Lighting Trends

New developments in the lighting market make energy-efficient lighting a smart choice

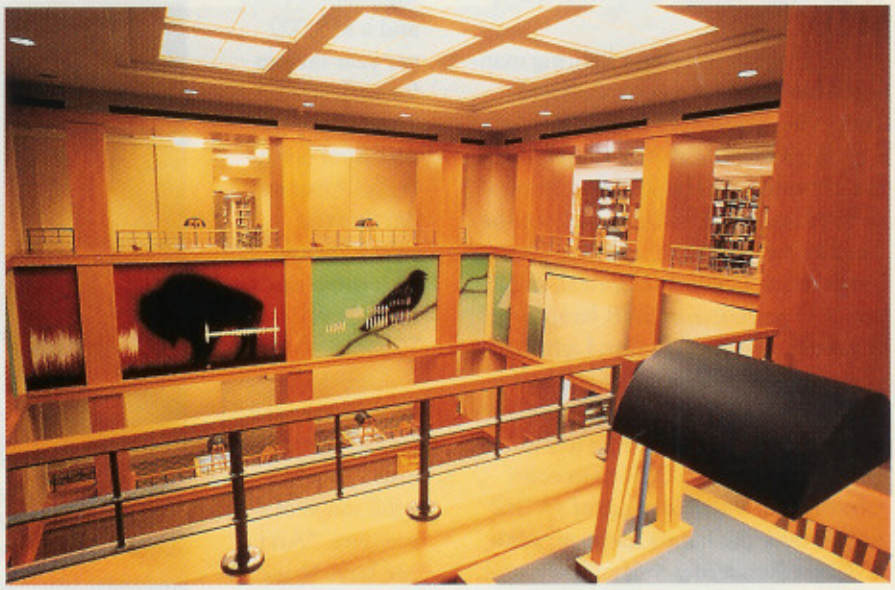

Photo by Steven Stone

The atrium of the Denver Central Library is lit from above by T8 lamps with electronic ballasts behind diffusing panels. By using energy-efficient fluorescent lights and emphasizing task lights to allow lower ambient lighting levels, lighting designer Nancy Clanton helped the entire facility achieve a lighting load of only 0.84 watts per square foot.

By: Daniel McQuillen

"We do lighting design as a profession, and we can hardly keep up with the fabulous changes that are happening almost daily," laughs Nancy Clanton, president of Clanton Engineering, a lighting design firm in Boulder, CO. "These days, there's no excuse not to use energy-efficient lighting."

As manufacturers continue to improve their lamp and ballast technology, designers like Clanton are gaining access to lighting products that are both more reliable and more energy efficient than earlier versions. According to a report by Frost and Sullivan, a research firm in Mountain View, CA, advances in R&D and manufacturing have forced down lamp prices and improved quality, while opening up markets for compact fluorescent, metal halide, and halogen lamps. In fact, the research firm predicts that the world market for lighting products will grow from $26 billion in 1996 to $28 billion in 2000.

And do the buildings ever need it. According to the Energy Efficient Lighting Association (EELA), less than 10% of the 70 billion square feet of the nation's commercial floor space has been upgraded with energy-efficient lighting products. This, coupled with the fact that commercial buildings account for 50% of the country's $75 million lighting bill — a bill that could be reduced by 20% to 50% with energy-efficient lighting — means that businesses and the environment together stand to benefit from the increased quality and lower prices.

Ceramic technology in the spotlight

Washington, DC-based lighting designer Claude R. Engle has no doubt about what the biggest news in high intensity discharge lamps is, if not the whole lighting industry. "Ceramic metal halides are the first real breakthrough in lighting technology since 1965," said Engle, who has worked on projects ranging from the Louvre in Paris to the Reichstag building in Berlin. Engle is enthusiastic about the new metal halide lamp because of the high-quality color of the light — quality made possible by high-tech ceramics. "It's darn close to incandescent, and can be used in lobbies and all the places that love the warmth of incandescent."

Metal halide lamps, part of the high intensity discharge (HID) family, function by adding ingredients such as sodium iodide and scandium iodide to the mercury-argon mix used in the common mercury vapor lamp. The gases are contained by a quartz tube, through which a current is passed to excite the gases and produce light. According to Paul Rorer, spokesperson for the EELA, the reason the lamps are now poised for rapid growth is the development of

"pulse-start" technology, which has allowed the older quartz tube to be replaced by a ceramic unit that increases color quality. The new lamps are twice as efficient as mercury vapor lamps and four to five times more efficient than halogens. Some of the higher wattage units are approaching an efficacies of 100 lumens per watt. "100 lumens per watt is a magic number, because you're getting the light and life of high pressure sodium with improved color rendering — the plusses without the minuses," said Rorer. The life span of the larger wattage lamps can reach 40,000 hours.

All three of the major lighting manufacturers produce a ceramic-based lamp. Cleveland, OH-based GE Lighting's ConstantColor CMH lamps are ceramic metal halides that fit into older metal halide fixtures without the need for new wiring or ballasts. The lamps are available as elliptical, single- and double-ended, or PAR lamps. Somerset, NJ-based Philips Lighting Co. has a line of ceramic metal halide lamps marketed under the MasterColor trademark which, according to Phillips, generate a stable 3,000 Kelvin color temperature within a range of +/- 200 Kelvin over the lamp's life span, a 80-85 Color Rendering Index (CRI), and efficacies of 81 to 94 lumens per watt. Osram Sylvania Inc., based in Danvers, MA, weighs in with it's Metalarc Pro-Tech lamps, which also have CRI values of up to 85, 3K color temperature and +/- 200 Kelvin shift over the lamp's life.

New fixtures have appeared to capitalize on this lamp's strengths. New Windsor, NY-based Lightron, for example, is now producing Multi-Beam 2000, a system that splits and channels the light from a 100-watt metal halide lamp out through four downlighting fixtures — and in the process is 50% more efficient than the four 60 watt halogen PAR lamps it replaces. Additional savings is earned due to the lamp's longer life: halogen PAR lamps are rated at 3,000 hours compared to 12,000 hours for the metal halide. "It becomes a 16-to-1 savings when you take the life of the lamps into account," said Steve Proner, director of engineering for Lightron. He would not comment on the price of the system besides assuring that it was "very competitive with four standard PAR downlights."

The system is competitive enough, in fact, to attract retail giant JCPenny, which has adopted the light fixture as a standard for all future buildings (a number which could amount to 1 to 2 million square feet a year). According to David Valcich, engineering manager for Plano, TX-based JCPenny, the system affords a $30,000 to $40,000 reduction in installation costs and a $15,000 per year savings for each store. "And the color rendition is fantastic. After we did five test stores, we said 'this is the way to do it,'" said Valcich.

One drawback to the new lamps, cautioned Engle, is a lack of a full range of wattages. "And if you have to use a larger lamp than you need, your effective efficiency drops." He also warned that, although the ceramic technology had greatly increased the lamp's color consistency, it is still inadequate for some situations: "With 200 degree Kelvin shifts, the lamps aren't ready for color-critical situations like art galleries," he explained. "Halogens are still required there."

Targeted for interior applications, GE Lighting's ConstantColor CMH ceramic metal halide lamps do not require new wiring of fixtures.

Lightron's Multi-Beam 2000 splits the light of one metal halide lamp into four separate downlighting beams.

Fluorescent lights

Currently, the T8 linear fluorescent tube is the workhorse of many energy-efficient lighting installations or upgrades. Electricity savings can reach 40% when these lamps are used in conjunction with electronic ballasts to replace older T12 linear fluorescent models and magnetic ballasts. For example, a study by The Lighting Research Center at Rensselaer Polytechnic Institute reported that an A&P grocery store in Connecticut realized an annual savings of $16,700 when it installed T8 lamps and electronic ballasts instead of T12s with magnetic ballasts and then utilized an automatic reduced light level strategy for nighttime hours.

Although most U.S. and European lamps are of high quality, Clanton recommends caution when using lamps from Asia: "they just don't have the same kind of quality control," she said. As a rule of thumb, she advises running

Light from Fusion lamps is distributed by light pipes over this sorting facility in Sweden.

descent dimmers, is UL listed and CSA approved, and costs $40-$70. Meanwhile, Rosemont, IL-based Advance Transformer Co. has expanded its line of Mark X Architectural Dimming ballasts to include ballasts for 26 -, 32 - or 42 - watt triple compact fluorescents at 120 or 277 volts. According to Jeff Irmer, vice president of marketing and product management for electronics for Advance, the ballasts are approximately two to two and a half times the cost of fixed output ballasts.

The long-awaited sulfur lamp

Ever since October of 1994 when Rockville, MD-based manufacturer Fusion Lighting Inc. introduced the sulfur microwave lamp (with help from the U.S. DOE), those in the lighting industry have been watching the high-tech lamp carefully.

Fusion's Solar 1000 sulfur lamp operates by bombarding a golf ball-sized bulb filled with sulfur and argon with microwaves from a device called a magnetron. The light emitted has a very high efficacy of 105 lumens per watt, a correlated color temperature of 6000K, a CRI of 79, and can be dimmed to 30% of output with less than 300 Kelvin color shift. Additionally, only 27% of the light emitted from the lamp is in the ultraviolet or infrared spectrum, compared to 50% for metal halide and 62% for cool white fluorescent. Recently, the company increased the lamp's lumen maintenance to 100%, and although the bulb has an essentially limitless lifespan, the system's life is limited by the magnetron's 20,000 hour rating.

Over the last several years, the lamp has won awards from *Popular Science* and *Discover* for its innovative design, and has been installed — usually with accompanying light-distribution systems by companies like 3M — in a number of demonstration areas, including the National Air and Space Museum, an auto assembly plant in Michigan, a subway installation in Sweden, and, just recently, an Air Force base in Ogden, TX. "We've been doing many prototype demonstration installations, but we believe that in '98 we'll be going to a production level," said Dan Estrada, a spokesman for the company. Although the price of the lamp varies depending on the delivery system, in a light pipe system the lamp's cost is approximately $2,500 per unit, plus $60 per foot of light pipe. "It's a competitive system when the life-cycle costs are considered," said Estrada.

"The jury is still out on the sulfur lamp," said Jo Anne Lindsley, principal of Lindsley Consultants Inc., a New York-based lighting design firm. "My initial opinion of the lamp after seeing it in a test demonstration in Washington was that the color was problematic — pale and slightly greenish. But the light can be filtered, and there are some experimental projects using fiber optics we might use it for."

A major problem with Fusion's lamp has been the weight of the power supply for the magnetron system, which could weigh as much as 50 pounds. The recently introduced Light Drive 1000 system, however, includes a new lightweight electronic power supply that allows the entire lamp system to weigh in at approximately 20 pounds.

The lamp also lacks a wide variety of fixtures, a problem companies like Cooper Lighting and Moldcast Lighting are working to address. In fact, early last year Cooper Lighting installed two prototype freestanding kiosks in the Sacramento Municipal Utility District building in Sacramento, CA. The kiosks use the Fusion lamp to indirectly light a 2,000-square-foot room. Meanwhile, Fiberstars is working on a fiber optic system that efficiently distributes the lamp's bright light.

Don't forget to recycle

For those doing building demolition or retrofits with fluorescent lamps, the question of what to do with old ballasts and lamps becomes just as important as what fixtures to install. Mark Eldridge, national accounts manager for Luminaire Recyclers Inc., a St. Paul, MN-based lamp and ballast recycler, likes to tell the story of a contractor involved with a demolition and remod-

GE's Ecolux lamps pass the TCLP test for mercury content.

eling project on a large mall in Florida. "During the project a local newspaper took a picture of the project for their business section, and front-and-center in the picture was a dumpster the contractor had filled with fluorescent lamps," explains Eldrige. Although the contractor didn't know of the regulations prohibiting landfill disposal of fluorescent lamps, once the picture hit the papers, "the phones started ringing." The EPA promptly stepped in to make sure the lamps were recycled properly.

Because fluorescent lamps contain mercury, the federal government and most states consider these products hazardous waste, and regulate their disposal according to the EPA's Toxicity Characteristic Leaching Procedure (TCLP) test. Although these disposal regulations are in a constant state of flux — due to constant debate over the danger of lamp mercury — 34 states are very strict about their requirements. In Florida and Minnesota, for instance, those who dispose more than 10 lamps a month must use a recycling program. Mercury is toxic to the nervous system,

Companies like Luminaire take fluorescent lamps and recycle the parts into useable materials: they extract the mercury from the lamps for use in new lamps, the phosphorous powder goes to concrete makers, and the glass and aluminum are recycled and sold. Ballasts are also recycled, with special attention being paid to those made before 1978; these older models often contain oil tainted with PCBs, and must be incinerated in special 6,000-degree furnaces that break down the dangerous chemical. Unfortunately, most recyclers charge a fee for their service, as the sales of recycled material alone does not generate enough profit.

Manufacturers, lead by Philips, have introduced low-mercury lamps to respond to concerns over mercury pollution. Philips was the first to introduce low-mercury lamps via its proprietary Alto technology. The company is planning to use the technology in 80% of all units manufactured and has recently moved the technology into the residential Home Light product line. Philips lamps with Alto technology feature 80% less mercury than standard fluorescents, with no difference in performance compared to standard fluorescents. GE Lighting introduced last year a series of lamps, the Ecolux line, which also have reduced levels of mercury in order to pass the TCLP test. Osram Sylvania markets low-mercury, TCLP-compliant lamps under the Ecologic name.

Over the past few years, the EPA has been mulling over two regulatory alternatives for the management of mercury-containing lamps: one alternative is to exempt the lamps from hazardous waste regulations. The other, the "Universal Waste Rule," is to simply streamline the regulations (reducing handling, storage, and transportation requirements), while retaining the key hazardous waste restrictions. According to Goldmacher, Philips is the only one of the big three lobbying for the Universal Waste Rule. "Our competition contends that the EPA's Green Lights program is suffering because the cost of disposal is keeping companies from doing retrofits, and that's why the regulations should be removed," said Goldmacher. "But that's simply not true. The EPA itself has said that the cost of disposal has never been a deciding factor." GE wouldn't comment on the matter, saying only that it would abide by any future EPA ruling. Osram couldn't be reached for comment.

Regardless of the EPA's course of action, recycling lamps with mercury-content remains an effective way to prevent mercury from polluting the environment, and is an important part of any energy-efficient lighting strategy.

Upcoming Lighting Conferences

February 1-4

Enlightening America '98
Location: The Grand Kempinski Dallas
First annual conference by the newly formed Energy Efficient Lighting Association. Exhibits and demonstrations of energy-efficient lighting products. Seminars on new lighting technologies, retrofit project financing, product compatibility, installation, marketing, and impact of utility deregulation.
Contact: EELA, CN 727, Princeton Junction, NJ 08550. Tel: (609) 799-4900; Fax: (609) 799-7032; Internet: http://www.eela.com.

May 26-29

LIGHTFAIR International 1998
Location: Las Vegas Convention Center.
Starting with a pre-show conference on Tuesday, LIGHTFAIR offers lighting designers a wide variety of seminars and presentations. Track titles include Energy & Facilities, Design Applications, and Research & Technology. The conference expects 341exhibitors and 15,500 attendees.

Ongoing

GE Lighting Institute
Location: Cleveland, OH
GE's Lighting Institute, also known as the "Univesity of Light," conducts seminars on lighting techniques and tools. What follows is a partial listing of the Institute's Application-Specific Seminars.

- February 2-4: Industrial and Inspection Lighting
- February 16-18: Store Lighting
- March 19-20: Museum Lighting
- June 15-17: Office and Institutional Lighting

Contact: GE Lighting Institute, General Electric Co., 1975 Noble Rd., Nela Park, Cleveland, OH 44112. Tel: (800) 255-1200