POWER EFFICIENCY PROJECT

Professor Max Powers' Power Efficiency Project (PEP) is brought to you by the Kansas Corporation Commission and Kansas State University Engineering Extension. Funding provided by a grant from the U.S. Department of Energy.

The LED Advantage

Since its groundbreaking inception by Thomas Edison in 1879, incandescent light bulb technology has remained relatively unchanged. In recent years, modern innovators have been working to develop more efficient ways to generate light. The most notable example is the **light emitting diode (LED)**, a solid-state technology that uses semiconductors to convert electricity into light. While the incandescent light bulb uses most of its energy to produce heat (only 10 percent of the energy consumed results in actual light), the LED bulbs generate little heat and produce significantly more light (lumens) per watt. It's no secret, however, that LED bulbs cost more to purchase than incandescent bulbs. Read on and see how LED benefits far exceed initial costs!

Case Study:

The LED and incandescent bulbs pictured in **Figure 1** were purchased at Menard's on March 23, 2016. The four-pack of 60W-equivalent LED bulbs cost $9.99, or $2.50 per bulb. The four-pack of 60W incandescent bulbs cost only $2.97, or $0.74 per bulb. With the LED bulbs costing 237% more than the incandescent bulbs, a thrifty consumer might think the incandescent bulbs are the better deal. But is this the case?

Figure 1: Bulbs purchased March 23, 2016.

As **Figure 2** shows, the estimated life for the Philips LED bulbs is 10 years, whereas the estimated life for the Sylvania incandescent light bulbs is only 0.9 years, both based on three hours per day. Consequently, we'd have to purchase 10 or more four-packs of incandescent bulbs to last as long as a single four-pack of LEDs (as seen in **Figure 3**).

Figure 2: Information labels for LED bulbs and incandescent bulbs.

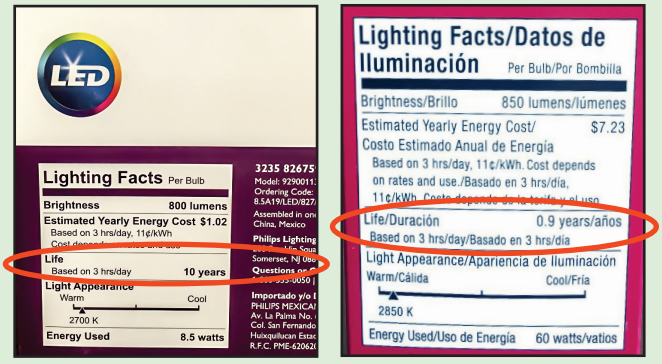
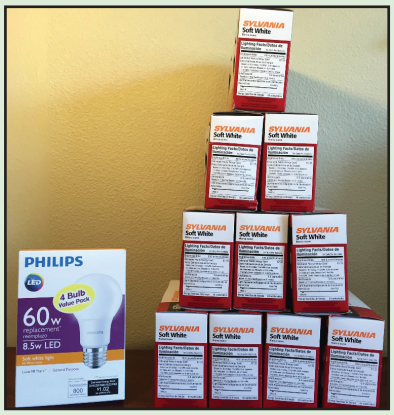


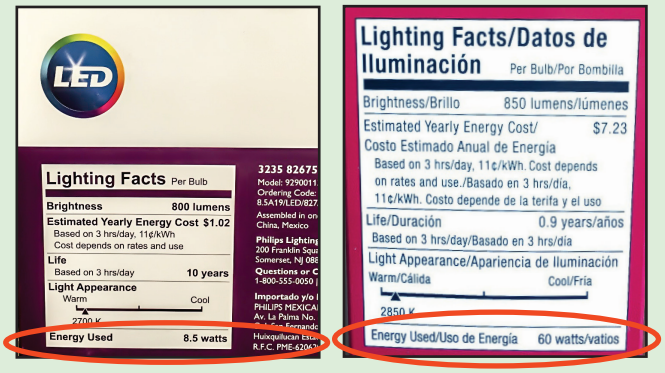
Figure 3: Equivalent number of four-packs of bulbs used over 10 years.



At the end of 10 years, our original purchase price for the LED bulbs remains the same at $9.99. However, we've now had to purchase 10 four-packs of the incandescent bulbs for a total of $29.70 (10 times the initial purchase price of $2.97, assuming, of course, the initial price hasn't increased over 10 years). Moreover, our example thus far only includes the cost of purchasing the bulbs. Let's see what happens when we factor in the energy costs.

We know that both bulbs have anticipated lifetime performance based on three hours per day. Electricity consumption is measured and billed in units of kilowatt hours (kWh). To obtain the kWh consumed by the bulbs, simply multiply the wattage by the number of hours, and then multiply by the cost charged by the electric company per kWh. The LED bulbs use 8.5 watts, whereas the incandescent bulbs use 60 watts (see **Figure 4**). Since the bulbs are rated in watts, and a kilowatt is 1,000 watts, we have to divide by 1,000 to get kWh. These calculations are as follows:

Figure 4: Information labels for LED bulbs and incandescent bulbs.



LED:
(4 bulbs) (8.5 watts/bulb) (kw/1000 watts) (3 hrs/day) (365 days/yr) ($0.1265/kWh)[1] (10 Years) = **$47.10** over 10 yrs (remember: the four LED bulbs last the entire 10 years)

Incandescent:
(4 bulbs) (60 watts/bulb) (kw/1000 watts) (3 hrs/day) (365 days/yr) ($0.1265/kWh)[1] (10 years) = **$332.44** over 10 yrs (remember: only four bulbs are operating at one time, but it takes 40 bulbs to last the full 10 years)

1. Table 5.6.B. Average Price of Electricity to Ultimate Customers by End-Use Sector (Kansas, Residential, April 2016 YTD) , U.S. Energy Information Administration, https://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_b, June 30, 2016.

Conclusion:

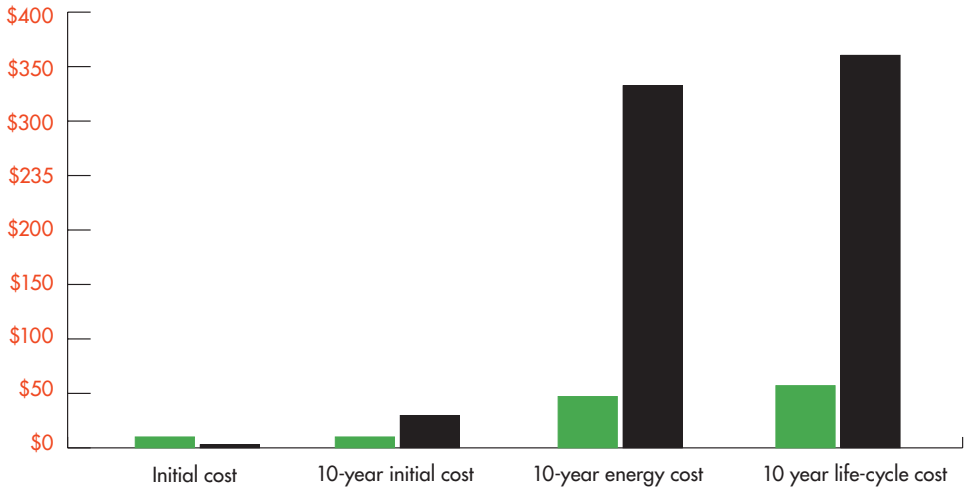
When taking into account the price of the bulbs and energy costs, the four-pack of LEDs saves more than $300 over 10 years! Imagine the savings potential in your home. The only time incandescents seem more economical than LEDs is at the checkout register. **When you factor lifetime performance and energy costs, LEDs clearly outshine the competition.**

Additional LED benefits:

- **Consume less energy**
- **More durable**
- **Produce less heat**
- **Longer life**
- **No mercury**
- **Instant light**

Life-cycle cost of LED vs. Incandescent

LED
Incandescent



For more information on LED lighting, contact Kansas State University Engineering Extension at 785-532-4998 or dcarter@ksu.edu.