

ENERGY



High-Efficacy Lighting New technology offers promise—and peril

BY TED CUSHMAN

How many builders does it take to change a light bulb? Answer: None. LED lamps never need changing, and anyway, LED light fixtures don't use bulbs.

OK, we're not there quite yet. But the no-light-bulb world is coming, and ready or not, it's time to embrace the future. And while LED lighting may have been over-hyped (for example, the truth is that even LED lamps do eventually need replacing), incandescent light, including halogen lighting, is on its way out.

The 2018 International Energy Conservation Code (IECC) requires 90% of all lamps in new construction to be "high efficacy" (defined in light output per watt of power input). Incandescent bulbs

don't qualify, and neither do halogens. To comply, your options using currently available technology boil down to fluorescent lamps or LEDs. And since most consumers do not like fluorescent lighting, your best bet is almost always going to be LEDs.

In California, the rules are stricter than the national model code: "Appendix JA-8," a lighting rule that's part of that state's Title 24 energy code, now requires 100% of all lamps in a new home to be high efficacy. Appendix JA-8 also mandates a whole slew of other quality standards for lighting fixtures ("luminaires") and lamps, including tests for longevity and light color quality.

The IECC national model code tends to get tougher over time.

Photos by Tim Mathiesen and Sergio Mazon



Sensitive and sensible. LED lights can provide beautiful and functional illumination in a full range of color temperatures and intensities, to support any aspect of life in a home. The LED chandeliers and pendants Tim Mathieson used in the vaulted living space above (1) mix well with daylight; warm outdoor lights (2) enhance an evening cookout. On page 39, LEDs in a hanging rail fixture use a quarter of the wattage of the halogen bulbs they replaced, while supplying the kitchen with better light.

Eventually, all lamping in all new homes throughout the nation will likely have to be high efficacy. Someday, the national standards may even encompass quality measures similar to the California requirements too. But in any case, California's economy is so big and influential that the national industry is already moving to qualify with Appendix JA-8. So California's vision of high efficacy, coupled with high light quality, is already being felt nationwide. And although the 2018 IECC won't take effect for years in many states, LED technology is advancing so fast that LED products are often the best practical choice anyway, in many cases.

If you want to get with the program, it's time to start learning about LEDs. Even though he's not in California, Boston lighting designer Sergio Mazon (mazonlighting.com) told *JLC*, "100% of my work right now is LEDs. I still think incandescent and halogen lights are beautiful, but I don't design with them anymore."

"EVERY PROJECT DESERVES GOOD LIGHTING"

Compared with incandescent and halogen lights, LEDs are a whole different animal. Incandescents and halogens are made with metal filaments that warm up when electric current is passed through them. Electrical resistance makes the filaments hot, and they get bright. That light emission, called "black-body radiation," is a fundamentally different physical process than the solid-state functioning of a light-emitting diode. An LED fixture can give you "as much" light as an old-school Edison light bulb. But the quality of the light is not the same. And people can tell the difference.

With careful selection and installation, LEDs can give you results as pleasing as any illumination that incandescents and halogens can provide—or even better. But you have to know what you're doing. In 2013, for example, experts from multinational lighting firm Osram re-lit the ceiling of the Sistine Chapel in Rome, with



Lighting a lifestyle. Sergio Mazon's custom lighting design specified LED luminaires for the basement living space, including a ceiling pendant, wall sconces, and accent lighting for art work in the entry (3), accent lights and downlights for the bar (4), cove lighting and art lighting for the billiard room (5), and color-tunable lights for the home gym (6), suitable for either a vigorous morning workout or a relaxing evening yoga session.

its centuries-old Michelangelo fresco paintings, using 7,000 LED lamps. The results are breathtaking. But you can be sure that the Vatican did not purchase the cheapest LED fixtures they could find at their local home center to light up the room where they gather to select the next Pope.

To get good lighting, builders need to put time and thought into it. Vermont lighting designer Tim Mathiesen (brilliant-ldi.com) told *JLC*, "Every project at every budget requires and deserves really good lighting. The budget does not have to be expansive to make lighting look good. But it does have to be considered. And LED technology, at this time, should always be a part of the conversation. It can be the major factor in providing great lighting." As the industry advances, said Mathiesen, "we're free to design an entire house to use LED. And that definitely has moved beyond what the code is talking about."

But the devil is in the details—and even for an expert, LEDs are a challenging technology. "LED is a mess right now," Sergio Mazon told *JLC*. "Yes, we can design energy efficiently, provide a good amount of light with comfort and ambiance, and full dimming, 100% with LEDs. They're small, they go everywhere, they save energy, and they're helping us do a lot of things we were not able to do before. But if people go to the home center and buy an LED retrofit lamp for two bucks, when they bring it home, it's cool, it's blue, and then it flickers, and then it turns off ... LEDs are creating a lot of nightmares. And the cheap ones are giving LEDs a bad reputation. Bad products can give an entire technology a bad name."

It's important to stick with reputable brands, Tim Mathiesen said, "the bigger and better manufacturers who have been in it for a long time already, like Cree, and Philips, and Soraa." In addition, in a market where technology is changing fast, and cheap



Sound and vision. Homeowners called Sergio Mazon for help when the buzzing of halogen transformers became intolerable. The job turned into a complete LED-based makeover that included tearing out the ceilings to relocate fixtures. The solution, which cut energy use by more than 60%, included hanging pendants for area illumination (7, 8) and small, discreet recessed fixtures aimed at featured artworks (8, 9).

knockoffs are everywhere, consulting with a lighting expert can make all the difference.

THE TROUBLE WITH LED LIGHTS

Early generations of LED lighting didn't live up to the hype, Tim Mathiesen said. "When Cree started releasing LED replacement A-lamps, I started buying them, and at that point the company was saying, 'Oh, yeah, 20,000 hours, no problem.' Well, I had bulbs that were failing after 150 hours. That's because we were still not good at manufacturing the bulb itself. The LED still worked, but the bulb was falling apart. That's not happening any more. Now we have bulbs that are lasting thousands and thousands of hours, and that will only continue to increase as the manufacturers get better at what they do."

But build quality and longevity are not the only concerns a

consumer might have with LED products. All sorts of performance factors can affect the consumer experience, and most of them are complicated enough to be hard for the non-expert to deal with.

Color rendering. The human eye is very sensitive to color, and human beings evolved to see things by sunlight. Many artificial lights don't produce the full "daylight" spectrum—and depending on what you're trying to look at, the partial spectrum they do produce can be disappointing.

Professor Michael Siminovitch directs the California Lighting Technology Center (CLTC) at UC Davis. Siminovitch pushed successfully to have the Color Rendering Index (CRI) included in the state's Appendix JA-8 lighting standard. JA-8 now requires a CRI rating of 90 or better and an "R9" rating of 50 or better. (The R9 value relates to lighting in the red part of the spectrum, which helps people see things like skin tone, or food in a kitchen.)



Lively serenity. Expert touches in this Sergio Mazon lighting project help this house work and feel better: Wall sconces sit behind the TV so as not to cast glare on the screen (10); accent lighting makes artwork pop (11); and bright kitchen lighting provides a well-lit workspace while avoiding glare (12).

Consumer disappointment with compact fluorescent lamps based on their flat color rendering has created resistance in the market to the whole idea of high-efficacy lighting, Siminovitch told *JLC*; one goal of the new JA-8 standard is to make the light in a home pleasing for people. “We wanted to ensure that consumers were going to have a positive experience with their lighting system,” he said. “There are faces, meat, wood, et cetera, and we know that anything less than 90 CRI is an absolute disaster. People spend \$5,000 on cabinets, and then they put in an Energy Star lamp that has no red in it, and they wonder why their cabinets look like crap.”

Vendors have responded: Few products on the market today rate lower than 80 CRI, and many 90-CRI (and better) lamps and fixtures are hitting the market. But the CRI standard itself is decades old—“outdated science,” a Department of Energy fact sheet remarked in 2016. “Two sources with the same CRI value can render

colors very differently,” the fact sheet says, “even to the point where a scene looks appealing under one source and unappealing under the other.” On the other hand, commented Sergio Mazon, “Some things that are 80 CRI are actually very good.”

DOE introduced a more sophisticated Color Rendering Index called TM-30 in 2015, but so far, the new system is just a voluntary tool. Meantime, no standard or rule can replace the subjective expertise of experienced lighting designers—or the preferences of their customers.

Dimming. Old-school incandescents got dimmer as the power put through them dropped. At the same time, their color would get warmer, turning from white to yellow to gold.

LED lights dim differently: Their light output decreases as their electronic controllers chop off part of the power wave entering the diode. The earliest versions didn’t change color as they got dimmer;

13



14



A flash from the past. This Sergio Mazon project, which dates back many years, shows the challenge designers face when trying to replicate traditional styles. The chandeliers in this kitchen (13) and hallway (14) have halogen bulbs, as do the hallway sconces. LED replacements for the 15-watt lamps are available, but Mazon said, “No LED is going to replicate incandescent or halogen precisely.”

they stayed white all the way down. Newer products can “dim to warm” using various strategies, but there can still be trouble. The lights may flicker visibly—or they may flicker at a rate you can’t see with the naked eye, but that you may see as a strobing effect when you’re looking at a spinning fan or taking a cellphone video. Even at full power, said Sergio Mazon, some line-voltage LED products may strobe in response to the 60Hz waveform of household current. Avoiding this effect, especially in cases where pulsing lights may interfere with other equipment, takes a specialist.

HIRE A “GEEK”

Any builder can certainly light a whole house using LED fixtures and lamps, knowing nothing at all about it, with affordable products from the local home center. Any electrician could handle the wiring and installation work, and even supply the lights. But

would your homeowners be happy with the result?

A good lighting designer will be able to put technical knowledge to work in the service of a design aesthetic. “I’m a geek, and I’m good,” said Sergio Mazon. “I can make it beautiful, but I’m constantly keeping myself up to date with the technology, looking at products, reading the spec sheets. So your dimmers are not going to make your LED flicker, and your lights will dim all the way down, with the color consistency the same.”

Although he’s a trained architect himself, Mazon said, “Lighting designers don’t have a style. Architects do. Interior designers do. Lighting designers make whatever is thrown to them beautiful and efficient, and comfortable. My thing is not to put my style there. It’s to be able to get that style into the best design for that client.”

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