

# LED 101

With new technology comes new opportunity, and LED can bring a range of benefits to many environments. This reference guide discusses the basics of LED technology and how the technology operates, how it can be applied to your space and how you can reap the benefits.





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# INTRODUCTION

Chances are, if you've considered a lighting upgrade recently, you've heard about LEDs. But what is an LED? How does it work? Why is it such a hot topic in the lighting industry? And what benefits can it have for you, the lighting consumer?

LEDs have been around for decades but have only recently come to prominence. As one of the most promising technologies in lighting today, forward-thinking decision makers are considering and discovering the benefits an LED retrofit can have for their facilities, whether for the exceptional controllability offered by LED, advanced dimming and scheduling capabilities, or unparalleled lifespan.

Today, the industry is witnessing a rapid growth in LED products for many applications. From roadways to retail, from sports facilities to office space—for all of your lighting needs, there is a capable LED solution.

When considering LED for a retail space, you'll want to follow the three guiding principles we outlined in our [Retail Lighting 101 eBook](#):

- 1 Attraction.** The lighting throughout your store should be enticing, guiding customers to special displays and throughout the entire space.
- 2 Appraisal.** Customers make a flurry of buying decisions from the time they walk through your doors—does your lighting give you the best chance that these decisions will result in sales?
- 3 Atmosphere.** Lighting can elevate your store's brand and image, and can leave a positive impression that lasts.



# HOW LEDs WORK

Simply, an LED—or Light Emitting Diode—is a diode that emits visible light when energized. Also referred to as a solid-state lighting (SSL) device, or a semiconductor device, an LED is energized by applying a voltage in the right direction (*more on that in a moment*), causing the semiconductor or diode to glow. A reflector cup then propels the light in the forward direction.

## Inside LED

In order for this process to work, the LED requires a driver. A driver, or power supply, creates electrical pressure (voltage), pushing charge carriers through the LED. The rate at which the electrical charge flows through the LED is called the current. Therefore, wattage is determined by multiplying the voltage and current.

The very first LED to emit visible light was invented in a GE lab in Syracuse, N.Y., in 1962—so why is it now that LED is beginning to fully break into the commercial market segment? The 1962 LED emitted red light and was then used in applications like instrument displays and digital watch dials. As LEDs of other colors became available, red, blue and green LEDs were combined to create a white light source. Today’s general lighting LEDs are made up of a blue LED as the primary light source, supplemented by a covering of phosphors that fill in the other regions of the light spectrum.

## General Use

Today’s general use LEDs are made up of the following components:

**Chip:** A layered semiconductor light source

**Package:** An LED chip, lead wires and an epoxy shell, enabling reliable use

**System:** Multiple LED packages, as well as the following four main components that make an effective LED:



### Optical:

LEDs are a directional light source, which means they emit light in a single direction. Through carefully designed lenses, light is directed only where needed, minimizing wasted light and energy consumption.



### Mechanical:

LEDs last for years, requiring enhanced durability of the entire system. Careful mechanical engineering protects LED systems from corrosion and humidity to ensure a long lifespan.



### Thermal:

LEDs are affected by heat in ways that other light sources aren’t, causing reduced life and color shifting. Therefore, LED systems require thermal management to dissipate heat and improve performance.



### Electrical:

The lifespan, light output and color temperature depend on specific electrical power (*wattage*) to operate effectively. This requires precise engineering to ensure the right amount of electricity is delivered to the LED chip.

## The Future

Increasing adoption of LED technology can have significant impact on energy consumption across the United States. By the year 2030, the U.S. Department of Energy estimates that LED technology could save approximately 190 terawatt hours of electricity per year. That’s the equivalent to the annual output of 24 large power plants. That’s enough electricity to power 95 million homes. And at today’s prices, it’s \$15 billion in savings.



# LED CAPABILITIES & ADVANTAGES

LEDs are considered among the most promising breakthroughs in lighting technology since the incandescent bulb, with the boundaries of efficacy and life being extended frequently thanks to constant innovation.

## Efficacy and Performance

Extended lifespans and limited required maintenance are two of the most attractive features of LED lighting solutions for applicable environments.

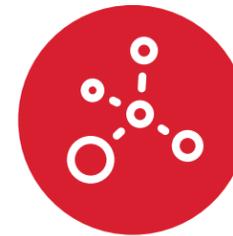
Lengthy performance of LED fixtures means less maintenance and replacement for you and your employees. High bay lighting is required in many environments, whether it's a large consumer floor space or a warehouse; maintenance and repair of such lighting can be costly and potentially dangerous without the right safety measures. By mitigating the need for frequent maintenance, LED systems can help save costs in the long run.

Additionally, many available LED options provide excellent color rendering with high R9 levels to bring out an object's colors where it matters most. Be it a merchandise display, an outdoor walkway, a high-traffic road or a football field, LED technology delivers. LEDs also offer superlative performance when it comes to aiming light. This ability can suit many different purposes, as light can be directed where it's needed and kept away from where it isn't, helping to improve aesthetics throughout any environment.

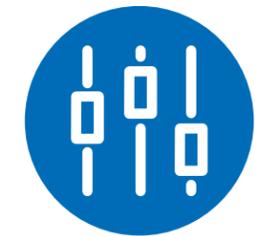
## LED Life Cycles

LED life is typically rated at 70% of initial lumens. For instance, if an LED is rated at 50,000 hours/L70, that means that half the product at 50,000 hours will have lumens greater than 70% of initial, and half will have lumens less than 70% of initial. This is often referred to as an average life specification.

## Controllability and Dimming



Rounding out the capabilities that LED can bring to any space is the technology's compatibility with advanced dimming and control options. Just as advanced technology has allowed for light sources to become more effective, so has it allowed for a comprehensive rethinking of the "light switch."



Comprehensive and fully customizable control options are now available, and no light-source technology is better suited for these advanced options than LED. These sophisticated control options range in complexity, and are scalable to best suit the needs of a given application. Ranging from simple switching, on/off time schedules, occupancy sensing and daylight harvesting, these control solutions can help greatly reduce total energy consumption.

## Look Ahead

While there is still some hesitation in the marketplace over the upfront cost of installing an LED system, the benefits that come with such a system far outweigh many legacy lighting technologies. Whatever your lighting needs, from outdoor site lighting to high bay to indoor accent lighting, from decorative directional lighting to channel letters and border lighting, there is an LED solution that can work for you.



## IN PRACTICE

As with any major business decision, care must be taken to ensure that a comprehensive lighting upgrade with LED technology will be worth the investment in the long run. Whether it's a full-scale, comprehensive LED upgrade across an entire operation or using the technology strategically in specific environments, your facility can reap the benefits.



Retail

### For Retail

An LED upgrade can help retail environments save and thrive, as evidenced by a comprehensive LED retrofit completed by GE Lighting and a major Midwest retailer. The store **saved significant kilowatt hours (kWh) per year** by converting its refrigerated display cases to LED, its sales floor lighting to LED, and its parking lot lighting from traditional metal halide fixtures to LED. Additionally, a global rollout of GE LED ceiling lighting across 200 store locations will save the retailer **energy and maintenance costs** over the next 10 years.



Municipalities

### For Municipalities

After a careful evaluation of its needs in the Downtown District, the [city of San Diego](#) initiated an LED upgrade that helped amount to more than \$250,000 in annual energy savings. The city commissioned a study that showed residents and business owners preferred broad-spectrum lighting, for which LED was well-suited. And with GE Lighting's LightGrid™ Outdoor Wireless Control System as well as dimming schedule features, the city is expected to see increased savings well into the future. The project includes replacing 3,000 high-pressure sodium lamps with GE's Evolve™ LED Post Top—Avery StreetDreams™ lighting fixtures.



Industrial

### For Industrial

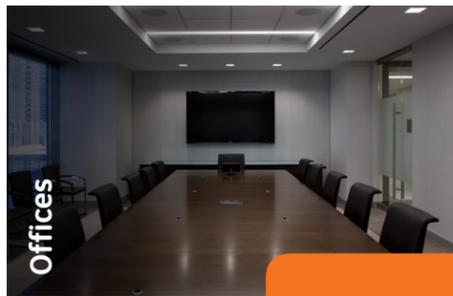
With the goal of improving energy usage and decreasing maintenance needs for its Golden, Colo., distribution center, [Natural Grocers by Vitamin Cottage](#) sought out an LED solution that helped accomplish those needs. A facility-wide replacement of 400-watt HID metal halide fixtures without motion controls with GE's LED high bay lighting with occupancy sensors helped reduce energy consumption by 93 percent and also reduced maintenance needs. Operational savings total more than \$23,000 annually, while reducing annual CO<sub>2</sub> emissions by 325,525 lbs. That's equal to planting 40 acres of trees.



Hotels

### For Hotels

After replacing 57,000 incandescent candelabra lamps—using 20 to 40 watts per bulb—with GE's 4.5-watt LED Candelabra Lamps at [The Venetian | The Palazzo](#), Las Vegas Sands can expect to reduce its annual electricity consumption by more than 8 million kilowatt hours (kWh). The resort follows the comprehensive Sands ECO 360° Global Sustainability program that features an array of best practices in four integral areas: green buildings, environmentally responsible operations, green meetings and stakeholder engagement.



Offices

### For Offices

LPL Financial in San Diego could not have achieved its dream of a **net-zero energy office** without GE's LED lighting, which will save **thousands in annual lighting energy costs**. The project converted fluorescent fixtures to LED, reducing total fixture count by nearly 40 percent. And with GE's LightSweep™ lighting control system and Aware™ occupancy sensors, LPL now enjoys dimming and daylight harvesting capabilities on every floor.

## Controls

Across all facility types, an LED lighting upgrade can help earn the credits necessary for Leadership in Energy and Environmental Design (LEED®) certification from the U.S. Green Building Council.



By assessing your facility's current lighting, you can determine whether or not an LED solution is right for you—and that starts with a lighting audit and a trusted partner. When you're ready to start your lighting project, contact GE Lighting and schedule an audit at

**[www.gelighting.com](http://www.gelighting.com)**.