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SEEING CLEARLY

Lighting Retrofits

Cut electricity costs with a lighting retrofit that can pay for itself in lower electric utility bills.

by **MICHAEL FICKES**

LIGHTING CAN ACCOUNT FOR up to 40 percent of a building's energy use, according to the U.S. Environmental Protection Agency (EPA).

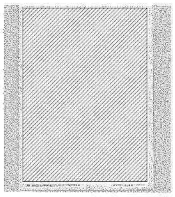
In Pre-K-12 schools that percentage is going down as schools implement day lighting strategies, retrofit with more efficient lighting systems, install dimmers to adjust light down when possible and put in occupancy sensors to turn the lights off when no one is around.

Unfortunately, many of today's schools were designed more than 20 years ago before daylighting designs with clerestories and skylights became popular. Nevertheless, school designs have always called for plenty of classroom windows admitting lots of natural light. Programmable dimmers can help to take full advantage of available daylight.

That said, the greatest efficiency gains will come from lighting retrofits that reduce power consumption while the lights are on and occupancy sensors that cut off power consumption altogether when rooms are not in use.

A lighting retrofit sounds like a major renovation that requires tearing out ceilings to replace fixtures and possibly creating an asbestos remediation problem in older school buildings.

But it really isn't that bad. "You can gut a fixture and leave the housing," says Tim



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Hogan, vice president, education market with lighting and lighting products manufacturer Acuity Brands, Inc., in Atlanta. "Then you replace the ballast, reflectors, refractors and the lamp and end up with the functional equivalent of a highly efficient, modern lighting system."

Many schools are retrofitting from old T-12 fluorescent lamps to the newer T-8 lamps. Fluorescent tubes are measured in eighths of an inch, so that a T-12 lamp is 12/8 of an inch or 1 1/3-inch in diameter, while a T-8 lamp is 8/8 of an inch or 1 inch in diameter.

"The trend in schools is to T-8 plus a different ballast factor," says Roy Sierleja, senior lighting specialist with GE Lighting.

What Is a Ballast Factor?

Fluorescent lamps are discharge lamps, explains Sierleja. They produce light when an electrical current flows through the gas inside the lamp.

By contrast, incandescent lamps produce light when electricity flows through a metal filament, heating the metal to a temperature that causes it to emit light. The electricity and the filament produce light. Incandescent lamps don't need any extra help.

Discharge fluorescent lamps do need extra help — from ballasts.

Ballasts are transformers that step up or step down the voltage that pushes current — the flow of electrons — into a fluorescent lamp. For a fluorescent lamp to start producing light, a ballast must step up the voltage to a high level, giving the lamp kind of a jump-start.

Once the lamp begins producing light, a feature of the ballast called the ballast factor lowers the voltage to produce the desired amount of light.

"Ballast factors describe how hard a ballast drives a lamp," says Sierleja. "T-8 fluorescent lamps produce 3,000 lumens with a ballast factor of 1.

"A facilities director might say that classrooms in this school don't need 3,000 lumens. In that case, we would select a ballast with a factor of 0.77 to drop the light as well as the wattage, saving some energy."

It works the other way, too, continues Sierleja. A gym that requires a lot of light may need a ballast factor of 1.15, which raises the voltage and produces more light.

When No One Is Around, Turn Off the Lights

It makes complete sense to turn off the lights in auditoriums, classrooms, cafeterias and gymnasiums when no one is using them. It saves electricity.

Then again, turning fluorescent lights off and on shortens their life. "The way to get the longest life from a fluorescent lamp with a standard instant start ballast is to leave the lights on," says Sierleja.

Obviously that isn't an option today. Schools that want to save electricity must turn the lights off whenever possible. Does that mean facility directors that want to save electricity must accept higher costs for purchasing more lamps? Fortunately no.

The answer once again has to do with ballasts. Standard instant start ballasts apply high voltage across the lamp and powers the light on as soon as you flip the switch, Sierleja says.

The high voltage heats a cathode that ignites the gas. Unfortunately, the instant high voltage also causes the chemical coating on the cathode to deteriorate. When an instant on fluorescent lamp is turned on and off throughout the day, the coating wears out faster and the lamp fails sooner.

The solution is a programmed-start ballast. "This ballast doesn't start with a high voltage required for an instant start," Sierleja says. "It simply heats the cathode. Once it is hot, the ballast delivers the high voltage that illuminates the lamp. It's called a soft start. It takes a couple seconds for the lamp to come on, but it extends the life of the lamp beyond the instant start ballasts."

[WHAT'S NEXT]

Coming Soon: LED Retrofits

ACCORDING TO TIM HOGAN, vice president, education market with Acuity Brands, Inc., in Atlanta, schools are beginning to turn to LED lighting technology.

"An LED is made of silicon wafers that glow when an electric charge is applied," says Hogan. "An LED lamp uses many wafers inside a shell with phosphors that manage the color of the light.

"A vast majority of new construction is moving to LED for outdoor lighting. Indoors, we're seeing LEDs used for down lighting — in cafeterias, offices and atriums.

"LED lighting makes sense for new construction because of the tremendous savings over the life of the building."

According to *www.eartheasy.com*, LEDs last 10 times as long as fluorescent lamps, produce no heat build-up and use one-third or less the energy of fluorescent lighting.

Unfortunately, the technology is probably still too expensive for retrofitting applications.

LED prices are moving in the right direction, continues Hogan. Adoption is increasing, and at some point we'll reach the critical mass that will enable attractive pricing for retrofitting.

Careful, Though

"The color of most LED sources — the essential aspect of light quality — is unpredictable and often poor across the markets," says Alexandra Mathews, vice president of international sales and marketing with the San Antonio-based Lucifer Lighting Company, in a prepared statement.

"Three different LED arrays may have the same published Kelvin ratings, yet the color temperature and rendering properties will vary all over the map," continues the statement.

Mathews recommends that architects and lighting-designers work with proven state-of-the-art LED technologies when designing school lighting systems. Proven technologies will also help ensure that LED systems come through on hours-of-service promises, too. Some configurations have suffered from what is being called lumen depreciation over time.

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The De-lamping Option

Sierleja also suggests a second retrofitting concept called de-lamping. This option is for schools with three-lamp fixtures in the ceiling. You would remove the three lamps and the ballast and reinstall two lamps and a reflector along with a new soft-start ballast. "This cuts power consumption by one-third," says Sierleja. "It also cuts the light output by one-third, but the reflector puts 20 percent back."

Paying for It

For a big retrofit, Sierleja says it makes sense to bring in a contractor. "Hire someone to come in at night," he says. "If you do it internally, it takes forever. An experienced technician can switch out a fixture in 10 to 15 minutes."

A small elementary school may have 1,000 fixtures, continue Sierleja, while a large high school may have 3,000 fixtures. At four fixtures per hour, it would take 750 hours to retrofit 3,000 fixtures. A crew of 10 could do the work in about 75 hours, two weeks of night shift work.

School districts working with Energy Service Companies (ESCOs) on larger energy efficiency projects might consider rolling a lighting retrofit into that work.

If you were only retrofitting the lighting system, you probably wouldn't involve an ESCO — unless you don't have the upfront money. ESCOs front the money, and you pay them back with the money you save on utilities.

Regardless of the kind of contractor you select, keep in mind utility company and government programs that will pay substantial sums to help schools pay for lighting retrofits.

"Many utilities offer rebates of $10 to $20 per fixture for retrofits," Sierleja says. "That will cover the cost of a ballast. Every lamp requires a ballast, but you can buy ballasts that drive one to four lamps. If you are retrofitting four-lamp fixtures, install four-lamp ballasts."

Then there is the federal Energy Policy Act of 2005, which allows commercial buildings that reduce watts per square foot to expense the investment rather than depreciating it over a number of years. Schools, of course, do not pay federal taxes and so can't expense the investment. The retrofit contractor, however, does pay federal taxes and the law allows certain organizations including schools to transfer tax savings to the designer of the retrofit — as long as certain standards are met. Check with your accountant.

Once you carry out a retrofit, Sierleja estimates that electricity costs will decline by enough to pay for the labor and materials required for the installation in 18 to 24 months.

After that, the lower costs become savings that can go toward educating students. SPM