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THE DARKNESS ISSUE:
MARK MAJOR ON HOW WE THINK ABOUT LIGHT—AND DARK • SOCIALITE • LOS ANGELES MUSEUM OF THE HOLOCAUST • THE CITY DARK • ZIA EFTEKHAR

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INVISIBLE TRANSLUCENT DARK BLACK
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REFLECT RAYLESS INDIRECT GLARE HAZ
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RADIANT TRANSPARENT BLIND LUMINAN
GLOW IN THE DARK BRILLIANT WHITEOU
GLOWING NEON STARLESS ULTRABRIGHT
LEGIBLE NIGHTTIME VISIBLE SPOTLIGHT
DAYLIGHT WARM SHADOWY TRANSLUCE
LUMINESCENT ASHEN BLAZING MASKED
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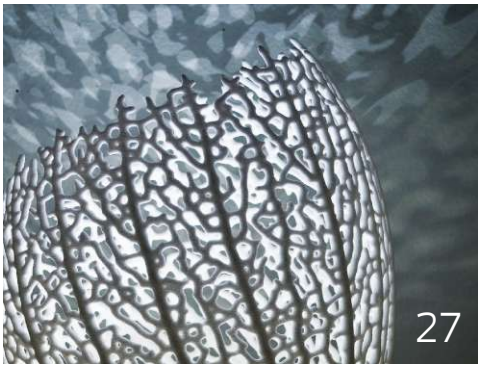

• CONTENTS

• FEATURES

• FRONT

TECHNOLOGY

• DEPARTMENTS

DESIGN

BACK

ARCHLIGHTING.COM For expanded article content, the latest news, and calendar listings and blogs. Also, read e-notes and ARCHITECTURAL LIGHTING's new digital edition.

Iwan Baan (left); James Provost; (top right); courtesy Nervous System (bottom right)

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"Light cannot exist without dark, and dark cannot exist without light. It is only when we can embrace all levels of illumination that we understand light's full potential—to console, to remember, to heal."

LIGHT AND DARK … AND LIGHT AGAIN

When I first put together the 2011 editorial calendar, all the way back in June 2010, I wanted to devote an issue to light from a different perspective. As so, I decided that we should spend some time exploring the very opposite of light—dark. It's not necessarily a novel idea, but ARCHITECTURAL LIGHTING hadn't really tackled the topic in such a direct way. I wanted to explore what it might mean to design with light—and without.

Since we spend so much time focusing on our illuminated world, maybe we should take a minute and examine those places where light is an incredibly precious commodity. In these places, such as remote parts of Africa, India, and Nepal, any kind of light, even a 1W LED lantern, becomes a game changer that allows a community to work, study, and live beyond the cycle of the sun. When light is so precious in places like this, it makes the recent conversations about impending lamp phaseouts seem somewhat frivolous. Dark-sky debates also become more complicated as we question whether we should have light at all in certain places. Should we expect to see the night sky in the heart of Times Square or does urbanization dictate that true darkness is something only to be seen in very remote areas?

The contrast between light and dark is something that began to take on more relevance as September 2011 approached, and with it the 10th anniversary of 9/11. In time, I am sure that the magazine will talk about the rebuilding efforts at ground zero from the vantage point of lighting. But for now, to speak of the place or the memorial that has opened in terms of how many luminaires or what type of light sources were used just doesn't seem right. It's not what that place is about.

Of the many memories I have of that morning in New York City, where I lived at the time, was the incredibly clear blue sky. Among the sights, sounds, and smells that I, like so many others, never thought that I would witness, there was this extraordinarily beautiful weather. And it made what was taking place all the more unnerving and unfathomable.

Several months later, I think it was February, I was walking home from an evening event at the Center for Architecture on LaGuardia Place. It was one of those really cold, but clear, winter nights when it hurts just to breathe. I turned right onto West Houston Street and made my way to the corner of 6th Avenue. As I stood on the northeast corner waiting for the traffic signal to change I looked south and was hit with an overwhelming sense of sadness. There was a void in the sky. The reference point that you could count on, no matter where you were in the city, was gone.

Is it possible to mourn the loss of a building, or in this case two? It wasn't so much the buildings themselves that I missed but what their absence represented. In the clear navy-blue night sky, I acutely felt the Twin Towers' absence, and was transported back to that morning and the bright-blue cloudless sky when, on this very corner, I witnessed the collapse of the North Tower.

A cab honked coming up 6th Avenue and the real world snapped back into focus. I waited for the light to change, all the while thinking about the beautiful light of that Indian summer day and of the darkness that evening. The contrast unified them.

And so it is with the symbols of our remembrance—of that day and the places which have been dedicated as memorials. From the twin beams of *Tribute in Light*, to the silhouetted profiles of the Staten Island September 11 Memorial, to the line of light that now washes the waterfalls of the recently opened National September 11 Memorial, we seek solace in the warmth of light, its illumination made that much more meaningful because it is surrounded by the dark. Light cannot exist without dark, and dark cannot exist without light. It is only when we can embrace all levels of illumination that we understand light's full potential—to console, to remember, to heal.

Elizabeth Donoff
Editor

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• BRIEFS

text by Elizabeth Donoff

The Choctaw Casino and Resort, Durant, Okla.

LUMEN WEST AWARDS

The greater Los Angeles lighting design community gathered on Saturday, June 25 to celebrate the Lumen West Awards. With these awards, the Los Angeles, Orange County, and Inland Empire sections of the Illuminating Engineering Society celebrated the accomplishments of their colleagues and peers. This year's event was held at the Rafael Moneo–designed Cathedral of Our Lady of Angels, and more than 250 guests joined the *Ocean's 11* themed event.

Twenty-two awards were given out, with two levels of recognition—five Awards of Excellence and 17 Awards of Merit. This year's Awards of Excellence: In the residential category, or Cutler Award, it went to **Private Residence**, Beverly Hills, Calif., Kaplan Gehring McCarroll Architectural Lighting; in the interior, or Guth Awards, they went to the **Hard Rock Cafe Tampa**, Tampa, Fla., Visual Terrain, and the **Battelle Grand Renovation at the Greater Columbus Convention Center**, Columbus, Ohio, Horton Lees Brogden Lighting Design; and in the outdoor, or Waterbury Award, they went to **Santa Monica Place**, Santa Monica, Calif., Kaplan Gehring McCarroll Architectural Lighting, and **Choctaw Casino and Resort**, Durant, Okla., Visual Terrain. •

Courtesy Visual Terrain

• **"Dialogue in the Dark"** This exhibit, on display at South Street Seaport in New York City through 2012, provides visitors a fully immersing experience into complete darkness. Guests, equipped with a walking cane, are assisted by blind and visually impaired guides through a series of specially constructed vignettes that recreate familiar New York City locations. They rediscover New York and learn how to maneuver through the city using all of their senses except sight during the 45-minute experience. Full details, including exhibition hours and ticket prices, can be found at dialognyc.com.

MATERIAL PROBLEMS

Shortages in rare-earth elements are challenging fluorescent lamp costs.

Cerium, Europium, Terbium, Yttrium. These are rare-earth elements (REE), part of a group of 17 metals that are used in a variety of products such as computers, flat screens, and lighting. With so many electronics being produced today, demand for these is more competitive than ever. While lighting accounts for less than 10 percent of their use, they are an absolute necessity in the triphosphor coating process of all T8, T5, delux T12, and compact fluorescent pin- and self-ballasted lamps. According to Sylvania in an Aug. 17, 2011, webcast, rare-earth metal costs have risen dramatically in the past 18 months. For example, the cost of cerium oxide has risen 3,530 percent since January 2010.

What is contributing to this cost? Prior to 2002, there were a few sources for the materials around the globe, including the Mountain Pass Deposit in California. But since then, China has moved to control 95 percent of the world's rare-earth production and has, in effect, forced other mines out of business due to the low production costs of China's mines. That is changing, as the Chinese government is now imposing new taxes and tariffs, enforcing new mining rules and regulations, and administering export quotas to regulate the amount of rare-earth materials available on the global market. According to Sylvania webcast presenter Paula Ziegenbein, in 2005 China exported 65.5 tons of rare-earth materials. In 2010, that amount dropped to 50 tons, and in 2009, 30 tons.

Because lighting manufacturers use such a small percentage of the overall available material, they are at a competitive disadvantage. Congress has recognized the impact on the global supply chain and is moving forward with several pieces of legislation, such as Senate bill S1113, that would initiate the reopening of previously closed U.S. mines.

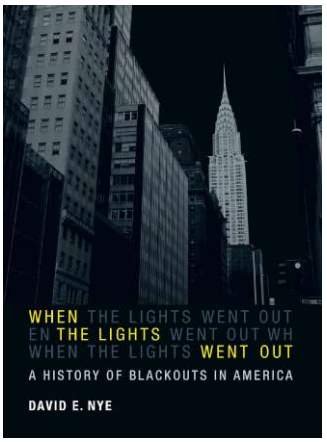
Lamp manufacturers such as Sylvania are also taking several steps to do what they can to minimize the effects of any increase in cost. Although the company is contracting with multiple suppliers, the cost increase does remain a real issue. According to Ziegenbein, Sylvania is also investigating the optimization of the powder weight, looking into REE substitutes, and looking into ways that it might be able to reclaim and recycle REE materials from spent lamps. Until the situation sorts itself out, Sylvania expects that fluorescent lamp prices will be subject to change every 30 days. •

LEUCOS USA ANNOUNCES COLLABORATION WITH LEGENDARY DESIGER EVA ZEISEL

American designer Eva Zeisel, who is set to celebrate her 105th birthday this November, is partnering with decorative lighting company Leucos USA, known for its contemporary Italian hand-blown glass luminaires, for her first lighting collection. The fixtures, to debut this fall, will include two pendants, two wall sconces, and two table lamps, and will feature Zeisel's signature organic forms, which call to mind the curves of the human body. They will be available with incandescent, fluorescent, or LED sources and in smooth, glossy white, and natural earth tones.

The development of the fixtures started with Zeisel's original cutout models. From these, Leucos's artisans will work to create the three-dimensional glass forms. As Zeisel explains in a prepared statement, "I always like to design at least two shapes together, so that I create a family that relates to each other. These lights are cousins."

Zeisel has had an extraordinary career. Her many accomplishments include developing and teaching the first course in ceramics for industry at the Pratt Institute in New York, and in 1946, being the first woman to have a solo show at the Museum of Modern Art in New York. In 2005, she was awarded the Cooper-Hewitt National Design Award for Lifetime Achievement. •



WHEN THE LIGHTS WENT OUT

*Historian **David E. Nye** explores the social history of blackouts in America.*

A fascinating look at the history of blackouts in America, *When the Lights Went Out* ($27.95, MIT Press, April 2010) explores these events in a cultural and social context. It is written by David E. Nye, professor of American history at the University of Southern Denmark, who has previously written several books on the topics of electricity, energy, and 21st-century technological innovation.

Nye divides the 292-page book into seven chapters: Grid, War, Accident, Crisis, Rolling Blackouts, Terror, and Greenout. This provides a framework for examining how the development and configuration of the U.S.'s electrical grid has contributed to the major large-scale power failures that have occurred since 1935. Nye highlights specific blackouts during World War II, the Great Northeastern Blackout of 1965, the 1977 New York City blackout, the 2000 California rolling blackouts, and the 2003 blackout that affected 50 million people from the Midwest to the East Coast and parts of Canada.

Depending on the circumstances that have led to each blackout—unanticipated, voluntary, or mandated—social response has varied widely. Some blackouts, such as the 1977 one in New York, caused chaos and social disruption. The blackout in 2003, by contrast, impacted an unprecedented number of people, but brought them together and created a sense of community. But no matter the circumstance, when we find ourselves without light and power, we become acutely aware of how dependent we have become on electricity.

"Blackouts are breaks in the flow of social time that reveal much about the trajectory of American history," Nye writes. "Each time one occurs, Americans confront their essential condition—not as isolated individuals, but as a community that increasingly binds itself together with electrical wires and signals." •

•FROM THE ARCHIVE

Corbis

LIGHT POLLUTION: ASTRONOMERS WISH FOR A DARKER FUTURE

From the Archive presents articles from the past 25 years, with new commentary from members of the lighting community.

original text by Gareth Fenley,
new commentary by Edward Bartholomew

original text has been edited and excerpted from the 1989 original

Astronomers are connoisseurs of light, collecting and analyzing tiny amounts emitted by stars and other distant objects in the universe. Even as they develop ever more powerful instruments, they face deteriorating conditions in the Earth's atmosphere that obscure the view. One of the biggest problems is light pollution—wasteful upward light from electrical outdoor sources that is scattered in the atmosphere and reflected back to Earth. To try to control it, astronomers have stepped into the political arena.

Although city dwellers might feel a wistful nostalgia for a starry night, light pollution does not actually hurt anyone. But it can be objectively defined and measured, unlike a related problem, light trespass—nuisance light that spills onto adjacent properties where it's not wanted.

When light pollution reduces the light-gathering capacity of telescopes, the effectiveness of multimillion-dollar facilities is compromised. Astronomers at the Mount Palomar observatory outside San Diego, which has the second-largest telescope in the world, began to lobby for a restrictive ordinance about 10 years ago when they realized the light scattered in the sky had increased to double the natural background level. Mount Wilson near Los Angeles, another of the world's premiere observatories, actually shut down for a few years because researchers could not use its telescopes with the sky glowing at five times the natural level.

Urban sky glow may seem an inevitable byproduct of civilization. In fact, mathematical models developed to predict the amount of light pollution at a site basically depend on two factors: the population of nearby cities and the viewer's distance from them. Unfortunately, observatories cannot just move when cities unexpectedly boom and sprawl. Only a few sites in the world have ideal altitude and climate, and the investment at existing facilities is expected to last a lifetime.

Some efforts prove that light pollution can be controlled. A strict ordinance passed in 1972 by

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EDWARD BARTHOLOMEW'S THOUGHTS:

This summer I went in search of darkness. The occasion was to view the Perseids meteor shower, which happen every summer in mid-August. Because I live in an urban area—Seattle—where there is a significant amount of light pollution, I had to drive about 40 minutes outside of the city to a state park just so that I could begin to observe this natural phenomenon without any interference from the haze of city light. As I returned home from watching this spectacle, I realized what a luxury actual darkness is.

This 1989 article argues for political and technical solutions to a complex issue: our relationship, as human beings, to darkness. The truth is that as a society we no longer value darkness; instead, we have been conditioned to fear it. Throughout the history of Western civilization, from literature to art to religion, the dark has been demonized. Due to advances in lighting technologies, we can ignore the night, thus expanding our time for leisure and productivity beyond the day–night cycle. Our global economies depend on this. Furthermore, our work as lighting designers has made us complicit in the eradication of darkness from our homes, work, communities, and landscapes.

The article represents the start of a lighting industry conversation regarding dark skies and each lighting designer's responsibility to control excessive light pollution through quality design. The effort to create quality lighting for our cities and landscapes, while still being mindful of lighting's impact on the surrounding natural world, has led to significant work and debate when it comes to the prescriptive guidelines that inform how we illuminate our exterior environment.

The most recent development is the long-awaited Model Lighting Ordinance and the inclusion of a significant sustainable-design LEED site credit that encourages a reduction in unnecessary exterior light spill into the night sky. This attempt to preserve darkness in the night sky was started by astronomers and concerned citizens who argued that a darker nighttime environment was ecologically responsible, more energy efficient, and allowed astronomers an unencumbered view through telescopes of objects in the night sky.

In addition, research on the impact of nighttime light on human health has found that excessive nighttime light, especially in the blue spectrum, has been identified as possibly increasing the risk factor for cancer in second-shift workers. On the basis of such studies, in December 2007, the International

(continued on next page)

Tucson, Ariz., has indefinitely extended the life of the world-class observatory at Kitt Peak, 40 miles from downtown. Measurements of sky brightness in 1988 showed that night viewing at the peak was basically unaffected by light pollution.

Ordinances such as Tucson's are politically viable because control of light pollution seems to make economic sense for the owners and users of exterior lighting. Astronomers are not asking people to turn off outdoor lights, but rather to use them more wisely for their basic purpose: to increase visibility at night, thus making travel safer, play more enjoyable, and business more profitable.

Kitt Peak astronomer David Crawford, member of light pollution committees in the Illuminating Engineering Society and International Astronomical Union, has made capital use of the energy issue. "Our big push is to get quality lighting, and by that I mean lighting that gets used and not wasted," he says. "If we could get all quality lighting—energy-efficient lighting that doesn't cause clutter and confusion on the ground—we'd solve the problem of safety better, we'd keep the sky dark, and we'd save money."

Crawford believes that light pollution is more than a specialized consideration for projects in a few parts of the world. "I think all architects and designers should be interested in and supportive of quality lighting, instead of blasting light all over the place, causing glare," he says. "One wants to increase visibility, not destroy it. If an architect and I went out at night to look at lighting installations and grade them, I think we would agree on almost everything. The better lighting jobs are the ones that require thought and common sense."

The Sodium Controversy

The most controversial element of astronomers' lobbying is a preference for low-pressure sodium (LPS) lighting. In this case, what looks better to astronomers looks worse to a lot of other people. Color is the key to the dispute, although efficiency and other factors have been dragged into the fray. LPS lamps are monochromatic: They emit virtually all their light at a single yellow-orange wavelength. This is a windfall to astronomers who use the technique of spectroscopy, which separates light into component wavelengths that reveal the composition of stars and nebulas. Because the single LPS spectral emission line is of little interest to the vast majority of researchers, light of that wavelength reaching the telescope can be filtered out and ignored.

High-pressure sodium (HPS), probably the most widely used lamp type in contemporary outdoor equipment, produces broad-spectrum emissions over much of the visible range. While this greatly improves color balance for human viewing, it also blocks out starlight at many wavelengths. Therefore, excellent cutoff shielding is crucially important for HPS luminaires located near an observatory.

Local political battles have become intensely heated as jurisdictions near major observatories in California, Arizona, and Hawaii enact restrictive light pollution codes. Surprisingly, a few surveys have shown that when exposed to different streetlighting sources without a lot of fanfare, most people have no preference. This hardly calms the storm over color rendering, however. On the technical side, several widely circulated reports have been prepared for utility companies and municipalities in the affected areas. Most recommend HPS rather than LPS.

"I think the good outdoor lighting engineer or architect sees a real problem with the use of a light source that is very yellow both in its direct light and in its reflected light, which affects visibility," says Mike Canavan, outdoor lighting specialist with Southern California Edison, whose customers almost unanimously choose HPS for streetlighting. "It is a fact that LPS is the most efficient light source that we have today. And it is also a fact that we can light roadways to a given level of illumination using HPS with less energy than we can with LPS." This last statement, while generally supported by most U.S. outdoor lighting engineers, may be open to question.

LPS lamps do convert electrical power to visible light more efficiently than other commercially available light sources: figures run about 200 lumens per watt for LPS and 140 for HPS, versus 20 for incandescent. Comparing total lighting systems, however, is much more complicated, and must take many factors into account.

Ballast losses for LPS lamps are proportionately higher than those for HPS lamps. Over the course of their lives, LPS ballasts also experience a moderate to substantial rise in wattage consumed, with the highest rises for constant-lumen lamps that maintain light output over life. HPS lamps experience lumen depreciation without ballast wattage rise.

Fixture efficiency is an even more important factor. Like a biaxial fluorescent lamp, an LPS lamp has a long, hairpin-shaped luminous arc. Because HPS is more of a point source, it lends itself to superior optical control.

Primarily because of the lamp shape, the light distribution from an LPS fixture is typically widespread and diffuse, while good HPS fixtures have more focused, precise optical control. A well-engineered HPS fixture delivers light more efficiently from the source to the target than an LPS fixture can.

LPS proponents often refer to the lamp's widespread use in Europe, where energy costs

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Agency for Research on Cancer, an arm of the World Health Organization, classified night shift work as a "probable carcinogen" due to the disruptive impact that light at night has on human circadian cycles and sleep patterns, especially the endocrine system through the suppression of the sleep hormone melatonin.

These efforts and justifications to preserve the night sky by reducing excessive lighting have often resulted in a defensive approach to lighting design. The dark-sky movement's objective is to constrict how we use light to express architecture, by holding designers responsible for the percentage of uplight and light trespass, which has never been fully embraced by the lighting community. This defensive approach to design promotes a checklist process that can be stifling to the creative process.

These efforts also play into the scarcity narrative of sustainability and energy efficiency, where lighting is the first building system to be constrained, if it is not strongly defended and justified. But instead of a restrictive way to use light, what if there was a practical and creative way to use dark? What if designers expanded their visual spectrum to include shade, shadow, and darkness as vital elements in the visual environment both at night and during the day?

Learning not to fear, but to value the dark encourages a holistic approach to visual problem solving, an approach that is not based solely on lighting, but the totality of visual experience including darkness. As designers gain an understanding of the utility of darkness, a broader and more balanced visual experience emerges. Instead of adding more light to eliminate darkness, designers can allow natural variability, including darkness, to occur. Through the designed use of darkness in all of its forms, designers are able to satisfy a wider range of human visual experience, including the yearning for depth, mystery, and splendor.

As I drove home early that morning from watching the meteor shower, I began to understand that darkness is not merely an absence of light, but a quality of vision, a quality that the addition of more light can never fully realize.

"Darkness does not distress us; we surrender to it as inevitable. If light is scarce then light is scarce; we will immerse ourselves in the darkness and there discover its own particular beauty," as Jun'ichiro Tanazaki said in *In Praise of Shadows*.

Edward Bartholomew is principal of Bartholomew Lighting, and a research assistant professor at the University of Washington. He is currently writing a book about designed darkness and its role in vision and architecture.

are high. Canavan explains why fixture efficiency makes a bigger difference in the United States. "Many parts of Europe use a catenary system, in which linear LPS lights are suspended from cable directly above the roadway. In that configuration, LPS can be continuous, and it does a fairly good job of lighting the road. That's not the way we light roads in the United States, and I don't anticipate we ever will. We light roads from off the roadway, and we are moving poles farther and farther from the right-of-way in the interest of safety. We must direct the light onto the task, and given those circumstances, the ball game changes immensely."

Although there is no final word on the sodium lighting controversy, a comprehensive independent report was prepared in 1984 by Ian Lewin of Lighting Sciences Inc. for the Arizona Public Service Company. Using manufacturers' reported data, independent photometric testing, and computer modeling with the program Site-Lite, Lewin compared technical and cost factors relating to the two types of sodium lighting. He analyzed a variety of fixtures and roadway configurations, chosen to represent everyday practice."The decision for or against LPS is complex," Lewin's report concludes. "There is no clear overall [economic] superiority for either HPS or LPS ... Decisions upon which to use should involve a study of the various factors."

Shielding, Good Looks, and the Bottom Line

Besides attempting to influence or regulate the choice of lamp, astronomers focus on three other major ways to reduce light pollution. They favor shielded luminaries, limited times of operation, and zoning that restricts outdoor lighting most stringently near an observatory. Most lighting-pollution codes include most or all of these measures.

Shielding in particular is an idea whose time has come, whether or not telescopes are nearby. "Shoebox" fixtures with highly efficient, glare-free optics are now specified for area lighting wherever quality illumination and power savings are important.

Globe-style streetlights pose a real problem, because many designers and clients consider their traditional appearance highly desirable in the daytime. At night, though, they waste a tremendous amount of light and are often glaring. "If you put enough light in that thing to get some light on the ground," says David Crawford, "you can't see the ground anyway because you've created so much glare. Add a little drizzle, and you can't see a darn thing." Fortunately, many manufacturers now make decorative outdoor lights that provide cutoff optics in traditional and contemporary globe designs.

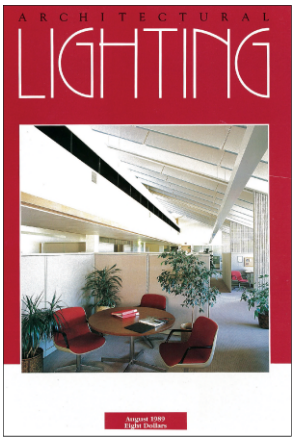
A Darker Future

Even the most successful efforts to keep the skies dark may not save observatories forever. Particulate air pollution, space debris, and radio-frequency interference also threaten to put them out of business. To those who suggest that space-based observatories will be the ultimate solution, David Crawford counters, "It costs many times more to do astronomy in space, say a thousand times as much. All observatories are suffering from chronic lack of funding now, so how can we afford to do it in space? It's not a viable solution."

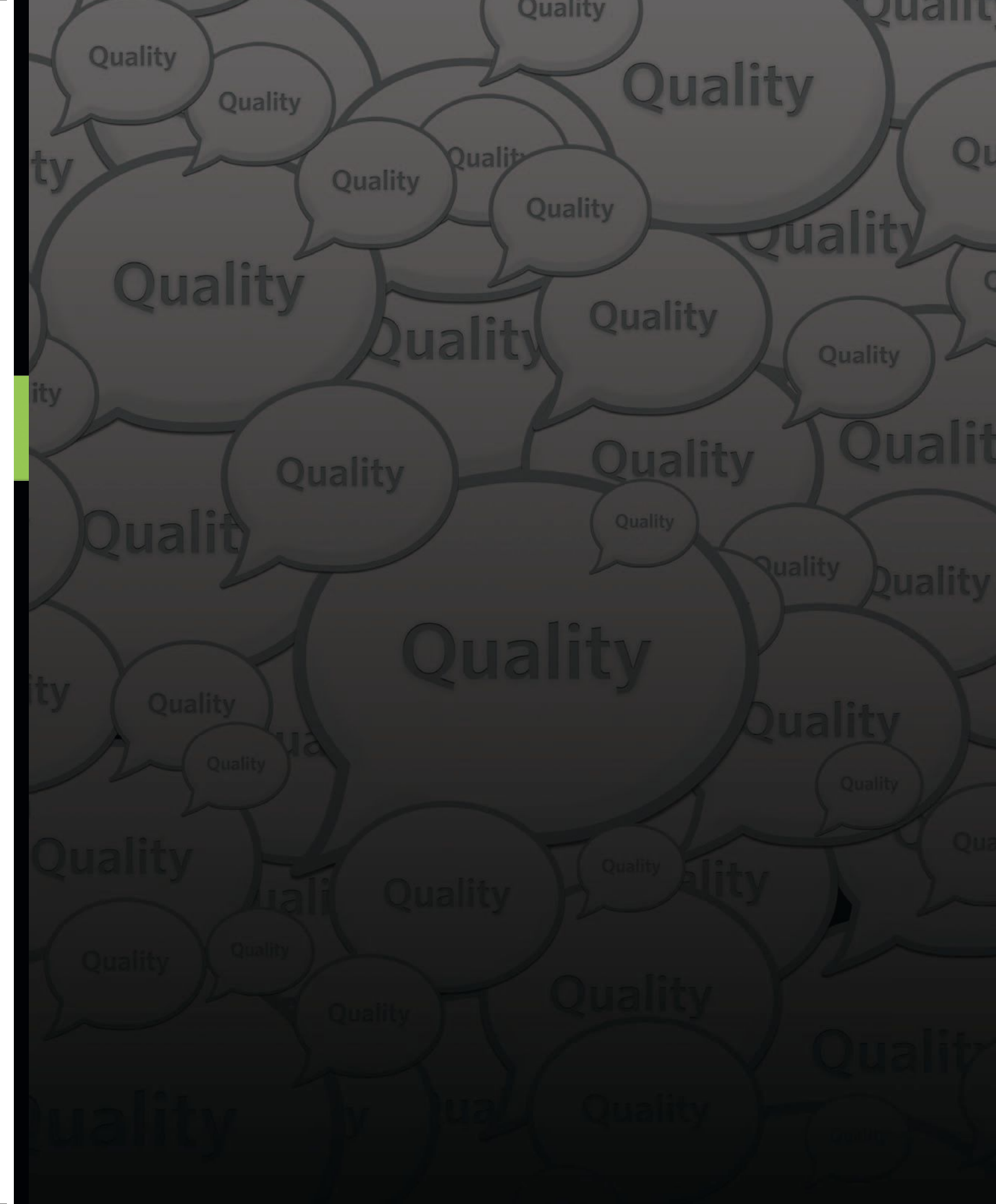
"For the indefinite future, some sites will stay very dark for astronomy. I'm very optimistic about that," Crawford says, "because I think both our push and the push of other people for better lighting will get things under control. However, I could be very pessimistic, too, for the long haul. Insensitivity to the environment, whether it's day or night, will get us into deep problems.

"The view of the universe that people get at night, particularly at dark-sky sites, is one of nature's greatest marvels. If we destroy that view, and in a few generations people can only see the Milky Way and galaxies on a screen in a planetarium, it'd be the same as only seeing nature on TV. That's not what we want, I think, for the Earth."

Light pollution is likely to generate more controversy for years to come, and both sides are still talking. "I think at some point in time we shall have a meeting of the minds," says Mike Canavan. "I don't think that's going to happen overnight. I certainly think that communication between the astronomer-supportive group [who favor LPS] and those who look at other sources of light as more appropriate is the only path we can travel." •



This article originally appeared in the August 1989 issue.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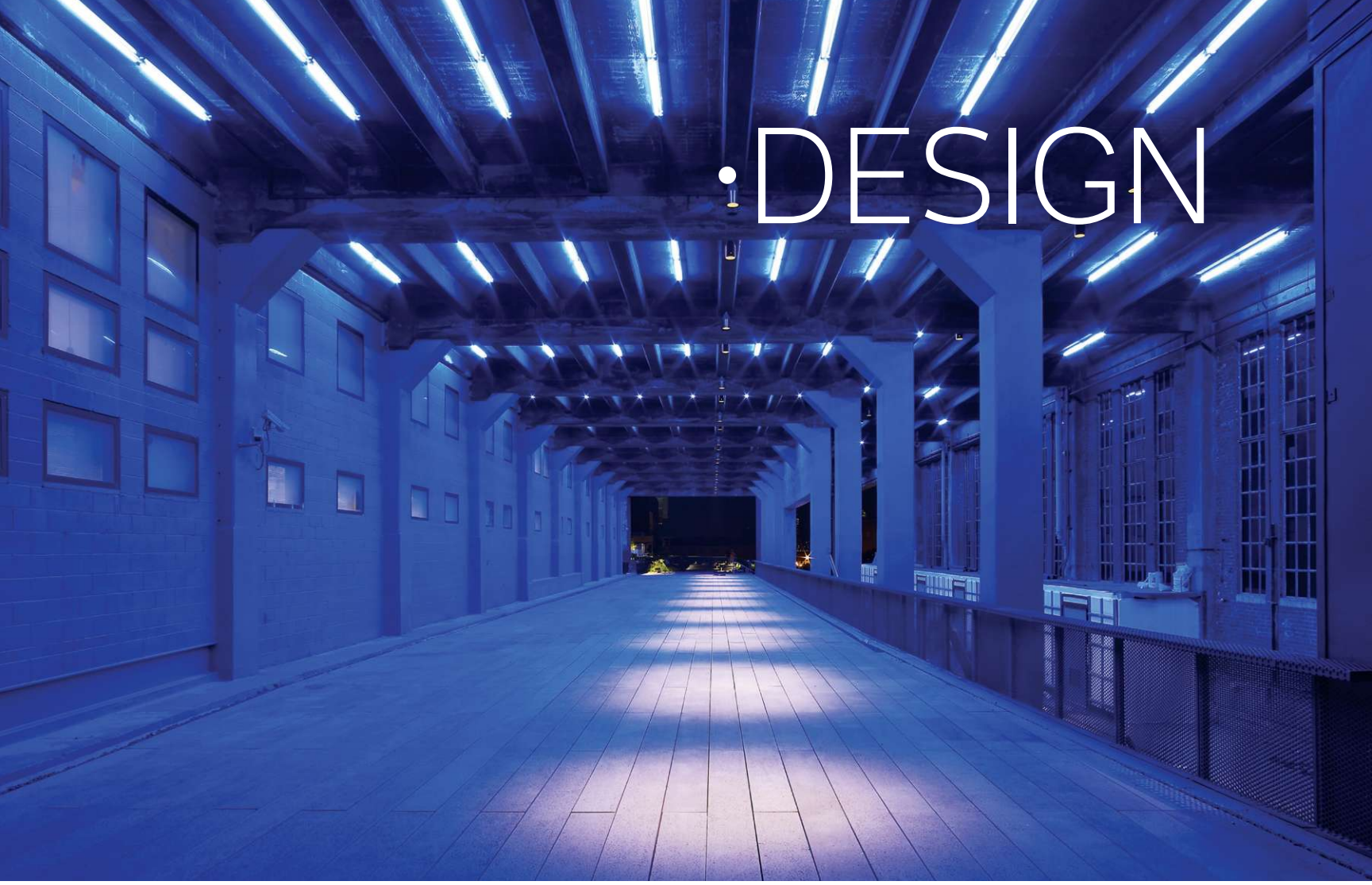


CRITIQUE

LIGHTING PRIMER

Architectural Lighting: Designing with Light and Space

text by Elizabeth Donoff

photos courtesy Princeton Architectural Press

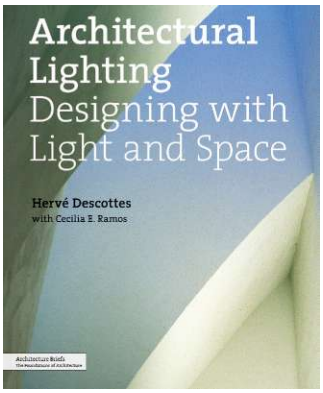
The Chelsea Market tunnel along the High Line in New York. Lighting designer Hervé Descottes uses this portion of the project to discuss how the space assumes a different identity at night from during the day. A deep, saturated blue light provides a visual cue for pedestrians and makes legible the tunnel's endpoints.

Unlike the vast library of architecture-focused volumes, the catalog of lighting-related titles pales in comparison. When a book is published on the subject of light and lighting, it is usually from a technical perspective, and assumes a preexisting knowledge of the subject, if only at a basic level. Fewer still are the books devoted to architectural lighting design, or, one might say, to the designing of architectural light. The recently published *Architectural Lighting: Designing with Light and Space* ($24.95, Princeton Architectural Press, March 2011), helps fill that void.

Written by Hervé Descottes with Celia E. Ramos, the 144-page primer is part of Princeton Architectural Press's Architecture Briefs series (it's the sixth in that series), which examines different single topics of interest to architecture students and young professionals. The series is meant to provide readers with a basic understanding of concepts and technical terms as it relates to the subject matter. The book is constructed with an architectural framework in mind and reflects Descottes's lighting practice—L'Observatoire International—in which he has collaborated with some of the most prominent design practitioners working today, such as architects Steven Holl, Jean Nouvel, and Peter Marino, and landscape architect James Corner.

From the start, Descottes is clear that this book is not meant to be a technical encyclopedia or a historical survey, but rather a reflection on "architectural lighting design in light of [my] reflections and experiences." To that end, the book explores the materiality of light both theoretically and analytically as it seeks to provide the reader with a visual understanding about lighting's potential as a form giver and creator of atmosphere.

The book is divided into two main sections: Six Visual Principles of Light (Illuminance, Luminance, Color and Temperature, Height, Density, and Direction and Distribution) and Analysis, which is an examination of six completed L'Observatoire International projects. The first section is by far the most technical that this design-oriented book gets, and it provides just the right amount of information for someone who is coming at light from an architectural, instead of a lighting, perspective.



Descottes has built his practice around these six principles, first introduced to him by lighting designer, sculptor, and philosopher Philippe de Bozzi in 1989. As his own lighting practice has grown, Descottes has "adapted and expanded" these principles, which he says serve as the basis for "a common vocabulary through which the visual and experimental aspects of lighting can also be properly addressed." Illustrative diagrams coupled with photographs of art and architecture installations aid the reader in visually understanding the principles being discussed.

In the Analysis section, Descottes revisits a group of L'Observatoire International projects that span from 1998 to 2009: the High Line in New York; the Newton Creek Water Pollution Treatment Plant in Brooklyn, N.Y.; the Jules Verne restaurant at the Eiffel Tower in Paris; Beige, a restaurant at the Chanel building in Tokyo's Ginza district; the Kiasma Museum of Contemporary Art in Helsinki, Finland; and the new Guthrie Theater in Minneapolis, Minn. In examining his own work, Descottes not only provides insight into his own design process but the also collaborative process between architect and lighting designer. These are projects where light and architecture are so interwoven that one cannot say where one discipline ends and the other begins.

Photographs and diagrams tie the projects back to the six visual principles, as Descottes explains exactly how each project addresses each of these criteria. Particularly helpful are the lighting charts that outline the specific luminaires used, their lamp type, and light output. The charts bridge the gap between design idea and real-time application—as do the appendices, which provide a final layer of accessible technical information covering such items as color temperature, basic characteristics of light sources, a lighting-symbol legend, and a lighting-terminology glossary. Looking at the six projects, it is not difficult to see how the six principles form a cohesive thread throughout Descottes's work, even though the architects and programs are not the same.

Rounding out the book's two principal discussions is a section called Essays. The section is composed of an interview—with architect Steven Holl—as well as essays by French designer Sylvain Dubuisson and landscape architect James Corner. These writings provide a window into how other design professionals see and think about light and lighting. Corner's essay is particularly on the mark as he describes the "revelatory power of light" and the symbiotic relationship between landscape and light. Understanding the play between shadow and light is paramount, he writes, in understanding space, working toward what he describes as "a phenomenology of luminosity."

In the introduction to *Architectural Lighting*, Descottes writes, "Lighting design necessitates a deep, meditative exchange of knowledge, and therefore it must be understood not as an interdisciplinary field but as a transdisciplinary one that traverses the boundaries of conventional thought." In his unique way, Descottes's work reveals the poetic nature of light as it connects to architecture. This introduction to architectural lighting and his work will surely leave the uninitiated wanting to know more. •

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REPORT

CONGRESS TACKLES EFFICIENCY

As important energy efficiency bills await Congress's vote, what should the lighting industry expect—and lobby for?

text by Amanda Kolson Hurley
illustration by James Provost

The lighting industry breathed a collective sigh of relief on July 12, when the House of Representatives defeated the BULB (Better Use of Light Bulbs) Act in a vote of 233 to 193. (The Act sought to repeal part of the 2007 Energy Independence and Security Act that requires incandescent lamps to become 30 percent more efficient beginning in 2012.) The fact that Congress would even spend time debating light bulbs when a decision on the $14.3 trillion debt-ceiling loomed was hard for many taxpayers to swallow. Now the debt-ceiling issue has been resolved—sort of—and, reflecting the cognitive dissonance that stems from having a Tea Party–tilting House and a Democratic Senate and President, two pieces of energy-efficiency legislation are coming down the line that differ starkly from BULB.

The first and higher-profile bill is the Energy Savings and Industrial Competitiveness Act (ESICA), introduced in May by Sen. Jeanne Shaheen (D-New Hampshire) and Sen. Rob Portman (R-Ohio). ESICA seeks to increase the use of energy-efficient technologies in homes, businesses, and factories, and to spur private-sector job creation. "By making it easier for employers to utilize energy-efficient tools, they can reduce costs, enabling them to use the savings to expand their companies and hire new workers," Portman said at a May 12 press conference.

A wide-ranging bill that purports to be a national energy-efficiency strategy (or at least the basis for one), ESICA has provisions relating to buildings, manufacturing, and the federal government. The package spells mainly good news for the lighting industry, says Robert Horner, director of public policy for the Illuminating Engineering Society (IES). Two particular high notes: loan programs would be created and expanded for energy-efficiency retrofits of commercial and industrial buildings, and a DOE program would be established for university-based building training centers that would provide training in efficient commercial building design and operation.

However, Title I of the bill, regarding building energy codes, gives Horner and his

"The feeling right now from the lighting profession is: If we continue to ratchet down these requirements, we're going to start affecting lighting quality, which has a snowball effect on occupants. ... We're looking at discussing this with the bill's authors in order to try to come up with a different [strategy]. We would like to have more consideration given to a performance- or outcome-based approach."

—Robert Horner, director of public policy, Illuminating Engineering Society

colleagues pause. This section calls for the DOE to establish national model energy codes, pegged to baselines of the 2009 International Energy Conservation Code (IECC) and ASHRAE 90.1 2010, and to set targets that lead toward a goal of net-zero energy buildings by 2030. The bill also empowers the DOE to assist states in adopting the model codes.

As Horner sees it, Title I "calls for continued ratcheting down of lighting power densities, [which] is of major concern to the IES. The feeling right now from the lighting profession is: If we continue to ratchet down these requirements, we're going to start affecting lighting quality, which has a snowball effect on occupants." Horner says that the IES will likely lobby to change these provisions in the legislation, and to advocate for increased use of daylighting. "We're looking at discussing this with the bill's authors in order to try to come up with a different [strategy]. We would like to have more consideration given to a performance- or outcome-based approach," he says. According to Horner, the IES and the International Association of Lighting Designers (IALD) are working "hand in hand" on this effort.

ESICA, which authorizes $1.07 billion over several years, passed the Senate Committee on Energy and Natural Resources with a vote of 18-3 and will be voted on by the full Senate post-recess. Horner calls its chances of passing into law "fair." He notes that there's a lot competing for Congress's attention right now, not least of which is an approaching election year. Although the bill has bipartisan support, "it's still on a fairly long track," he says.

In its original version, ESICA included provisions that set or raised standards for certain appliances, including dishwashers, room air conditioners, refrigerators, and freezers, as well as GU-24 base lamps, and outdoor lighting. These provisions have been dropped because they already appear in another piece of legislation that's before Congress: the Implementation of National Consensus Appliance Agreements Act, or INCAAA, introduced by Sen. Jeff Bingaman (D-New Mexico) in Sept. 2010 and reintroduced with updates by Bingaman and Sen. Lisa Murkowski (R-Alaska) on Feb. 17 of this year. Because it is concerned with standard-setting, INCAAA does not contain any authorizations—"it would not incur any new spending," as Bingaman said when he introduced it.

INCAAA's proposed lighting standards—including a phaseout of general-purpose mercury vapor lamps—are based on consensus agreements between industry and energy-efficiency and environmental organizations. They pass muster with Horner, except for one set that applies to general-service fluorescents. Horner cites a major implementation challenge: The highest efficiency fluorescents require increased use of rare-earth phosphors for manufacture, and China, which is virtually the only supplier of rare-earth phosphors in the world, has raised prices and cut back on allocations for export. The IES may ask Congress to hold off on implementing the changes for fluorescents, Horner says, until this supply problem can be addressed.

Regardless of what Congress's return brings, Horner is cheered by one of last year's crop of laws—the Federal Buildings Personnel Training Act, which instructs the U.S. General Services Administration to identify core competencies and offer training for federal employees charged with building operations and maintenance, energy management, and design. Potentially, Horner says, lighting professionals might both take part in this training and provide it. The industry could be affected in multiple ways, "all of them positive." •

Amanda Kolson Hurley is a freelance writer based in Maryland. Formerly the executive editor of ARCHITECT, AL*'s sister magazine, she has written for publications including* Preservation, Urbanite *(Baltimore), and* The Wilson Quarterly.

IN FOCUS

PEDDIE SCHOOL IAN GRAHAM ATHLETIC CENTER

A new natatorium gives a New Jersey boarding school an illuminated presence.

text by Jennifer Bickford
photos by Ken Douglas

The illumination scheme for the athletic center's façade does more than just highlight the architecture, it lets people know when the swim team has had a successful swim meet. Victory is signaled by the appearance of the school's color—Peddie blue—achieved with blue T5HO linear fluorescents controlled separately.

Located eight miles from Princeton, N.J., the Peddie School in Hightstown, N.J., is a private coeducational boarding school with an enrollment of 557 students. After acquiring additional land to expand athletic fields and facilities, the school sought to combine several buildings into one unified athletic center. Completed in January 2010, the structure, designed by RMJM Hillier, now houses the existing field house, fitness center, wrestling room, and pool, as well as male and female locker rooms.

Sitting at the edge of the campus, the new athletic center is "almost a proscenium to the rest of the campus," explains design architect Barbara Hillier. To create a building that could define the school and become a "transparent edge" along the south end of the campus, Hillier sought out Illumination Arts and principal Faith Baum, with whom they had previously worked, to design the interior lighting for the pool and the public spaces.

Conceptually, the theme of water was the jumping-off point for the design, and it led to the idea of a transparent skin glowing from within. The exterior walls of the natatorium are glass, while the interior is composed of a prefabricated dual-resin sandwiched wall system with a 4-inch-interior airspace. The multilayered walls help to regulate the building temperature throughout the year, and the translucency of the resin allows plenty of daylight into the space while still providing privacy for the swimmers.

The natatorium is home to Peddie's nationally acclaimed swim team as well as the Peddie Aquatic Association, which provides community swimming classes and prepares swimmers to compete at state, regional, national, and international levels. Because the facility hosts competitive swim meets, the light level on the pool's surface is required to be a minimum of 50 footcandles. To achieve these levels, Baum used a high-performance 1,000W metal halide luminous linear lighting tube to achieve an even light distribution. This light-pipe system consists of an acrylic tube coated with an optical film to evenly disperse the light along the tube's 30-foot-length, with an illuminator located at one end. At 35 meters (115 feet) long, 12 tubes were required to light

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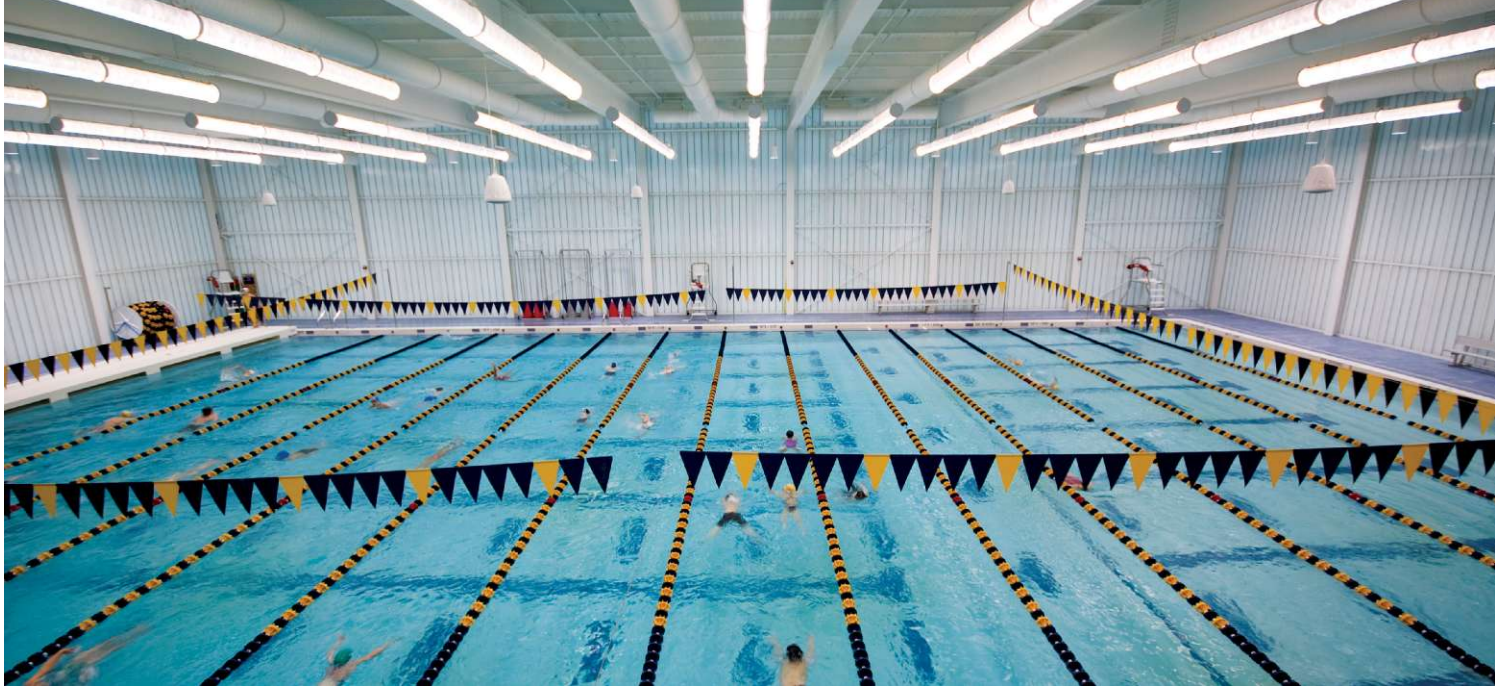


The main feature of the athletic center is the natatorium (above), which houses a competition-regulation swimming pool. The pool is lit with a light-pipe system that uses 1,000W metal halide lamps to provide the required 50-footcandle-level of glare-free illumination on the water surface. Metal halide downlights illuminate the surrounding deck areas.

the length of the eight-lane pool and two tubes with a 10-foot gap at the center were needed to span the width. The light pipes are alternately switched, meaning only half as many need to be on during the day when daylight contributes to the illumination of the space. Metal halide pendant downlights illuminate the deck perimeter as well as the spectator seating. From the exterior, the translucent building appears animated and alive, and Hillier describes the entire structure as being "enlivened by the interior lighting" at night.

For special occasions only, such as an important swim meet or to celebrate a win, an additional layer of decorative lighting was designed into the façade to define both the pool and Peddie's image on campus. Pendant-hung linear fluorescent wallwashers with blue fluorescent lamps wash the perimeter walls from the interior, turning the exterior a vivid hue of blue and backlighting the school's name. This distinctive look informs the rest of the school and the community that the swim team has won their meet.

Careful selection of lighting sources and daylight harvesting allowed for an energy-efficient design solution that also met the demanding requirements of competitive swimming. Baum was excited about the idea of a luminous wall material from the project's start and sought to create "an ephemeral glowing facility" for the Peddie School that was both dramatic and sustainable. The new Peddie School Ian Graham Athletic Center signifies a win-win situation for both the school and the community as they team up to share and celebrate a passion for aquatics. •

Details

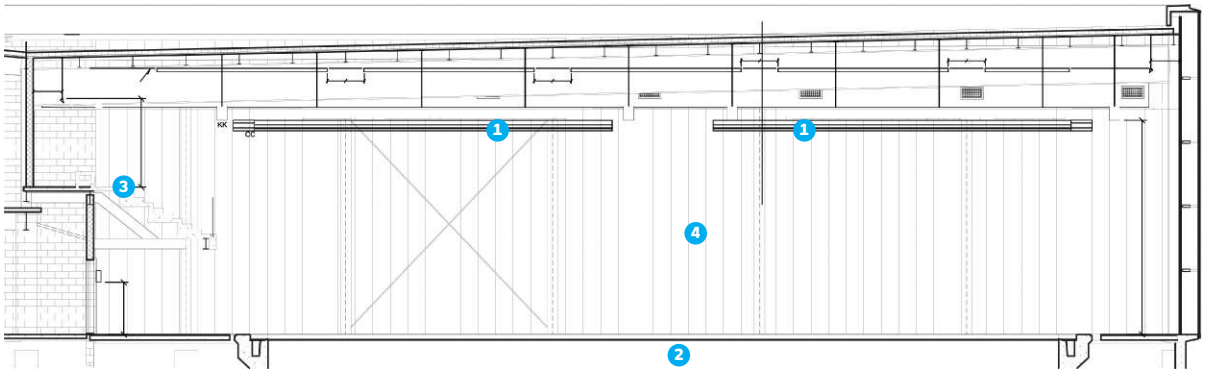
Project: Peddie School Ian Graham Athletic Center, Hightstown, N.J.
Client: Peddie School, Hightstown, N.J.
Architects: RMJM Hillier, Princeton, N.J.
Lighting Designer: Illumination Arts, Bloomfield, N.J.
Project Size: 42,000 square feet
Project Cost: $26 million

Manufacturers

Bega (39W T6 ceramic metal halide bollards at sidewalk); **Indy** (32W compact fluorescent recessed downlights at building entry and toilet rooms); **Insight Lighting, Illusions** (Natatorium light pipe with 1000W metal halides); **Kenall Mfg. Co, Millenium Edge** (32W compact fluorescent surface-mounted downlights with natatorium finish at pool locker room); **Kim Lighting** (39W T6 ceramic metal halide steplights along exterior); **Kirlin Co.** (Natatorium 175W metal halide deck downlights, and 32W compact fluorescent recessed-lensed downlights at toilet rooms); **Pinnacle Architectural Lighting** (T5HO linear fluorescent downlights and wallwashers at concourse); **Winona Lighting** (T5 and T5HO blue fluorescent wallwashers at natatorium seating area and blue luminous wall, and 39W T6 ceramic metal halide wallwashers in lobby)

Building Section
Natatorium East/West (Latitudinal Section)

not to scale



1. Light pipe
2. Pool
3. Seating area and stands
4. Dual-resin sandwiched wall system with 4-inch interior airspace

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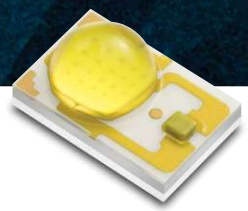

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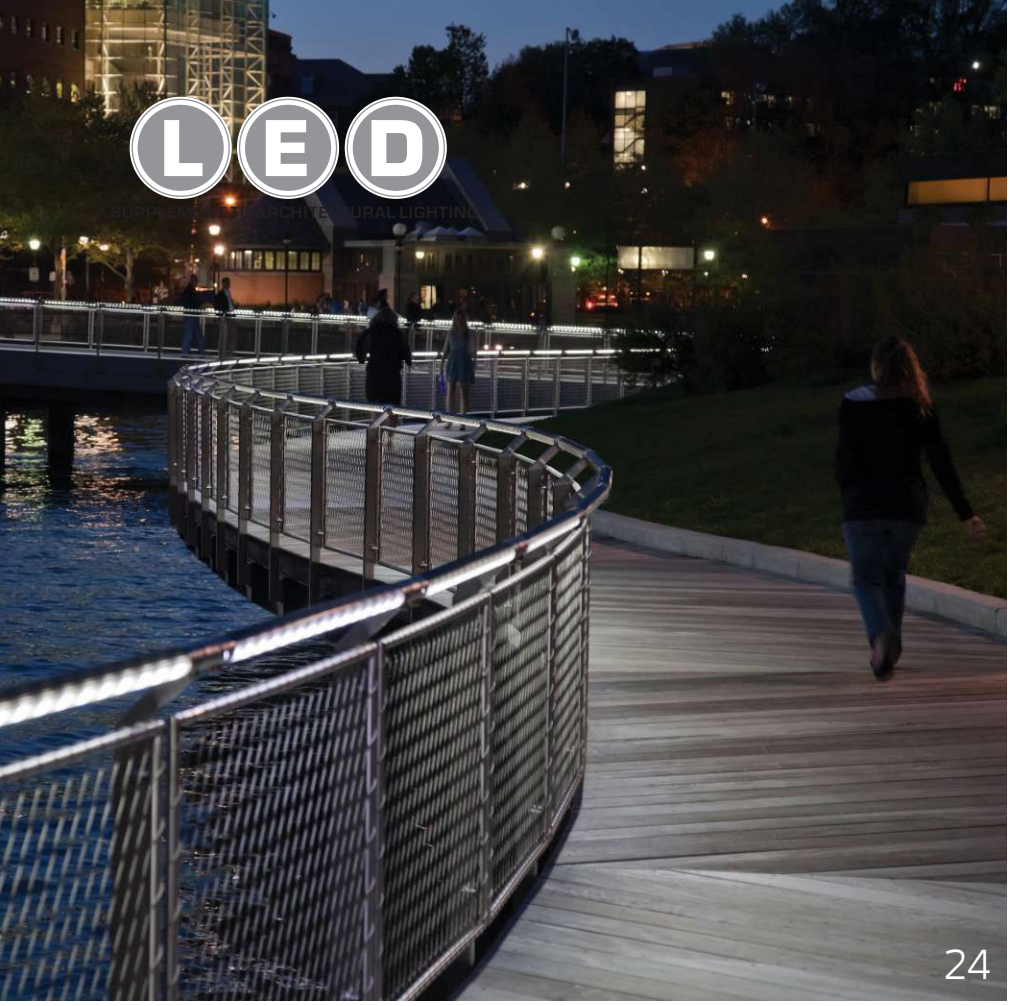

•CONTENTS

• FEATURE

• FRONT

• DEPARTMENTS

• BACK

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David Sundberg/ESTO (top left)

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"Any competition or race requires that there be at least two or more parties involved."

THE L PRIZE PROCESS: BALANCED OR BIASED?

The Aug. 3 announcement of the L Prize winner in the 60W replacement lamp category ("L Prize Winner Announced," page 8) should have been an exciting and celebratory milestone for the lighting industry. Instead, the announcement only confirmed what was already a foregone conclusion—that the prize would go to Philips. One can't blame Philips for turning in its letter of intent when the competition was newly under way in 2008 (the competition was originally outlined in the Energy Independence and Security Act of 2007), and then submitting the 2,000 required samples of the lamp for the 18-month testing period. One can, however, be frustrated with the competition itself—in its format and its administration by the U.S. Department of Energy—as well as by other lighting manufacturers for their ambivalent approach to the program.

Let's start with the competition itself. It is a well-intentioned initiative, but its format was flawed from the start. It did not set hard and fast deadlines that would have established an even playing field. Instead, the open-ended nature of the entry process left a lot of gray area. Without a definitive schedule for submitting letters of intent followed by samples, so that the testing process could begin, the process was skewed before it even started. Yes, in March, the Lighting Science Group sent a letter of intent to submit; GE Lighting followed in July. But one has to wonder why either of them bothered at all? Were they trying to save face before the Aug. 3 announcement?

And now that the 60W category winner has been declared, "DOE has closed the 60-watt category and will not accept or evaluate further entries in this category," according to the L Prize website. Yet this statement contradicts the DOE's description of the winner: "In each category, the first entrant to successfully meet the full competition requirements will receive the cash prize. Up to two additional entrants may be eligible for program partner promotions." If the DOE has closed the 60W category, then how will they be able to select two additional entrants for these promotions?

As a competition administrator myself (of the AL Light & Architecture Design Awards), I do think the DOE had an obligation to reach out to all lighting companies and encourage them to submit in a timely fashion. Or, at the very least, I would have thought that the traditional big three lamp manufacturers—Philips, GE, and Osram Sylvania—would have jumped at the chance to outdo one another in the development of "the" LED replacement lamp. But perhaps the lighting industry has been so bent and twisted out of shape with the mergers and acquisitions of the past several years that this is no longer possible. And while I know that Philips is proud of their accomplishment, it must be a little bittersweet that their entry essentially went uncontested. So I have to wonder if the acknowledgement of being the L Prize winner is somehow diminished?

The competition format raises another concern: Is such a program really open to all lighting companies? Or did the sample requirement—2,000 lamps—eliminate the possibility of anyone other than a large, established manufacturer from participating?

The L Prize Competition does have two other categories, the PAR38 halogen replacement lamp and the 21st Century Lamp Prize. In January, the PAR38 category was put on hold with a vague explanation from the DOE that it was "reconsidering the program based on lessons learned from the 60W category." Is this a recognition that the competition format needs to be reconsidered? And, as of press time, there is no word when the 21st Century Lamp Prize will commence.

Any competition or race requires that there be at least two or more parties involved. The L Prize only seems to have reinforced the status quo of government bureaucracy and dominant market players. The competition could have signaled so much more—as we attempt to integrate more energy-efficient lighting into our homes and workplaces—if it had really been an even playing field.

Elizabeth Donoff
Editor

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text by Elizabeth Donoff

L PRIZE WINNER ANNOUNCED

Philips Lighting North America wins the 60W replacement lamp category.

The L Prize award ceremony. From left to right: Arun Majumdar, director of ARPA-E; Zia Eftekhar, CEO, Philips Lighting North America; Senator Lisa Murkowski, R-Alaska; Senator Jeff Bingaman, D-New Mexico; Liesel Whitney-Schulte, commercial program manager for the Wisconsin Energy Conservation Corp.; and Ed Crawford, general manager of lamps, lighting systems and controls, Philips Lighting.

On Aug. 3, the U.S. Department of Energy (DOE) announced Philips Lighting North America to be the winner of the 60W replacement lamp category in the Bright Tomorrow Lighting Prize competition, also known as the L Prize. The $10 million prize also carries with it a federal contract purchasing agreement (the lamp will be listed as an approved option for U.S. agencies making replacement lamp purchases) and a number of L Prize partner promotions and incentives, including the support of 31 utilities and energy efficiency program partners. Philips hopes to have the prize-winning 4.1-inch-tall LED L Prize lamp in stores by early 2012. Based on photometric testing that follows LM-79 standards, the 10W 120V A19 lamp has a rated average life of 25,000 hours, an output of approximately 900 lumens, a color-rendering index of 90, and a color temperature of 2700K. The lamp is intended only for interior usage.

The competition, outlined as a provision of the 2007 Energy Independence and Security Act and launched in 2008, is the first sponsored by the federal government that encourages the implementation of high-performance, energy-efficient lighting, as well as the research initiatives involved, with a specific focus on solid-state lighting. The competition is composed of three categories: one for 60W incandescent replacement lamps, one for PAR38 halogen replacement lamps, and the 21st Century Lamp Prize, which calls for the development of an LED replacement lamp that meets 150 lumens per watt or better. To date, the DOE has only proceeded with the 60W category. (The 60W incandescent lamp is the most widely used type of lamp in the United States, and represents approximately half of the domestic incandescent lamp market. Nearly 425 million 60W incandescent lamps are sold in the U.S. each year.) On Jan. 5, the PAR38 competition category was put on hold, and the 21st Century Lamp Prize has yet to be launched.

In September 2009, Philips was the first company to submit an entry for the 60W category. Two thousand samples of Philips' 10W EnduraLED lamp were put through 18 months of testing and were evaluated for their ability to balance performance, quality, lifetime, cost, and availability, as well as their ability for widespread adoption and mass production. According to the National Electrical Manufacturers Association, a substantial amount of the manufacturing process for the lamps is required to occur in the U.S., and "the manufacturer must provide evidence that it is fully prepared to produce at least 250,000 units of the winning entry in the first year and increase annual output in later years."

Short- and long-term performance testing was conducted by independent laboratories, and field tests were conducted throughout North America by utilities and other competition partners. The lamps were examined under a variety of stressful conditions, including high and low temperatures, humidity, vibration, high and low voltage, and electrical waveform distortions.

continued on page 10

• **Video: The L Prize Testing Process** Hear how the LED L Prize 10W lamp from Philips was tested according to the L Prize's guidlines (bit.ly/qNL70H) and how the L Prize partners were involved in the field-testing process (bit.ly/q5Sefd).

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continued from page 8

"We looked at the L Prize challenge as an opportunity to innovate and develop an energy-efficient alternative to a product that has remained largely unchanged for over a century," says Zia Eftekhar, CEO of Philips Lighting North America. "The fact that we are the first and only company capable of submitting a product and completing 18 months of rigorous testing not only underscores our commitment to innovation and quality, it highlights our ability to bring meaningful leading technologies into the mainstream."

Philips was the only company to submit both the letter of intent and the required 2,000 samples, so their entry went essentially unchallenged. In March, Lighting Science Group sent a letter of intent to submit. In July, GE Lighting also submitted a letter of intent to submit. But neither company has provided the number of lamps required for the 18-month testing period. The L Prize competition remains open, so other lighting manufacturers will still be eligible for federal purchasing contracts and program partner support.

According to information from the DOE—and posted on Philips' L Prize website, philips.com/lprize—it is estimated that "if every socket in the U.S. converted their 60W incandescent lamps to this new 10W L Prize lamp, the country could save approximately 35 terawatt-hours of electricity in one year, and avoid 20 million metric tons of carbon emissions. That's enough electricity to power the lights of nearly 18 million U.S. households, or nearly triple the annual electricity consumption of the city of Washington, D.C." •

The Philips LED L Prize lamp

CREE ACQUIRES RUUD LIGHTING

Cree and Ruud Lighting are the latest lighting companies to join the mergers and acquisitions activities that have characterized the lighting industry over the past several years. The announcement, that Cree was acquiring Ruud Lighting, was made on Aug. 17 and involves a stock-and-cash transfer estimated at approximately $525 million. The acquisition of Ruud Lighting gives Durham, N.C.–based Cree, principally known as an LED chip and LED lamp manufacturer, entrée into the luminaire side of the industry. The deal allows Ruud Lighting greater resources to ongoing technological developments in LEDs, and helps them to move faster in meeting market demands for LED products.

Ruud Lighting, based in Racine, Wisc., and founded in 1982, has consistently embraced evolutions in technology, and the company hasn't wavered from that when it comes to solid-state lighting (SSL). It began to steer the majority of its product development toward SSL in 2005 and 2006, well before many of its competitors did so. In 2007, it established BetaLED to focus on LED fixtures for outdoor applications and KramerLED to respond to interior LED luminaire needs.

The deal with Cree might seem uncharacteristic of the independently minded Ruud Lighting, but company founder Al Ruud doesn't see it that way. "Yes, Cree did come to us; it was not something we were looking for, but when you look at the two companies and the values, the cultures, the people, and our core competencies, what we've done complements one another very much."

The move also speaks to how Ruud sees the future of the lighting industry. "One thing that it [the acquisition] does that I think a lot of people don't recognize is that if we move to the adoption of LEDs, there are more opportunities for the industry," he says. "There isn't a great need for expanding the legacy industry products that are out there. If we can go and replace the installed base of inefficient 20th century lighting products with LED products, it's a tremendous opportunity for the entire industry."

Ruud notes that both his company and Cree "share a passion" for expanding the LED industry. Even though Ruud Lighting will become part of Cree, Ruud will remain in Racine with a certain level of independence within Cree's corporate structure. Logistical details of the deal are still being worked out. Also, according to Ruud, the merger should be easy in the sense that the two can easily distinguish between the lighting and the components sides of each business. This will enable each entity to maintain separate research and development departments, but still allow for collaboration between the fixture and components groups as product or technological development requires.

Going forward, Cree and Ruud Lighting's main goal is to look for the opportunities that create the best "overall portfolio synergies." Ruud admits that there will probably be some consolidation in the supply chain—but that has more to do with reducing any potential confusion in the marketplace. "For the specification community, you'll see a full portfolio product line under Cree and BetaLED. We are one company and will act as one company." This will also translate to how the two will present at industry trade shows such as Lightfair. Ruud indicated that the BetaLED 2012 Lightfair booth will feature all Cree lighting systems and the Cree booth will highlight Cree's components, in order to respond to the different customer bases.

As part of the merger, Ruud has joined the board of Cree and will serve as vice chairman of lighting. His primary responsibility will be on the lighting side of the business. His son, Christopher Ruud, will continue as president of Ruud Lighting. "The acquisition was the right thing to do and provides opportunities for our staff here [in Racine], because it provides for more rapid growth," says the elder Ruud. "We are looking for the best way to use the people and resources that we have. They are a very important resource and there are no jobs at risk in this situation." •

IT'S LIKE A FERRARI AND A HYBRID HAD A BABY.

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MINIMIZING SSL FLICKER

Lighting Research Center reports provide guidance.

The Lighting Research Center in Troy, N.Y., has published a report in the journal *Lighting Research & Technology* on the subject of flicker and stroboscopic effects as they relate to solid-state lighting (SSL). The human factor studies were funded by the Alliance for Solid-State Illumination Systems and Technologies (ASSIST) and will serve as the basis for future ASSIST recommended guidelines on flicker in SSL systems. The new report identifies thresholds and acceptance levels for indirect perception of flicker. Project and report summary can be found at bit.ly/oRBrsQ. •

ALTMAN LIGHTING PLANS EXPANSION

Yonkers, N.Y., will help the company modernize its facility to produce LEDs locally.

In an effort to keep one of its own local, the city of Yonkers and the Board of the Yonkers Industrial Development Agency announced in April that they would pass a resolution to negotiate the terms of an economic incentive package with Altman Lighting, a leading theatrical stage and architectural lighting company. The move would help Altman Lighting facilitate its $4.6 million modernization plan to upgrade its existing 100,000-square-foot facility and to replace equipment in order to begin manufacturing LED lighting systems in Yonkers. Altman's investment plan also includes the creation of 10 new positions to complement the existing 103 jobs at its 57 Alexander Street facility. The ability to manufacturer locally allows Altman Lighting to maintain its market competitiveness and to eliminate the need to send production work overseas to China. •

DOE SOLID-STATE LIGHTING UPDATES

Through its various market development, product testing, and research program initiatives, the U.S. Department of Energy's solid-state lighting program continues to champion LED technology and integration.

• In May, the U.S. Department of Energy (DOE) published an update to its annual Solid-State Lighting (SSL) R Multi-Year Program Plan (MYPP), previously released in March. The MYPP report describes the DOE's numerous initiatives meant to further their mission to accelerate SSL technology adoption. The report also touches on annual SSL R funding opportunities, provides a status update and trend highlight for both LEDs and OLEDs, and provides an overview of the DOE's current SSL R project portfolio. A pdf of the report can be downloaded at ssl.energy.gov/techroadmaps.html.

As an extension to the MYPP report, the DOE has also released a manufacturing R&D road map report. It can be downloaded from the DOE's website at 1.usa.gov/npKCjk.

• As part of its Lighting Facts program, the DOE has published *Lighting Facts Product Snapshot*. An overview of LED replacement lamps, the report provides verified performance data for close to 1,000 market-available LED replacement lamps that have been registered with the Lighting Facts labeling initiative. Because of the rapid advance of solid-state lighting technology, the *Product Snapshot* is updated twice a year. The guide is available to download at lightingfacts.com.

• The DOE has published the second edition of the *LED Luminaire Lifetime: Recommendations for Testing and Reporting*. The document was prepared by a working group formed by the DOE and the Next Generation Lighting Industry Alliance to provide consistent information on the topic of LED luminaire lifetime. A pdf of the guide is available at bit.ly/oyuc68.

• The DOE has completed Round 12 of product testing through its CALiPER (Commercially Available LED Product Evaluation and Reporting) program. This latest round of CALiPER focused on the following areas: SSL downlights, SSL tracklights, benchmark 100W incandescent A-lamps and 70W to 100W halogen equivalents, SSL replacements for linear fluorescent lamps in high-performance troffers, and SSL and benchmark covelights. A summary report can be downloaded at ssl.energy.gov/reports.html.

• In its ongoing efforts to promote the accelerated adoption of SSL technologies, the DOE has announced two funding opportunities for Round 8 of its Core Technology and Product Development program. Core technology projects should focus on applied research. Product development projects should focus on using information gathered from basic or applied research initiatives. Applications are due Nov. 3, and complete details are available at eere-exchange.energy.gov.

Round 7 results were announced in June, and the DOE awarded $14.8 million to eight projects. Four of these projects will focus on core technology research to further the technical knowledge base for SSL general illumination. Two projects will concentrate on improving the commercial viability of SSL materials, devices, or systems. The final two projects will examine ways to achieve cost reductions while enhancing product quality by utilizing improvements in manufacturing equipment, processes, or monitoring techniques. For details about these projects go to ssl.energy.gov.

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LED MARKET FORECAST

Analysts predict that LEDs will have the predominant share of the lighting market over the next few years.

$2 billion

LED global revenue will reach close to $2 billion by 2017
(Source: Frost & Sullivan)

39%

Architectural lighting has a 39% LED market penetration
(Source: McKinsey & Company)

75%

General lighting accounts for 75% of the total lighting market
(Source: McKinsey & Company)

Lighting industry market reports are often difficult to come by. There are several reasons for this. First, there is no one definitive source for reliable information that captures the global lighting market as a whole. Second, these types of reports are not produced on an annual basis, and usually have a purchase fee that is cost prohibitive for a small company or an individual. When one does finally have the ability to access the material, it is usually out of date by at least two to three years. In the lighting industry, particularly with the rapid infiltration of solid-state lighting, that is practically a lifetime. But thanks to some recently released reports, understanding the makeup of the lighting market is becoming more attainable.

The most significant of these reports is from McKinsey & Company, and was commissioned by Osram. *Lighting the Way: Perspectives on the Global Lighting Market*, takes a broad view of the industry with particular reference to LED market share—present and future. The report's information is sourced from data collected by McKinsey in June 2011 when they surveyed lighting professionals and consumers in the United States, Germany, Japan, China, Russia, Brazil, and India. Feedback was provided by more than 650 respondents representing the design sector and more than 1,000 respondents representing lighting products consumers. The report is divided into three sections: an overview of the global lighting market, an examination of the impact of LEDs on lighting, and an examination of specific lighting areas and the penetration of LED market share.

Overall, the report indicates that the global lighting market will reach revenues of approximately €110 billion ($154 billion) by 2020. Contributing to this growth are population increases, urbanization, government regulations, and energy efficiency measures. At present, LED technology remains too expensive to be competitive from an application standpoint. However, accelerated growth over the next decade will change that. With continued investment, it is anticipated that LED costs will decrease at a rate of 30 percent per annum. The McKinsey report suggest that "the LED lighting market will amount to almost €65 billion ($91 billion) by 2020—close to 60 percent of the overall lighting market."

The report goes on to look at the three main sectors of the lighting market: general lighting, automotive lighting, and backlighting. Backlighting is expected to decline by 2020 as the increase in high-brightness LEDs will require fewer LEDs to be used for this type of application. Automotive lighting is expected to see continued growth thanks to the LED conversion of headlamps.

But it is general lighting, which accounts for 75 percent of the total lighting market, that will see the greatest transformation due to LEDs. Architectural lighting applications in particular, viewed as an area of early adoption because of the incorporation of color control, will see an 85 percent market share by 2020.

In evaluating current and future LED market share, the McKinsey report notes that, because of the complexity and fragmentation of the lighting industry, it is important to assess not just applications, but lighting and lamp technologies, geographical location, and end-market structure. With these four factors in mind, it is easy to see why LEDs are transforming the lighting industry and the entire value chain. A copy of the McKinsey report can be found at archlighting.com. •

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LEDS IN THE SPOTLIGHT

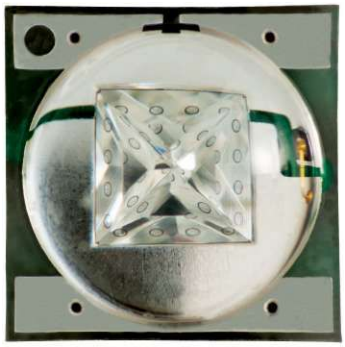
The latest in LED luminaire offerings.

text by Elizabeth Donoff

13W GE Energy Smart LED, GE Lighting

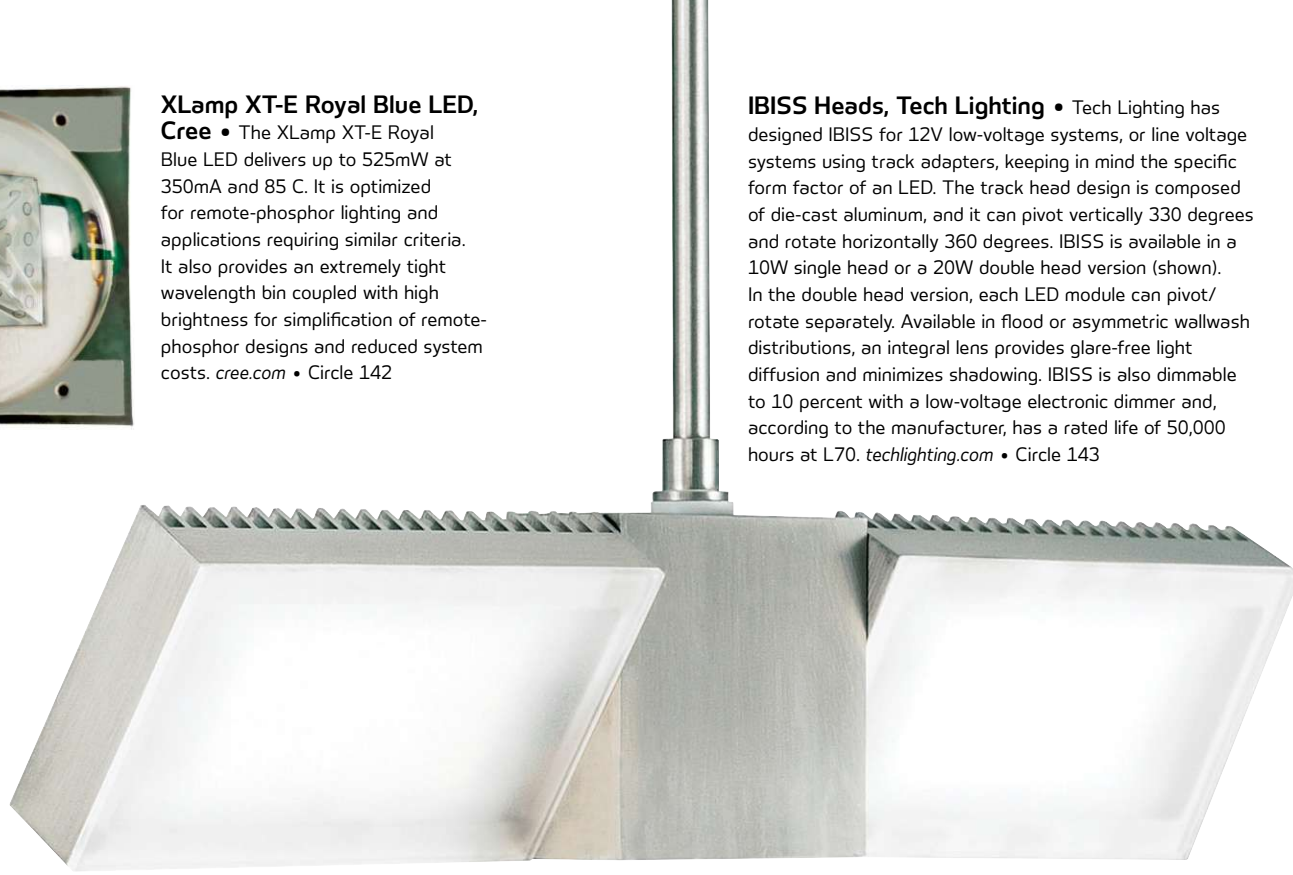
• This dimmable 60W incandescent replacement lamp is part of GE's full family of Energy Smart LED incandescent replacement lamps being introduced over the next 16 months. According to GE, the 13W LED lamp will be available in November, and the 75W and 100W incandescent replacement LED lamps (18W and 27W, respectively) are anticipated for fall 2012. The lamps deliver omnidirectional light as well as smooth dimming and eliminate flicker. When off, the lamp has the appearance of a soft-white incandescent lamp. *gelighting.com* • Circle 140

LinearDrive 720D, eldoLED • EldoLED's LinearDrive 720D for full-color LED applications in architectural, façade, entertainment, and stage lighting applications has been updated to support 5V, 12V, 24V, and 48V LED strips, meaning the driver can support, simultaneously, multiple LED strips that run on different voltages. The strips can operate separately or concurrently, which provides a great degree of design and installation freedom. The driver dims down to 0.1 percent for smooth color fades, and can be used with all major protocol systems—DALI, DMX, DMX/RDM (remote device management), and zero to 10V. *eldoled.com* • Circle 141

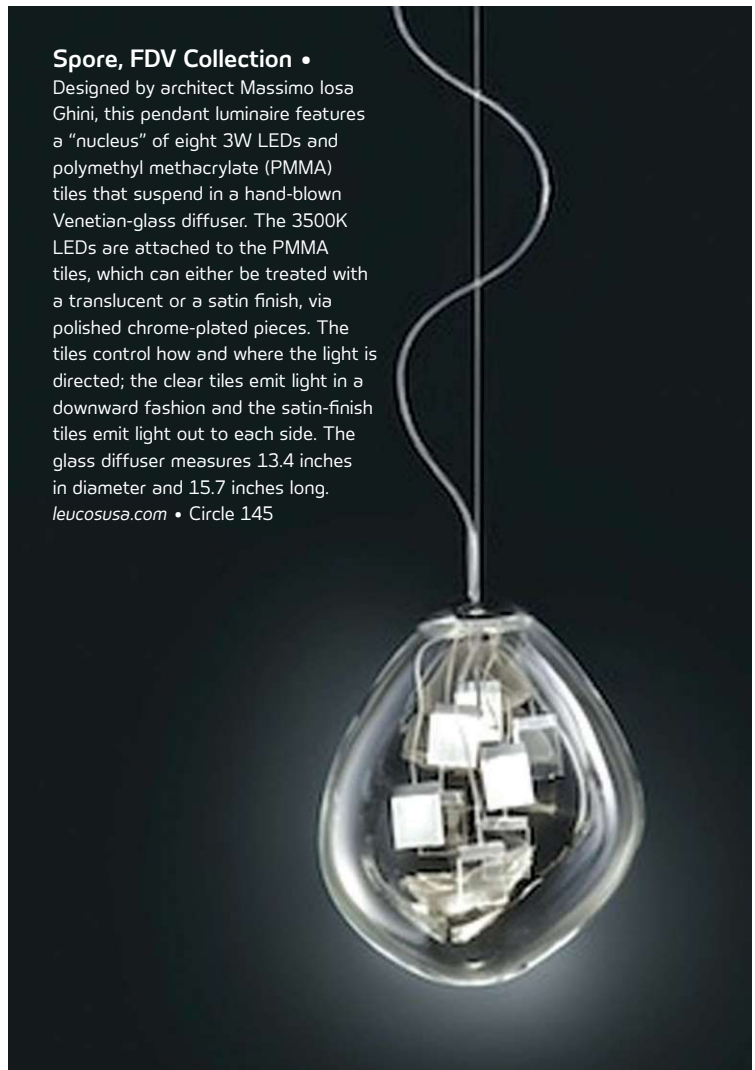


XLamp XT-E Royal Blue LED, Cree • The XLamp XT-E Royal Blue LED delivers up to 525mW at 350mA and 85 C. It is optimized for remote-phosphor lighting and applications requiring similar criteria. It also provides an extremely tight wavelength bin coupled with high brightness for simplification of remote-phosphor designs and reduced system costs. *cree.com* • Circle 142

IBISS Heads, Tech Lighting • Tech Lighting has designed IBISS for 12V low-voltage systems, or line voltage systems using track adapters, keeping in mind the specific form factor of an LED. The track head design is composed of die-cast aluminum, and it can pivot vertically 330 degrees and rotate horizontally 360 degrees. IBISS is available in a 10W single head or a 20W double head version (shown). In the double head version, each LED module can pivot/rotate separately. Available in flood or asymmetric wallwash distributions, an integral lens provides glare-free light diffusion and minimizes shadowing. IBISS is also dimmable to 10 percent with a low-voltage electronic dimmer and, according to the manufacturer, has a rated life of 50,000 hours at L70. *techlighting.com* • Circle 143



VFL LED Streetlight Luminaire, We-ef • The VFL LED streetlight luminaire features We-ef's One LED Concept (OLC) technology, which aligns the LEDs in the same direction, and untilted, to provide an even level of light distribution. A special acrylic lens minimizes the amount of light reflected from the diode into the luminaire's housing, which also incorporates the heat sink. The fixture is offered in three wattages—28W, 42W, and 49W—and three color temperatures—warm-white 3000K, neutral-white 4000K, and cold-white 5000K. Wattages can be adjusted to respond to changing exterior lighting condition via a factory-installed Eco Step Dim module, a software-controlled dimmer. The luminaire is composed of only two die-cast components, including the housing, which is made of a marine-grade, recycled, corrosion-resistant, low copper-aluminum alloys. The fixture head mounts easily onto a variety of different streetligting poles. *we-ef.com* • Circle 144



Spore, FDV Collection • Designed by architect Massimo Iosa Ghini, this pendant luminaire features a "nucleus" of eight 3W LEDs and polymethyl methacrylate (PMMA) tiles that suspend in a hand-blown Venetian-glass diffuser. The 3500K LEDs are attached to the PMMA tiles, which can either be treated with a translucent or a satin finish, via polished chrome-plated pieces. The tiles control how and where the light is directed; the clear tiles emit light in a downward fashion and the satin-finish tiles emit light out to each side. The glass diffuser measures 13.4 inches in diameter and 15.7 inches long. *leucosusa.com* • Circle 145

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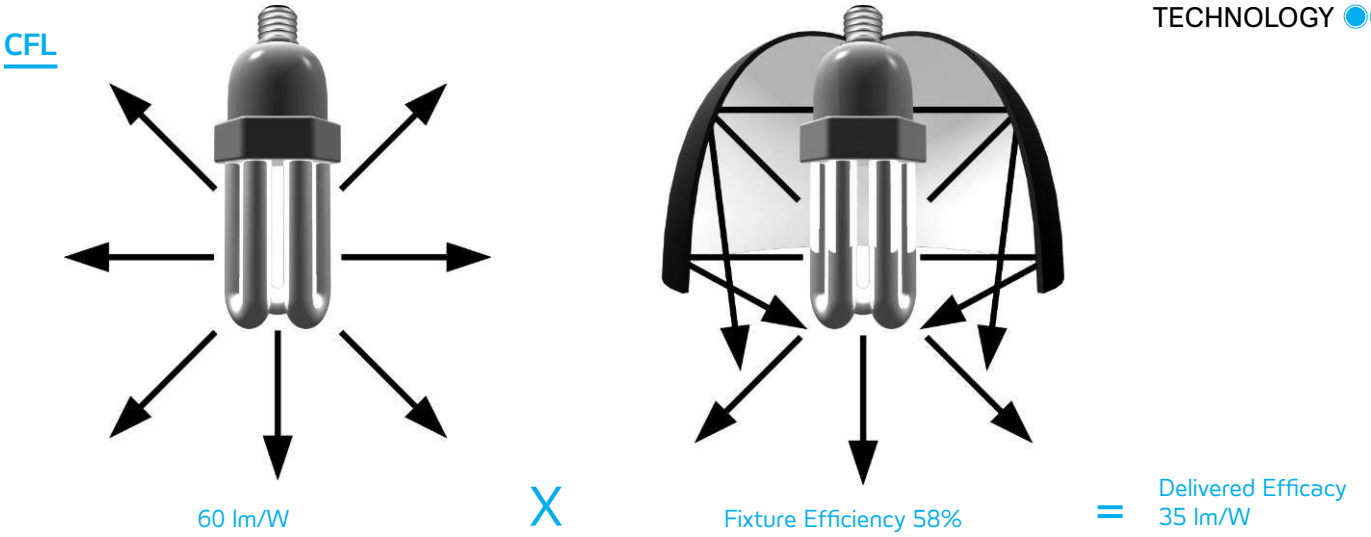


LED FUNDAMENTALS

Designing for LEDs and their specific attributes.

text by Monica Hansen
images courtesy of Cree

The large energy savings potential using light-emitting diodes (LEDs) for general illumination is undeniable, and the adoption of LED lighting is increasing at a rapid pace. A number of LED lighting fixtures manufactured today exceed the efficacy and lifetime of conventional lighting technology in certain applications. While the performance and cost structure of LED lighting technology is evolving swiftly, we are just scratching the surface of innovations in LED fixture design that can improve the value proposition.

ANATOMY OF AN LED

An LED is a semiconductor device that generates light. Those used for lighting are made by depositing indium, gallium, and nitrogen on a silicon carbide (SiC) or sapphire wafer to create the active layer or light-generating layer. Metal contacts are added to the semiconductor film and the wafer is then diced into many small LED chips, also called die. When an electrical current is applied to the chip, electrons and holes form and recombine in the active layer to produce light, which is generally blue or green for indium-gallium-nitride LEDs, the type of configuration used for creating white LEDs.

The LED chip is then mounted into a package where a phosphor is added to convert some of the blue light to other colors such as red and yellow. These new colors combine with the remaining blue light to produce a white light. Finally, the package is topped with a lens to help direct and shape the light for the intended application. The LED package provides protection for the LED chip from the outside environment and acts as a conductive path to carry generated heat away from the chip via a thermal pad.

The LED package is then incorporated into a light fixture, or luminaire, along with a heat sink for thermal management, a driver for power conversion, and secondary optics for tailoring the light distribution. The LED luminaire requires a system design

approach that carefully integrates and balances the competing requirements of optics, mechanics, electronics, thermal management, and light-generation elements.

TRADITIONAL LAMPS VS. LED TECHNOLOGY

LEDs and traditional light sources have very different features that affect how they perform. Incandescent lamps make light through heat. Electricity is passed through a tungsten filament, and the filament's electrical resistivity creates enough heat to make it glow. LEDs generate light through a process called electroluminescence, in which photons are generated by the

Contrary to an incandescent lamp, the evacuation of heat from the LED chip is of critical importance since heat in the LED chip drops its efficiency.

recombination of electrons and holes in the semiconductor film. Contrary to an incandescent lamp, the evacuation of heat from the LED chip is of critical importance since heat in the LED chip drops its efficiency. LED lighting has a number of attributes that make it advantageous for many applications. Beyond their much-touted efficiency and longevity, a number of other attributes make LEDs desirable for many applications, including:

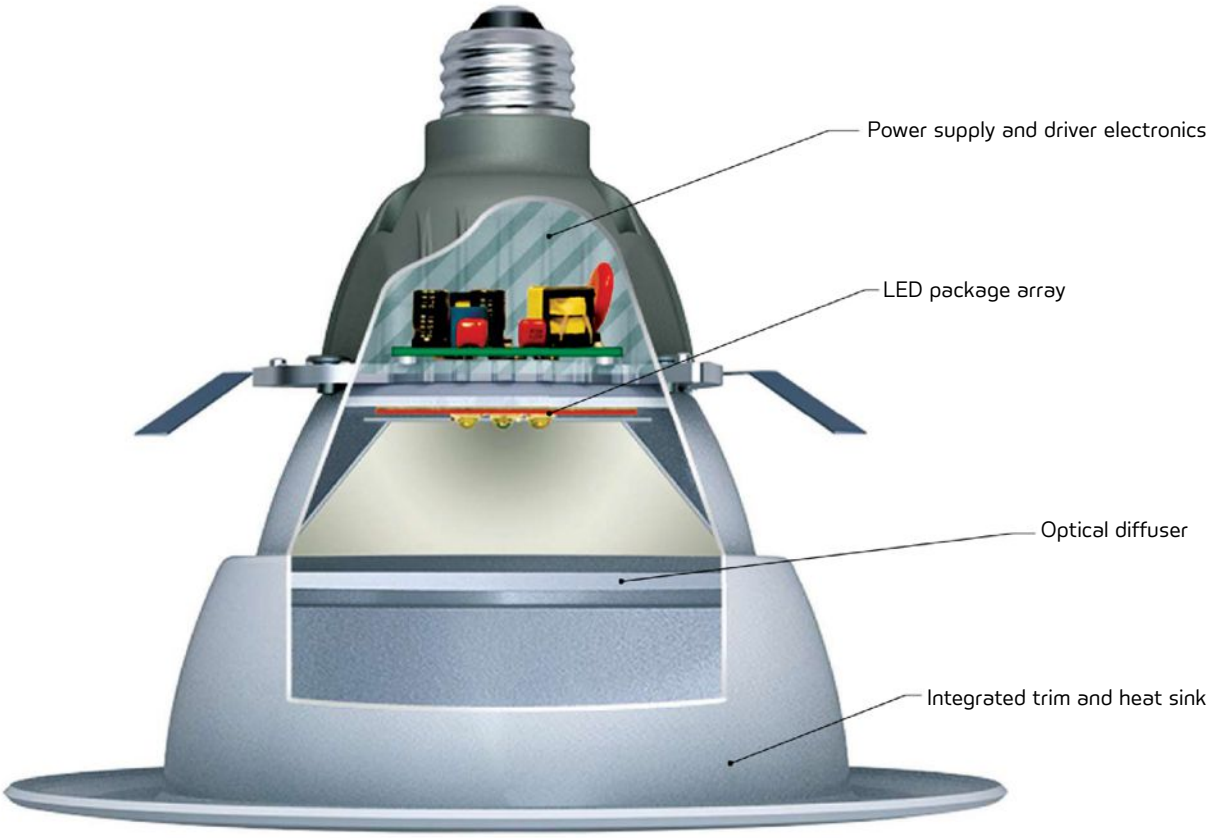
- Directionality of the generated light: directional LEDs vs. omnidirectional lamps
- Ruggedness: no glass, similar to the robust electronic components found in cellphones
- Size: Compact, low-profile light source with LEDs
- Controllability: LEDs are inherently controllable and dimmable
- Tunability: LEDs can tune color point and spectral power density
- Reduced environmental impact: no toxic mercury in LEDs and less landfill waste (due to their long lifetimes)
- Instant start: no warm-up time or re-strike delays
- No ultraviolet (UV) or infrared (IR) emission: less heating (IR) and impact art (UV)

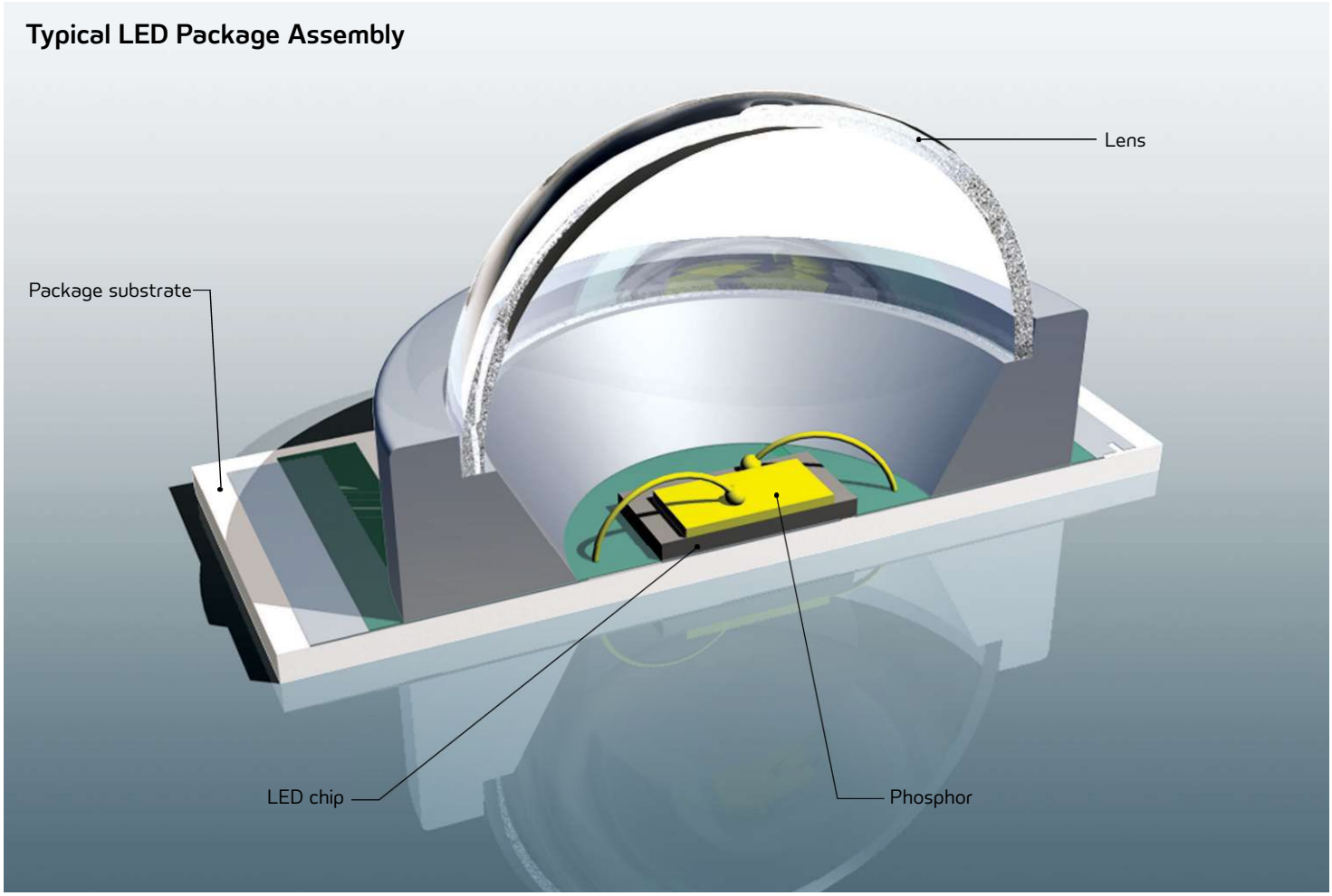
Taking advantage of the unique attributes of LEDs will allow new features and performance capabilities not available with traditional lighting. For instance, directionality is what makes LEDs advantageous in numerous applications. They can outperform traditional lamps in a recessed downlight since they focus light down to the target surface. None of the LED light is directed up into the fixture where it is wasted—as is the case with compact fluorescents.

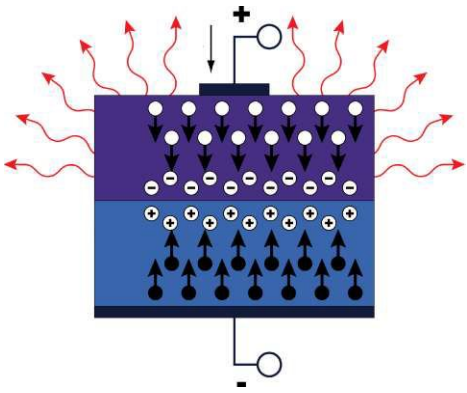
DESIGNING FOR LEDs

Designing LED fixtures requires a choice between a complete luminaire based on LEDs or an LED-based lamp for an existing

Cross Section of an LED Downlight







A diagram of how indium, gallium, and nitrogen—the typical combination of rare-earth metals used for creating white light LEDs—are deposited on a silicon carbide or sapphire wafer to create the light-generating layer of an LED.

fixture. A complete luminaire design can best harness the LED characteristics by better balancing the competing requirements of optics, mechanics, electronics, thermal management, and the light engine compared to a retrofit lamp design. Designing for an existing socket form-factor limits the heat dissipation solutions, the space available for driver circuitry, and the optical design choices. Removing these constraints provides degrees of freedom to innovate and create greater value for the end-user through better performance, longevity, and cost.

Fluorescent troffer fixtures are a good example of how focusing on a fixture instead of a replacement lamp can provide performance benefits. According to the Department of Energy's CALiPER testing program, LED replacement products do not match the performance of the benchmark 4-foot linear fluorescent lamps. (See *CALiPER Benchmark Report, January 2009: Performance of T12 and T8 Fluorescent Lamps and Troffers and LED Linear Replacement Lamps*, bit.ly/nwH4KN.) The CALiPER program did show that 2-foot by 2-foot LED recessed troffers outperformed their fluorescent benchmarks. New 2-foot by 4-foot LED troffer replacement products entering the market also outperform their fluorescent counterparts, while the available LED replacement tubes do not demonstrate the same level of performance. This example illustrates how freedom from traditional form factors can provide improved product performance and added value for the end user.

A smart system design is critical when trying to optimize performance and cost. A smart fixture design should tie in some of the necessary fixture elements, such as the trim in a recessed downlight, to improve the system performance. In the recessed downlight example, the downlight trim can use more of its surface to dissipate heat from the LEDs

while maintaining the aesthetics of the fixture. This integration of functionality into the essential fixture elements can keep costs down too.

Some of the features of LEDs also provide the opportunity to improve the function of various luminaires. The compact nature of the LEDs can provide slim, low-profile fixtures for applications such as undercabinet lighting or parking-garage lighting, that reduce the fixture size seen with traditional technology.

Some attributes of LEDs can also provide new opportunities to tailor light output in ways that would not be practical with conventional technology. In addition to the ease of controllability for smart lighting controls—such as occupancy sensing, daylight harvesting, and demand-response—the ability to tune spectral characteristics can provide new functionality. The ability to adjust the color distribution of light or the intensity of a particular part of the spectrum can have impacts in health and productivity. It can also give rise to adaptive lighting, where this tuning is used to create different lighting environments.

To access the full potential of LEDs for general illumination, the unique and superior properties of LEDs must be considered and designed into LED fixtures. LED products that fit existing lighting sockets are not able to use LEDs to their full advantage. Breaking away from these traditional form factors will help unlock the technology's full promise. •

Monica Hansen is a research scientist and contracts manager at Cree, where she concentrates on research related to general illumination applications including managing Cree's government contract research on solid-state lighting. During her 12-year tenure at Cree's Santa Barbara Technology Center, she has led an R&D team developing gallium nitride laser diodes and managed the metal organic chemical vapor deposition growth laboratory before moving into her current position. She holds a doctorate in Materials Science from the University of California, Santa Barbara, and a bachelor's in materials science and engineering from the University of Arizona.

Binning: What's All the Fuss?

LED manufacturers have to manage the variations in LED properties during mass production to provide device performance that is repeatable. Packaged LEDs are sorted based on key properties such as luminous flux and chromaticity, creating "bins" in which LEDs are sold.

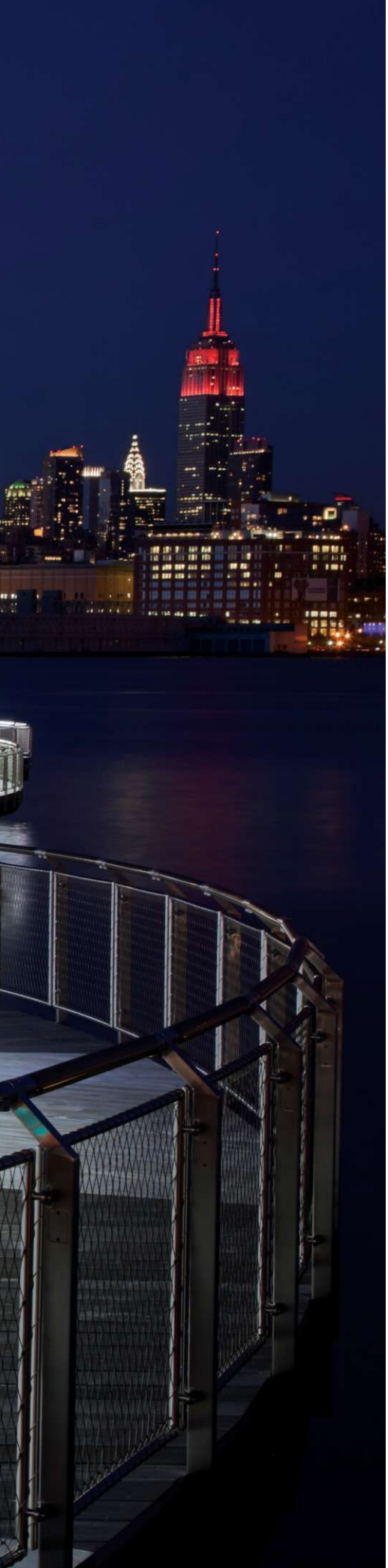
Much of the headache with binning can be eliminated at the LED package level. Manufacturers have sophisticated systems to mix and match LED chips and phosphors to produce multichip packages that result in very tight color control within a two-step MacAdam ellipse. This is comparable with that of incandescent bulbs, which is the highest bulb standard for color consistency. These types of LED packages eliminate the need for chromaticity binning, thus enabling luminaire and lamp manufacturers to deliver consistent color with ease. Some LED luminaire manufacturers choose to do this mixing and matching themselves with individual LED components, but many luminaire makers rely on the LED manufacturer's expertise in producing color-consistent LED packages for ease of luminaire manufacturing. These tightly binned LED components essentially eliminate the issue of chromaticity binning for most of the SSL value chain.

Another type of binning that has gained prominence involves the "hot/cold factor," which compares the relative light output of the LED package at a high temperature. In addition to the change in light output, the chromaticity also shifts as a function of temperature. Some manufacturers have begun to offer hot binning, where the package performance is measured at high temperature. This is an attempt to help the customer better understand what the expected performance of the package will be at the steady-state operating temperature of the luminaire. The challenge comes if the customer's LED luminaire does not run at the same temperature and operating current that the LED manufacturer uses for hot binning. The luminaire maker still needs to scale the LED package's performance for their fixture design. It is also essential that LED manufacturers publish data on how the LED light output and color point shifts with increases in temperature and drive currents. This way, a luminaire maker can determine the performance of the LED package at their given luminaire operating conditions. Many manufacturers have design tools to help customers estimate LED output at their operating conditions.

MARITIME LIGHTS

A custom LED handrail system gives Hoboken's Pier C Park a discreet light source that emphasizes the landscape's sinuous curves.

text by Aaron Seward



This page and previous page: ©David Sundberg/Esto

Hoboken, N.J., is in the midst of reforging its waterfront from a derelict landscape of moldering industrial and maritime infrastructure into verdant parkland for recreation and leisure pursuits. The latest piece of this is Pier C Park, a playground and promenade designed by New York's Michael Van Valkenburgh Associates. Situated within the rectilinear footprint of the long-vanished original Pier C, the park, supported by a new platform of concrete pylons, simulates a barrier island. Set in the Hudson River and reached by two bridges, the park's curving boardwalks capitalize on views of Manhattan while sheltering the inner reaches—a sunbathing lawn for adults and a sculptural "play land" geared toward youngsters of all ages.

At night, the playful form comes to life by the delicate tracery of a customized LED handrail system from James Carpenter Design Associates (JCDA). "In designing the handrail we were trying to create a unique look that would frame and accentuate the sinuous profile of the park itself," JCDA director and founder James Carpenter explains. "It really stands out against the formality of the esplanade along the Hoboken waterfront and the surrounding rectangular piers. We took it a step further by designing lighting into [the] handrail, developing a system that would provide the required amount of lumens on the pier to meet code, as well as wash some light down on the water."

JCDA's challenge was to design a system that would adapt to the curvy form without the budget-busting consequences of customizing each piece to match that form—and then to integrate lighting. Of course, the system also would have to be extremely robust: vandal resistant and capable of holding up under marine conditions and exposure to salt water. Carpenter reassembled a team he had worked with for the base of 7 World Trade Center—stainless steel specialists TriPyramid Structures and filtration-systems experts Johnson Screens.

For the handrail itself, the team adapted a technology from the water-filtration industry—a spiral stainless steel wire tube with an automated manufacturing process and a high degree of precision—making it both affordable and pleasant to hold in the palm of one's hand. The hollow tube also allows for the easy integration of the LED system, a 4W-per-foot linear fixture from i2Systems, an LED technology company that specializes in a number of areas including marine applications. Each fixture contains one long run of 10 white LEDs wired in two series of five. The LEDs are encased between a black anodized aluminum housing and a clear acrylic optic bonded together with a UV-cured adhesive.

"Their longevity made LEDs the obvious choice for the project," Carpenter says. "They also give a finer texture with little sources of light that you read through the handrail. In addition, the diameter of the handrail is too small to accommodate fluorescent tubes. Plus, fluorescent would be too omnidirectional, radiating up in the eye, or sky, or out in the river. We would have had to mask all that and then we wouldn't be getting the total benefit of energy we're using. LEDs you can focus."

The LED fixtures slide in and out of the handrails as a complete piece for easy replacement. Each tube is capped at the ends with custom stainless steel pivot castings, allowing the straight sections of rail to link together and follow the curves of the pier. The pivot castings connect to stainless steel stanchions spaced every $4\frac{1}{2}$ feet and which stand 42 inches tall. The fixtures' wiring runs down the stanchions to connect to driver boxes beneath the deck. The stanchions also support a balustrade of fine cable-net mesh stretched on stainless steel frames, which provide security with a minimum of visual impairment. The mesh also captures and reflects the dappled light bouncing off of the water's surface. During the day, light is provided by the sun. At night, the LEDs take over.

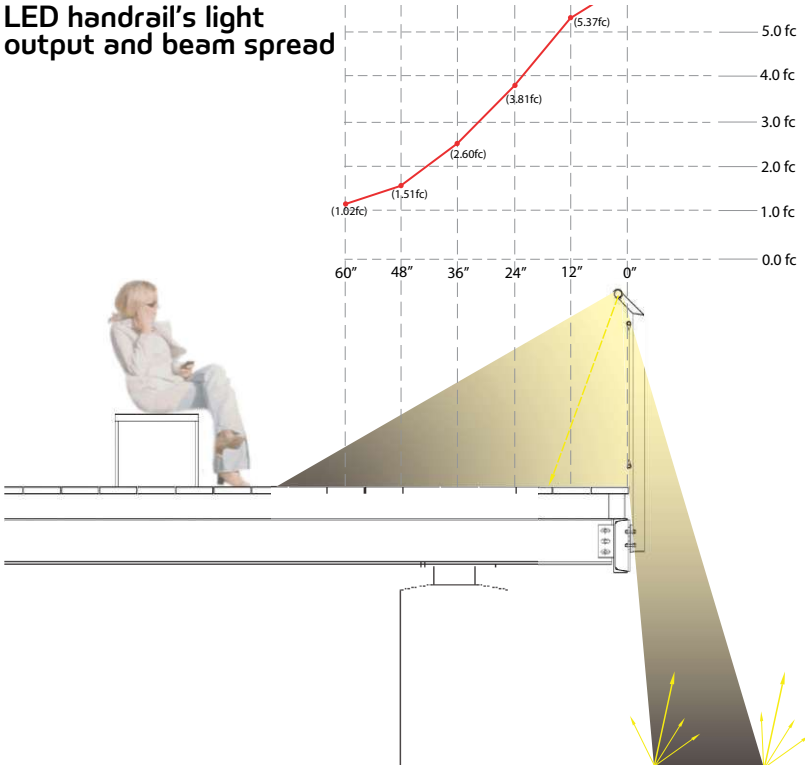
"We played around a lot with the spread of the lens and settled on a 65-degree beam angle with a wide lateral throw," Carpenter says. "That gave us a good coverage of the deck, concentrating along the edge of the walkway, and casting some light down into the water where it rebounds onto the balustrade."

In addition to being cost-effective—all of the handrail components, including the LED light strips, cost $1.4 million—and responding to the park's curvilinear site, the system has an added wayfinding benefit: It casts all of its light downward, near visitors' feet, so they can see where they are walking. This also keeps glare out of people's eyes, leaving the view across the Hudson to the twinkling skyline of Manhattan virtually unobstructed. •

The park overlooks the Hudson River with a view of the Manhattan skyline. Residents walk a series of footpaths that take shape as a series of meandering piers. At night, these are illuminated by a custom-designed LED handrail system that provides the proper amount of light—4W per linear foot—and can withstand the outdoor conditions.

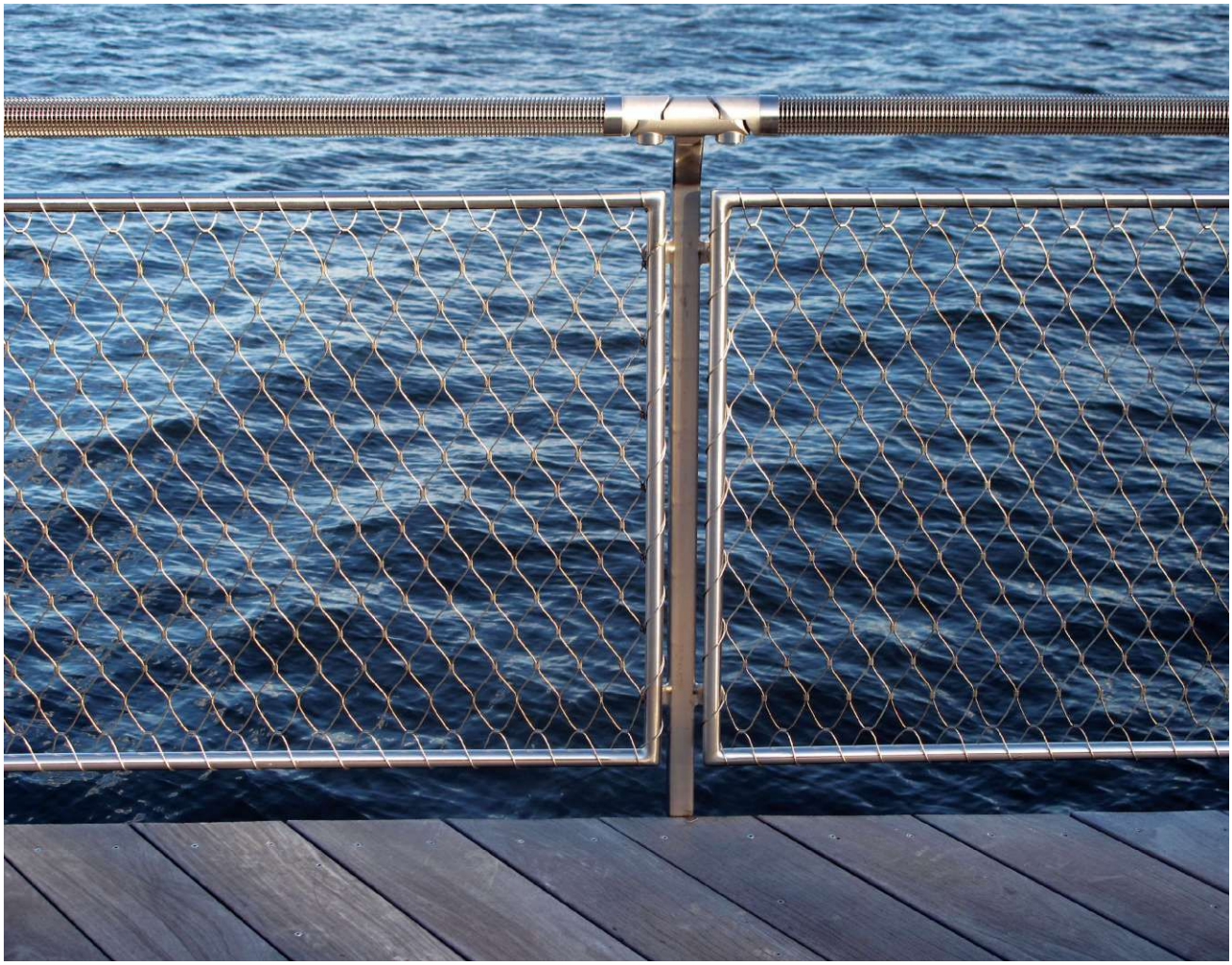
Designed by James Carpenter Design Associates, the LED handrail achieves optimum performance, providing even illumination that does not interfere with a viewer's sight lines. To do this, the LED strips have a beam spread of 65 degrees and are positioned 20 degrees off the vertical within the aluminum extrusion (top right). A cable mesh is used for the balustrade's infill panels so that the handrail system does not obstruct the city and water views (bottom right). During the day, the handrail still retains a striking profile as it defines the edges of the pier pathways (this image).

LED handrail's light output and beam spread



Details

Project: LED Handrail System at Pier C Park, Hoboken, N.J.
Client: City of Hoboken, N.J.
Architect (LED handrail system): James Carpenter Design Associates, New York
Landscape Architect (Pier C Park): Michael Van Valkenburgh Associates, Brooklyn, N.Y.
Project Cost: $1.4 million
Project Size (handrail length): 1,800 linear feet
Code Compliance: All fixtures are ROHS (restriction of hazardous substances) compliant (including lead and mercury free).
Watts per Square Foot: 4W per linear foot
Manufacturers: i2Systems (modified S-Line series LED luminaire with 150W E02 stainless steel power boxes); Johnson Screens (handrail welded spiral-screen tube and mesh infill); TriPyramid Structures (handrail parts fabricator)



Photos: ©Richard Kress, JCDA; Illustration: ©JCDA

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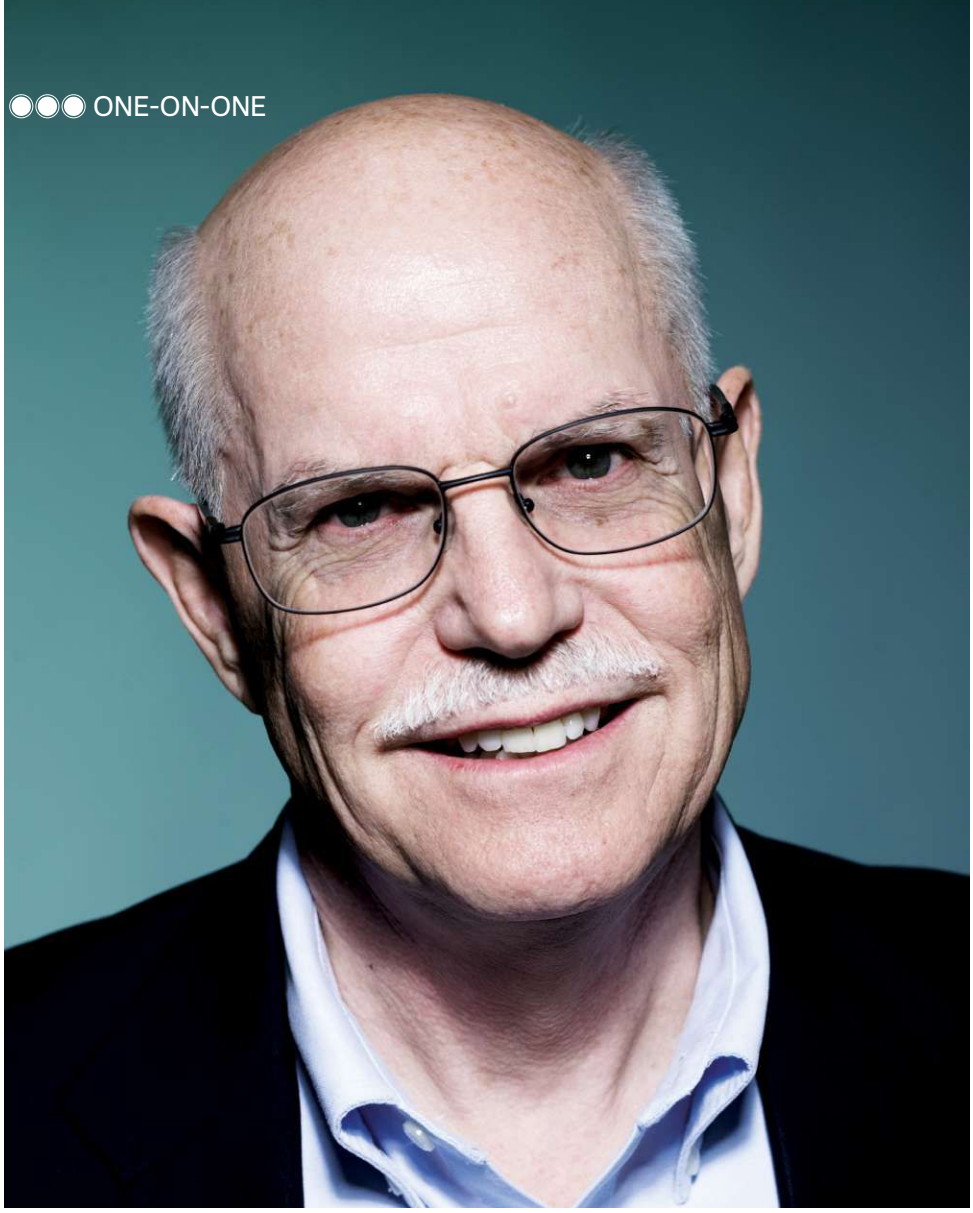

Terry Clark

interview by Elizabeth Donoff
portrait by Jeff Singer

"Manufacturers have a responsibility to avoid some of the lessons we learned a long time ago. There are glare bombs being built and offered today—that's just shocking. I don't understand the dynamics of an LED company to make that kind of choice. We are shooting ourselves in the foot, returning to painfully bright luminaires. That's where a savvy design community has to step in, reject them and say that's not acceptable."

With business degree in hand, Terry Clark was on his way to a career in the high-tech industry, but then a management recruiter approached him and asked him to take a look at the lighting industry. That was 20 years ago, and the rest, as they say, is history. In that time Clark has built a company—Finelite—and put his stamp on solving glare in the workplace. Creating affordably priced, quality luminaires that provide glare-free illumination has been the company's central mission. In the constant strive to build a better luminaire, Clark sees every potential obstacle as an opportunity for new knowledge and growth. "Lighting," he says, is "a wonderful place to be right now."

What do you find fascinating about lighting?
In one word: collaboration. Lighting is a tremendously people-oriented business.

What makes a great luminaire?
When you are able to understand the users' needs and provide a luminaire that can deliver.

How has business changed the past 20 years?
Like all businesses, we've had a tremendous compression with respect to the time we have to make intelligent responses to the market's needs. We have to do more with less, and we've got to do it faster.

Where is the business of lighting heading?
Lighting is an extremely segmented and fractionalized industry. The thrust of solid-state lighting, of more intelligent sensors and controls, is actually accelerating the segmentation. This is a golden age for division managers and entrepreneurs to identify a segment and do it extremely well.

What do you find exciting about the current integration of LEDs into lighting?
The type of LEDs Finelite has chosen for our application is the mid-power LED that is the workhorse of the TV and display industry. The TV industry isn't meeting its sales projections. That means there are millions of mid-power LEDs that have to be sold. As a result, we have seen price drops that I did not expect to see until late 2012, early 2013. The upside for us is that it lets us bring out state-of-the-art products more quickly.

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NATURAL WONDER

Massachusetts-based design firm Nervous System combines algorithms and aesthetics for a new line of custom light fixtures.

text by Elizabeth Evitts Dickinson

Nature's organic patterns are amplified via shadow and light in Nervous System's design of the Hyphae lamp.

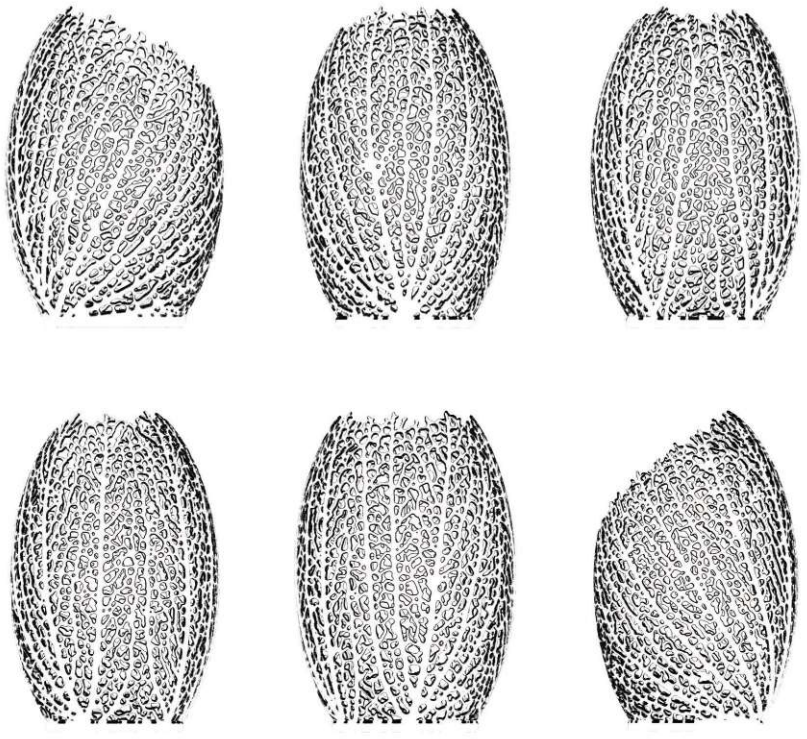
Nature is a frequent muse for designers, with the organic world informing all manner of form, pattern, and color. Massachusetts-based Nervous System takes that inspiration to the next level with designs that digitally replicate the cellular composition of plant and animal life. Since founding the company in 2007, designers Jessica Rosenkrantz and Jesse Louis-Rosenberg have developed complex computer algorithms that mimic the growth process of natural organisms, from algae and amoeboid protozoa to coral and dendrites. They then capture the resultant forms in surprising materials—such as felt and rubber—using high-tech fabrication techniques to create an elegant and affordable custom jewelry line. Now the designers are focusing their combination of computational science and high style on lighting.

In July, Rosenkrantz and Louis-Rosenberg released Hyphae, a line of one-of-a-kind lamps designed to look like the intricate vein structure of leaves. ("Hyphae" refers to the branchlike vegetative growth of fungus, which also resembles the delicate pattern visible in a leaf.) Fabricated out of white nylon, the 5.3-inch-by-8-inch lamps have a sculptural feel and are reminiscent of the fragile remains of a deteriorating autumn leaf. The impression when lit is sublime, creating interplay of light and shadow that looks like moonlight through a forest. "Lighting is always fun to play with because you get the effects of the form that we designed and the light casting shadows. It allows something to be small and have a large effect," Rosenkrantz says.

The designers wanted dramatic shadows from the branching pattern so they chose to use three LEDs rather than just one lamp (with the added bonus that the LEDs use a combined total of 3.6W of power and have an estimated life of nearly six years of continuous use). The base of the lamp is a laser-cut acrylic plate with three nonslip rubber feet and, because each is unique, an inscription of the lamp's production number.

The inspiration for Hyphae came several years ago when Louis-Rosenberg read a paper

Drawing illustration of Hyphae lamp variations



The form and pattern of the Hyphae lamp mimics the internal veining structure of a leaf as it combines the architectural and mathematical interests of its designers—Jessica Rosenkrantz and Jesse Louis-Rosenberg. Using a custom-calibrated algorithm, they re-create a natural phenomenon and create truly one-of-a-kind fixture designs.

titled "The Role of Elastic Stresses on Leaf Venation Morphogenesis" in the journal *PLoS Computational Biology*. Louis-Rosenberg is a math whiz who met Rosenkrantz in 2004 at the Massachusetts Institute of Technology where they were both undergraduates. She was studying biology and architecture and the two started dating. "We lived in the same dorm, which is how we met. He wasn't that interested in design in the beginning," Rosenkrantz says.

The *PLoS* article outlined a theory of how leaves form their veins, and this prompted a search for existing computer algorithms to test that theory. Louis-Rosenberg and Rosenkrantz discovered the work of Adam Runions of the Algorithmic Botany group at the University of Calgary. Runions had developed a simulation that mapped the way leaves develop their internal structure. "It was an elegant model," Louis-Rosenberg says.

But it needed work in order to turn it into a 3D design object such as a lamp. For one thing, Runions's algorithm was slow. Most simulations take days of computer crunching to produce a final result. Rosenkrantz and Louis-Rosenberg needed the algorithm to spit out final forms in a matter of hours, so they adapted the original model. "We played a lot with the structure inherent in the algorithm and we added some parameters that would optimize it," Louis-Rosenberg says.

With the program streamlined, it now takes just 10 to 20 minutes to "grow" a custom Hyphae lamp. Each fixture is unique, since the algorithm produces a different result each time, as in nature. The computer runs the algorithm and the veins develop to form a singular three-dimensional shape. The computer file is then sent to Shapeways, a fabrication company in New York that uses selective laser sintering to 3D print the lamp, a process normally reserved for prototypes.

Hyphae is their first foray into the creation of a 3D object, and it requires special consideration when speccing a material. "You are limited with the materials you can use with 3D printing," Rosenkrantz says. They choose nylon because it is inexpensive yet durable for a consumer product and it stays cool when exposed to the heat of a lamp. "We're really interested in having affordable designs that are all one of a kind and individually designed," Louis-Rosenberg says.

Denise Sprengelmeyer is the owner of Modern in Portland, Ore., a store specializing in contemporary designs. She started selling Nervous System jewelry last summer and plans to carry Hyphae. She says the design process wows her patrons: "From planting a computer 'seed' and creating vein formations, then producing the pieces via a 3D printer—it is quite impressive."

Nervous System is now expanding with a line of housewares and a second line of lighting set to be released this fall. Could furniture be next? "We are moving more in that direction," Rosenkrantz says. •

This page and previous page: Courtesy Nervous System

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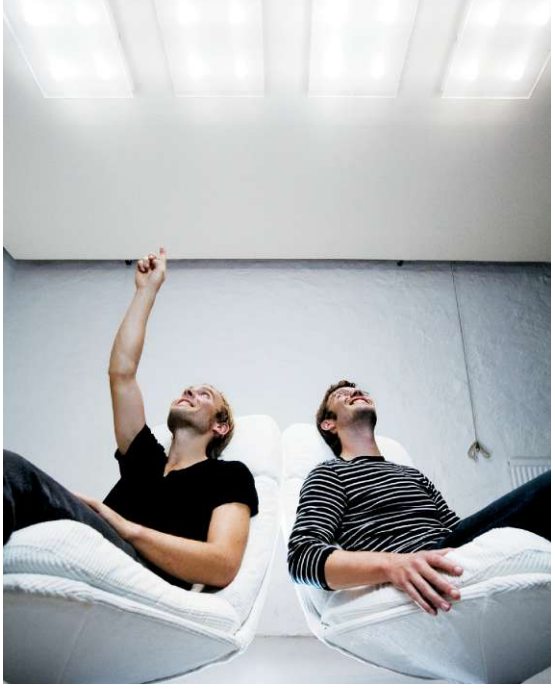
HERE COMES THE SUN

New products that capture the sun's lighting potential.

text by Elizabeth Donoff

Pharox Solar Kit, Lemnis Lighting • This solar-powered LED lighting kit has a spherical lamp, a detachable solar panel that attaches to the lamp with a 10-foot-long cable, and a built-in USB connection to charge mobile devices. The battery can be charged in eight hours of full sunlight. The highest light level illuminates an area of 100 square feet, and can deliver nine hours of light. At the two lower levels, it can deliver up to 45 hours of light. *lemnis-us.com* • Circle 125

Sunlight Delivery System, 3M • This new daylighting solution is designed for commercial building applications. It uses a GPS-equipped rooftop collector with a single roof penetration to actively track the sun's path. Horizontal and vertical ducts lined with 3M reflective film transports the light into a building's interior, where it is then delivered to specific locations via multiple fixtures. The reflective film, which has a reflectivity greater than 98 percent, allows the system to carry sunlight longer distances with less light loss. A lighting-control component provides consistent light levels in dark or overcast conditions. *3marchitecturalmarkets.com* • Circle 126



SP3, Parans • This third-generation light system consists of a receiver, a group of cables available in four different lengths (16-, 32-, 49-, and 65-feet), and six luminaires. The heart of the system is the receiver, which can follow the sun for a full 360 degrees. One receiver can provide natural light for a 430-square-foot space. Installation only requires that you know where south is in regards to the building location. *parans.com* • Circle 127

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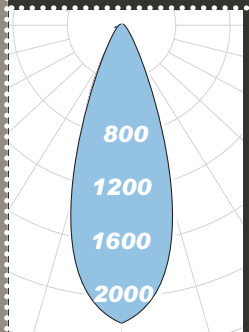

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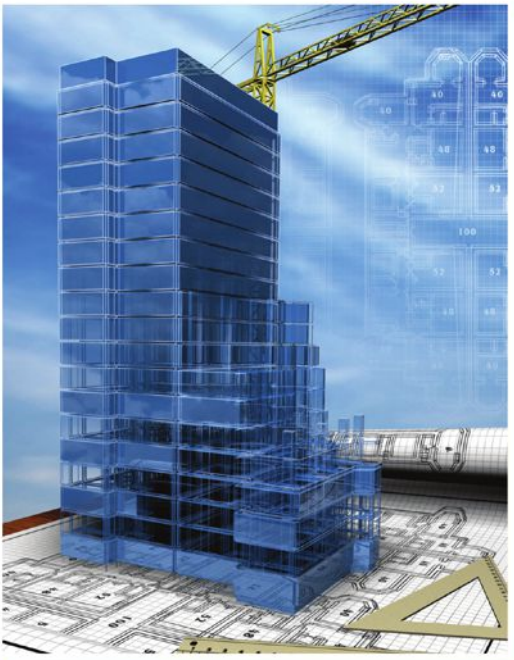

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DESIGNING IN THE DARK

text by Mark Major

Darkness may best be defined as the absence of visible light. This alone suggests the manner in which light, and its counterpart, always coexist. We cannot think of one without the other, and understanding the relationship between the two is the key to lighting design. As designers, we not only think in terms of the quality and quantity of light we employ, but also the degree of contrast and depth of shadow we create. We can decide to retain darkness rather than simply add light.

It is very difficult to experience absolute darkness in the natural world. There is always some presence of light, however minimal, whether it is the light from stars long extinguished, the soft ambient glow of reflected sunlight from the moon, or the omnipresence of man's impact on the planet. It is only when we deliberately create total darkness that we can fully experience the condition. But to what end? As artist James Turrell has observed, we even dream in light. Unlike many other creatures, we are not well adapted to total darkness. We are a diurnal, not a nocturnal, species. We have evolved to see *in* light.

If it is difficult to experience total darkness in the natural world, then it is almost impossible to escape the presence of visible light in our built environment. We live in a society that seeks to use light at every opportunity. Whether this is to help extend the day, provide safety and security, or simply enhance our lives, we employ bountiful amounts of light. Turning the lights off has become a far more conscious act than turning them on.

To that end, when we talk about darkness we are rarely referring to a total condition rather than the degree to which light is present. This leads us into the world of shadow and shade that is so familiar to artists. When learning to sketch, we are taught to prescribe a circle with a line. It only becomes a sphere when we add shade. It only exists as an object in space when it casts a shadow. The relationship between light and built form is entirely composed in this manner. Indeed, many of our references to darkness are through art, whether it is the chiaroscuro of the painter, the dramatic contrast of the theater designer, or the atmospheric design of the film director.

But there is another side to darkness. Like light, it has both a poetic and symbolic role in our society. Light and dark have significant meaning to many people in all traditions—whether it is the good versus evil of Western religion or the yin and yang of Eastern philosophy.

So like light, darkness is not just about quantity but also perception. It is about the psychological as well as the physiological, about illusion as well as reality. Darkness is not just the negative. It has its own presence and purpose. It can conceal and contain, create privacy and silence. And thus in darkness, like light, we find not just purpose, but a certain quiet beauty. •

Mark Major is an architect and designer who works with light. He is a director of the award-winning, British design practice Speirs + Major.

text by Elizabeth Donoff
photos courtesy Toby Cumberbatch

SOCIALITE

A Cooper Union engineering class creates a sustainably designed solar lantern for African communities in a remote outpost of northern Ghana.

It started with one class assignment. In 2006, Toby Cumberbatch, professor of electrical engineering at the Albert Nerken School of Engineering at the Cooper Union for the Advancement of Science and Art in New York was looking for a way in which he could introduce systems thinking, sustainability, and materials engineering to his first-year class. He wanted the students to think about engineering and design "in a broad spectrum" where they could "learn about things in parallel." Familiar with solid-state lighting and LEDs, he thought some kind of lighting device might be just the type of project in which the students' skills and creative problem solving could be put to the test, and so he tasked them with developing a lighting system for the poorest people on the planet. The light would need to be multifunctional, be able to be used for two days without a recharge, cost less than $10, and be recognized as a must-have object by the people who would purchase it.

According to Cumberbatch, the first prototypes were crude, made of bamboo and soda bottles. But the students were on to something, and the following semester, several members of the class asked if they could continue working with Cumberbatch in an independent-study capacity. With support from a National Science Foundation grant, the students continued working on the prototype. Then, in the summer of 2007, they traveled to Nambeg in northern Ghana, one of the most remote parts of Africa, to see how their solar lighting system would be received. (Cumberbatch's ties to Africa and Ghana go way back; it's where he grew up.)

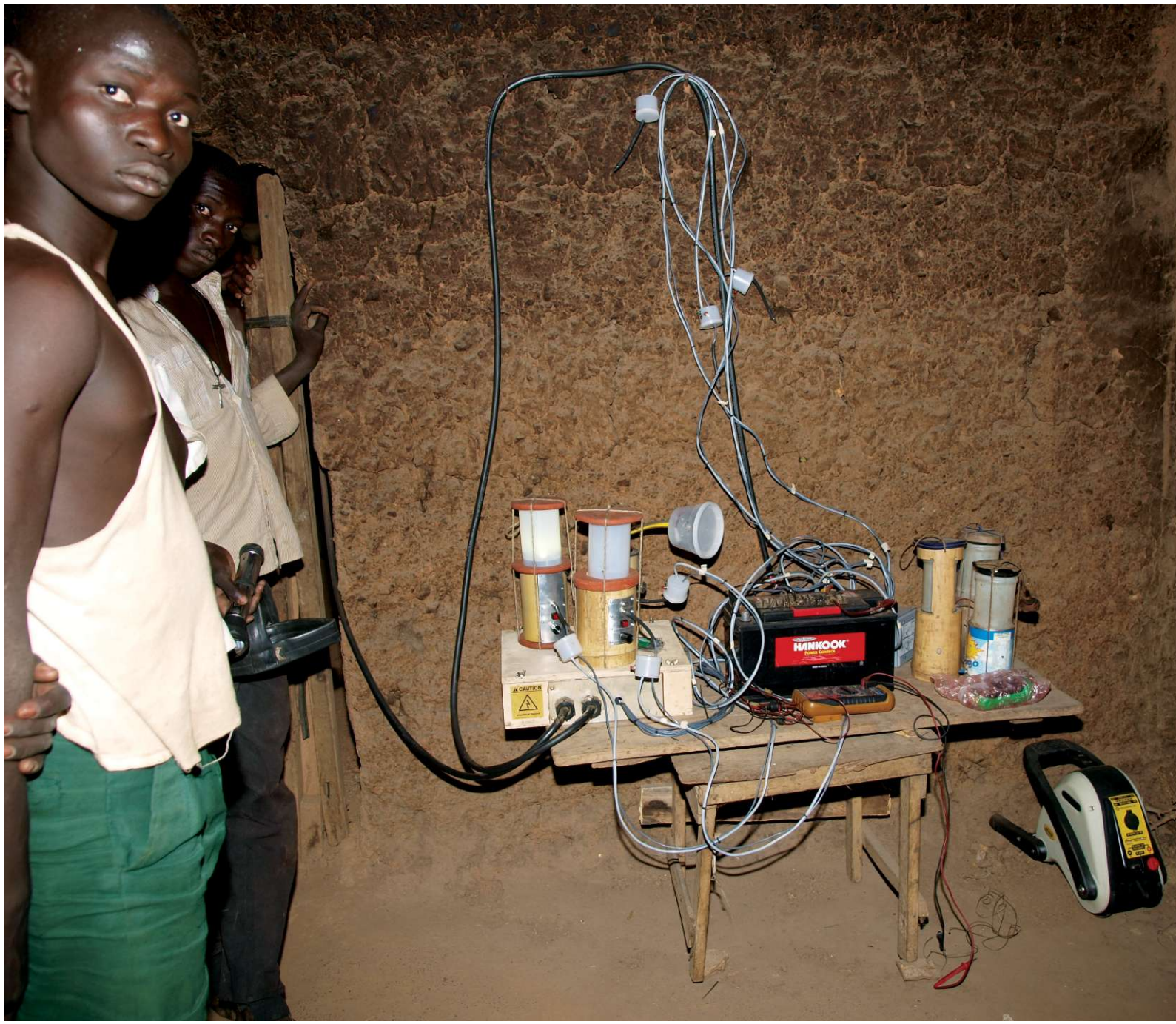
Since then, the project has become about more than just light. Cumberbatch, along with four students—David Berger, Michael Gazes, Anurag Panda, and Gaurav Namit—have continued to travel to Ghana and work with the local communities that they first met in 2007. The result of this travel and work is SociaLite, the third generation of their self-assembled lighting system and rechargeable solar LED lantern. Besides the obvious social impact of bringing light to this remote region, SociaLite is a mechanism for learning and entrepreneurship, and it is teaching its creators just as much as have the people for which it was intended. •


Socia

The SociaLite solar lighting system, composed of LED lanterns made from recycled, locally available materials and a charging station, has been developed with the social, political, and economic structure of African villages in mind. Key to developing this project was the premise that there would be a cost associated with the lantern. Otherwise, as Cumberbatch notes, "If you give something away for free, it has no value." Each village voted on whether or not they wanted to collaborate with the Cooper Union team before they signed on. This collaboration meant testing early prototypes and providing feedback (below). The students then continued to refine the prototype. The challenges were many: How could they design the system to be accessible, durable, sustainable, and maintainable once they left? Simplifying the circuit board was one way, so that there wasn't a steep learning curve for villagers to learn how to assemble the components (left).

1,500

MILLION PEOPLE DO NOT HAVE ACCESS TO A CLEAN, AFFORDABLE SOURCE OF LIGHT



500

THE NUMBER OF VILLAGES PARTICIPATING IN THE SOCIALITE LIGHTING PROGRAM

The success of SociaLite has been substantial, especially considering that the working model that Cumberbatch and his team developed was independent of involvement from nongovernmental organizations (NGOs). Villagers take great pride in their participation in the project and the testing of the prototypes (top left), despite the somewhat rudimentary conditions (top right). In fact, the lighting system has fostered an entrepreneurial spirit among villagers, and selling the lanterns is given a prominent place in the center of the village (above). To date, 400 lanterns gave been sold and another 800 have been ordered. It is designed with LEDs and charging circuitry, and an AVR microprocessor with a battery life of four years. At full power, SociaLite stays illuminated for 40 hours; at low power, it has a 200-hour life. Even those who earn less than 25 cents per day are able to purchase a lantern and have access to portable light that was once previously unavailable.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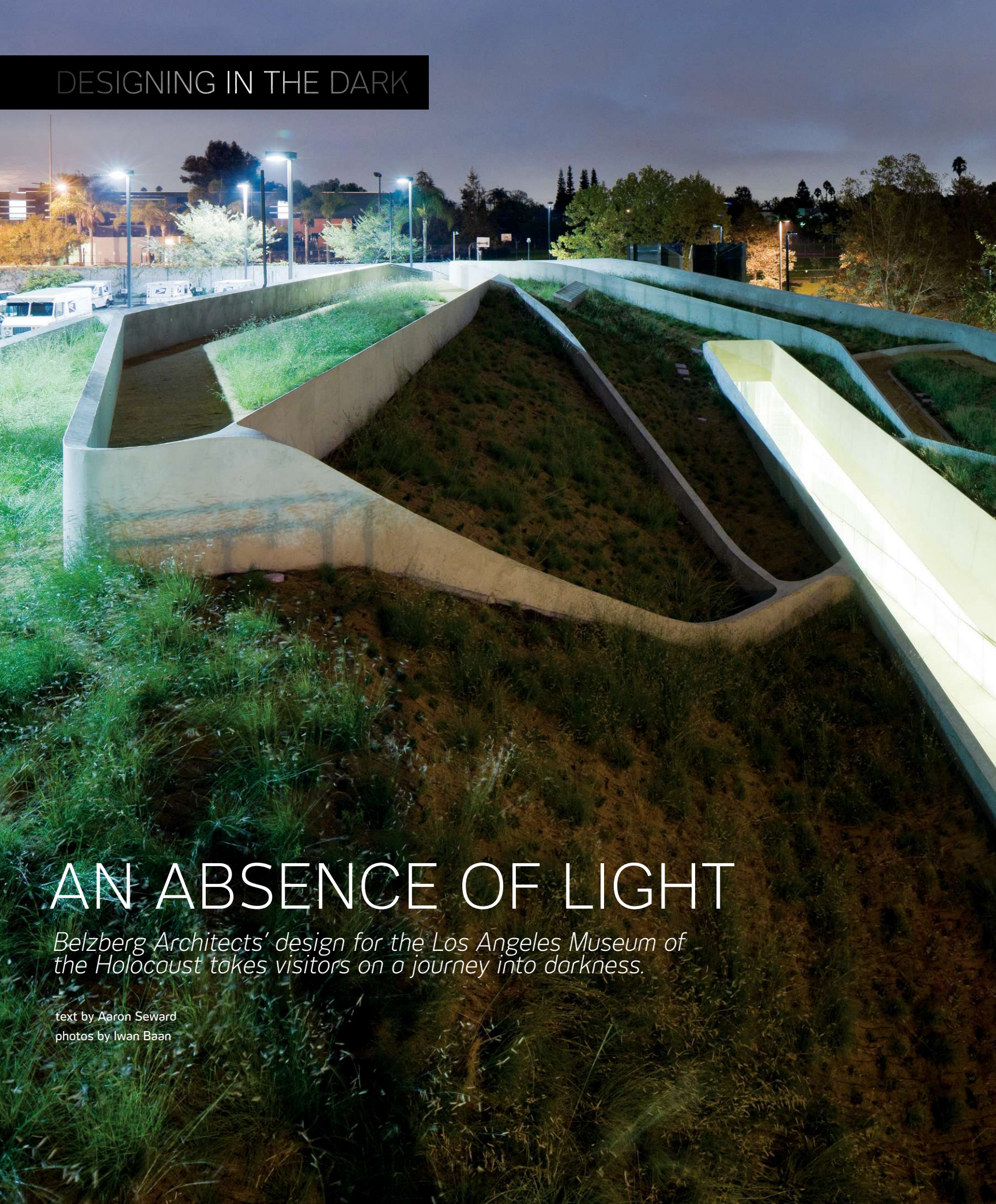


AN ABSENCE OF LIGHT

Belzberg Architects' design for the Los Angeles Museum of the Holocaust takes visitors on a journey into darkness.

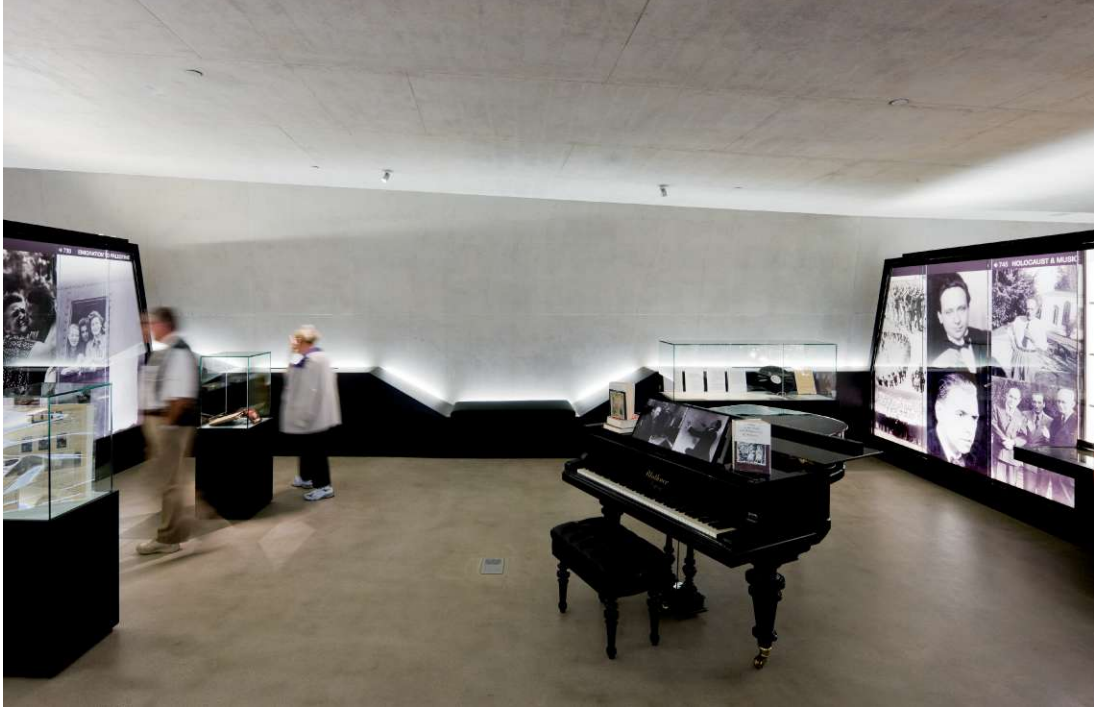
text by Aaron Seward
photos by Iwan Baan

Visitors descend into the museum along a sloped ramp and are confronted with a somber architectural interior (right). The museum displays are designed to provide a sensory experience so that museum visitors can form a personal connection with the images and artifacts they are viewing (this page).

The Los Angeles Museum of the Holocaust (LAMH) is the oldest Holocaust institution in the United States. It was founded in 1961 by a group of survivors with the express mission of spreading awareness about the unthinkable horrors perpetrated upon them and millions of other Jews, Gypsies, and other assorted "undesirables" by the Third Reich. Until very recently, the museum—which does not charge for admission—exhibited its artifacts and interpretive displays in rented spaces while it gathered the funding to build a permanent home. The stars aligned for LAMH seven years ago when the city of Los Angeles granted it a lease in Hollywood's Pan Pacific Park on a plot of land adjacent to an existing Holocaust memorial. With the money and real estate in hand, the museum hired Hagy Belzberg of Belzberg Architects to design it a fitting space. (The museum officially opened in October 2010.)

Belzberg took a metaphorical as well as urbanistic approach to finding an appropriate architectural language to tell this blackest tale of modern history. "The client wanted a monumental building," Belzberg explains, "but our concept was to go underground, to design a semisubmerged nonbuilding. That allowed us to not only maintain the beautiful open space of the park by having a green roof atop the museum, but also to control natural light and create a layered experience in which visitors literally delve into darkness as they travel through the exhibition."

The design concept and its realization makes a powerful impression upon visitors who arrive at the street level main entrance where they are able to see over LAMH to Pan Pacific Park, an idyllic scene where families lounge and children play. From the entrance, visitors walk down a steadily graded ramp, flanked by clerestory windows that leak small amounts of daylight to the exhibition spaces below. As museum guests descend, the recreational sounds of the park slowly dissipate until they arrive in the hushed and submerged lobby and begin to learn about the horrific acts that humans have committed against one another. This dichotomy—between the peaceful pursuit of leisure and the ghastly



Details

Project: Los Angeles Museum of the Holocaust, Los Angeles
Client: Los Angeles Museum of the Holocaust, Los Angeles
Architect: Belzberg Architects, Los Angeles
Structural Consultant: William Koh & Associates, Tarzana, Calif.
Mechanical Consultant: John Dorius & Associates, Calabasas, Calif.
Plumbing Consultant: Tom Nasrollahi & Associates, West Hills, Calif.
Soils Engineer: Irvine Geotechnical, Pasadena, Calif.
Methane Engineer: Carlin Environmental, Tustin, Calif.
General Contractor: Winters-Schram, Los Angeles
Technology Consultant: Potion Design, New York
Millwork Specialists: Spectrum Oak Products, Orange, Calif., and Swiss Woodworking, Gardena, Calif.
Project Cost: $450 per square foot (including displays)
Lighting Cost: Not available
Project Size: 27,000 square feet
Code Compliance: Meets California Title 24 requirements and has received LEED Gold certification from the USGBC
Manufacturers/Applications:
Antares (linear T5 cove lighting with integral ballast for museum interiors); **Hunza Lighting** (inground 35W metal halide fixtures at building exterior, 20W adjustable inground metal halide fixtures at the exterior perimeter, and 5W LED wall-recessed step lights at the exterior); **Janmar** (8W LED monopoints, custom 20W metal halide pendants, and recessed compact fluorescent fixtures with a patented PAR30 optic for museum interiors); **Light Integration** (custom LED grazers at ramp, displays, and shelves)

apparition of Nazi brutality—is the first lesson in the history of the Holocaust. "The whole idea of formal contradiction was our metaphorical compass," Belzberg says.

Architecturally, the connection to the park is not lost once visitors enter the museum. The concrete arches and columns that support the subterranean building's spaces echo the plan of the park's pavers. Here again, Belzberg imbued the structure with the same dualism established by the juxtaposition of the park and the museum. While the concrete materiality expresses robustness and structural safety, the columns themselves are twisted in form, introducing an element of unease. This offsetting of expectations is continued by the lit display cases, which are painted black. Refined, geometrical, and constructed from medium-density fiberboard, they contrast the organic, curving forms of the superstructure.

Perhaps the most powerful architectural metaphor, however, is delivered by a combination of the sequencing of the exhibition spaces along with the slope of the ceiling and the gradation of the lighting. The museum's plan is roughly U-shaped. Visitors travel this U on a chronological voyage through history. It begins with a telling of Jewish life in Europe before World War II, continues with the rise of Nazism, then goes into the ghettoization and deportation of Jews before arriving at the concentration, labor, and death camps. Throughout this passage the ceiling drops steadily from 20 feet tall to 8 feet tall. The feeling of compression and claustrophobia is reinforced by the lighting, which grows dimmer as the clerestory windows and skylights taper off, until at the bend of the U there is no daylight at all.

The electric lighting scheme echoes the daylight effect. Belzberg, whose office oversaw the lighting design for the project in consultation with area lighting agency representatives Light Group L.A., positioned custom LED grazers outfitted with 3W LEDs at the daylight apertures to deliver a consistent and non-varying level of light throughout the course of the day. "Photometrically we didn't want two sources," he says. "We wanted the lighting to behave the same whether artificial or natural so that they work together and as day turns to night the subtleties are not experienced." In addition to the grazers, 8W LED monopoint spotlights on the ceiling highlight the displays. The beam spread on these fixtures varies throughout the chronology, going from wide and diffuse to narrowly focused so that when you arrive at the bend of the U the light is zeroed in on the display cases. The displays themselves add to the lighting mix throughout the museum. The graphics are all backlit with custom LED grazers that use angled plastic snoots to provide an even wash of light and prevent hot spots. The mechanically ventilated cases are lit with tiny 1W LED spots.

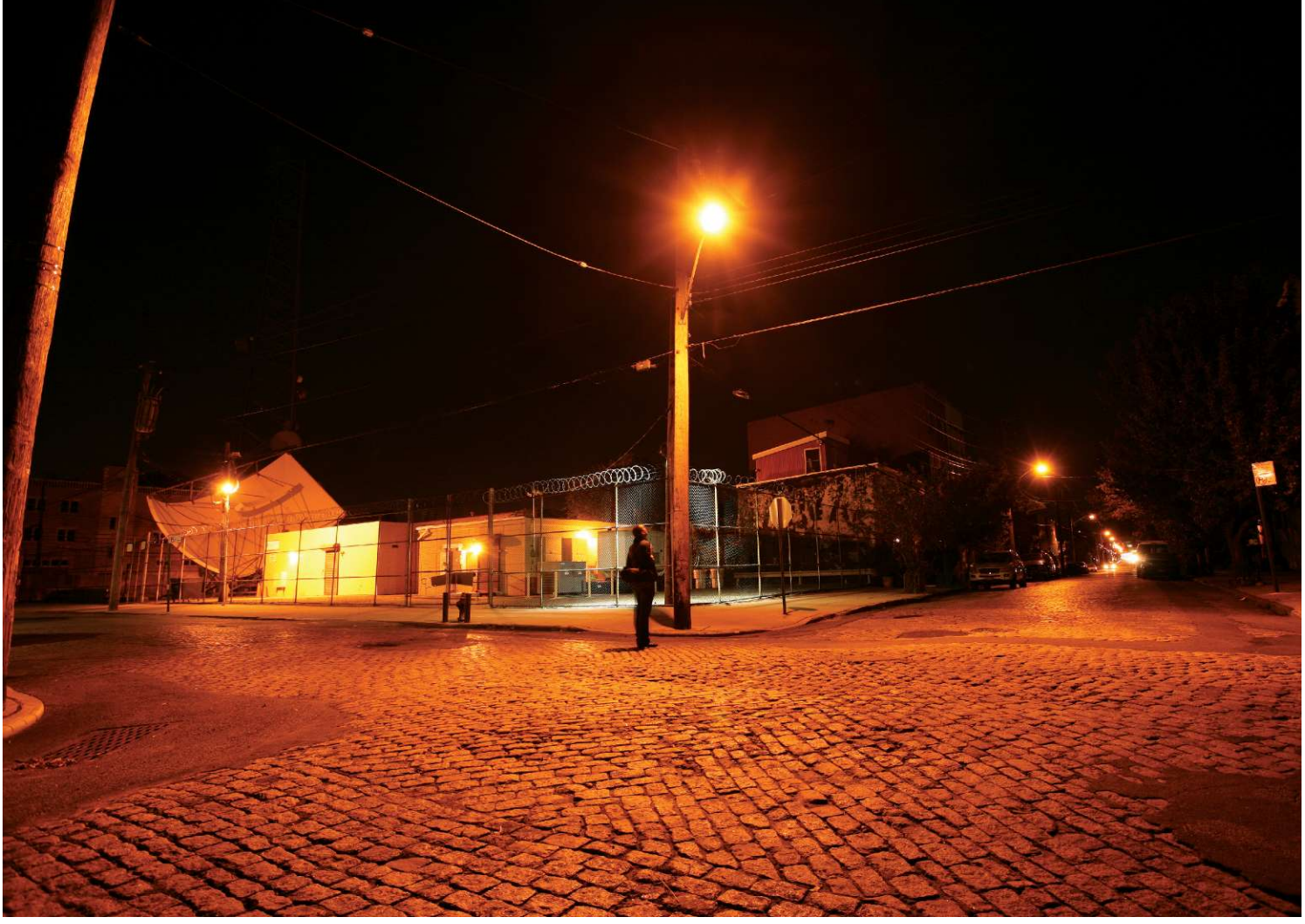
This journey into darkness, of course, ends with a passage back into light. After rounding the bend of the U, visitors travel through exhibitions detailing the international response to the Holocaust, and the resistance, rescue, and life of Holocaust survivors after liberation. Along this path the ceiling rises again and the light level increases. The museum's final note is a survivor presentation room, where visitors have the chance to meet a survivor and hear their story—a living testament to human perseverance—before returning to the sights and sounds of the park above and everyday life. •

In the second gallery, the "Rise of Nazism," (facing page, far left) the ambient light levels begin to step down as do the floors and the ceiling height. The compression of architecture and light continues through the next several galleries, which discuss some of the Holocaust's darkest moments—deportation, extermination, and the concentration camps—until the light levels and ceiling heights begin to rise in the galleries devoted to resistance and rescue and "Life After Liberation" (facing page, left). Hard surfaces, complex geometries, and calculated light levels create a distinctive and immersing museum environment (this page).

text by Elizabeth Donoff
photo by Ian Allen

THE CITY DARK

*Filmmaker **Ian Cheney** explores contemporary society's relationship to the night sky.*

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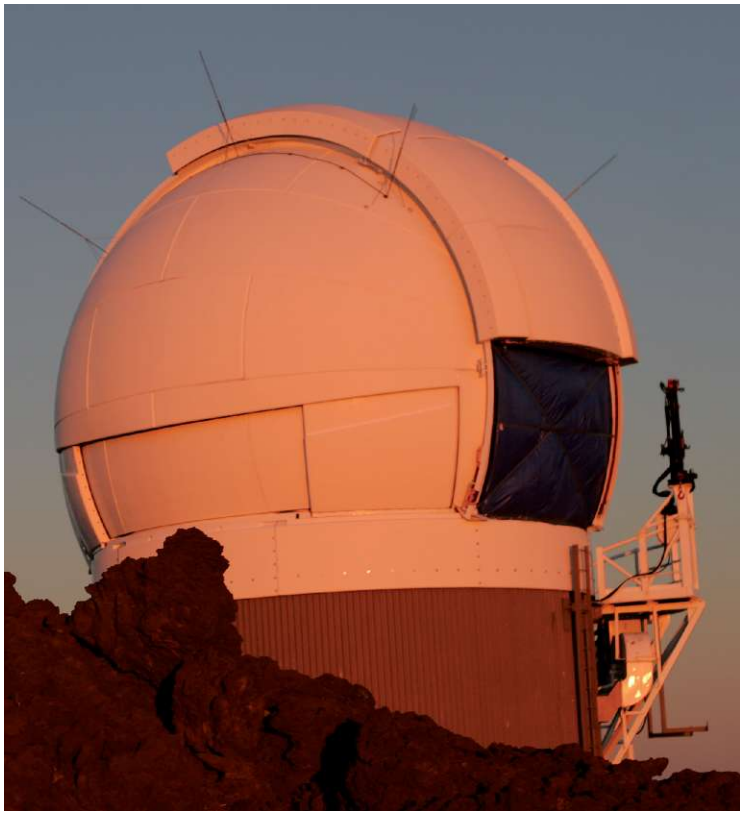

What do we lose when we lose the night? This central question begins the film *The City Dark* (thecitydark.com), filmmaker Ian Cheney's quest to find the night sky and understand the complex relationship between light and dark. The film is Cheney's personal journey, a three-year-long project prompted by his memory of the starry Maine nights of his childhood.

"Why couldn't I experience the same thing in New York City?" he asks when I meet him in Washington, D.C., for the film's August screening at the Environmental Film Festival. "I was acutely missing something, but I couldn't exactly say what it was. How do you give value to something like that?"

Cheney is no stranger to documentary filmmaking or tackling subjects that have to do with the environment. With several films already to his credit—including the Peabody Award–winning *King Corn* (2007), which is a look at food production in the United States, and *The Greening of Southie* (2008), which is the story about a Boston housing developer who is integrating green-building strategies—*The City Dark* continues the theme of environmental queries. "I didn't really know anything about the [dark-sky] issue or anything about lighting when I began the project," he says. "Each interview led me to the next person or angle to examine."

One thing he did know was where he wanted to start—with astronomers. He first spoke with some astronomers at the Mont-Mégantic observatory in Notre Dame des Bois, Quebec, Canada, which is the first observatory to have its dark-sky reserve be recognized by the International Dark-Sky Association in 2007. (A dark-sky reserve is an international preserve of darkness around a facility to maintain ability to view the night sky.)

From Quebec, Cheney's journey took him back to New York, then Maine, Arizona, New Mexico, Florida, and Hawaii. Along the way he met people as diverse as the subject matter itself—astrophysicists, astronauts, astronomers (professional and amateur), writers and historians, night-sky enthusiasts, Boy Scouts, biologists, neurologists, criminologists, and lighting designers (Howard Brandston and Hervé Descottes make appearances). More than two dozen interviews are incorporated into the film, which unfolds in a series of six "chapters," each of which looks at the issue—the loss of the night sky—from a different vantage point.

The first chapter, The City Bright, sets the stage and begins to suggest that the loss of the night sky is about more than merely not being able to see the stars. As amateur astronomer Sam Storch says in a scene filmed at Jones Beach on Long Island—where stargazing was prevalent and popular in the 1970s—"It just doesn't get dark anymore."

The next section, Islands of Dark, sees Cheney travel to "Sky Village" in Arizona, a community of amateur night-sky enthusiasts founded by astrophotographer Jack Newton more than 30 years ago. In this chapter, Cheney also travels to Hawaii to interview the astronomers and scientists at the University of Hawaii, considered to be the best location on the planet from which to observe the Milky Way and the night sky in all its glory.

Nature and the Night explores how manmade light impacts animals and their natural habitats. From the disruption of bird migration caused by the reflections from building glass to the plight of hatching baby sea turtles along the Florida coast that walk inland instead of toward the ocean, more wildlife is impacted by artificial light than we realize.

Night Shifts, the fourth chapter, examines the relationship between light and human health, in particular long-term exposure to artificial light late at night. Cheney interviews a breast cancer patient and several noted physicians, including neurologist Dr. George Brainard at the University of Pennsylvania, one of the leading researchers on the subject of melatonin production.

The fifth chapter, Why We Light, examines the social context of light and touches on some of the traditional arguments about why there is the need for light at night—mainly, safety and prevention of crime.

By the time we arrive at the final chapter, Astrophilia, we have made the complete journey with Cheney and have witnessed his realization: The illuminated city plays an important role in our cultural imagery, and is just as important as the stars and the night sky.

Overall, the film's narrative is balanced and the discussion is thought provoking. You come away with the conclusion that something is indeed lost in our human condition when we lose our connection to nature and the ability to see the stars. But that loss must also be put into perspective by countering it with the benefits of living in a modern society. Unfortunately, sorting out the pros and cons of these two competing interests will only continue to get more difficult as we live faster and faster lives in a 24/7 world. The real challenge is how we find a way to balance these two competing interests.

The City Dark is an honest and very reasonable portrayal of the issue without being preachy. Cheney hopes that it will help people to have a greater awareness about the physical environment and how we light it. "I don't want to give up on the idea that you can see stars in the city," he says. "Its a way of thinking about the future and grappling with modernity." •

Scenes from *The City Dark*: Light spill from a city street light (top); trying to track star configurations in Times Square (bottom left); an observatory, a portal to viewing the night sky (bottom right).

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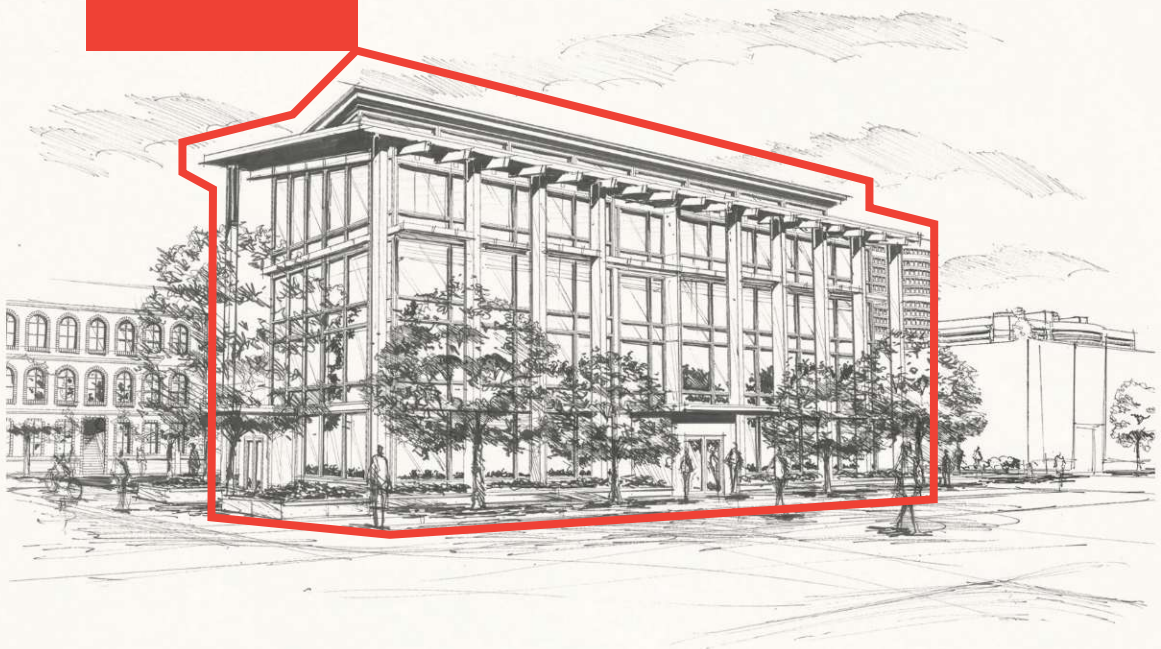

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AD INDEX

Zia Eftekhar

interview by Elizabeth Donoff
photo by Jeff Page

> **"Light is a basic truth. Everything that we see, most of what we do, and much of how we feel is touched by light."**

• **More Online** For an expanded version of this interview, go to archlighting.com.

Zia Eftekhar is part of a rare lighting breed of industry professionals who have the hindsight of 40-plus years of experience. His first job was with Lightolier as a junior designer, a position he took so that he could earn money for his post-graduate work in industrial design. Eftekhar went on to carve out a prominent career at Lightolier, and successfully saw it through two acquisitions, first with the Genlyte Group and then with Philips. In 2010 he became the CEO of Philips Professional Luminaires and in 2011 assumed the role of CEO of Philips North America. Eftekhar continues to think about lighting's big picture, and its evolution from components to systems thinking.

What do you consider innovation in lighting?
Innovation is taking great discoveries and great inventions and bringing them to everyday life.

How has the business of lighting changed since you began your career?
In terms of fixtures, there weren't a lot of large companies, and there wasn't any single company that had double-digit market share. While during the '80s and '90s a number of consolidations changed the picture for fixture companies, in the light-source business there was an equilibrium of fewer, much larger companies, because the barrier to entry was much higher than in the fixture business. With solid-state lighting, a window of opportunity has opened, and there are more new entrants into lighting than there were 10 to 15 years ago.

What did the L Prize win mean for Philips?
The L Prize was a fantastic recognition of Philips's innovation and involvement in LED science, technology, and manufacturing viability. But what the L Prize really did for us was that it set the performance bar a notch higher. It motivated us to reach further.

Can the industry make the integration between lighting and electronics?
The business model itself is reasonably consistent with what we've been used to the past 100 years. I don't see it changing that much. The difference is that instead of glass and filament, it's an electronic device that is going to generate the visible light.

What is Philips's legacy?
An absolute commitment and desire to bring meaningful innovation to the market that impact people's lives in a positive way.

How do you innovate and grow a global business, especially in this economic climate?
You have to keep the balance between short-term and long-term objectives. That's essential.

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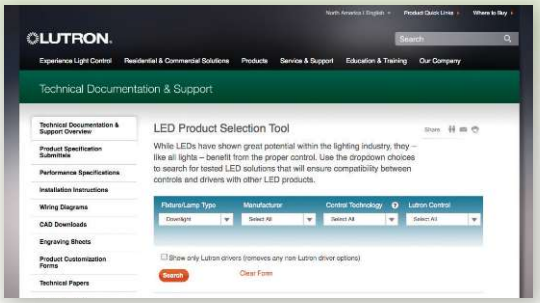

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