

Light emitting diode  
(led) - one of today's  
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and rapidly-dev...

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The Energy Independence and Security Act was signed on December 19, 2007 by President George Bush. This act aimed to move the United States toward greater energy independence by increasing the production of clean, renewable fuels and increase the efficiency of products, buildings, and vehicles (Summary of the Energy Independence and Security Act, 2016). This act it contained specific guidelines for lighting and lightbulbs. The most significant requirement for lighting called for a 25% reduction in energy use for lighting. This requirement helped pave the way for LED's and the technology that followed. Light emitting diode or LED is one of today's most energy-efficient and rapidly-developing technologies (LED Lighting, 2018). LED lighting is helping consumers and companies save money over traditional lighting methods. LED's are very different from other lighting such as incandescent bulbs and CFLs. Some of the key differences include:

- Light Source: LEDs are small is size and are powered by a printed circuit board.
- Direction: LEDs emit light in a specific direction. This makes LEDs more efficient, with other types of lighting, the light must be reflected to the desired direction and more than half of the light may never leave the fixture (LED Lighting, 2018).
- Heat: LEDs emit very little heat. In comparison, incandescent bulbs release 90% of their energy as heat and CFLs release about 80% of their energy as heat (LED Lighting, 2018).

LED lighting can produce other cost reducing benefits for companies and consumers other than the well-known energy savings. In this case we will

focus on the manufacturing industry and examine the ROI for an LED lighting retrofit. This will focus on energy savings, maintenance cases and a reduction in accidents to determine if LED lighting is something a manufacturing company should invest in. Estimated energy savings per year: LED's use, on average, 50% less energy than other forms of lighting (5 Important Reasons You Should (Finally) Embrace LEDs, 2018). We will use the following as an example. An existing manufacturing company has 200 128-watt T8 fluorescent fixtures (four-32 Watt bulbs in each fixture) are replaced with 200 52-watt LED panels. Assume that this project is happening in a manufacturing environment and that the electric rate is 10.78 cents per kilowatt-hour (the national average for kWh in June 2018 (U. S. Energy Information Administration - EIA - Independent Statistics and Analysis, 2018)). We will also assume the lights are operated at 2870 hours per year. (U. S. Energy Information Administration - EIA - Independent Statistics and Analysis, 2016).

The annual electric cost for the traditional CFLs is \$7,907.33 and the LED annual cost is \$3,212.35, saving me \$4,694.98 per year. With the positive annual energy savings, this benefit would help my company over all and lead me to believe the LED lights is a good investment (Exhibit A) (LED Waves' LED Savings Calculator, 2018). Estimated reduction in maintenance costs: LED' can last 3-4 X longer than any current light source (LEDs, 2018). By upgrading to an LED system at a manufacturing facility you are reducing the amount of times you need to pay someone to replace the burnt out lights. This can get costly because most lights in a manufacturing facility are hard to reach. Using the above example I've estimated the hourly rate to replace

4 light bulbs to be \$21.42. Using the calculator and estimating the average life of a CFL at 8,000 hours. This equates to changing the light bulbs every 2 years and 9 months compared to every 20 years and 11 months with LED's. The annual labor costs to replace the CFL bulbs is approximately \$1,430.00 per year. Over the total life of the LED's the estimated maintenance savings is \$28,600 ( $\$1,430 \times 20\text{yrs}$ ) (Exhibit A) (LED Waves' LED Savings Calculator, 2018). With the maintenance costs reduction it would lead me to believe the LED lights is a good investment for my company. Estimated reduction in workers comp/accidents claims: According to the U. S. Bureau of Labor Statistic's 2016 report. Approximately 3.9 nonfatal occupational injury and illness incidents are filed per 100 full-time equivalent manufacturing workers (Bureau of Labor Statistics, U. S. Department of Labor, 2017).

A work-related injury has an average loss of approximately \$38,000 including wages, productivity loss and medical expenses directly to the company (Dorn Companies, 2011). In manufacturing environment, 19% of the injury cases filed were a result of a fall, slip or trip (Bureau of Labor Statistics, U. S. Department of Labor, 2017). If we can reduce the number of times an employee replaces light bulbs, climbing ladders or using equipment to reach, we may be able to reduce the fall, slip and trip injury rate. Of the 254,941 manufacturing companies in the United States in 2014, approximately 93% or 237,747 companies have less than 100 employees, see Exhibit B (Small Companies Dominate the Industrial Landscape, 2014). An interesting additional benefit of the LED technology has to do with the color temperature or the light wave the LED emit. Sleep specialist and

circadian rhythm expert, Dr. Michael Breus states, blue light suppresses melatonin production for more than twice as long as other light wavelengths, and alters circadian rhythms by twice the degree (Breus, M., Dr., 2018). Blue light exposure can be helpful during the day, especially in the morning and early afternoon.

Research shows exposure to blue-light during daytime hours can be beneficial in several ways, including (Breus, M., Dr., 2018):

- Reducing daytime sleepiness
- Speeding reaction times
- Elevating alertness
- Strengthening attention span

On the color temperature spectrum, LED lighting, specifically a cool white designed for manufacturing facilities, produce greater amounts of the blue light spectrum compared to the traditional CFL's (Exhibit C) (Color Temperature, 2015). With this additional blue light wave an individual may have increased their ability to stay alert and reduce the number of accidents. Using color temperature and the 3.9 injuries per 100 employees' statistic. Unless I was one of the 7% of manufacturing companies that have over 100 employees. I do not think that at a 19% fall, slip and trip accident rate it would be worth the investment to purchase LED's as a way to reduce accidents.

## **Conclusion**

Overall this project would pay for itself in roughly 2.1 years and would save the business owner \$123,870 over the lifetime of the equipment purchase (Exhibit A) (LED Waves' LED Savings Calculator, 2018). The initial investment in LED's are well worth the initial investment cost for a manufacturing facility. The energy savings alone help reduce overhead for the company. While researching other job's LED's can do, the reduction in maintenance is another positive that LED's can make. By reducing the number of times and cost for an employee to replace the traditional CFL's, we reduce the potential for accidents and also reduce the overall maintenance cost. One thing I was not aware of is the average size of the manufacturing companies in the United States. I didn't realize the overwhelming majority of the companies employ less than 100 works. Installing LED's to help reduce accidents may not be beneficial for the majority. But for companies that have large workforces and several accidents per year, it may be worth looking into to help reduce the overall workers comp cost.