DOING MORE WITH LESS
How technology growth in entertainment lighting is requiring less of your budget
EXECUTIVE SUMMARY

Those who manage lighting for small entertainment venues such as churches, restaurants, and small theatres know the transition from tungsten to LED fixtures is not an easy move to make. It’s no secret that LED fixtures cost more than tungsten, or that LED fixtures are more energy efficient. Unfortunately data specific to entertainment lighting illustrating how much more expensive and how much more energy efficient is limited and often irrelevant.

While cost and environmental impacts are important, there are other questions to be asked when considering a change to your fixture inventory.

• How long will it take before I see a return on investment (ROI) from my LED fixtures?
• How will my designers be impacted by my LED vs. tungsten fixture choice?
• What maintenance and operation benefits exist with LED fixtures?

Technology is changing so quickly that the most important questions to ask may be: What cutting-edge products will impact me in the future and what are industry leaders focusing on?

IS THE DATA RELEVANT?

The moment the federal government began discussing the ban of incandescent light bulbs, the entertainment industry was bombarded with LED fixture options, each better, flashier, and shinier than the last. The problem was there was no measured data on why one was better than another. The technology was too new.

In the beginning energy savings was the biggest claim, but as the industry started asking the right questions, it became clear that a fixture that’s only on for a few hours a week – as they are during theatrical shows, special events, religious services, and restaurant hours - cannot be compared to a fixture in a residential or commercial application that is on for 12+ hours a day. When we figure all of the up-front costs, we’re suddenly looking at decades instead of single years before we see a return on the initial investment.
WHAT FACTORS INTO ROI?

Let’s start by taking a look at electrical costs. In 2012 ETC gathered data from 5000 small theatres around the United States and came to the conclusion that entertainment lighting fixtures are on for an average of 2 hours a day or 730 hours annually. Using current cost/kwh data, when on at full, an LED fixture costs $0.03 per day to operate while the average tungsten fixture costs $0.13 per day.¹

For a system with 90 fixtures, we get an annual electricity cost of $985.50 for LED and $4,270 for tungsten.

Simply put, exchanging a 575W tungsten fixture with a 150W LED fixture is a 74% increase in energy savings. This translates into a savings of 34,164 lbs of CO2 saved each year.²

These numbers clearly favor LED fixtures. But now let’s add in the initial cost of the fixture and the change in system infrastructure. Although the majority of this data is from small theatres, similar conclusions can be drawn for restaurants, churches, and other similar venues.

Looking at the cost of a system installation that includes dimmers, relays, conduit, control, and 90 fixtures, we come up with a much more complicated equation.

<table>
<thead>
<tr>
<th></th>
<th>Daily Fixture Operating Cost</th>
<th>Average Cost of Theatrical Equipment for New System</th>
<th>Average Cost of Infrastructure Installation (conduit, cabling, labor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten</td>
<td>$11.70</td>
<td>$167,075</td>
<td>$48,000</td>
</tr>
<tr>
<td>LED</td>
<td>$2.70</td>
<td>$291,522</td>
<td>$12,000</td>
</tr>
</tbody>
</table>

*Numbers from ETC’s 2012 Future Theatre data mining were averaged from 2012 ETC purchase orders and ETC system installation costs.

A tungsten system of this size costs nearly 5x more to operate each day and 4x as much to install as an LED system of the same size. Purchasing all LED fixtures however will cost nearly double.

With up-front costs of LED fixtures substantially higher, and infrastructure substantially lower, the entire situation once again becomes very gray. What is clear is that we cannot base our decisions solely on the lower operating costs of LEDs.

An additional issue worth mentioning is what happens when you turn a fixture off. A tungsten fixture at 0% draws zero power. An LED fixture at 0% still draws a small fraction of power, as if it’s waiting for someone to turn it on again.

Adam Bennette, leading authority on theatrical practices and author of *Recommended Practice for DMX 512: a Guide for Users and Installers* says, “This continuous consumption adds up significantly if energized all day long. Unless end users change their working practices, they could end up consuming more electricity (than tungsten).”

¹ Average US cost/kWh in October, 2015 was $0.11 according to the US Energy Information Administration
² One fixture uses 1.22 lbs. CO2/kWh
Although the carbon footprint savings are clear, higher initial fixture costs and constant power draw are definitely big negatives for LED fixtures. But there are other questions to consider. Let’s take a look at some of the less explored issues behind LED vs. Tungsten fixtures starting with color.

COLOR

Coloring the light of a tungsten fixture is done with gel. The more saturated the gel color, the brighter the fixture needs to be to successfully transmit that color. While some use gel with white LED fixtures, the use of colored LED fixtures is more common. Colored LED fixtures have color mixing capabilities built in. One fixture has thousands of color options. With colored LED fixtures, it often takes substantially less power to achieve the same color output.

For example, a tungsten fixture using R80 gel, and powered at full will not be as bright as the colored LED equivalent when powered at full. For this reason, when working with tungsten fixtures brighter saturated color generally equals more power. However, when we shift the conversation to less saturated colors and white light, the inverse is true - tungsten fixtures come out ahead the large majority of the time.

The following graph shows two ETC fixtures - a tungsten and a colored LED - both at full, both matching the listed gel color. As you can see, the amount of light, or the lumens, that the LED fixture produces with these colors is in some cases substantially more than the tungsten.

It is hard to deny the overwhelming benefit of using one colored LED fixture with unlimited color choices; one fixture, one location, thousands of color options. This is one area where tungsten fixtures cannot begin to measure up. But as we’ve seen so far, with any benefit comes a failing. The lack of gel can be just as much of a disadvantage as it can be a blessing.
Technicians, designers, and educators are now faced with the challenge of how to choose and manipulate color without walking to a cabinet and picking out a known gel. No longer can we put R80 in front of a fixture and get the rich dark blue we’re used to. Now it’s a formula, a trust of the fixture software, and in the beginning, several hours of tweaking to get the colors right. Add fixtures with varying color mixing engines (RGB, RGBA, CMY, X7), and the learning curve may become overwhelming.

Between color matching, power consumption, and fixture and system costs, it’s clear that deciding between LED and tungsten fixtures comes down to personal budget and venue. Thankfully however, there are a few absolutes, a few black and white issues that might make your decision a little easier.

**LOWER OPERATING TEMPERATURE OF LEDS**

The operating temperature of LED fixtures is substantially lower than that of tungsten. This is a big positive for LED fixtures with no real drawback. For anyone who has ever had to focus tungsten fixtures, you are more than familiar with the bulky gloves and burn risk that accompany them. With LED fixtures, these are non-issues.

The proximity to flammable items is much less of a concern with cooler LED fixtures than it is with tungsten. Surface temperatures of tungsten fixtures average at 400° - nearly two and a half times as much as LED temperatures which average around 150°. As you can imagine, lower fixture temperatures lead to lower cooling system costs.

On average, 90% of heat generated from lighting needs to be removed by a cooling system.³ We can logically figure an all tungsten system with five times the heat as an all LED system, requires five times the cooling system. Although it’s a bit of an oversimplification, the benefit of lower temperature LEDs is clear when considering cooling system costs.

Additionally, accessories like gobos and gels that deteriorate because of a high heat environment, now last for months or years without discoloring, distorting, or bleaching. This translates to a smaller maintenance budget, and less time replacing accessories.

³ [http://www.lightsearch.com/resources/lightguides/hvac.html](http://www.lightsearch.com/resources/lightguides/hvac.html)
LAMP LIFE

Now for what might be the biggest pro with LED fixtures: there is no lamp. Let me say that again – there is no lamp in an LED fixture. Never again will you have to bring in a batten minutes before a show starts to re-lamp a fixture that unexpectedly burned out. Never again will you have to send a student up to the catwalk to change a lamp (and then refocus a fixture) just to have another burn out 24 hours later. Never again will you have to schedule a lift or worse, set up scaffolding to change the lamps that have been burned out for months because it’s too hard to coordinate schedules or maneuver around church pews or dining room tables.

The amount of work that goes into maintaining a lighting system is substantial. Re-lamping fixtures that die every 2000 hours (or less) is a big downfall of tungsten fixtures. Once these fixtures burn out, they often stay dark until once or twice a year when your space is closed for maintenance.

The cost of your time never having to be spent on re-lamping fixtures is substantial.

CURRENT TRENDS

While the US government has not put any restrictions on tungsten lighting for entertainment applications, the global push to reduce greenhouse gasses is clear. Venues worldwide are finding cost-effective ways to switch to LED fixtures.

There are a small handful of companies that offer retrofit kits. These kits enable you to remove the lamp housing from a tungsten fixture and replace it with an LED source. For some fixtures this involves replacing the large majority of the fixture. For others the steps to installation prove to be time consuming and frustrating.

Unfortunately all current retrofit options include striking a mounted fixture, using additional tools, and rehanging the fixture. This involves the time-consuming task of rehanging and refocusing the modified fixtures. All for a more energy efficient light source that may not match in light output or color temperature.
CONCLUSION

There are a number of important questions to be asked before purchasing LED fixtures. Many of the answers to those questions come down to what is right for your space and budget.

We’ve discussed a number of the large issues for entertainment lighting venues including the following:

- It’s difficult to measure power consumption and usage no matter what the fixture type.
- LEDs are more expensive than tungsten but the shift in technology comes with a new set of features and benefits that may make the upfront cost worth it.
- Changing technology on experienced designers and technicians requires a learning curve that may be time consuming to overcome.
- Technology is changing so quickly that moving an entire lighting inventory to LED may be a hard cost to stomach. There’s no way to know what new fixtures will come out next.

The ideal situation for any space looking to make the switch to LEDs would be an affordable retrofit option that:

- Does not require additional time or infrastructure changes.
- Eliminates the HPL lamp with an LED source that is dimmable.
- Allows you to replace your tungsten lamps without breaking focus, re-gelling fixtures, or interrupting your current fixture installation.
- Works well with your existing inventory, enabling your designers to continue to use gels and gobos in the same manner they are used to, all at an affordable price point.

“There are many good reasons to use a good LED stage light... but none of them are about short-term financial gain.”

— Adam Bennette
WHAT IS ETC WORKING ON?

Technology continues to grow and new solutions from the industry are surely on the horizon. Only time will tell what the industry develops next. As an answer to many of the short-comings of each type of fixture, ETC has developed a true retrofit for existing Source Four tungsten fixtures.

The Source 4WRD™ retrofit kit replaces the tungsten burner assembly of a Source Four fixture with an LED source. The Source 4WRD is cool to the touch, eliminating the need for gloves. With no lamps to replace maintenance time is cut, lamp inventory costs are eliminated, and the need for ladders and lifts is reduced.

One of the biggest benefits is this white-light LED is color matched in temperature and intensity to existing Source Four fixtures. The Source 4WRD was designed with your existing system in mind and is controllable with either DMX or AC dimming, making it a true plug and play option for any retrofit.

For more information on the Source 4WRD, see our website at www.etcconnect.com

ABOUT ETC

ETC is a global leader in the manufacturing of lighting and rigging technology for entertainment and architectural applications. Founded in Madison, Wisconsin, in 1975, ETC was a college project that grew into a major business, with Fred Foster as the current chief executive officer. ETC’s international headquarters is located in Middleton, Wisconsin. The company also has offices in Mazomanie (Wisconsin), New York, Hollywood, Orlando, Hong Kong, Copenhagen, Ede (the Netherlands), Rome, London, Berlin, and Holzkirchen (Germany). ETC employs close to 1000 people around the globe.

Since its beginning, ETC has earned an industry reputation for unmatched technical and customer service. In addition to its own renowned service department offering 24-hour phone support, ETC has almost 300 authorized service centers throughout the world, staffed by hundreds of certified technicians.

ETC products are found in small and large venues worldwide, such as theaters, restaurants, schools, performing arts centers, television studios, houses of worship, casinos, museums, theme parks and opera houses.

For additional resources on color temperature of LEDs vs. Tungsten fixtures, combining an existing inventory of tungsten fixtures with new LED fixtures, and learning to manipulate new LED color so it matches existing tungsten color, see our website at www.etcconnect.com.

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