

TECHNOLOGY PROFILE – LIGHTING

LED Technology

LED technology has revolutionized lighting and has changed the way lighting designers approach their projects.

BY STEPHEN MARGULIES



Photo courtesy of Lutron.

IT IS TRULY AMAZING TO ME whenever we start a new project how lighting technology has evolved in the last five years, and we are excited to see where it may be going. These developments have influenced how we design our projects, how owners use their facilities and homes, and how we experience electric light in our daily lives. In this article I describe some of the more critical evolutions and revolutions and how this new technology has influenced our practice.

energy

When I started practicing 39 years ago, we designed office space to a lighting power density of 2 to 2.5 watts per square foot. That means for a 150 square foot office our energy usage was between 300 and 375 watts to light that private office. Today we can light that office for around .5 watts a square foot, so that same office can be lighted utilizing 75 watts of electricity.

375 watts to 75 watts. That is an 80% reduction — and this is only one of the advantages of LED light sources.

The second advantage is extended lamp life. 39 years ago, halogen light sources were rated at 2,000 hours — at best — which means if we used these light sources in 24-hour spaces the lamps would have to be changed around four to five times a year. New LED light sources are rated to last 50,000 hours — at worst — and are now even lasting as long as 100,000 hours. That means the light sources for these 24-hour spaces will last up to 12 years before they need to be replaced. These engineering marvels are really an incredible improvement in energy, as well as maintenance costs that are easily quantifiable.



size matters

Additional benefits to these new light sources are not as easily quantifiable. The aesthetic benefits we experience with these light sources are experiential and so not easily measured. These new light sources have allowed for the development of smaller lighting instruments.

Downlights that traditionally were 6" to 8" in diameter are now 2" to 4" in diameter and achieve the same output. Recessed lights that use to require 10" to 12" of recessed depth now get similar results in less than 4" of recess depth. There are now light fixtures that can fit into 5/8" of sheetrock depth. Cove lighting that was integrated into a profile that may have traditionally required a space that was 8" x 12" can now be integrated into a section that is 4" x 6".

This miniaturization of light sources has changed the way we integrate light into architecture. Smaller, more powerful lighting instruments give us more opportunity to experience the light in a space, without seeing so much of the light fixtures themselves.

color

LED light sources have the ability to deliver a full range of varying color. From fully saturated colors to variations of white; cooler whites and warmer whites, similar to the way we experience daylight are now common practice for interior spaces. In fact, these light sources can be programmed so that they are one color at one time of the day and change color at other times of the day. This technology is called Tunable White.

A common metric of this tunable white technology is called CCT (Color Correlated Temperature). The higher the CCT number the cooler the appearance of the light source. The lower the number, the warmer the appearance. Common CCT's range from 6,000 for daylight down to 1800 for candlelight. When you go to the Home Depot lighting department you will see these colors marked on the box. 2700k is considered warm and 5,000k to 6,000k is considered cool and sometimes called Daylight. Daylight is really a misnomer because daylight changes color throughout the day; but I guess it is a good marketing tool.

LEDs also can be mixed in a way to enhance different spectral characteristics, bringing out specific colors in an enhanced way. This has had a significant impact in illuminating artwork, retail and hospitality spaces.

Can you imagine having the ability to tune a light source for specific pieces of art with the same lamp? One piece may have rich blues and another piece may have wonderful ambers. We did this for one of our art collector clients who we call pioneer # 1 and we experienced seeing colors in their artwork that we have never seen before. Many museums and art galleries are taking advantage of this newfound ability. This technology uses a mix of red, green, blue and white LED's and is called RGBW technology.

Colors of food and clothes can now be optimized improving their visual appearance with RGBW LEDs and thereby improving the merchandise salability. Vegetables and meats can be displayed in a more vibrant way than ever before. Richness of reds and greys can be brought out like never before. This metric is measured using a term called CRI (Color Rendering Index). It is a scale from 1 to 100 and most LEDs have a CRI rating of 80. We are seeing CRI ratings of up to 95 and experiencing these improvements. The higher the number the better the light source will render colors.



Photo courtesy of Lutron.



Although we do not often have a blue or yellow room, we can now program the color of light to achieve fully saturated colors. This is great for special event spaces and is also done using RGBW technology.

Hotel rooms and residences can completely change their atmosphere from a cool daytime crisp appearance to a warm romantic evening setting. LED light sources can be programmed to work like a traditional incandescent light bulb. When you dimmed an incandescent bulb the color of the light got progressively warmer. This same aesthetic can be achieved with LED light sources using a technology called Warm Dim. This is extremely useful in residential and hospitality environments. The lamps use a mixture of warm and cooler LEDs and follow a dimming curve when controlled by simple dimmers.

control

I have been amazed at other industries that have been revolutionized by technology. Setting up a SONOS system in my own home is so straight forward and the benefit of digitization of sound and wireless communication protocols are simply amazing. Amazon Alexa and Firestick have also revolutionized my own digital world. One Firestick and Alexa got rid of three remote controls, one cable box and has gained credibility with my wife because she can turn on my home theater in our living room with one button on one remote, or even ask Alexa to do the same. Content can be called up with a simple verbal command or a button press.

Well, these capabilities in the lighting industry are at a relatively early stage of development and the user interphase and control strategies are just developing. Plug and play is not quite there yet. For example, if we are trying to implement Tunable White technology in a space, we typically want that to happen in the background without the user even knowing it is happening. Walk into your kitchen in the morning and press the bright button and the light color should match the daylight coming through your window (5,000k). Walk into your kitchen in the late afternoon and the daylight color should match the penetrating daylight (3200k). Serve dinner in the evening and the color of the light may be closer to warm incandescent (2,500k). Warm dim is a plug and pay technology, however it does not give the full benefits of tunable white light sources.



cooking

True color changing and vibrancy settings require the expertise of an experienced lighting chef. Finding the right recipe of blue, red, green and white content is an artform and a technical challenge. I would never give one of my residential clients this capability unless they were committed to learning the walk-and-the-talk of this art and science. Setting up an art gallery or a museum to enhance the experience requires a skill set. In one of our client's homes we set the interior lighting to follow the color change of daylight; however, the artwork was optimized for each piece and was not programmed to change based on the color of the daylight. This client we call pioneer # 2 and he was invested in working on getting this right. It took a lot of experimentation until we got it right.



experience it

These color-influencing technologies are best appreciated when you can be immersed in the technology. I became a believer of the power of these technologies when I first saw them in a Ketra sales office in NYC. During the presentation the electric light changed color and followed the daylight color changes through the sunset. I could not believe how much the color of the electric lights shifted during this demonstration until it was complete and when I was shown what the space would have looked like under a traditional fixed color lighting system I was hooked, line and sinker! Today Ketra is under the Lutron brand and they have recently opened an experience center in New York City where this emersion will make anyone a believer in the power of LED lighting.

A company called USAI is also a leader in this industry and have created extremely powerful lighting instruments that are changing the way we approach lighting design. They too have an experience center in New York City where they can demonstrate how powerful this new technology is. I highly recommend seeing both of these facilities and experience the power of light yourself.