



Daylighting's Feel-Good Story

As LEDs shrink LPDs to new lows, should daylighting proponents 'go big' by focusing more on health benefits and less on energy savings?

BY PAUL TARRICONE

This is the story of how *the law of unintended consequences* meets *the law of diminishing returns* and what they both mean for daylighting. Writing in the August 2014 issue of *LD+A*, Willard Warren noted that “. . .one of the consequences of [LED proliferation] is that as LPDs decrease to 0.5 watts per sq ft or less, it's harder to economically justify daylight sensing and control [for side-lighted/windowed spaces] because of the law of diminishing returns.”

Put another way, more efficacious LEDs may be draining the ROI right out of daylight harvesting.

Indeed, when the designers of the nation's first net-zero energy elementary school critiqued their own work on the Richlandville, KY, school, in an article entitled “Rethinking Daylight,” they wrote that if they had it to do over, they would eliminate the daylight harvesting system and simplify the controls, thereby saving \$1,200 per classroom. At the same time, they would increase students' views of the outdoors with one 12-ft long central window along the rear wall, face all classroom windows in the north-south direction and employ solar shades.

Might this revised strategy for the Kentucky grade school be a metaphor for the future of daylighting? Will complicated controls become a tougher sell as LEDs drive down LPDs? And as a result, will the value proposition for daylighting become less about energy savings and more about health and productivity?

A panel of lighting professionals weighs in on the topic.



Christopher Meek,
University of Washington Department of
Architecture

LIGHTING POWER SAVINGS ARE STILL CRUCIAL

I firmly agree with Bill Warren’s contention that the case for the inclusion of daylight in buildings should be based on the positive attributes it provides to occupants in terms of health and productivity, and that space quality and human comfort should be paramount in any design equation. We know that daylight and views support the circadian system and provide a much richer indoor experience.

However, I disagree that we have reached a point where lighting power savings realized from daylight performance have become less relevant. This is especially true in our highest-performing buildings. The office I work in is located at the Bullitt Center in Seattle, WA, a six-story 55,000-sq ft net-zero energy office building that uses 70 percent less energy than a current code building and has a lighting system with a connected load of less than 0.4 watts per sq ft in the tenant suites. Despite this very lean lighting system and a comprehensive controls regime, lighting remains the single largest energy end-use in the building at 23 percent of annual energy—inclusive of controls. Daylight-responsive dimming (to OFF) is central to meeting those conservation targets—and, more importantly, is absolutely crucial for meeting the net-zero energy targets while providing a very high-quality visual environment.

Justifying this on simple energy economics is tough and will only get tougher as lighting technology improves. I heartily concur with Bill that our charge going forward will be to better quantify the non-energy benefits of daylight in buildings based on health and human performance. Though hard figures remain elusive, the correlations are clear. It will be a great day when we can design with a pure focus on outcomes for people and let the kilowatts speak for themselves.



Naomi Miller,
Pacific Northwest National Laboratory

TOO MANY POOR DESIGNS

I’m frankly very pleased that many workspaces have dropped below the LPD threshold where daylight dimming controls are required. I’ve seen too many installations where daylight dimming controls are poorly designed, poorly installed and/or poorly commissioned, and consequently save little to no lighting energy. That makes the expense of the products and installation hard to justify.

Daylight and views are immensely important in most kinds of spaces. The daytime high light levels measured at the eye are important for circadian health for diurnal workers. The views and changing weather patterns are important for visual information, and the normal sky and weather changes are stimulating to our brains. If the windows are not heavily tinted, or tinted with colors that skew color perception, the color rendering of daylight is obviously familiar and “natural.” As long as the daylight apertures are designed to limit offensive glare, daylight is great stuff for our well-being and our mood.



Eric Lind, Lutron

DON'T COUNT OUT CONTROLS

Designing for the building occupants should always be in the forefront—both to improve the comfort, health and productivity of employees, and to maintain a sustainable, economically sound environment. That said, I do still see significant economic justification for a dynamic lighting control solution.

- Compared to fluorescent fixtures, adding dimming to LED fixtures can be accomplished at a much lower incremental cost. In fact, many manufacturers are now including dimming in the base fixture package.
- If dimming is included, adding daylight harvesting adds even less incremental cost—basically just adding a single sensor per room with little to no startup cost due to the automated nature of sensor setup.
- The cost of the daylight sensor is generally the same cost as the occupancy sensor, and proper daylighting often provides a similar percentage energy reduction, but a considerably larger percentage peak power reduction than occupancy sensing. This suggests that, when added to high efficiency lighting systems, daylighting offers economic justification that is similar to, if not superior to, occupancy sensing.
- From a wellness perspective, it may turn out that to meet occupant health we actually need periods of higher light level than we currently design for. As we achieve the recommended lighting power density in these spaces, we may need to increase lighting power to the point where daylight harvesting provides significant cost savings.



Pete Shannin, Acuity Brands

LEDs AND CONTROLS WORK HAND-IN-HAND

Daylight harvesting controls can be justified on the basis of economic benefit, even as LED systems improve LPD. This is because the cost of daylight harvesting controls will also benefit from the adoption of intelligent LED lighting as these controls systems become distributed, that is, integrated into the luminaire. As such, the adoption of LED systems will also lend itself to the adoption of distributed integrated controls.

While economics is a very important consideration in the design decision, we also believe it's important to take a holistic view of the space's lighting needs. This includes understanding the quality of light needed for the application. From a daylighting perspective, this includes CRI levels, footcandle levels and glare; human factors including circadian rhythms, flicker and productivity; client sustainability goals, tax incentives and regulatory drivers; and total cost of ownership that incorporates energy savings, maintenance costs and disposal fees.

Effective daylighting solutions consisting of top-lighting and side-lighting—or a combination of both—should not only optimize energy savings, but also provide benefits that clients will find compelling in tandem with the design criteria.

‘Rarely will you hear an architect say, “Let’s put in windows because of all the energy we will save!” ’

Nancy Clanton



Neall Digert, Solatube International, Inc.

WANTED: A MORE 'ENLIGHTENED CONSUMER'

The North American marketplace has long been unique in its use of annual energy-cost reduction as a primary way of evaluating and justifying the benefit of daylight in building design. Other global markets, on the other hand, have required the effective use of, and occupant access to, daylight as a critical feature of building design. The outcome has been mandated use of daylight in both construction codes and energy codes, as opposed to just being treated as an energy-conservation feature. Proper application of daylight in integrated building design is widely recognized as a critical element of truly sustainable design, one that leads to creating a building that is not only energy efficient, but one which truly nurtures the occupants within.

As electric lighting systems become increasingly efficient, justifying daylighting systems purely on the associated simple paybacks of daylighting solutions (from a first-cost, lighting-energy-savings viewpoint) becomes more difficult. Other critical issues must enter into the customer's evaluation of daylighting's true benefits. As sustainable design has become a common driving element in modern design practice, many design teams have been justifying the use of daylighting systems using other human-centric and/or carbon footprint-based benefits. These include occupant health and productivity benefits, increased product sales in retail environments, reduction in a building's carbon footprint, desire for net-zero energy design solutions, and decreased first costs associated with HVAC systems and site-based power generation equipment.

When properly assessed, these benefits can greatly overshadow the pure annual lighting energy-savings benefits, reducing the daylighting system's payback from a number of years to, in some instances, a number of weeks.

However, today, it takes an enlightened consumer to understand the true implications of daylight as a critical element of building design. Perhaps with the increased efficiencies that are possible with today's electric lighting equipment, North America, too, will expand the requirement for daylighting integration in building design into all aspects of code-mandated design.

THE TAIL SHOULDN'T WAG THE DOG

People love daylight. Rarely will you hear an architect say, "Let's put in windows because of all the energy we will save!" Typically, windows are designed in a project for the connection to the outdoors including the health and view benefits of the occupants. Dimming the electric lighting when daylight is plentiful is an added energy saving benefit, but not the primary reason for windows.

Electric lighting designs are now achieving record low LPDs because of great efficient solid-state lighting solutions. Even though daylight dimming is exempt from the energy codes for low LPDs, it is still the right decision to dim all electric lighting in areas where daylight is plentiful. Remember that just meeting the energy code is the worst design allowed, not the best. Net-zero energy buildings are challenging all of us to find every possible good design decision. Dimming lighting in daylight areas is a great design decision since it does not affect the lighting quality.

I agree that daylighting should be based on the health and enjoyment benefits instead of saving energy. But it has always been that way. Energy benefits were an added bonus. □



Nancy Clanton,
Clanton & Associates



Daylight, Good Night

The case for daylight's health benefits has been bolstered by research published in the *Journal of Clinical Sleep Medicine* that shows a direct correlation between employee health and access to daylight in the workplace. Among the key findings is that workers with windows at the workplace slept an average of 46 minutes more per night during the work week than daylight-deprived workers.

Moreover, when surveyed, workers with windows reported better quality of life and activity patterns than their counterparts without windows.

Forty-nine workers participated in the study conducted by the University of Illinois at Urbana-Champaign and Northwestern University: 27 workers working in windowless environments and 22 comparable workers in workplaces with significantly more daylight.

In its conclusion, the research team stated: "We suggest that architectural design of office environments should place more emphasis on sufficient daylight exposure of the workers in order to promote office workers' health and well-being."