Seven Different Lights

LEDs Are Putting Out Of Business

By Stouch Lighting

Incandescent Bulbs

Incandescent Bulbs

The incandescent light is your classic light bulb. It produces light with a wire filament. The metal wire is surrounded by a translucent glass bulb that is either filled with an inert gas or evacuated (a vacuum).

What's the upside to incandescent bulbs? They're really cheap to manufacture and accordingly, they're really cheap to purchase (typically a dollar or two). Incandescent bulbs are widely available and adaptable to a large range of voltages, light outputs, and current (working well with both AC and DC power).

Why would LEDs put incandescent bulbs out of business? Incandescent bulbs are very inefficient energy consumers. They convert less than 1/20th of the energy they consume into visible light. A large portion is lost as heat. This all translates to cost. Although the sticker price is low, incandescent bulbs will cost you money over time based on the inefficient way in which they operate. In a large-scale building (like schools, hospitals, or commercial buildings), this inefficiency will really add up.

Professional Tip

LEDs are particularly relevant for retail and hospitality organizations that often haven't changed over from incandescent bulbs to a more efficient and higher quality product like LED lighting. Paybacks on an LED retrofit project replacing incandescent lamps would be excellent regardless of the project size.

Halogen Lamps

Halogen Lamps

Halogen lamps are actually a type of incandescent light. They're the kind that is filled with inert gas as opposed to a vacuum. The gas used is one of the five halogen elements from the periodic table (bromine, chlorine, fluorine, iodine, or astatine). The purpose of the gas is to chemically react with the tungsten filament and in so doing, re-deposit evaporated metal back onto the filament (known as the halogen cycle). The net effect is to increase the lifespan and visual clarity of the bulb.

What's the upside to halogen lamps? Halogen bulbs produce a very high quality light (better luminous efficacy and higher color temperature) than comparable standard bulbs because they're able to operate at a hotter temperature. They are used as projection lamps, as flood lights on vehicles, and in medical applications that require high quality light.

Why would LEDs put halogen lamps out of business? The electrical costs of running halogen bulbs (particularly those being used on a large scale) are significantly higher than LED lights. Additionally, the potential lifespan of LED lights is an order of magnitude larger than incandescent bulbs like halogen lamps.

Did You Know? The lights that illuminate the new year numerals in Times Square during the dropping of the ball used to be halogen lamps. But starting in 2010, LED technology took over and started halogen lamps on the long march towards obscurity...

Mercury Vapor Lights

Mercury Vapor Lights are a type of gas-discharge lamp that generates light by sending an electrical discharge through ionized mercury gas.

What's the upside to mercury vapor lights? On the plus side, gas-discharge lights are much more energy efficient than incandescent bulbs (not quite as good as some of the new LED technology but much better than your traditional light). They also enjoy the advantages of a fairly long lifespan and they produce a high quality light. As a consequence, they're frequently used to illuminate large factories or warehouses, sporting venues, and for street lighting.

Why would LEDs put mercury vapor lights out of business? Mercury vapor lights produce short wave ultraviolet radiation that can be hazardous to the skin or eyes. This is usually prevented somewhat by the exterior glass of the bulb itself. Problems typically develop, however, in the event that the bulb becomes damaged (e.g. from contact with a baseball). Of note, even with the outer bulb intact to protect against UV emissions, hazardous rays still escape and have been known to damage materials in their vicinity (e.g. the polycarbonate plastic used in greenhouses degrades significantly due to mercury vapor light emissions).

Additionally, the toxic nature of mercury gas makes mercury vapor lights particularly hazardous when they break in closed, indoor spaces without sufficient ventilation (e.g. in the home or office). According to the Swiss Federal Office of Public Health "mercury vapor emitted by broken lamps are a danger to health if larger quantities of vaporized mercury are leaked, such as if several linear-form mercury lamps, each containing up to 15 milligrams of mercury, were to break open in a room."

Did You Know? According to international lighting manufacturer Osram, mercury vapor lighting is being phased out entirely in the European Union. Here is what they had to say about it:

> *"With the second step of the EU directive...coming into force on 13th April 2015, all mercury vapor lamps (HQL®), mercury hybrid lamps (HWL®) and many sodium vapor lamps (NAV® plug-in) are no longer permitted to be placed on the market in the European Union."*

Fluorescent Bulbs

Fluorescent Lamps

Fluorescent lights are another type of mercury vapor gas discharge light. T-5 bulbs are the most current generation. They are smaller, more efficient, and produce better light than their earlier cousins (1980s T-8 technology and 1930s T-12 technology). They are more energy efficient than incandescent bulbs but have a higher initial cost. Additionally, the fact that they contain mercury makes them a hazardous waste material requiring special handling for disposal.

What's the upside to fluorescent lights? They are very energy efficient, have a long lifespan, and produce a high quality light.

Why would LEDs put fluorescent lights out of business? In the last few years LED efficiency has surpassed that of fluorescent lights and its efficiency improvements are progressing at a much more rapid rate. Further, fluorescent lamps require the use of a ballast to stabilize the internal current that produces light. When the ballast has a minor imperfection or is damaged, the light can produce an audible buzzing noise. Other shortcomings include the following:

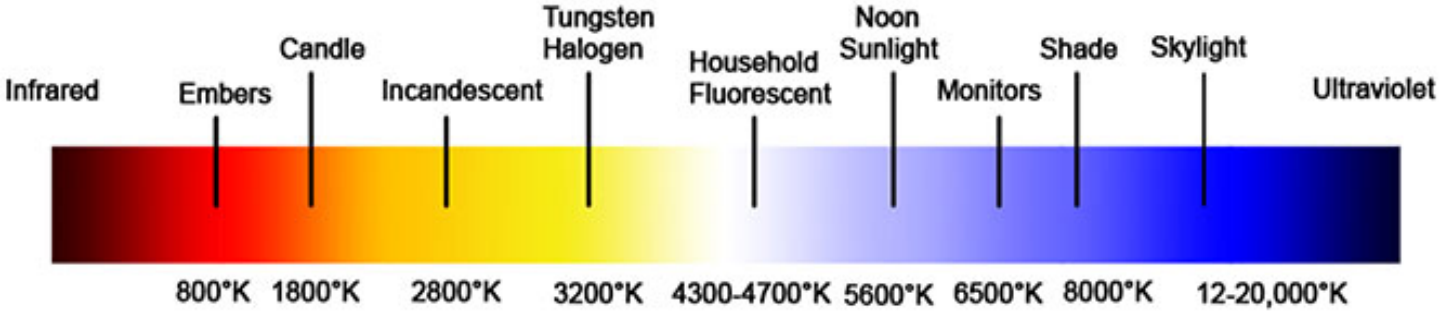
- Fluorescent lights can cause retrofit problems due to their elongated shape.
- Fluorescent lights can present waste disposal issues due to their reliance on mercury.
- Fluorescent lights are non-directional, meaning that they emit light for 360 degrees. As you might expect, a large portion of this light is wasted (for example, that portion that is directed at the ceiling).

Metal Halide Bulbs

Metal Halides

Metal halides are compounds formed when metal and halogen elements combine. They include things like sodium chloride (salt) and uranium hexafluoride (the fuel used in nuclear energy reactors). Metal halide lamps produce light by passing an electric current through a combination of mercury and metal halide gas. They function very similarly to other gas-discharge lamps (e.g. mercury vapor) - the principal difference being the composition of the gas. The introduction of metal halide vapor generally improves both the efficiency and the quality of the light.

What's the upside to metal halide lights? Metal halide lights are 3-5 times as efficient as incandescent bulbs and produce a much higher quality light. In many cases, and depending on the particular mix of metal halides, they have a very high color temperature (up to 5500K). This means that metal halide bulbs can be very useful for high intensity applications like vehicle headlamps, athletic facility illumination, or for photographic lighting.



Why would LEDs put metal halide lights out of business? Some metal halide lamps have long warm-up periods (5-10 minutes) when the light is first turned on or in the event that the power source is interrupted. Additionally, there is a small risk that a metal halide lamp can explode. Although this is rare and there are preventive measures that reduce risk, there is still the possibility of injury or damage as a result. Typical preventive measures include changing bulbs prior to their expected end of life and en-masse as a group (versus spot changing single bulbs that actually fail). This can significantly increase costs and significantly shorten the useful lifespan of the light.

Compact Fluorescent

Compact Fluorescent Lamps

Compact Fluorescent Lamps: Compact fluorescent lights are designed to replace incandescent light bulbs by fitting into the same fixtures that your standard house bulb typically occupies. Overall they are a large improvement over incandescent (utilizing only 20% - 33% of the energy) and lasting roughly ten times as long.

What's the upside to compact fluorescent lights? CFL bulbs operate in pretty much the same way as your standard fluorescent light, they just look a lot different. They have the same upside: good energy efficiency, long lifespan, and a high quality light. In addition to that, they are compact (as you might expect from the name). As such, they can be used in day-to-day situations that don't necessitate re-doing your interior lighting.

Why would LEDs put compact fluorescent lights out of business? As good as fluorescent light efficiency has become, LED is better (and continues to improve at a more rapid pace). As long as fluorescent lights last, LED light last much longer. Further, fluorescent lamps require the use of a ballast to stabilize the internal current that produces light. When the ballast has a minor imperfection or is damaged, the light can produce an audible buzzing noise. Other shortcomings include waste disposal issues (due to CFL reliance on mercury), and non-directional light generation. Non-directional light generation is a bigger deal than you might think. For example, light that is being directed at the ceiling rather than the room is wasted light. Therefore, CFL (as well as the related standard fluorescent bulbs) might have good "source efficiency" (i.e. it looks good on paper), but will fall short of LED when it comes to the more important measure: "system efficiency" (actual efficiency in real world applications).

Sodium Lamps

Sodium Lamps

High and low pressure sodium lights have been in commercial production since the 1930s. They utilize sodium in an excited state to produce a monochromatic yellow light. Although the light is very efficient, the poor color rendering severely limits its useful applications (historically for street or tunnel lighting).

What's the upside to sodium lights? Sodium lights operate in a range where the human eye is very sensitive and so there is less power required to achieve the same lighting effect. For this reason they are very efficient. Additionally, despite their long warm-up period (5-10 minutes), low pressure sodium lamps will re-ignite immediately in the event of a power interruption.

Why would LEDs put sodium lights out of business? Sodium lamps have the worst color rendering of any bulb. They produce a dark yellow glow which is generally a very low quality light. Additionally, there are serious waste disposal issues with sodium lamps. In particular, they have been known to start fires in the event that the lamp is broken and the sodium metal is exposed. The sodium can catch fire even in the event that the lamp is broken on the ground. For this reason it is safest to break sodium lights under water and then to subsequently dispose of the destroyed bulb. Lastly, HPS and LPS lights are monochromatic, so they can mess with your color vision if you look at them for an extended period of time.

Comparison Chart

Beating The Competition

LED lights are beating the competition in just about every category. They're more efficient, have higher source efficiency than most of their competitors, and more importantly, have much higher system efficiency than just about any light out there. Their lifespan is up to four times that of the next best option and they produce an extremely high quality light without the risks of gas-discharge lamps. Check out this chart for a side-by-side comparison of LED and the competition.

Type of Light	Luminous Efficacies		Color Temperature (Note: candle light is ~ 1500K while sunlight is ~ 5000K at midday)	Lifespan	Color Rendering Index (CRI)
	Source Efficiency (Lumens/ Watt)	System Efficiency (Lumens/ Watt)			
LED Light	37-120	>50	2700K-6000K (Yellow-Light Blue)	25,000 to 100,000+ hours	65-95
Incandescent Light Bulb	10	<10	2700K (Yellow)	1,200 hours	95+
Halogen Light Bulb	24	<24	3000K (Yellow-White)	2,500 hours	90+
Mercury Vapor Light	35-65	<30	5600K-6000K (White-Light Blue)	24,000 hours	45
Fluorescent Light Bulb	50-100	Highly Variable	4200K (White)	7,000 to 15,000 hours	62-80
Metal Halide Bulbs	75 - 100	<30	3200-5500K (Yellow-White-Light Blue)	6,000 to 15,000 hours	60
High & Low Pressure Sodium Light	100-190	Highly Variable	1800-2200K (Orange)	18,000 to 24,000 hours	0-25
High Intensity Discharge (HID) Light	120	<30	1800-6000K (Orange- Light Blue)	6,000 to 24,000	0-60

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