LED WATCH

James Brodrick

RETHINKING HOW IT'S DONE

Two R&D projects show what may be possible in the most traditional of spaces

While the U.S. Department of Energy's (DOE) SSL Program continues to focus R&D funding on driving improvements in efficacy, color quality and other performance parameters, two recently completed DOE-funded projects represent something of a departure. These projects looked to optimize application efficacy in innovative and holistic new ways that challenge the norm. Both go beyond current practices to include novel form factors, adaptive control of light output and spectrum, creative types of user interfaces and new takes on architectural integration.

IN THE CLASSROOM

The first involved a partnership between RTI International and Finelite to develop and test an LED-based integrated classroom lighting system that makes it easy for teachers to control light levels and chromaticity in three classroom zones, and that also incorporates daylight harvesting to further reduce energy consumption. The project's focus was on more than just efficacy, as one of the objectives was to spur demand for energy-efficient lighting in schools by demonstrating some of the potential non-energy benefits of easy-to-control tunable lighting in future classrooms.

Together with sensors and a controller, the fixtures form a U.S.-made system operated from a user interface that's either mounted in the front of a classroom or accessed through a wireless handheld device, and was designed based on input from more than 80 teachers and school administrators.

The system (**Figure 1**) features continuous tunable white light ranging in color between 2700K and 6500K, delivered at a luminous efficacy > 125 lumens per watt at all CCTs. This level of performance greatly exceeds the energy efficiency of competitive technologies; according to the developers, it represents more than a 25 percent improvement in energy efficiency over fixed-CCT fluorescent lights, and better than a 22 percent improvement over the average fixed-CCT LED luminaires listed in the LED Lighting Facts database.

The system includes integrated sensors that can harvest daylight in the classroom and selectively dim luminaires to maintain a constant lighting level. Its LED light sources are expected to last for more than 10 years of typical use, with < 15 percent decrease in light output —far longer than conventional fluorescent lighting technologies, which require replacement every three to five years. The result is a simple, energy-efficient, glare-free lighting system that's easy to install, conforms to all applicable building and electrical standards, and meets or exceeds all DOE goals for system-level performance in the "classroom of the future," including luminous efficacy, color rendering, vertical and horizontal illuminance, and product reliability.

IN A HEALTHCARE SETTING

The second project, carried out by Philips Lighting Research North America, sought to redefine lighting for healthcare patient suites (patient room plus bathroom) by developing an innovative LED lighting system that was 40 percent more energy-efficient than traditional fluorescent incumbent technologies; met all the visual and non-visual needs of patients, caregivers and visitors; and improved the patient experience. The solution was driven by state-of-the-art multichannel LED platforms and Power over Ethernet drivers, as well as by control technologies that provided spectral tuning and became part of an intelligent connected lighting system.

In addition to spectral tuning, the system's technology platform offers adaptive behaviors as well as fast and simple installation and commissioning, with diverse functionality that allows for

TWO APPLICATIONS OF COLOR TUNING

Figure 1.

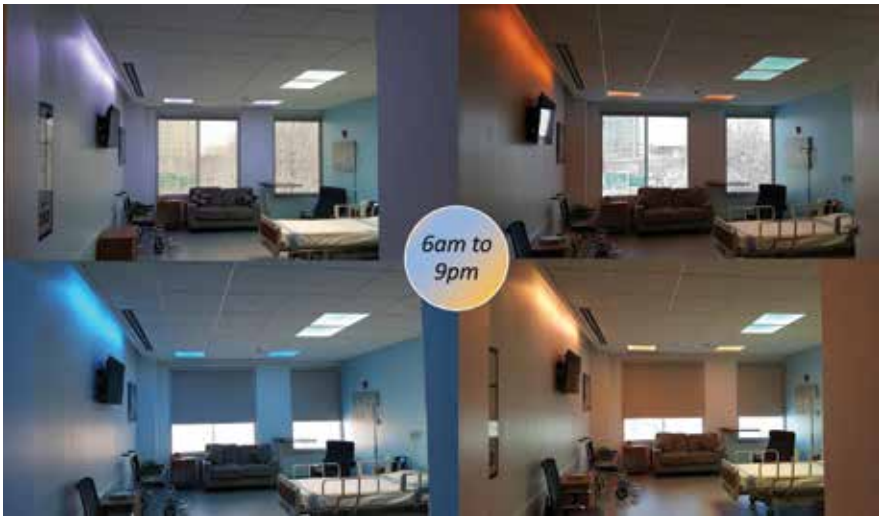

Figure 2.

delivery of white and colored light for user control and energy management. It also makes use of occupancy, daylight and user controls, with intuitive user-control interfaces for patients, family and caregivers.

Four independent color channels enable the production of a wide range of tunable-color and tunable-white combinations. When operated in tunable-white mode, the system provides CRIs that range between 80 and 85, with CCTs that can be tuned from 2700K-6500K.

Using advanced controls, the system will give patients and staff a very different lighting experience, not only adjusting the lighting intensity based on the availability of outside light from the windows when appropriate, but also adjusting the CCT of the luminaire above the bed, and adjusting the color points of the luminaires around the bed's perimeter over the course of the day—from warm in the morning to cool at midday and back to warm in the evening (**Figure 2**). When the bathroom lights are turned on in the middle of the night, they come up gradually to allow the patient's eyes to adjust. When all of this functionality is combined into a complete application solution, the system uses 40 percent less energy than incumbent fluorescent systems.

A full-scale mock-up of the lighting system was set up at Philips' lab in Cambridge, MA, and the system was found to meet visual criteria (confirmed by calculations, simulations and measurements in the field) and non-visual criteria (confirmed by setting circadian stimulus targets and performing calculations using the calculator developed by the Lighting Research Center). In addition, human-factor evaluations were conducted with a range of users from the healthcare and lighting professions. The general consensus was positive, with requests to pilot the system in multiple healthcare facilities, in recognition of its value to patient and staff well-being in addition to energy saving.

Although solid-state lighting has come a long way in a short time, its remaining potential is considerable and extraordinary. Tomorrow's lighting systems will become increasingly complex and entail much more than the lighting we know today. The two projects described above illustrate that, and provide a tantalizing foretaste of what's possible when we break out of our box and rethink how it's done.

James Brodrick is the lighting program manager for the U.S. Department of Energy, Building Technologies Office.