LED vs T5 Technology: The Advantages and Disadvantages

"Heat is the great enemy of lighting system performance, and LED systems are no exception." – Randal Smith, Lighting Design Lab News (Winter 2006)

A Comparison by:

Sydney Sanchez and Scott Sweeney
Department of Research and Writing

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LED lighting is one possible wave of the future. As more companies retrofit their buildings to reduce energy consumption, many may turn to LED lighting solutions in their efforts to reduce energy costs. While promising, current LED technology may not be the best solution to fix your company's energy inefficiencies. This paper compares LED and T5 lighting technologies and illustrates the advantages and disadvantages of both energy efficient lighting solutions.

Efficacies of T5 and LED Bulbs

In 2009, the Institute of Electrical Engineers (IEEE) compared the heat dissipation and thermal degradation efficacy between T5 and LED bulbs. *They discovered that T5 bulbs perform significantly better than LED bulbs.* The measured efficacy of a 14 Watt T5 fluorescent lamp was 96.7 lm/W, while the measured efficacy for the best performing LED lamp was only 78.5 lm/W. In this study, the T5 bulb performed better than its estimated 96 lm/W rating, while the LED performed significantly worse than its 107 lm/W rating. Thus, this study observed a 28.5 lm/W disparity between the assumed heat dissipation of an LED bulb and the actual heat dissipation of a LED bulb. Another study performed by The Lighting Research Center found that the more frequently used 21 Watt T5 bulb produced a high efficacy rating of 100 lm/W,[i] while GE is currently manufacturing a 26 Watt T5 bulb that has a rating of 111 lm/W.[ii] These studies both conclude that T5 bulbs produce more light (lumens) compared to the amount of power they consume in Watts. The study argued that; "For general illumination applications, the LEDs in this comparison are inferior to T5 lamps in terms of energy efficiency and efficacy."[iii]

Heat Dissipation and Overheating

The case study by IEEE also examines the heat dissipation of each lamp and found that the T5 lamp dissipated about 73% of its total lamp power as heat. However, the LED lamp in this study dissipated about 87% - 90% of its input power as heat. This high heat dissipation percentage can greatly increase additional cooling costs in your building, significantly reduce bulb lumen life, and lead to possible bulb failure.

LED fixture heat dissipation and overheating is a growing consumer concern. An Illumra Green Systems executive recently discussed this issue in an article entitled "The Biggest Barrier to LED Lighting." In this article, the author suggests LEDs have the potential to double their temperature after they have been in use for an extended period of time. The resulting increased LED temperature can reduce the lamp's life hours by more than 50%. The author describes why LEDs are more prone to overheating than fluorescent bulbs by stating,

> "Most light fixtures have been designed to take light from a (fairly focused) point source, the filament in the bulb, and diffuse it evenly over a space. Putting lots of LEDs at one point concentrates the heat, making it harder to keep the LEDs cool."[iv]

To prevent heat concentration in an LED fixture and avoid LED bulb failure, users must provide additional system cooling, resulting in higher HVAC costs and greater energy use.

Source and Upfront Costs

IEEE's case study also demonstrates that T5 lighting is a more cost-effective lighting solution. The study records the source cost of both T5 lighting and a T8 sized LED bulb using the measurement of $/1000 lm.[1] Study results show that T5 bulbs performed at a source cost of approximately $3 per 1000 lm, whereas the best comparison rival single LED bulb cost more than $70 per 1000 lm.

The up-front cost differential between fluorescent fixtures and LED fixtures is also substantial. According to the study, **"**The Use of LED fixtures in Healthcare Facilities," the fixture cost for an LED is around $333.[v] Thus, LED retrofitting requires significant upfront investment in contrast to emerging fluorescent technology (i.e. at least 3 times more expensive). This significantly higher per-unit fixture cost proves that LED retrofitting is an expensive proposition and far from an ideal solution for any company's bottom line.

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CRI Index

Another factor to consider before replacing your current light fixtures with more energy efficient light fixtures is the **Color Rendering Index (CRI).** The CRI measures a bulb's ability to reveal small shade variations between colors on a scale ranging from zero to one hundred. A report written by *Measurement Science and Technology* shows that T5 fluorescent lights have a significantly higher CRI than LEDs. T5 lights obtained a CRI rating of 85, while the single LED received a rating of 70.[vi] This study suggests that T5 bulbs may produce a higher quality light than LED bulbs. Other studies have shown that higher quality light yields numerous benefits, including increased worker productivity.

[1] Source Cost is expressed as the ratio of one dollar to every 1000 lumens consumed. ($/1000 lm)

LED and Lifetime

Multiple studies show that T5 lighting displays significant advantages over LED lighting. However, it is difficult to refute the benefits associated with LED technology, such as increased lifetime, low driving voltage and fast response time. While some LED bulbs are marketed as having a 100,000 hour life, actual longevity is not yet proven. This is because:

(i) the actual lifetime of an LED is dependent on its thermal environment

(ii) inadvertent overheating of LEDs typically results in increased lamp lumen depreciation.[vii, viii]

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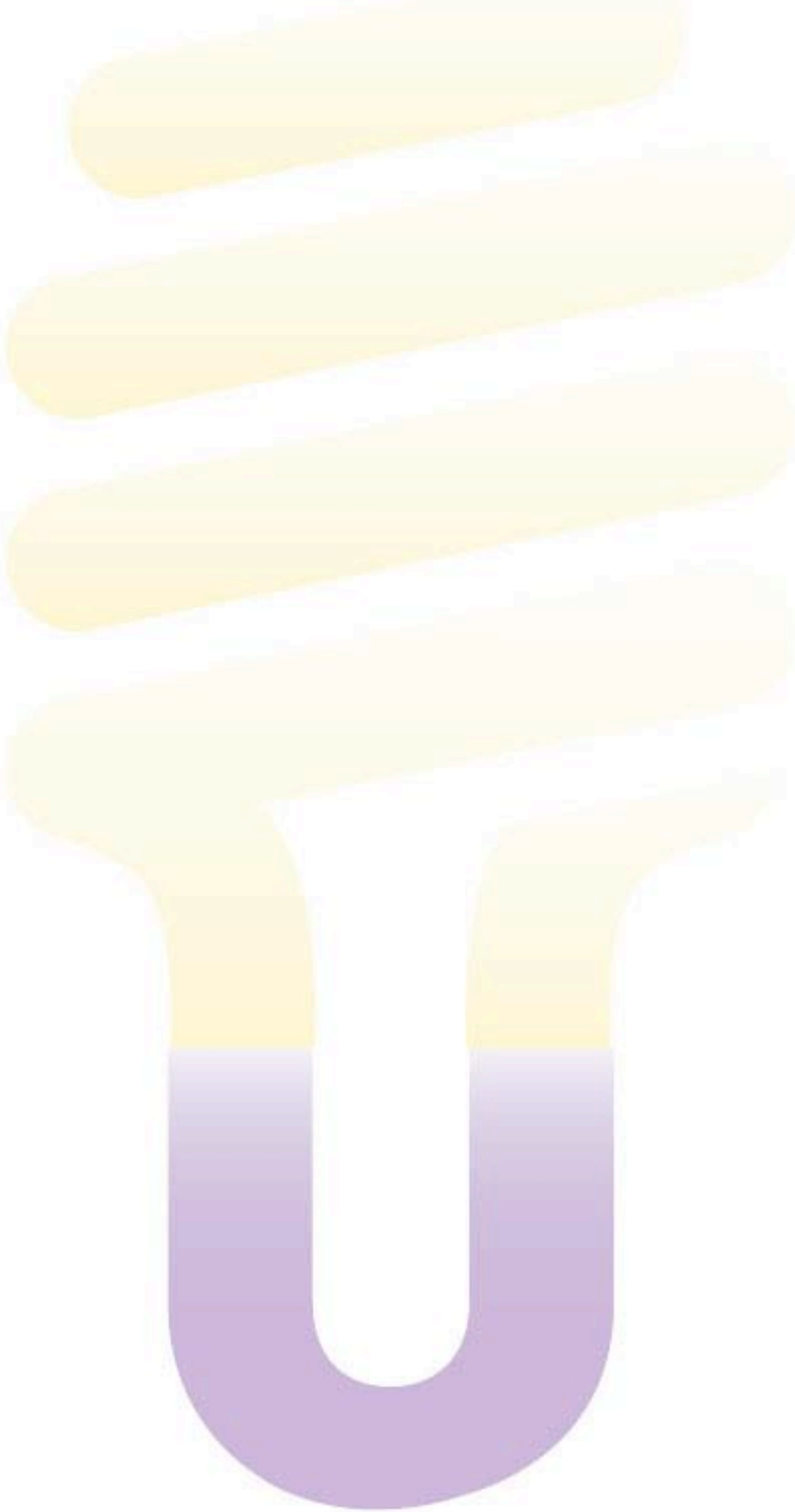
Studies, including one performed by the Energy and Environment Research center in Lecce, Italy, as well as one performed by the IEEE, demonstrate that after 50,000 - 60,000 hours, high-powered LEDs produce less than 70% of their initial output and consequently, must be replaced.[ix, x] Although studies have proved that LED lamps may not last as long as their rated 100,000 potential life hours, LEDs currently maintain a longer lifespan than fluorescent bulbs. According to the U.S. Department of Energy, high powered LED bulbs can have anywhere between 35,000 - 50,000 useful life hours, while linear fluorescent bulbs maintain anywhere between 20,000 - 30,000 useful life hours.[xi] However, when comparing the costs of LED and T5 bulbs, the longer life hours can appear trivial. Today, LED bulbs cost nearly 24 times more than T5 bulbs. This significant cost differential is due to the high cost associated with the complexity of LED bulb technology, while T5 technology simply consists of efficient bulbs without integrated electronics. When a 4' linear T5 bulb burns out, it costs less than $3.00 to replace.[xii] Comparatively, it costs approximately $71 to replace a LED bulb.[xiii] Therefore, by spending equivalent dollars on a T5 bulb and the nearest comparable LED bulb, you could buy enough T5 bulbs to last over 590,000 life hours.

Conclusion

LEDs have proven to be extremely effective due to their long lifespan and increased efficiency. Many companies have successfully purchased LED exit signs and substituted other hard-to replace lighting fixtures with LED bulbs. However, T5 fluorescent bulbs have performed significantly better in multiple studies that are critical to commercial and residential usage. If you are looking at retrofitting your building from old T12 or T8 lighting fixtures to a more efficient technology, it is important to consider crucial factors such as heat dissipation, the CRI rating, efficacy, overall cost, and lifespan of your bulbs. Before you make the leap to energy efficiency, make certain your new lighting technology is the best in its field.



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