Cold Climate Housing Research Center
CCHRC
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Upgrading Fluorescent Lighting

Making the switch to LEDs

In Alaska, public buildings and facilities spend more than $115 million each year to provide lighting to roughly 5,000 facilities. Many buildings that use fluorescent lighting have the potential to save a lot of money by switching to more efficient LEDs (or light-emitting diodes). As LED technology has progressed over the past decade, the number of products and manufacturers has ballooned. While this has helped LEDs gain market share, it presents a challenge for building owners and operators who are trying to select a product among a vast number of options.

CCHRC conducted a study that included a market review and product testing to find representative LEDs from a crowded marketplace that could easily and cost-effectively replace fluorescents in Alaska buildings. The study also includes an economic analysis with estimated cost-savings and payback times for the retrofit. In an attempt to find the lowest-cost solutions, the report focused on UL Type A (ballast-compatible) and B (line voltage) lamps. The full report, which can be found at cchrc.org, is a resource to help facility owners, operators, and maintenance personnel make informed decisions about lighting-related energy savings. Modifying existing fixtures requires licensed electricians and adherence to manufacturer's instructions to maintain the UL listing of the fixture.

LEDs were tested in a darkened interior room at CCHRC's Research and Testing Facility in Fairbanks.

Lamp Selection

CCHRC performed a brief market review to determine appropriate choices for replacing fluorescent lamps, which entailed searching industry databases of more than 7,000 LED products. Several parameters included:

- System power (not just bare lamp power) less than 17 watts (W) per lamp.
- Minimum 1500 manufacturer reported lumens
- Manufacturer with a substantial track record and at least a 5-year warranty.
- DesignLights Consortium (DLC) certification
- Availability and prevalence in Alaska
- Restriction of Hazardous Substances (RoHS) compliance

Lamp Testing

Testing was performed at CCHRC's Research and Testing Facility in Fairbanks, Alaska in a darkened interior room with one luminaire (fixture) and no exterior windows. Interior windows were covered to ensure no lighting would interfere. Researchers measured the system power in watts and the illumination in foot-candles. They also monitored for an effect known as the 60-Hertz (Hz) related flicker. This refers to the flicker from the lamp due to the 60Hz frequency of the electric grid, which can produce adverse health effects. It was evaluated with a cell phone camera that is able to pick up the flicker in an image.

After testing fluorescent lamps to establish a baseline, researchers tested seven LED replacements. Illumination was measured with the light meter in five locations for each test: 2 feet off the ground directly below the light, 69 inches and 93 inches off the ground along the long axis wall, and 69 inches and 93 inches off the ground along the short axis wall.

Light Output

Lights were chosen that would provide comparable illumination as the fluorescent lights they were replacing. Lamps significantly lower in illumination than the old fluorescents were not deemed adequate replacements unless there was a change in a room's use or design foot-candle requirement. Of the seven LED lamps tested, three demonstrated greater illumination below the lamp than older fluorescent lamps. However, none of the LEDs could provide higher illumination than a new fluorescent lamp.

Power Use

All tested LED lamps demonstrated considerable power reduction over the fluorescent lamps. **The three lamps with the highest illumination, including two Type A and one Type B lamp, had an average reduction of 45% compared to the fluorescent baseline.**

Tradeoffs

There are certain advantages to each lighting type: When a Type B lamp fails it is a direct result of the lamp. However, when a Type A lamp fails, it could be due to the lamp or the ballast. On the other hand, all of the Type B lamps exhibited some degree of flicker and none of the Type A lamps demonstrated flicker.

Economics

What is the payback of switching an Alaska building from fluorescents to LEDs? The report looks at replacing 1,000 fluorescent lamps at a typical public facility in Fairbanks with LEDs that provided the closest one-to-one illumination and used 45% less energy. In this scenario, we include not just the initial capital cost of the new lamps and materials, but also maintenance, lamp use, and labor over time.

Alaska has roughly 5,000 public buildings that could achieve significant financial and energy savings by switching fluorescent lamps to LED lighting.

This scenario assumes the following conditions:

- Golden Valley Electric Association's effective commercial rate of 14 cents/kWh and $21.62/KW for demand charges.
- Fluorescent lamp prices of $4/lamp.
- LED lamp prices of $10/lamp for ballast compatible (Type A) or line voltage (Type B) lamps and $15/ballast for 2-lamp ballasts.
- Lamp usage rate of 8 hours/day

An LED retrofit can provide a simple payback as quickly as 1-3 years, depending on the project. That's well within the LED's rated life of about 50,000 hours (equivalent to 17 years at average usage rates) and the typical 5-year warranty period. If the fluorescent lamps are upgraded during a normal maintenance cycle then the cost of the normal re-lamping is deducted from the costs of the LED upgrade, thereby shortening the payback period further. Conversely, if an LED retrofit is performed outside a normal maintenance cycle then the payback is longer but still favorable. See the full report for complete details of these scenarios.

Wrapup

When cost is the greatest factor in a lighting retrofit, the following guidelines may apply:

- If the ballasts are relatively new and compatible with LEDs, then a UL Type A LED lamp replacement is most cost-effective.
- If the ballasts need to be replaced for any reason, then a UL Type B LED lamp replacement is most cost-effective.

Upgrading fluorescent lamps to LEDs can offer substantial savings for facilities. The report attempts to narrow down the many choices and provide guidelines for building owners and managers to decide on a replacement that best fits their needs.

As the LED market matures, the risk of lamp failures goes down, and there is a lessening chance of the payback not occurring within the lamp's life. However, based on past failures with LEDs, consumers should be careful to purchase lamps from established manufacturers that can support significant warranty claims, if need be.

For the full report and additional resources on lighting and efficiency, visit cchrc.org