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K-12 Energy-Lite Lighting

by Michael Fickes

K-12 schools across the country can cut electricity bills dramatically by retrofitting with energy efficient fluorescent lamps, adding occupancy sensors and implementing daylighting strategies where possible. In some schools, emerging LED technology can cut electricity costs even more than fluorescent lighting in certain applications. Some districts are also experimenting with more general use of LED lighting.

The Springfield City School District in Springfield, Ohio, recently upgraded its lighting technology in the hopes of reducing lighting costs without compromising quality.

It worked. The district spent $332,400 on retrofit lighting gear and labor and will save $104,240 per year in electricity costs, recouping the cost of the upgrade in a little over three years.

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The Springfield City School District project touched eight elementary schools, four middle schools and one high school.

The retrofit replaced 32-watt T-8 lamps with 28-watt T-8 lamps in classrooms, offices and corridors, says Greg Smith, president of Energy Optimizers USA, who handled the project. Based in Tipp City, Ohio, Energy Optimizers specializes in energy conservation projects for K-12 schools.

Adding to the savings, three-lamp fixtures with reflector kits replaced four-lamp fixtures in the classrooms, and two-lamp fixtures with reflector kits replaced three-lamp fixtures in the corridors.

In the gymnasium, they replaced electricity-hungry metal halide lamps with new six-lamp T-8 fluorescent fixtures and lamps plus occupancy sensors.

Energy Optimizers also equipped the restrooms, hallways and large areas of the school with occupancy sensors that turn off the lights when no people are present.

“Springfield City illustrates the savings that districts with newer buildings can expect,” Smith says. “Districts with older buildings have additional opportunities. For example, you can replace incandescent exit signs with LED exit signs.”

Older schools often have exit signs illuminated by incandescent lamps, which typically draw 40 watts. LED signs draw just four watts. In addition, LEDs last for years and require virtually no maintenance hours for changing lamps. Estimates place the 10-year cost of one incandescent exit sign at $535.20. That doesn’t seem out of line, unless, of course, you compare it to the 10-year cost of one LED exit sign: $76.50, less than $10 per year.

A school district with 1,000 exit signs across 50 or so school buildings and a dozen or so administrative and maintenance facilities can exchange incandescent exit signs for LED signs and reduce electricity costs from $535,200 to $76,500 over 10 years and from $53,520 to $7650 per year.

Improving Lighting Technology, Declining Lighting Costs
While LED lighting is gaining credibility in some school lighting applications, four-foot long fluorescent lamps remain the K-12 workhorse. Mounted in standard two-foot by four-foot fixtures, these lamps have made steady improvements in energy efficiency over the years.

Twenty years ago, 40-watt T-12 fluorescent lamps provided most of the lighting for K-12 classrooms, offices and corridors. By the middle of the 1990s, 32-watt T-8 lamps had replaced the T-12s. T-8 lamps remain prevalent today.

T-12 and T-8 lamps. What’s the difference? Each comes as a four-foot tube. The difference is the diameter of the tubes. A T-12 lamp is 12/8 of an inch or 1 ½ - inches in diameter. A T-8 lamp is 8/8 inch or 1 inch in diameter.

In short, the T-number reflects the number of eighths of an inch in the diameter; the lower the number, the smaller the diameter.

Likewise, recently introduced T-5 lamps are 5/8 of an inch in diameter.

Experts doubt that T-5s are ready to take over. T-5 lamps operate at 28 watts, the same wattage as T-8s. “Moreover, the T-5 ballasts use slightly more wattage than T-8 ballasts, making them less energy efficient overall,” says Patrick J. Marquez, PE, LEED-AP, an electrical project manager with Baltimore-based James Posey Associates, a consulting engineering firm that provides mechanical and electrical design and engineering services.

By reducing the diameter of the lamps, engineers generally reduce the amount of power consumed. While not true in the case of the T-5 lamp, it may eventually be true as the technology improves.

“In addition, smaller diameter lamps give fixture designers more flexibility and enable them to improve the optics of the fixtures,” continues Marquez. “While the power needs of T-5s aren’t less, the quality of the lighting is improving. That may be important in some installations.”

The Big Rooms
Lighting schemes for some larger school spaces are focusing on energy efficiency, too.

In the gymnasium, for instance, 150-watt metal halide lamps are losing out to T-8 and T-5 lamps that use about one-third of the wattage required by metal halide lamps. “Fluorescent lamps not only save energy, they solve a problem characteristic of HID (high-intensity discharge) lamps like metal halide, Marquez says. “HID lamps require five to 10 minutes to re-light after being turned off. If there is a power outage, the lights won’t come right back on. Fluorescent lamps don’t have that problem.”

Metal halide lamps also shift color over time; fluorescent lamps do not.

Cafeterias are also shifting to fluorescent lighting in middle schools and high schools. Elementary school cafeterias are a bit different.

Elementary school cafeterias often double as auditoriums and use two lighting systems. At mealtime, energy-efficient fluorescent lamps provide illumination. Auditoriums, however, require lights that can dim, brighten and cast a spotlight. “Incandescent and halogen lamps are easy to dim,” Marquez says. “Fluorescent fixtures offer dimming but not the same level of control. Incandescent and halogen lamps are here to stay in auditoriums.”

Daylighting Strategy
“Many studies note that natural daylight boosts student productivity,” Marquez says. “Our goal as lighting designers is to find the best way to bring daylight into a classroom without creating glare or heat.”

The idea is to harvest or use the natural daylight that comes through the windows of a classroom, supplementing it with artificial light when necessary and dimming the artificial light when natural light is available.

What About LED Lighting
Light emitting diodes (LEDs) are attracting attention as lighting sources that provide even more energy efficiency than fluorescent lamps, but only in certain applications. “Lighting in classrooms will continue to operate using linear format T-8 or T-5 fluorescent lamps, which can integrate with daylight harvesting systems,” says Al Near, senior vice president of sales and marketing with New Windsor, N.Y.- based USA Illumination, a lighting manufacturer that provides efficient lighting solutions for a variety of faciltiies.

Marquez agrees. “We don’t see LED as a good alternative for linear 4-foot fluorescent tubes,” he says. “Making a linear LED tube requires stringing together a lot of LEDs. We’ve seen a couple of these, but I don’t think they do the lighting job, and they require large power supplies that generate a lot of heat.”

LED lighting can handle specialty applications, however. LEDs provide down lighting in hallways and highlighting for architectural features. “It is an excellent decorative light,” Marquez says.

“Lighting costs make up 50 to 60 percent of a typical school electricity bill,” Smith says. “The next largest electricity user is the HVAC system.”

As the power requirements of fluorescent lamps and LED lights continue to shrink, it is becoming possible to shrink the percentage of electricity used by lighting systems. How low can you go? Lighting will always be a major component of school utility costs, but by applying new, efficient lighting technologies and adopting lower wattage lamps as they become available, it may be possible to cede the title of top electricity guzzler to the heating, ventilating and air conditioning system.

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