August</td>
<td>17</td>
<td>17:00</td>
<td>1.14</td>
</tr>
<tr>
<td>September</td>
<td>17</td>
<td>17:00</td>
<td>1.14</td>
</tr>
<tr>
<td>October</td>
<td>20</td>
<td>20:00</td>
<td>1.96</td>
</tr>
<tr>
<td>November</td>
<td>19</td>
<td>19:00</td>
<td>1.65</td>
</tr>
<tr>
<td>December</td>
<td>19</td>
<td>19:00</td>
<td>1.65</td>
</tr>
</tbody>
</table>
Critical peak demand savings (kW savings) are calculated by month, utilizing study savings determinations and appropriate measure-level, 8760-hour load shapes. The result is savings per hour for all 8760 hours of the typical calendar year. The results are then inspected for each month to identify the maximum average hourly demand by hour per month, as shown in Table 4-2.
5. DISCUSSION OF KEY FINDINGS

This technology trial found that there were 12,439 kWh energy savings per year when the legislature is in-session. This is a 79% energy savings. The savings during a year the legislature is out-of-session will be about 1,000 kWh less. The critical peak demand savings in July is 1.14 kW. The maximum critical peak demand savings in a legislative year is 2.53 kW and occurs in March which is a shoulder month.

Inconclusive results for the lighting levels indicate that the lighting level will satisfy IES standards. The lighting level was reduced, but to quantify the level a more rigorous approach would be needed for this application where abundant daylighting is available. This approach would require access during night hours and the ability to control the lights in the space during the testing period.
6. RECOMMENDATIONS

The implementation of LED lighting can provide significant savings. Both energy and demand savings are easily generated. One recommendation is to ensure that the replacement LED lighting will not reduce lighting below acceptable levels. The cost of LED lighting is higher than traditional lighting but the cost is rapidly declining. Incentives for LED lighting will promote a measure with a long effective useful life.

To produce the best study results a technology trail should be implemented in a location where the operation is typical for a majority of potential applications. The trial would also be selected for a location where the measure can be exclusively monitored without cross interference from other loads. A site should be selected that does not have access restrictions that can delay the implementation or study of the measure.
APPENDIX A: LED SPEC SHEETS

Below are copies of the LED Spec Sheets.

EarthLED LumiSelect PAR38 Dimmable

LumiSelect PAR38

The premiere dimmable PAR38 spotlight, LumiSelect PAR38 powered LED spotlight in PAR38 form factor downlights or billboards, utilizes 12-2 Watt LED light engines, achieving light output comparable to a 100-120 Watt Spotlight power.

Specifications and Dimensions:

- Power Consumption: 24 Watts
- Light Engine: 12×2 Watt with LumiSelect Technology
- Input Voltage: 277V AC (Worldwide)
- Luminous Flux: 1000 Lumens (Warm), 1200 Lumens (C)
- Color Temperature: 2800 K (Warm), 4000 K (White)
- CRI: 75 (Typical)
- Beam Angle ~25 Degrees
- Lifespan: > 50,000 Hours (MTBF)
- Construction: Aluminum with Integrated Heatsink
- Physical Dimensions:
  - Overall Length ~ 5.08 in (129.17 mm), Diameter ~ 4.78
  - Weight ~ 12 Ounces
- Base Types Available: E26/27
- Great For: Spotlights, Down Lights

Cost to run for one year ~ $7.01

Calculated assuming 8 Hours a day operation, 365 Days a Year
LED LandScape

PROVIDING ENERGY EFFICIENT LIGHTING SOLUTIONS

FEATURES

- High output LED with minimal power consumption
- Rugged exterior to hold up to nature’s forces
- 50,000 rated life reducing maintenance significantly
- Non obtrusive in architectural bronze or black
- Bright white light illuminating your building for increased visibility and safety
- Smooth tilt adjustability to highlight or evenly illuminate your façade
- Easy retrofit with slip fitter mount and hard wire ready
- Available in 15 or 25 watt with spot (12 and 16), wide (30) or very wide flood (120) beam angles

50,000 hour lamp life and low energy consumption make this fixture a perfect low maintenance green alternative to traditional outdoor lighting technologies. These compact luminaires come in rugged housing that will withstand harsh weather conditions.

Don't be fooled by imitators. Energy Focus' products are made in the USA and feature permanent contact information in the die-cast lens ring.
LED Lighting Technology Trial Report – NV Energy

March 2012

Appendix A

LED Landscape

<table>
<thead>
<tr>
<th>Model</th>
<th>Color Temp</th>
<th>Beam Spread</th>
<th>Size</th>
<th>Electrical Connection</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED 5</td>
<td>765 75 CRI</td>
<td>NSP 12° Beam</td>
<td>15 Small Fixture</td>
<td>HWC 0° Cord, hardwire leads</td>
<td>AB Architectural Bronze</td>
</tr>
<tr>
<td></td>
<td>835 80 CRI</td>
<td>SPT 16° Beam</td>
<td>26 Large Fixture</td>
<td>HWD Direct hardware</td>
<td>BK Gloss Black</td>
</tr>
<tr>
<td></td>
<td>3500K</td>
<td>NFL 32° Beam</td>
<td>15Watt</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>VFL 120° Beam</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specifications

Full 0° - 180° Positioning

Available Beam Spreads

<table>
<thead>
<tr>
<th>Beam Spread</th>
<th>12°</th>
<th>16°</th>
<th>32°</th>
<th>120°</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED 7W</td>
<td>50K</td>
<td>54K</td>
<td>54K</td>
<td>54K</td>
</tr>
<tr>
<td>LED 15W</td>
<td>30K</td>
<td>30K</td>
<td>30K</td>
<td>30K</td>
</tr>
</tbody>
</table>

Assumptions:
- Annual Hours: 4200 (1576/0.5)
- Energy Cost = 10¢/ kWh
- Cost to change light: $5.00 each

Energy Consumption:
- LED 7W: 120lm
- LED 15W: 600lm

Annual Operating Cost:
- LED 7W: $78
- LED 15W: $111

Lamp Life (hrs):
- LED 7W: 50,000 hrs
- LED 15W: 50,000 hrs

Energy Focus, Inc. 33000 Aurora Road Solon, OH 44139 T (888) 327-7877 (440) 716-3300 F (440) 716-3314 W energyfocusinc.com © 2009 Energy Focus, Inc. All rights reserved. Energy Focus, Inc. reserves the right to change specifications for product improvements with prior notice. IFD06603-S
# Elumenus LED Post Top Replacement

<table>
<thead>
<tr>
<th>Parameters</th>
<th>PTLR-15W, 21G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>AC 90-277V</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>50-60Hz</td>
</tr>
<tr>
<td>Power Factor</td>
<td>&gt;0.95</td>
</tr>
<tr>
<td>Harmonized Distortion</td>
<td>&lt;15%</td>
</tr>
<tr>
<td>Power Efficiency</td>
<td>88%</td>
</tr>
<tr>
<td>Working Voltage</td>
<td>70W</td>
</tr>
<tr>
<td>LED Consumption</td>
<td>14W</td>
</tr>
<tr>
<td>System Consumption</td>
<td>15W</td>
</tr>
<tr>
<td>LED Luminous Efficiency</td>
<td>&gt;90 LM/W</td>
</tr>
<tr>
<td>LED Initial Flux</td>
<td>1400L</td>
</tr>
<tr>
<td>Lamp's Efficiency (%)</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Average Illuminance (EAV) 9 Feet height</td>
<td>&gt;110 Lux</td>
</tr>
<tr>
<td>Effective lighting Area 9 Feet height</td>
<td>6 x 15M(2)</td>
</tr>
<tr>
<td>Color Temperature</td>
<td>6300K</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>&lt;75°C</td>
</tr>
<tr>
<td>Working Temperature</td>
<td>35-40°C</td>
</tr>
<tr>
<td>IP Rating</td>
<td>IP65</td>
</tr>
<tr>
<td>Warranty</td>
<td>6 Years</td>
</tr>
<tr>
<td>Product Dimensions</td>
<td>2.3&quot; W x 6&quot; L</td>
</tr>
</tbody>
</table>

## FEATURES

* High Luminance Efficiency
* Superior Energy Savings
* Light Consistency
* Long Life (50,000 hrs)
* Reduced Maintenance
* Wide Range of Color Temps
* Wide Beam Angle
* Reduced Heat Output
* Qualifies for Potential EPACT
* Light Weight (<2lbs)
EarthLED

Long Life: 50,000 + hour lifespan exceeds even the highest quality fluorescents tubes
Extreme Efficiency: Over 80% more efficient than traditional fluorescents tubes
Flicker-Free Lighting: Eliminate eye strain and headaches associated with fluorescents lighting
Shatter-Proof Design: Will not break even if dropped
Double Energy Savings: DirectLED FL tubes require no ballast saving even more energy
No Mercury Inside: Allows the use of tube lighting when mercury contamination is not an option
Flexible Voltage: Use tube lighting in AC 85~277V or DC 12V Input Environments
No Interference: Perfect for settings where precise instruments can be disturbed by fluorescent tubes
Instant Starting: Starts right away no matter the temperature or conditions

Power Consumption:
- 8 Watts (2 Ft. / 60 CM)
- 15 Watts (4 Ft. / 120 CM)
- 24 Watts (6 Ft. / 183 CM)

Light Engine:
- 180 SuperBrite LED (2 Ft. / 60 CM)
- 300 SuperBrite LED (4 Ft. / 120 CM)
- 420 SuperBrite LED (6 Ft. / 183 CM)

Input Voltage: AC 110~277V or 12V DC

Luminous Flux:
- 800 Lumens (2 Ft. / 60 CM)
- 1500 Lumens (4 Ft. / 120 CM)
- 2400 Lumens (6 Ft. / 183 CM)

Color Temperature: 3000 K (Warm), 6000 K (Cool)
CRI: 75 (Typical)
Lifespan: > 50,000 Hours (MTBF)
Operating Temperature: -4~104°F (-20~40°C)
Construction: Frosted, impact resistant plastic & integrated heat sink
Physical Dimensions: Diameter - 1.18 Inches (3 CM)
Base Types Available: Bi Pin T8, T10, T12 Compatible
Tired of the hassles associated with traditional fluorescent tubes? Complete your total transition to LED technology with the EarthLED DirectLED™ FL Series. The DirectLED FL series is a replacement for traditional T8/T10/T12 fluorescent tubes allowing you to bring LED technology to environments never before possible.

**Volume Pricing is Available! E-mail for a customized quote.**

**Volume Orders handled in days, not weeks! Big Jobs, little jobs, we supply them all!**

**Key DirectLED™ FL Series Benefits:**

- Long Life: 50,000 + hour lifespan exceeds even the highest quality fluorescent tubes
- Extreme Efficiency: Over 80% more efficient than traditional fluorescent tubes
- Flicker-Free Lighting: Eliminate eye strain and headaches associated with fluorescent lighting
- Shatter-Proof Design: Will not break even if dropped
- Double Energy Savings: DirectLED FL tubes require no ballast saving even more energy
- No Mercury Inside: Allows the use of tube lighting when mercury contamination is not an option
- Flexible Voltage: Use tube lighting in AC 110v-277v or DC 12V Input Environments
- No Interference: Perfect for settings where precise instruments can be disturbed by fluorescent tubes
- Instant Starting: Starts right away no matter the temperature or conditions

NEW! Downloads:

- PDF Install Guide
- Photometric Data

DirectLED FL Series for General Illumination

EarthLED FL series are well-suited for use anywhere: homes, offices, museums, galleries, shop windows, hotels, restaurants, meeting rooms, just like conventional fluorescent lights.

DirectLED FL Series for Task Lighting

Task lighting is required for visually intensive environments, such as reading, writing or some kitchen countertop use. The great light quality of DirectLED FL makes your task lighting more effective and easier on your eyes. Locating DirectLED FL underneath your cabinets, shelves, office cubicles etc. can allow you to achieve an ideal task lighting setup. Furthermore, the linear profile of DirectLED FL is also unobtrusive to the design environment allowing them to be integrated anywhere a standard fluorescent is used.

DirectLED FL Series for Display Lighting and Signage

Good light quality and low heat generation makes DirectLED FL a great green alternative for display lighting. No longer worry about heat damage to your valuable merchandise displayed on your counter. You will also be surprised at the ideal display light cast by the quality light output of the
DirectLED FL is also an excellent candidate for signage back lighting. Since DirectLED FL series feature high output, only a small quantity of DirectLED FL tubes need to be utilized on a even a large billboard or sign. DirectLED FL allows you to instantly make your advertising and messaging energy efficient and Earth friendly.

**Built to a Higher Standard.**

Since introducing LED based fluorescent tube replacements more than a year ago, we've seen plenty of low quality LED tubes hit the market. Unfortunately these are cheaply made at best and dangerous at worse. All of our DirectLED FL products are built to withstand the unique daily demands of tube lighting.

Let's take a look at our DirectLED FL side by side with some of the other products you may have seen (DirectLED FL on right, low cost generic competitor on left):

Most LED Tubes on the market utilize inexpensive plastic tubing shoddily fitted over low quality plastic and caps. This leads to a product that feels quite flimsy. You can even notice this competitor using a plastic film to hide the electronics inside the tube. DirectLED FL uses a solid aluminum heat sink housing, frosted tubing and solid end caps. The DirectLED FL series is completely flame retardant and built to CE and UL compliant standards.

The top side of the tube reveals the competitor uses low quality plastic tubing creating a dismal & dirty looking light. DirectLED FL uses a proprietary frosted tubing to better duplicate the look of traditional fluorescent tubes. We dare you to tell the difference between a DirectLED FL and standard fluorescent tube once installed!

Things aren’t any better on the inside either. Notice the LED circuit board that “floats” freely in the tube with no provisions for heat dissipation. The tubing itself is very flexible and bends easily. DirectLED FL tubes are rigid and do not flex. In short, DirectLED FL is built for demanding real-world use. The competition? Who knows!

Ballast Free Installation For Even More Power Savings.

The DirectLED FL Series does not require the use of a ballast thus allowing you to save even more energy. As an added benefit there is no ballast to break or fail ensuring even longer life. No ballast also means that the DirectLED FL can be used in T8, T10 or T12 fixtures for the ultimate in compatibility. Installation is simple but does require basic wiring knowledge. Simply disconnect or bypass the ballast during installation to install the DirectLED FL. “If you do not feel comfortable with this type of basic wiring, please call an electrician.”

Watch the DirectLED FL in Action

NEW! DirectLED Fixture allows the use of DirectLED FL Tubes Outdoors

Now available! The DirectLED Fixture is an IP65 rated outdoor fixture for DirectLED FL 4 Foot (120cm) tubes. Made from durable and shatter resistant ABS plastic, the DirectLED Fixture allows you to install LED Fluorescent Tube replacements in the harshest of outdoor environments. Best of all, since the DirectLED Fixture uses no ballast, installation is a breeze.  

Expand the horizons of your project today with the DirectLED FL Fixture.

Retrofitting T8/T10/T12 Tubes? We’ve Got you Covered.

The DirectLED FL Series is available in T5 and T8/T10/T12 compatible versions as well as several different lengths to allow you to select the most appropriate level of light output and performance for your application.

DirectLED FL - T8/T10/T12 Tube Replacement

DirectLED FL Utilizes large arrays of high power LEDs to provide up to 2400 lumens (length dependent) of quality, flicker-free light. DirectLED FL is an economical way to replace commonly used fluorescent tubes in your home or business.

Specifications and Dimensions:

- Power Consumption:
  - 8 Watts (2 ft. / 60 CM)
  - 15 Watts (4 ft. / 120 CM)
  - 24 Watts (6 ft. / 183 CM)

- Light Engine:
  - 180 LED (2 ft. / 60 CM)
  - 300 LED (4 ft. / 120 CM)
  - 420 LED (6 ft. / 183 CM)

- Input Voltage: AC 110~277V or 12V DC
- Luminous Flux:
  - 800 Lumen (2 ft. / 60 CM)
  - 1500 Lumen (4 ft. / 120 CM)
  - 2400 Lumen (6 ft. / 183 CM)

- Color Temperature: 3000K (Warm), 4100K (Neutral), 5800 K (Cool)
- CRI: 90 (Typical)
- Lifespan: > 50,000 Hours (MTDF)
- Operating Temperature: -4~104°F (-20~40°C)
- Construction: Impact resistant plastic & integrated heat sink
- Physical Dimensions:
  - Diameter - 1.18 Inches (3 CM)
  - Base Types Available: Bi Pin T8, T10, T12 Compatible

Downloads:
- .PDF Install Guide
- .Photometric Data
- .Lumen Maintenance Data (Lifespan Testing)

Cost to run for one year*:

- $2.34 (2 ft. / 60 CM)
- $4.36 (4 ft. / 120 CM)
- $7.01 (6 ft. / 183 CM)

http://earthled.com/DirectLED-t8-fluorescent-led-tube-replacement.html
LED Lighting Technology Trial Report – NV Energy

T8 LED Fluorescent Tube, LED Tube, Fluorescent Replacement, LED Replacement Tube...

Calculated assuming 8 Hours a day operation, 365 Days a Year with $.10 KWh Electricity Cost

Volume Pricing is Available! E-mail for a customized quote. Volume Orders handled in days, not weeks!

Have a special request or custom configuration? E-mail for a customized quote.

NEW! DirectLED FL Outdoor Fixtures

Install your DirectLED FL T8/T10/T12 fluorescent replacements outdoors with our specially designed IP65 Watertight Fixtures!

- IP65 Rated Fixture is suitable for the harshest of outdoor environments
- Available in One or Two Tube Configurations
- Shatter resistant ABS and Polycarbonate construction
- Ballast free design saves energy and simplifies installation
- Allows the use of LED Tube technology in areas you never thought possible.

DirectLED Fixture 4 Ft. Single Tube

Currently available via Special Order:
E-mail for a customized quote.

DirectLED FL - 4 Ft. Dual Tube

Currently available via Special Order:
E-mail for a customized quote.

Also Available:

NEW! DirectLED FL T5 Series

T5 Fluorescent Tube Replacements

Learn More

Browse All Products