Pictured here is the M&M retail store on Broadway in New York City.

LED Evolution

Understanding the present and future potential of LED lighting and the retail environment.

BY RON HARWOOD

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By now many of you have seen a stream of sales people come through your office claiming to have the answer to your lighting energy and efficacy concerns. For retail interiors, virtually every "pitch" will deal with LEDs, and only a rare few will be touting the older fluorescent and the new, almost miniature, metal halide lamps.

Because economic times are tougher than usual, I have seen an increase in sales pressure where the salespeople have omitted some key facts, or perhaps have had so little training that they only know how to sell what's in their bag, with little clue about the real facts of their products' performance. If I sound somewhat dismayed, it's because I believe that LEDs will eventually become a significant — if not dominant — light source; but as with many new or revolutionary products, it is often being misrepresented and clearly misunderstood. This fact has caused (and will continue to cause) hardships for the unsuspecting buyer, who can ill-afford to invest in products that claim to save energy and thus create a valid payback scenario, while providing disappointing results in other pertinent areas. Essentially, no one wants to spend money to save energy and then have warranty problems, installation problems and inspection problems — or lose sales because the "look" of the product has suffered.

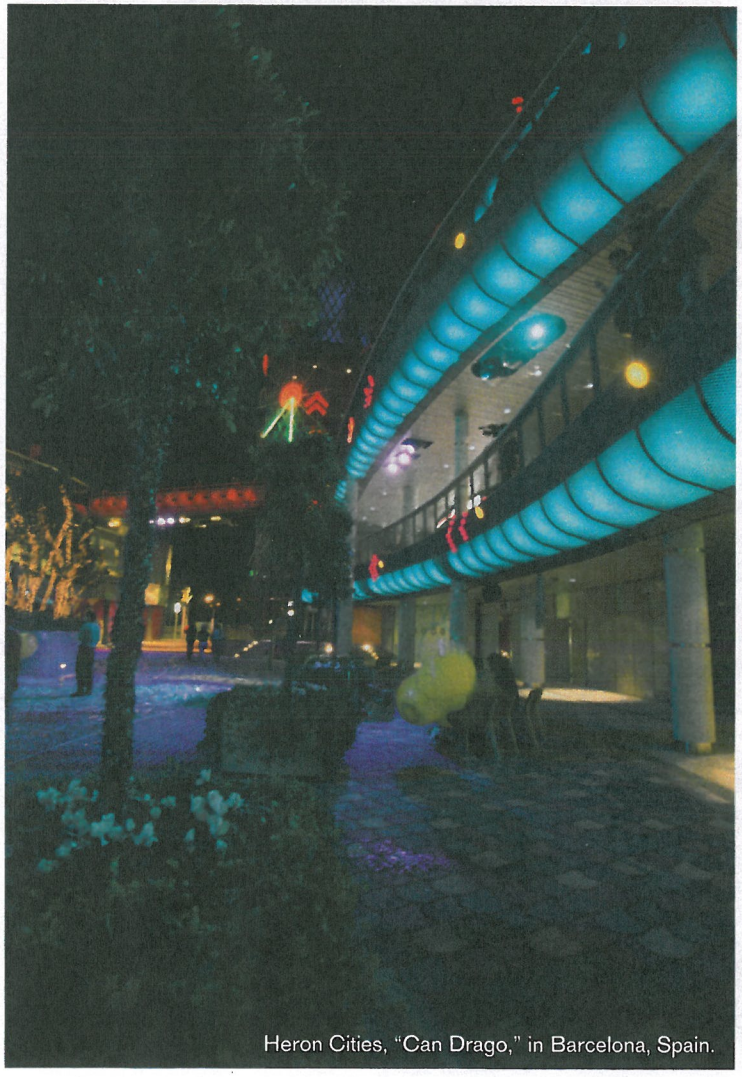
ENERGY EFFICIENCY

It is absurd to save energy by simply turning the lights out, yet some retail stores have remained over-lit because they do not have the resources to retrofit to a new, more efficient system. Some store chains are afraid they will under light a space for fear of dramatic sales losses. Generally, there is fear of change, and any substantive improvement in bottom-line savings must not sacrifice sales. Ironically, the lighting design community as a whole seems to be struggling with marketing itself to be the trusted source of redesign. Further, I see very few lighting designers looking to provide new lighting designs that are 100% LED for retail spaces. Part of the issue with our hesitation is the lack of experience with the new source, which leads to a lack of trust that new designs will be successful in both the short and long term.

WHERE TO BEGIN?

Let's first understand the current and commonly used light sources. The vast majority of retail spaces, mostly big box and low to mid-range revenue per square foot, are illuminated with fluorescent tubes of some form. These tubes have prescribed quantities of light output (measured in lumens) and concomitant energy consumption. Most stores have fluorescent lighting systems that were not designed to dim. Imagine that your store had an array of florescent lights that *could* be dimmed. Simply by dialing them down 10% or 20%, you would actually save the commensurate amount of energy.

Some store chains opted for more sophisticated metal halide light



Heron Cities, "Can Drago," in Barcelona, Spain.

sources in the last 10 or more years. These sources provide very good color rendering and a high degree of texture rendering, unlike most fluorescent tubes. For jewelry stores, metal halide was a great option to provide sparkle and save as much as 70% of the energy that would otherwise be used by quartz halogen. These HID lamps, like fluorescent, come in prescribed light outputs with coincident power consumption. Unfortunately, they cannot be easily or cheaply dimmed.

Now that LED light sources have arrived, where do they fit in? First, for the most part, the most efficient and least expensive LEDs to manufacture are physically small and have low wattage consumption; typically one to three watts per chip, they produce between 80 and 100 lumens per chip *in theory*. Placed in light bulbs or fixtures, these LED sources emit more like 40 to 70 lumens per watt, so they are essentially the same or slightly lower in light production efficiency than fluorescent and metal halide. Where the salesmen somehow manage to "guild the lily" in promoting LEDs is in the area of *usable light*. What the term "usable light" means is a quantification of how much light actually escapes the light fixture and becomes usable within a space or area. This figure is in contrast to the raw efficiency of the light source in open air.

In the near future however, we will see raw LED efficiencies higher than 120 lumens per watt and usable light in the area of 80 lumens per watt; this potential is what makes LEDs so interesting as the source of the future.

Because higher efficiencies for LEDs are achieved with the low wattage chips, many chips arrayed together is what we are commonly seeing in the commercial replacement market. This means that, to replace any form of incandescent, quartz halogen, metal halide or fluorescent lamp, several chips need to be clustered near one another to produce enough light. If a 39-watt metal halide lamp produces 2,600 lumens, in theory, it could take approximately 26 one-watt LED chips clustered together to replace it. When manufacturers place this many chips close together, the heat produced by the tightly knit grouping becomes significant enough to require large aluminum "heat sinks" behind the chips. Pictured in this article is a typical LED replacement for an incandescent PAR lamp. The spiral "fins" are made of aluminum and meant for cooling the LED chips.

Inside the M&M retail store in Orlando, Florida.

Some of the LED PAR and Mr-16 shapes cannot be dimmed, which does not make good long term sense. If LED chips *can* be dimmed, why make a lamp replacement without that capability? I am sure that adding dimming capacity adds some cost, and certainly adds some electronic expertise, but suffice it to say that these lamps are not a true replacement for incandescent lamps if they are not dimmable, so be cautious if you are replacing lamps in track heads or recessed lights where there are already dimmers on the circuit, or if you wish to add dimming in the future.

In general, the quickest payback in the retrofit market is when you can accurately replace an incandescent or quartz lamp to the degree

that there is acceptable color rendering and brightness. There are many examples of LED light sources saving four to six times more energy than incandescent lamps; you just have to be very cautious when going about the process. The easiest test for the retailer is simply to buy a few "screw-in" LED lamps and install them alongside the incandescent or quartz lamps on the same track or in the same row of recessed lights. Color rendering differences will then be very obvious, as will light intensity and beam spread. Many of the LED replacement lamps attempt to achieve similar intensities by narrowing the beam — not unlike adjusting a water hose so that it shoots water farther but in a narrower pattern. This technique can be disastrous to a retail space.

Color rendering in retail is one of the most important issues related to customer comfort. Most LED chips, when built to a "cooler," seemingly "bluer" color rendering, produce more light per watt. This is because there is less filtration, or "white" color additive to the chip. While jewelry, especially diamonds, can look really good under a bluer light, yet apparel such as the lingerie seen in Victoria's Secret would appear cheap, and clearly not seductive. Testing your merchandise with LED sources is the only way to feel comfortable with the potential changeover. Of course, as a professional lighting designer, I would offer that merchants should retain experts (and not the LED salesmen) to test and specify the potential new sources, or suggest changing the entire fixture if the result will be more profitable in the long term.

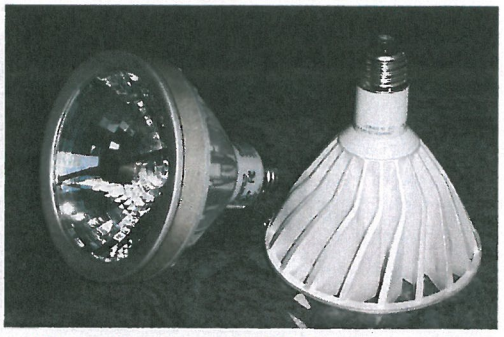
Actual payback in retrofitting your stores to LEDs is a bit challenging to ascertain. If your store staff currently changes the lamps themselves, I would not allow a factor for this cost to be in the formula. Over the years, as I have brought payback formulas to retailers, there have been opposing views on maintenance factors. Some chains hire a lamp company and others simply tell the store manager to figure it out themselves. It's obvious that, at $50 or more an hour, hiring a company to just change a few light bulbs is really costly. Therefore some lamp salespeople, looking to enhance the payback time, factor in the cost of replacement as a potential direct savings. When this is done, coupled with saving around 40% on electricity when the retrofit is done properly, a payback within 5 to 7 years is possible. When the only factor is the cost of energy and the cost of lamp replacement, the payback could take up to 15 years. To add a factor typically forgotten in the payback formulas, many LED linear sources require a special remote power supply.

Power supplies are similar to transformers in that they convert the input voltage to something different on the output side. Because power

supplies take up space and produce heat, manufacturers often place these in a separate envelope, and not within the LED fixture itself. Where linear LEDs are used to replace neon or fluorescent for under-shelf or cove lighting, or generally when a power supply is needed to convert the voltage from 120 or more to 12/24 volts, the power supply itself typically lasts only 7 years, on average. This means that an electrician may be needed somewhere down the line, maybe 5 to 10 years from installation, to replace the power supply. When this occurs, the payback formulas do not look very good. Arguably, in retail applications where landlords may require redesign in 5 to 7 years, the payback issues change even more. If you have to demo your ceiling in five years, the payback for energy savings needs to occur before the lease requires a total refit.

What happens when just a few LED fixtures or lamps fail, and how would you replace them? For linear systems used for cove lighting, where LEDs have replaced neon or fluorescent, and assuming that a few years have gone by before a fixture fails, there is a big concern that the replacement fixtures will not match in color or light output. There is even concern that the same profile, extrusion and lensing will not be available either. The simple reason for this is that the LED manufacturing techniques continue to improve both color and light output, and that replacement LEDs are actually time-sensitive in that regard. The passing of just 1 year could potentially make the accurate "matching" replacement of LED products very difficult!

Are LEDs easy to install? In the case of simply unscrewing a light bulb: absolutely! The standard socket LED replacements are installed in the same way as a regular light bulb, but there is a potential catch-22. Even though the LED lamp is almost always lower wattage consumption, and even though these lamps typically produce less heat than what they replace, the fixtures have not been listed by a testing agency such as Underwriters Laboratory for use with an LED lamp. Be sure to check with your inspection authority before simply replacing your old PAR lamps with LED replacements. If your insurance company requires that all products meet code, there is a catch-22 to be addressed.



Pictured here is a typical LED replacement for an incandescent PAR lamp. The spiral "fins" are made of aluminum and meant for cooling the LED chips.

Speaking of code compliance, some of the LED under-cabinet lights and some of the LED cove lights come with relatively normal electrical wire connections not that different from cord. This is because UL does not require metallic cable as a protection for this particular low-voltage application. UL, however, is not the building authority or the National Electrical Code. These bodies interpret the codes to mean that no exposed or unprotected electrical cable can be used within walls, ceilings or even in coves. We are seeing many inspectors require that the exposed cord be covered by some form of approved metallic sheathing or conduit. Be advised!

IN CONCLUSION

By now it seems that I have described enough hurdles and hardships to indicate that I am generally against the use of LEDs in retail spaces. This is not the case. First, our firm believes in reducing our national carbon footprint. Second, when wisely specified and properly installed, LEDs can be a very effective means of lighting, providing many design opportunities that did not exist before LEDs were commercialized. Third, when applied to areas where the lighting tasks and the light source can be within a few feet, LEDs are the best way to go. Under shelves, in display cabinets, in lower ceilings (9 feet and less), for night lights and emergency lighting, and especially in coves, LEDs, when properly specified, are absolutely the right choice.

Like any other new change in technology, and in an era when we have gone from massive desktop computers to iPads, we need to be cautious and use common sense so that our hard-earned dollars burn the least amount of coal and get the most light for the investment. **RFB**

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