Lighting Systems

Energy Saving Opportunities

- Turn off lights when not needed. (This can produce energy savings of 15 to 50 percent.)
- Install the most efficient lamps available. (Energy savings of up to 30 percent are possible by switching to more efficient lighting equipment.)
- Install lighting control systems, motion sensors, and timers.

Occupancy sensors can detect people in a room and are especially good for bathrooms or meeting rooms that are empty for large periods of the day. These sensors can come with an on-off switch. Light sensors or motion sensors are useful for exterior security lighting and doorways. These sensors respond to sunlight (turning light sensors off) and movement (turning motion sensors on).

Timers can be programmed to turn on and off at certain hours for interior or exterior use.

- Replace tungsten lightbulbs with new energy saving "compact" fluorescent lamps.
- Replace incandescent exit lamps with LED exit fixtures.
  Exit signs that used incandescent bulbs were common, but have since been taken off the market in Canada as LED have much longer lives. Use LED exit fixtures to avoid the more frequent incandescent replacement costs and lower efficiency.
- Convert mercury vapor to metal halide or sodium vapor.
- Use Metal Halides and High Pressure Sodium Lamps in large, open areas.
- Interior: If buildings with high ceilings are not using fluorescent lamps, they are likely using high-intensity discharge lamps. Older types, like mercury vapour, should be replaced with metal halide lamps. Even if you must replace the ballast or the whole fixture, the replacement will be economical and improve light quality. Metal halide lamps render colours better, they are available in a variety of power outputs and have long lives. New big box retail stores use metal halide lamps. Metal halide spotlights are also available for displays (with lower energy costs than halogens).
- Exterior: High pressure sodium (HPS) lamps are the most efficient lamps and are good for exterior security and large open areas where light quality is not critical. (In similar areas where you want good light quality, for example doing detailed work, metal halide is the better choice). HPS lamps emit a yellow tint. They are available in a range of power outputs: 35-1000 W and have an extremely long life. Replacing outdoor incandescent lamps with HPS lamps can lower costs 80-90 percent. The payback is under 2 years.
- Be aware of the difference with low pressure sodium lamps. They are efficient but have a muddy yellow colour.
- Install electronic ballasts and matching lamps. Modify fixtures (add reflectors, lower height).
- Replace T-12 fluorescent lamps with T-8 with electronic ballasts.
- Install automatic daylight dimmers.
- Install day lighting (e.g., light tubes or light pipes, skylights, clerestory windows, and light shelves).
- Use thin fluorescent tubes (26mm or T8). They have the same light output as the thicker (38mm or T12) but use less energy.
- As the thicker tubes fail, replace them with thin ones. (Check the suitability of older fittings first.)
- Use the minimum amount of lighting required to perform tasks effectively and safely.
- Locate desks requiring the most light nearest to the windows.
- Keep lamps clean and remove unnecessary lamps.
- Make it easy for employees to turn off lights.
- Install switches for smaller areas. Often one main switch controls dozens of lights not needed.
- Use messages next to switches to make people aware of the need to conserve energy.

- Use localized controls for turning lights off.
- Clean shades: A dirty shade can cut down light by 20 percent.
- Replace flickering tubes promptly.
- Use light coloured surfaces to improve illumination levels. Paint and decorate in light colors, as light colors reflect light.
- Install "zoned" lighting in preference to main room lights.
- Use natural light whenever possible. Turn off lights near windows when daylight is adequate.
- Turn off lights in unused common areas such as copy rooms, break rooms and conference rooms.
- Use one large bulb instead of several small bulbs that add up to higher wattage.
- Avoid using incandescent task light (desk lamps) by switching to compact fluorescents.
- If you are making improvements to outdoor lighting, consider shields to reduce glare and focus the light in the desired direction. Focussing light downward not only means substantial savings, it also limits wasteful light pollution into the night sky.

Incandescent

Because of its relatively poor efficiency, incandescent lighting is quickly being displaced by other lights. It is still used in areas where lights are to be switched often, dimmed for variable output, or in very cold temperature applications.

Life of an incandescent bulb is generally about 1000 hours, with extended service versions of up to 2500 hours. Another category called "long life" can reach operating hours of 5000 to 6000 hours. Note that that longer life is achieved through the use of heavier filaments that produce less light and work less efficiently.

Colour rendition is very good. A close "relative" of this source is quartz, which is basically an incandescent filament in an envelope containing special gases.

Efficiencies of about 21 to 23 lumens per watt with life ratings of 2,000 hours can be achieved. Loss of lumen output at the end of life is normally less than 10 percent of the initial values. Loss of lumen output in cold weather is less than 5 percent.

Compact Fluorescent Lamps

Fluorescent lamps have been created in compact form to replace incandescent lamps. Compact fluorescent lamps (CFLs) are four-times more efficient than standard incandescent lamps and 10 times the average lifespan with lower maintenance costs. CFLs have improved to have good light quality — they have been used in modern hotels for corridor lighting and are encouraged as well for residential use. CFLs are good for high use areas: lobbies, security, and displays. Compact fluorescent fixtures with reflectors provide an excellent substitute for flood lamps. To ensure CFLs are the right choice, test out a few for acceptability. Certain low-use areas such as closets might still warrant keeping incandescent lamps, but for the most part it makes sense to replace them with another type of lamp. For more information on CFLs: oee.nrcan.gc.ca/energystar/english/consumers/light.cfm?Text=N&PrintView=N#cfl

Incandescent lamps	Compact fluorescent lamps
25 W	5 W
40 W	7 W
60 W	13 W
75 W	22 W
100 W	28 W

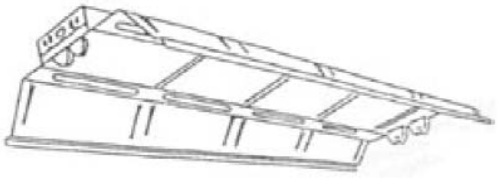
Equivalent wattages to replace incandescent lamps with compact fluorescent lamps.

There are only a few compact fluorescent lamps that can be used in dimmer switches. Carefully read the packaging of each CFL product to determine whether or not the CFLs can be used in conjunction with a

dimmer. Manufacturers who have products that work with dimmers include Philips, Osram Sylvania and General Electric.

Long Tube Fluorescents

The longest life in the compact fluorescent lamp family belongs to the long tube fluorescent lamps. They last 20,000 hours — twice as long as the compact fluorescent. These long tubes can replace standard fluorescents:



Open style fluorescent fixture

Standard fluorescent	Long tube fluorescent
F20	18 W
F30	24 W
F40	36 W

Equivalent wattages to replace standard fluorescents lamps with long tube fluorescent lamps.

T8 Fluorescent

T-8 fluorescent lighting is extremely popular because of its efficiency, relatively good colour rendition, and very good life (15,000 to 24,000 hours). T-8 fluorescents require a ballast for operation because they are an arc discharge lamp. Standard electronic ballasts are designed for reliable operation down to 10ºC (50ºF) with low temperature versions available down to -18ºC (OºF). Compared to the standard T12 lamps, T8 lamps are 10 percent more efficient. The T8 electronic ballasts use 30 percent less energy than old magnetic ballasts. Depending on actual fixture construction, fluorescent lighting still remains a very economical lighting source. Sometimes lamp jackets or sleeves are used over the lamps to maximize light output at cool temperatures. There is no problem with fluorescent lights during momentary power dips (such as during the starting of air conditioners or other large loads) as arc re-strike is virtually instantaneous. Lamp output is highly dependent on temperature. Output is maximum (100 percent) at about 25°C (77°F) and falls to about 70 percent at -l°C (30°F). Loss of lumen output at end of life is normally about 20 percent of the initial values.

A T12 (top lamp) and a T8. The T12 measures twelve eighths of an inch or 1.5 inches in diameter; the T8, eight eighths of an inch or 1 inch in diameter. Pin spacing is the same for both lamps, facilitating replacement.

Metal Halide (MH) (Standard Technology or Probe-Start)

Because of its good efficiency as well as very good colour rendition, metal halide (MH) is a very popular light source. A lumen loss of about 30 percent can be expected at the end of life. Some probe-start metal halide lamps have tended to explode at the end of their life, particularly if they were used continuously and never shut off. Rated life is about 10,000 to 20,000 hours.

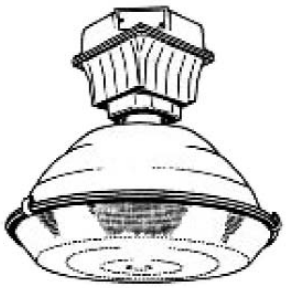
There is very little lumen loss at lower temperatures [-1°C (30°F)] compared to fluorescent lamps. Metal halide lamps perform best in the Base-Up or Base-Down operating position. There is a roughly 15 percent light loss when the lamps are operated up to 30 degrees above or below horizontal. Always select a fixture with Base-Up burning for efficiency and ease of maintenance.

Metal Halide is effectively the same lamp type as mercury vapour except that metallic additives have been added for extra efficiencies. It requires a somewhat different ballast from a mercury lamp because of higher starting voltages.

A mercury lamp operates well on a metal halide ballast, but a metal halide lamp does not operate on a mercury ballast. Warm-up and re-strike times for metal halide lamps are slightly less than mercury

Metal Halide (MH) (Pulse-Start)

Pulse-start metal halide, a new technology should be considered primarily because it is about 20 percent more efficient than standard metal halide. In some cases lamp life is also longer.



Enclosed Pulse-Start Metal Halide Lighting

Pulse start is now available in a broader range of wattages between 175 and 400 watts. Lamps are ignited by a starter that emits a pulse (hence "pulse start") rather than relying on the ballast open circuit voltage. As a result pulse start has better cold temperature starting reliabilities than the standard (probe-start) MH lamps.

Because pulse start systems are becoming more popular, prices for both fixtures and lamps are dropping. As a rule, the total fixture (and lamp) cost of a standard versus a pulse-start metal halide system is about equal, even though about 20 percent fewer pulse-start fixtures are required. Installation cost is lower and more important, less energy is required for the future life of the system. Warm-up and restart-time is faster for pulse-start technology.

Pulse-start metal halide lights have a 2-minute warm-up and a 4-minute restart time compared with probe-start metal halide lights, which have a 4-minute warm-up and a 15-minute restart time.

Caution: For all MH lamp types, it is very important that failed lamps be changed out quickly to avoid progressive damage to the ballast.

High Pressure Sodium (HPS)

High pressure sodium (HPS) lighting is quickly gaining popularity in both indoor and outdoor applications because of its efficiency, low cost, and excellent lumen maintenance. A loss of about 20 percent of initial output can be expected at the end of its life. The colour of light is golden or light amber and is quickly gaining acceptance in all applications where colour rendition is not critical.

High Pressure Sodium Wall Pak

A good variety of lamp wattages is available (70, 100, 150, 250, 400, and 1000 watt) as well as fixture types by many manufacturers. Ballasting for HPS sources is more critical than for mercury/metal halide sources as the ballast must have greater regulating properties as well as an electronic starting circuit to "fire" or start the lamp. Ballasts must be integrally mounted with the lamp because of the high lamp ignition voltages required.

Because HPS lamp output is relatively position insensitive, lamps can be operated in any position. HPS has excellent cold temperature operation and quicker warm-up as well as re-strike times, compared with mercury and metal halide.

Although HPS do not rupture at end of life, a totally enclosed fixture is still recommended to protect the lamp, particularly in sports areas. Normally lamp life is about 24,000 hours, but dual-arc HPS lamps are available with a life of 30,000 to 40,000 hours. Dual-arc HPS also have the advantage of instantaneous re-strike during a power "dip" or very short term outage as the "second" arc re-strikes immediately while the "first" arc cools down. As with metal halide a burned-out lamp should be changed quickly as the ballast will gradually suffer damage.

It is very advantageous (if possible) to match exterior as well as interior lamp wattages. A very popular lamp is the 250 watt, as well as the 400 watt.

Low Pressure Sodium

Low Pressure Sodium (LPS) lighting is closely related to the fluorescent lamp since it is a low-pressure, low intensity discharge source and has a linear lamp shape. The lamp consists of an arc tube enclosed in a clear tubular outer bulb. The arc tube is enclosed in a vacuum created inside the outer bulb. The colour of the light is a monochromatic yellow. It can be used in applications where colour rendition is not critical.

A large variety of wattages is available, from 18 to 180 watts. This source has the highest efficiency of all sources, ranging from 100 to 180 lumens per watt. Ballasts are required to operate this source. Typical start-up times are about 12 minutes, with re-striking of the lamp immediately after interruption. This lamp type starts and performs well at temperatures below -1°C (30°F). Rated life is 18,000 hours. Wattage increases 7 percent, and lumen output decreases 5 percent, by the end of lamp life.

This source is very good for exterior applications but has suffered market loss to HPS and MH, primarily due to system cost. Another drawback is that these lamps emit a muddy yellow colour.

Lighting Ballasts

The average rated life of ballasts for most ballasted light sources is 15 years, and up to 20 years for premium quality ballasts.

The life of a ballast can be dramatically shortened if it is subjected to high temperatures for extended periods. For High-Intensity Discharge (HID) ballasts, it is advisable to leave a minimum 6-in. space between the top of the ballast housing and the ceiling.

Fluorescent fixtures should always be tightly surface mounted to ceilings to improve heat transfer. Suspending fixtures from ceilings results in low ballast temperatures. However, T8 electronic ballasts have very low losses and are not as temperature critical as the magnetic versions.

For more information on technical specifications on lighting, you can refer to The Lighting Reference Guide (2005) from the Government of Ontario available at: www.energy.gov.on.ca/english/pdf/conservation/LightingGuide.pdf

Find more lighting tips in the US Environmental Protection Agency's guide for congregations: "Putting Energy into Stewardship": www.energystar.gov/index.cfm?c=small_business.sb_congregations