



T H E C E N T U R Y S E R I E S

Lighting In A Sustainable Future

The author takes a look at five key sustainable design issues and what the industry—including the IESNA—can do to move lighting along the continuum of progress



By James R. Benya

Several decades ago, scientists began warning us in earnest of the many threats to the health of the planet. From the pollution of the air and water to the contamination of the soil and the residue of toxins everywhere we turn, it defies common sense to belittle the warnings and continue the damage. Efforts to effect change continue, recently slowed by politics in the U.S. but proceeding aggressively in Europe.

In the last few years, the issues have evolved from “energy efficiency” to “sustainability.” While energy efficiency is a significant issue, it fails to address all of the environmental issues that are also part of the equation. To the lighting industry, the concept of sustainability is the consideration of all of the impacts of lighting on the built environment. For example, we use fluorescent lamps to design more energy efficient lighting, but the mercury used in fluorescent lamps is an extraordinarily toxic material that must be handled properly. We humans are notorious for sweeping our mistakes under the proverbial rug, so in sustainable terms, the energy efficiency of the light source must be weighed against the other risks to the environment.

Current politics notwithstanding, the second century of the IESNA must deal intelligently, proactively and in all possible ways correctly with the “sustainability” of the lighting products and applications we develop and promulgate. We should expect to be held increasingly accountable and we need to have good answers for everything we do. Looking forward as far as we can, the following will probably be our key challenges.

Fewer Watts When It Counts. No other initiative has received more attention lately than global warming. In simple terms, it is caused by the increased percentage of CO₂ in the atmosphere, primarily the result of burning fossil fuels. It will result in many profound environmental changes, including rising ocean levels

and weather patterns that threaten our ability to survive in certain parts of the world. Global warming is all but a foregone conclusion, regardless of political debate.

We’ve all seen the statistics. In the U.S. we consume 25 percent of the world’s annual energy, yet we constitute less than five percent of the population. No other nation of any size—including China—comes close in terms of overall consumption, and in per capita consumption, Japan and the U.S. are off the charts compared to the rest of the world. In terms of electrical energy use, lighting maintains a solid 20-25 percent of the overall electrical energy consumption, with

lighting energy use. In some respects, it will be pretty easy, as there remain millions of square feet to retrofit and our new technologies permit increasingly lower power density. But we also need to learn about time-dependent energy, too. A watt saved during demand peaks is much more valuable than at midnight. So rather than discuss watts per square foot, as we do now, we must develop a more sophisticated methodology in which we consider the energy use of our lighting design in a mature context of “when.”

As part of this effort, we must learn to do daylighting right. Daylighting must be wrestled from the grips of

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commercial lighting energy and industrial lighting energy playing major roles in the total energy consumption of these building types. Residential lighting energy seems to have lesser impact, but it’s still pretty important.

The fact that we use too much energy is not news—we have been struggling with the issue of lighting energy efficiency since the oil embargo of 1973. To the credit of lighting, we have made significant improvements, dropping average connected lighting power density about 75 percent in new construction since 1973. Moreover, we have aggressively retrofitted a large percentage of older buildings, achieving significant reductions throughout our stock of buildings. The president of ASHRAE, Bill Coad, noted that of all energy use types, lighting has stood out as having responded with significant savings and improvements since 1973.

It appears that the single most important thing we can do is to continue the trend towards ever lower

architectural fashion, and illuminating engineering must step in and help control architectural fantasy and hubris. If we succeed in this effort, without cutting out one “watt per square foot” we could reduce the meaningful time-dependent energy use 50 percent or more. This is a huge opportunity that we must not ignore.

To achieve these goals, key systems and components will be new generations of lighting controls. Intelligent switching and dimming will permit proper modulation of the light and power levels. I believe very strongly in energy codes to guide the process, so we must continue to evolve ASHRAE/IESNA 90.1, California Title 24 and the other energy codes and standards.

Using Fewer and Better Materials. A big part of “sustainability” is the use of less and more renewable materials. Compared to most other building components, lighting is comparatively weightless and uses

very little material. Moreover, lighting lends itself to the use of recyclable materials (steel, aluminum) and plentiful materials (glass). In this respect, lighting has a minimum impact.

Still, there are a lot of things that we can do better. We can begin by using recycled and low inherent energy materials, and avoiding finishes and parts that require environmentally problematic processes, products and residue. We might also think about using smaller luminaires, too, although that trend is already in place with the T5 generation.

Our biggest challenge, however, is to find a high efficacy, high color rendering light source that does not use mercury or other toxins. This is part of the race towards LED lighting, for this technology seems to promise this critical feature. In the meantime, we must continue to evolve current light sources towards the lowest possible use of heavy metals, and to ensure the proper recycling and/or management of the waste stream of lamps and other components. Because mercury has become a flash point for environmentalism, the lighting industry must be particularly diligent in dealing with it. While laws preventing the use of mercury containing lamps are not a good idea at the moment, we owe the planet a whole new world of lighting without it as soon as humanly possible.

Photobiology. In 1965, a photographer named John Nash Ott wrote a book called *Light and Health*, his pseudo-scientific treatise on how light affects living creatures. Lacking proper scientific training, Ott confused the benefits of “full spectrum” lighting with what we now understand to be the body chemistry of circadian rhythms. Ott believed that ultraviolet light was the secret elixir, and from this book and the subsequent *Light, Radiation and You* he promoted his concepts. To this day, a number of small companies still sell healthy light products, including “Ott Lights.”

Common sense tells us that light must affect living beings, but until the last decade, the lighting industry did a poor job of addressing the issue. Only

recently did we begin learning of the role of circadian cycles in human health, but sadly, we are barely funding any research in applied lighting and daylighting, even in the critical areas of healthcare facilities. Instead, we investigate long shot links like light and cancer (probably to get more press).

In its groundbreaking work in schools, the Heschong Mahone Group reported a dramatic improvement in student performance in schools with daylighting, view windows, or both, in comparison to electrically lighted, enclosed school classrooms. While the mechanism has yet been isolated, the causal effect is scientifically clear. In Europe, there are laws requiring day-

Modern outdoor lighting is our industry's Love Canal

light and views for workers. Given the benefits, one wonders why the same is not true in the U.S. for schools and other applications.

The use of light in therapeutic applications is best left for medical science, but the lighting industry must get its act together in the field of photobiology. I have recently found amazing claims and products on the industry's mainstream websites, uncontested and therefore receiving the appearance of legitimacy. If we fail to properly address this evolving field, don't be surprised if you find some hard to believe pseudo-science becoming a requirement to achieve a LEED rating.

The Night Sky. In developed nations of the world, it appears that we have installed outdoor lighting everywhere we can get electricity. Indeed, outdoor lighting has become an art form and a competition between neighbors, especially in commercial lighting. Think Times Square. Las Vegas. Tokyo. Shanghai. Paris. It sometimes seems out of control—in fact, it is.

Modern outdoor lighting is our industry's Love Canal. With wanton disregard for the environment, lights have been installed not only in overabundance in our cities, but also in sea turtle nesting zones, wildlife refuges and other delicate environments. We only begin to have the slightest idea how badly our lighting affects living creatures at night. From the millions of birds killed each year by disorientation and interrupted migration patterns due to lights in tall buildings, to the countless deaths of fish and other water creatures due to lighting on shore and boats, evidence is beginning to show up everywhere that outdoor lighting has serious negative environmental effects.

In the 1970s, astronomers and their communities began to address the growing problem of light pollution, but until the 1990s, most lighting laws and ordinances strove only to reduce outdoor lighting that detracted from astronomy. These were selfish laws, encouraging the use of low pressure sodium lamps despite the lack of color rendering, the potential for decreased visibility and the horrid appearance. It was not until the advent of the International Dark Sky Association (IDA) and its broader view did the focus change to shielding and reduced lighting, rather than forcing a spectrum favorable only to astronomers.

Our pursuit of photobiology and a need to understand human vision better has recently revealed, among other things, a new photoreceptor in the eye, which appears to circumvent the optical system and directly affect the endocrine system, stimulating the circadian cycle. This profound discovery at last explains phenomena described by Ott and other, more legitimate researchers throughout the world. Among its findings include the understanding that in order to have strong and healthy circadian rhythms, we must have bright days *and* dark nights. We've also learned that there are wavelengths that don't have much effect on the circadian cycle, enabling us to better design circadian-friendly lighting.

A direct implication of this is that human health can be affected by lighting of any kind as the human approaches his/her sleep cycle. This revelation should be prominent in our approach to both interior and exterior lighting. Therefore, by logical extension, we can also theorize that the same effects occur in outdoor lighting with other creatures, although we know enough to suspect that the wavelengths will differ.

At this very moment, the IDA is promoting its model lighting ordinance (MLO), a carefully crafted document designed to give flexibility in outdoor lighting planning to communities, while preserving all current IESNA lighting recommendations. The IDA MLO is seen as a document designed to change and improve, much in the same way the National Electric Code and ASHRAE/IESNA 90.1 change every three years or so. It works to prevent all forms of light pollution by preventing bad lighting rather than trying to effect good lighting. Given the intense scrutiny this document has received from a broad range of environmentalists, astronomers, energy experts and lighting specialists, this is a standard that should receive the full support of IESNA. But it hasn't, at least not yet.

Energy Codes and Sustainability Standards. No single newcomer to our world of standards and regulations has had more impact than the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design). LEED has, for the first time, given the construction industry a workable, common sense, practical and complete tool for evaluating the "sustainability" of the construction of, and in its newest standards, the operation and maintenance of buildings and the built environment. Almost every new building project for any government body must now receive LEED rating. For instance, in the State of Washington, all school projects including K-12 and state colleges must receive at least LEED Silver.

The IESNA is barely represented in the process. But the IESNA should

FLASHBACK

LD+A: July 1984

Today the Trump Boardroom is the star attraction, but back in 1984, the Trump Tower Retail Atrium was the hotspot. The six-story atrium was described in an LD+A cover story as "New York's newest tourist attraction, surpassing the World Trade Center and the Empire State Building combined for number of visitors per day."



not feel alone; public reviews of proposed standards by USGBC don't seem to result in public discourse or change. The USGBC simply develops whatever it wants. Committee balance is not really checked. In other words, in order to have the greatest possible impact in the shortest possible time, USGBC has ignored the standards processes of ANSI and simply surged ahead. In doing so, they have created standards that aren't well written, are wide open to interpretation and cheating, and in some cases, may be concealing anti-competitive influences.

Then there is the International Energy Conservation Code (IECC), now the most common energy code for buildings in the U.S. The International Codes Council at least has an ANSI-like process, but once again, the IESNA seems to only have a tertiary role in affecting IECC language. Had it not been for the personal intervention of a few key lighting people, in March, the IECC would have passed a 50 percent reduction in retail lighting energy allowance from its 2002/2003 values with its proposed 2006 standard. What public review?

Then there are the many other codes and ordinances that are developed by a host of agencies ranging from the National Fire Protection Association to the International Building Code. For IESNA to stay involved in LEED, IECC and all of these others is imperative. For us to evolve lighting in a coordinated manner into a simple, effective and work-

able framework, we need to be working from a single, well-debated, open and scientific foundation. Throughout my career I have counted on IESNA to provide this, and as we face our future, I challenge IESNA and its members to live up to its mission as "the Lighting Authority" and provide comprehensive leadership in our sustainable future.

LD+A's "Century Series" celebrates pioneers, achievements and developments in lighting, as IESNA approaches its centennial in January 2006.



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