COOPERATIVE EXTENSION
WASHINGTON STATE UNIVERSITY
ENERGY PROGRAM

Energy Efficiency FACTSHEET

Dimmable Compact Fluorescent Lamps

Description: Dimmable versions of compact fluorescent lamps (CFLs) allow adjustment of lighting levels to meet user requirements and increase occupant comfort. CFLs produce about 4 times as much light as an incandescent lamp of the same wattage and can last ten times longer. Dimmable CFLs can save additional energy. The use of dimmable CFLs is increasing due to improved product availability and reliability. The color rendition of many models is similar to an incandescent lamp.

A CFL works much like a standard fluorescent lamp. It consists of a short tube or globe filled with a gas that produces light when high voltage electricity from a ballast flows through it. The ballast is either magnetic or electronic and can be either permanently attached to the tube (integral), or can be removable (modular).

While the integral models have the lowest first cost, modular models are clearly most economical in the long run. The integral configuration has a screw-in base, so it is a direct replacement for standard incandescent lamps. The modular configuration has a lamp with two or four pins on the bottom that plug into a socket; thus the lamp can be replaced without replacing the ballast, which have a life expectancy five times longer than the lamps. Ballasts for modular configurations may be hard-wired within a fixture or enclosed within a screw-in base.

Dimmable CFLs are available for both integral and modular designs. Most use electronic, rapid start ballasts. Dimming can be achieved gradually, without flicker, and without changes in color temperature. Some types of ballasts and controls utilize low voltage wiring to regulate the dimming and some simply reduce the power to the ballast. It is important that the lamp and dimming system be compatible.

Applications: Dimmable CFLs can be used in new construction or to retrofit existing incandescent fixtures in office buildings, residential and institutional living facilities, and any other place where incandescent fixtures have been used in the past. Most dramatic savings will be in applications with high annual operating hours. Compared to incandescent lamps, CFLs reduce the heat load (a benefit in summertime and a detriment in the heating season); thus, maximum benefit would result from installation in a climate with a long cooling season.

CFLs produce a more diffuse light than incandescent lamps, so they are good for area lighting. Dimming varieties are particularly good in spaces where ambient light level control is desired. Many occupants appreciate the ability to reduce light levels to suit their activities.

Be careful retrofitting integral CFLs with ballasts in recessed fixtures because heat buildup can affect ballast performance. Also note how the reflector behind the lamp in the existing fixture performs with CFLs; the larger size and taller base of CFLs may affect the fixture's performance. The best approach may be to try out several models before purchasing any large quantities. It is a good idea in any dimming application to operate the lamps at full output for approximately 100 hours before beginning to dim them.

Regarding type of dimmer to use, solid state dimmers are the most expensive, and in retrofit applications require a third wire to be installed for control. However, many CFL manufacturers do not recommend using the simpler and less expensive dimmers designed for incandescent lamps, and some strongly discourage it. The harmonic distortion such inexpensive dimmers create can range from 150-3000 percent. High harmonics can negatively impact sensitive electronic equipment (computers, communications, building automation, etc.) that is increasingly common in federal facilities, especially if that equipment is on the same circuit as the lighting. If only a few CFLs are being considered for dimming, this may not be an issue, but for larger installations the cheaper ballasts should be avoided.

Photoelectric sensors can maintain light level as lamp output changes and daylighting levels change, reducing energy use; see the Technology Profiles "Daylight Dimming Controls" and "Compensating for Lamp Lumen Depreciation" for more information on this opportunity.

Performance/Costs: CFLs produce approximately four times more light output per watt than incandescent lamps. This means a 100-watt incandescent lamp can be replaced with about 25 watts of CFL. Simple paybacks are usually less than 3 years with lamps that operate more than 4,000 hours per year.

Many CFLs have an expected operating life of 10,000 hours, which is 5 to 13 times longer than incandescent lamps. This can save a great deal on the maintenance labor for lamp replacement. Dimming increases savings even further. As with many energy efficiency measures, the exact reduction in energy use due to dimming varies widely with application and operation. However, a 30% reduction is reasonable to expect if building occupants receive some awareness training and encouragement to take advantage of the technology.

With proper controls, CFLs can be dimmed from 100% down to 10% light output. Dimming controls cost about $100 to $125 for a wall-mounted solid-state dimmer that can control up to a 20-amp circuit; for retrofit applications, a third control wire must be installed. A conventional dimmer designed for incandescent lighting may cost only $10 or less. However, as described under "Applications" above, such dimmers are generally not recommended. Solid state ballasts are also slightly more energy efficient.

In systems designed with hard-wired modular ballasts, up to three lamps can be connected to a single ballast. The incremental cost of CFL dimming over non-dimmable CFL fixtures will vary depending on number of lamps per ballast, but for a large installation the incremental difference might be as low as $10 per fixture. An integral dimmable lamp and ballast may cost $25-35, while a modular lamp and ballast may cost $45. However, the integral lamp and ballast must be replaced every 10,000 hours; with the modular equipment, the lamp can be replaced for about $5 every 10,000 hours, while the $40 ballast lasts 150,000 hours.

An important benefit of dimmable lighting in office and conference areas is greater occupant comfort and convenience. Office overhead

lighting often causes glare and reflection on both computer and paper-based work tasks, and dimmer light may be more appropriate for these tasks and during presentations with projected images. Research by the Lighting Research Center concludes that employees who have lighting control available in the workplace feel a greater sense of empowerment and job satisfaction.

Example: You are constructing a new building with a large lobby and hallways with ample natural lighting. You are considering overhead compact fluorescent lighting with dimmable ballasts. The total area is 10,000 square feet. CFL lighting will average 1.0 watts per square foot. The building operates from 6 AM to 11 PM, six days a week. Switched lights would be on for 4,992 hours per year, for total energy consumption of 49,920 kWh/yr. The space would contain about 400 CFL fixtures.

Dimmable ballasts cost $4,000 more than conventional ballasts; additional controls and wiring cost $1,500. An average 30% reduction in energy use per year would save $1,050 in energy use (15,000 kWh at $0.07/kWh) and $216 in electrical demand charges (3 kW at $12/kW/month for 6 months, assuming that peak demand is set by air conditioning during high solar gain.).

Simple Payback on Investment in Dimming Control =

Additional Costs for Dimmable Controls / [Energy + Demand Charges] =

[$4,000 + $1,500] / [$1050 + $216] = 4.3 years

Availability: There are several manufacturers of CFL in both integral and modular ballast designs. There are two major manufacturers of dimmable ballasts for modular installations.

For Additional Information:

ENERGY STAR - compact fluorescent light bulbs

http://www.energystar.gov/products/cflbulbs.html

For information on performance and cost effectiveness of CFLs.

Manual vs. Dimming Controls

http://www.lightforum.com/technology/dimming.html

Addresses the pros and cons of occupant vs. photosensor control of lighting in a daylighted office environment.

Retrofit Control Devices

http://www.lightforum.com/technology/retrofit2.html

From Advanced Lighting Guidelines published by the California Energy Commission. Gives an overview of lighting controls, including daylighting.

Daylighting for Commercial and Industrial Buildings

http://www.eren.doe.gov/consumerinfo/refbriefs/cb4.html

An EREC Reference Brief from the U.S. Department of Energy, Energy Efficiency and Renewable Energy Network.