Solid State LED vs. Traditional Light Sources

LEDs differ from traditional light sources in the way they produce light. In an incandescent lamp, electric current heats a tungsten filament until it glows or emits light. In a fluorescent lamp, an electric arc excites mercury and argon atoms, which emit ultraviolet (UV) radiation. After striking the phosphor coating on the inside of glass tubes, the UV radiation is converted and emitted as visible light.

An LED is a semiconductor diode. It consists of a chip of semi-conducting material treated to create a structure called a p-n (positive-negative) junction. When connected to a power source, current flows from the p-side or anode to the n-side, or cathode, but not in the reverse direction. Charge-carriers (electrons and electron holes) flow into the junction from electrodes. When an electron meets a hole, it falls into a lower energy level, and releases energy in the form of a photon (light).

All light sources convert electric power into radiant energy (visible and invisible light) and heat in various proportions. Incandescent lamps emit primarily infrared (IR), with a small amount of visible light and heat. Fluorescent and metal halide sources convert a higher proportion of the energy into visible light, but also emit IR, ultraviolet (UV), and heat.

LEDs generate little or no long wave IR or UV, but do generate a small amount of heat that must be conducted from the LED die (p-n junction) to the underlying circuit board and heat sinks, housings, or Luminaire frame elements. Controlling the junction temperature is what thermal management is all about and is where the patented technology used in the Solstice light engine really shines.

Benefits of LEDs vs. High-Intensity Discharge (HID) Lamps

The primary benefits of LEDs are their reduced energy consumption, minimal lumen depreciation, longer lifetime, directionality and durability. One of the greatest advantages of LED fixtures is their lifetime, which reduces maintenance costs. At a ten-year lifetime (compared to two years for a metal halide bulb), municipalities and sign owners will need to change far fewer bulbs, ballasts, and igniters. In fact, maintenance savings alone are sufficient to make LED fixtures cheaper on a lifecycle basis than conventional fixtures.

The "instant-on" and dimming ability of LEDs offer additional energy savings through control strategies that can brighten and dim based on time of day, ambient light, or any other control parameters desired. Motion sensors can turn LEDs on or off instantly, allowing lighting to be used only when needed. Typical outdoor lighting (MH or HPS) has a re-strike time of a few minutes before they can turn on and therefore cannot be used with motion sensors.

LED fixtures use a fraction of the energy of traditional lamp sources. This reduces emissions of mercury from coal power plants, which leads directly to reducing greenhouse gas emissions. LED products contain no lead or mercury (are RoHS compliant), and are made from fully recyclable materials.

Finally, because LEDs emit directional light, there is more control over what is illuminated (streets and sidewalks) and what is not (the night sky). This makes for easier compliance with the Dark Skies Initiative, which aims to reduce light pollution and its associated wildlife impacts.

Importance of LED Lumen Output vs. HID Lamps

Comparing the lumen output of LEDs to a discharge source is not an accurate way of measuring effective light output of a Luminaire. HID lamp lumens are measured spherically, counting all the lumens being produced over 360 degrees. The discharge arc tube is NOT a point source and is difficult to optimize optically, making for poor light collection efficiency and utilization. Many light fixtures have to redirect most of the lumens produced by a bulb, losing as much as 50% of the output.

LEDs on the other hand are directional and have practically no wasted lumens. Virtually every LED lumen is directed and placed to maximize efficiency. A more accurate evaluation is to measure actual foot-candles or LUX on the ground. In addition, HPS and MH lamps have a considerable initial light output loss within the first 6 months. LEDs have no such drop and deliver useful light (with only slight depreciation) for 12 to 15 years before needing replacement.

Measuring Light Effectiveness: Photopic vs. Scotopic Vision

'Photopic lumens' refers to the amount of light emitted from a light source as measured by a light meter. The typical light meter is most sensitive to the yellow-green part of the color band. This is the light that is seen by the cone receptors in the eye, the eye's cone activated or photopic vision.

However, the rod receptors in the eye also receive light, called rod activated or scotopic vision. This light, which is rich in the blue portion of the spectrum, isn't measured by the typical light meter. Therefore, until now, lighting manufacturers have only measured light output based on the eye's sensitivity to one type of vision (photopic).

A true evaluation of lumen effectiveness comes from the combination of the light received by the rods and cones (photopic and scotopic); or 'seeable lumens.' Therefore, measuring only photopic lumens is misleading when comparing different colors of light. This is why even though a lower lumen reading is obtained with a LED vs. HPS or Metal Halide; the LED will produce more seeable light.