



HOME LIGHTING

Minnesota Department of Commerce Energy Information Center

It may seem hard to beat the familiar Edison light bulbs we've all used for years. They are inexpensive, fit our fixtures, are readily available and give off a pleasing light we are all comfortable with. However, the standard incandescent light bulb is terribly inefficient. Because almost all of the electricity going into it is lost in heat, the light bulb is actually much better at providing heat than light.

Choosing energy efficient bulbs

New lighting products are not only more energy efficient, they offer many more possibilities to improve the quality of lighting our homes, indoors and out.

Comparing cost and efficiency

The new technology and how to use it: 4 strategies

Strategy 1: Replace standard incandescent lamps with compact fluorescent lamps.

Room-by-room lighting ideas

This guide looks at some of the new technologies for residential lighting, identifies four basic strategies you can apply, then provides specific examples of how to put the new strategies into practice throughout your home - room by room.

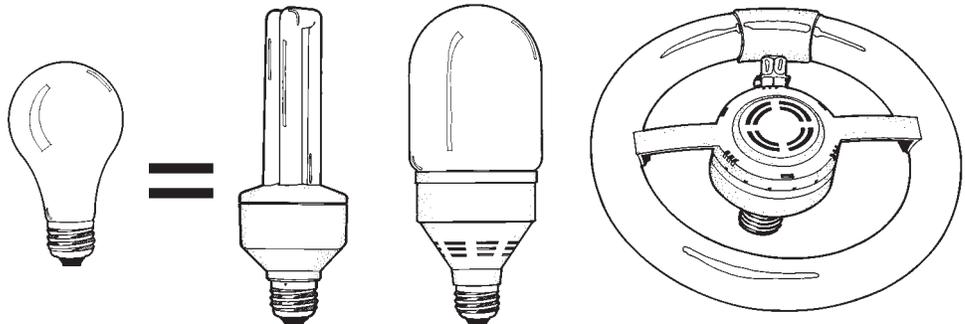
No other new product in the lighting industry has had as great an impact as the compact fluorescent lamp (CFL). Modern CFLs have taken the best aspects of fluorescents - high efficiency and long life - while eliminating traditional problems of

Outdoor lighting

Do's and Don'ts

Common replacements

Incandescent Watts (lumens)	Compact Fluorescent Watts (lumens)
60 (900)	16 (900)
75 (1200)	20 (1100-1200)
100 (1750)	30 (1600-1800)



Compact fluorescents come in a variety of shapes and sizes to fit different fixtures.

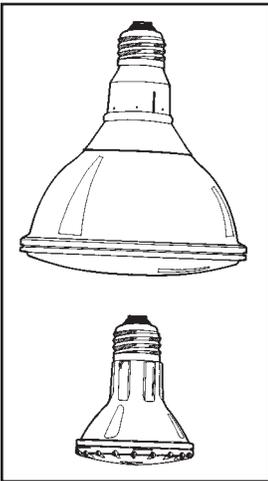
Related Guides:

- Low Cost/No Cost Ideas
- Appliances

Tip:

Look for the new "improved color" fluorescent tubes.

If you can't use fluorescents, look for "halogen" bulbs.



Tungsten-halogen reflector lamps are 40% more energy efficient than incandescent R-lamps.

poor color, flicker and noise. Although, CFLs still cannot be used with dimmer switches and do not perform well outdoors in cold weather. They cost an average of \$10 to \$25 per bulb, but they last ten times longer than incandescents and use 60 to 75 percent less electricity!

You'll get the most benefit by switching to CFLs wherever you use high wattage incandescent lamps more than three hours per day – often in the kitchen and family room.

Strategy 2: Replace standard incandescent ceiling fixtures (especially in the kitchen and laundry area) with fluorescent fixtures equipped with tri-stimulus phosphor lamps.

These lamps provide the energy savings of fluorescent lighting with an improved color that complements rather than clashes with natural daylight. Kitchen and laundry areas especially need and use lots of light, so look for big savings in these areas.

New fluorescent 4-foot tube lights coated with "tri-stimulus" phosphors come in three shades of white. The "warmest" of the three provides a light similar to incandescents and is designated 3000K. The lamp with the coolest hue has a rating of 4100K. There is also a lamp with an "in-between" color designation of 3500K. When offered the choice, most people prefer 3000K and 3500K lamps. Although these lamps cost about \$8 to \$12, with a rated life of 20,000 hours they can be expected to last over ten years in most residential applications.

Strategy 3: Replace incandescent spot and flood lights with "T-H" PAR lamps. Or better yet, manufactured compact fluorescent flood lamps. These new arrivals on the market in R-30 and R-40 sizes can easily replace many floods and spots used indoors.

In places where fluorescent lighting cannot be used, tungsten-halogen (T-H) lighting is a good choice. Basically a more efficient form of incandescent lighting, although not as efficient as fluorescent, "halogen" bulbs produce a crisp light that brings out the true colors of your furnishings – which makes this lamp popular with decorators.

In your recessed ceiling or track lighting fixtures, a good replacement is the T-H PAR (parabolic aluminized reflector) lamp, which is 40 percent more energy efficient than incandescent reflector

lamps, costs about \$7 and can be used indoors and outdoors.

You can also get T-H "A-line" (traditional style) bulbs to replace standard 60, 75 and 100 watt incandescents. They use 12 percent less electricity and have a longer life – at an average cost of \$3 per bulb.

Strategy 4: Use automatic lighting controls in dining rooms, hallways – or anywhere!

A number of easy to install lighting controls are available that will increase your lighting flexibility, your home security and your energy savings.

- **Electronic dimmers**, especially popular in dining rooms, regulate the brightness of incandescent and tungsten halogen lights, allowing you to create an informal, relaxed atmosphere – and they save energy.
- **Motion sensing light switches** turn lights on and off automatically when someone enters a room, offering "no-hands" light control for hallways, bedrooms and other areas where lights are inadvertently left on, or as part of your home security system.
- **Electronic timers** provide precise, automatic on-off control of light fixtures and are often used for home security. For instance, they will turn specific lights on automatically at dusk and off at "bedtime" making your house appear occupied when you are away from home.

How to compare cost and efficiency

Why would you buy a \$20 compact fluorescent bulb rather than a \$1 incandescent? Because the more costly efficient bulbs produce more lumens (light) per watt (electricity used) than the cheaper bulbs, and last up to 10 times longer, making them a better bargain in the long run. The two basic pieces of information you need to find the best buy and the right product are right on the package.

Watts – This is often the only number people look for when buying a light bulb. It tells how much power the bulb consumes, but nothing about the light output.

Average lumens – This is the amount of light given off by the bulb.

Efficiency = Lumens per watt

For example: A 75-watt incandescent bulb uses 75 watts of electricity and provides 1,200 lumens. A 20-watt compact fluorescent uses 20 watts of electricity (one-fourth the amount) and provides the same amount of light (1,200 lumens). Which is the better deal?

Combined cost of lighting – To determine the real cost of lighting, add the cost of the bulb (initial cost plus replacements) and the electricity cost. For example, compare the operating cost of a single 20-watt CFL and a 75-watt incandescent (over the life of the bulb).

	Bulb cost (Initial x replacement)	Electricity (10,000 hours)	Total
75W Incand.	\$1 X 13 = \$13	\$48.75	\$61.75
20W Com. fluor.	\$20 X 1 = \$20	\$13.00	\$33.00

How to evaluate your lighting

To evaluate the lighting you presently have, take a tour of your home in the evening, turning on the lights as you go from room to room. Are you getting the light you need in each area? First, you should know that lighting generally falls into one of three categories:

Accent lighting is used to highlight specific objects, such as art work, shelves or plants. It can also illuminate wall surfaces in a soft wash of light or accentuate the texture of the surface.

Task lighting directs light to specific activity areas. Lights under cabinets to illuminate kitchen work surfaces, or a reading lamp next to that favorite chair are two common examples of task lighting.

Ambient lighting distributes light broadly throughout a space, such as the traditional single ceiling fixture located in the center of a room. Ambient lighting by itself is still adequate for general activities that are not visually demanding, but will not give you the quality of light you need for reading or sewing.

To make sure you get the lighting you want, choose and locate accent fixtures first, then choose and locate task lighting fixtures. If additional light is still needed, use ambient lighting fixtures.

Putting the strategies to work

Experts know that the right lighting can dramatically change the look and feel of a room. Following are several ideas that you can use to enhance the beauty of your home and increase your lighting energy efficiency – room by room.

In the kitchen ...

- Mount low profile fluorescent tube fixtures under cabinets above work surfaces to provide the light you need for food preparation and clean-up. They should be mounted as close to the front of the cabinet as possible to avoid counter-top glare. A good choice is a thin T5 fluorescent tube lamp that consumes 8 watts per linear foot.
- Use recessed ceiling fixtures or track lighting with 45-50 watt T-H PAR 38 flood lamps over a work island or open counter. (See Sidebar: Spot or Flood lights – What’s the difference?)
- Use a pendant fixture over the table equipped with either a 60-watt incandescent lamp or a T-H “A” lamp on a dimmer switch. Better yet, a 20-watt compact fluorescent approved for dimmer use.
- For ambient lighting, use ceiling-mounted fluorescent fixtures with tri-phosphor lamps (choose 3000K or 3500K for medium to warm color). Select a ceiling fixture that directs some of the light up toward the ceiling. This minimizes the “gloomy” look of a dark ceiling and can make a small room feel larger.

In the dining room ...

- Combine a decorative fixture or chandelier over the dining table with other fixtures which provide ambient light. A hanging fixture by itself usually becomes a source of glare if it is used to brightly illuminate the entire room.
- Use T-H PAR spot lamps in recessed ceiling or track fixtures as accent lighting to highlight a painting or to illuminate a buffet. For distances of six feet or less, 45-50 watts per lamp is sufficient. Beyond six feet, use 75-watt lamps. Better yet, try one of the compact flood lamps.
- Install separate dimmer switches for each type of lighting to provide maximum flexibility.

Spotlights or floodlights - what's the difference?

When purchasing bulbs for recessed ceiling or track lighting fixtures, you may have to choose between “spot” or “flood” versions of the same bulb. You will be disappointed if you mistakenly purchase the wrong type.

Spot lights direct the light more intensely into a smaller, tighter beam. Use spot lights primarily for accent lighting applications, but never for ambient lighting.

Flood lights disperse the light into a wider beam - lighting a broad area less brightly than a spot light. Flood lights are most often used for ambient ceiling or track fixtures.

Safety code for closets!

According to the state's safety code, certain precautions must be taken when using incandescent bulbs in closets. For instance:

- The lamp must be enclosed. You cannot use an open bulb in a closet.
- Surface mounted incandescent fixtures must be at least 12 inches from shelves or clothing rods.
- Lamps in recessed fixtures and surface-mounted fluorescent fixtures must be 6 inches or more from shelves or clothing rods.

Contact your local building inspector if you have further questions.

In the living room or family room ...

- Use CFLs with high light-output bulbs in reading lamps next to furniture. The circular style (30-watt) with an electronic ballast will give you 2200 lumens – equivalent to a 150-watt incandescent bulb.
- Use T-H PAR flood lights in recessed fixtures over game tables or activity areas. Add dimmer switches for maximum light control and energy savings.
- Try a technique called “wall washing” for ambient lighting. Look for the new recessed ceiling fixtures made for compact fluorescent lamps or use a decorative wall bracket with fluorescent tube fixtures. Directing the light toward ceilings and walls reflects light throughout the room. (Note: This is not as effective in rooms with dark colored walls.)

In the bedroom ...

- Soft, ambient lighting is usually adequate and attractive for bedrooms, with an additional reading lamp or two at the bedside.
- In a master or guest bedroom, install one ceiling fixture using two 15-20 watt compact fluorescents or 60-75 watt incandescents.
- In a child's room add automatic wall switches that turn lights off when the room is unoccupied.
- Adding a light in the closet can be useful when you want to avoid lighting the entire room. Although, be aware that there are safety code restrictions to placing incandescent bulbs too close to clothing or other combustible materials. (See side bar.)

In the bathroom ...

- Use dimmable fixtures with incandescent or tungsten-halogen lamps on both sides of the mirror for the best cosmetic lighting. A second-best choice would be lighting above the mirror.
- Provide lighting above bath and shower areas for safety – especially in larger bathrooms – with recessed or surface mounted ceiling fixtures.

Outdoor lighting

Recent developments in outdoor lighting have greatly expanded the possibilities to increase the

safety, security and beauty of your property as well as saving energy. Following is a description of some of the products available, along with suggestions for how to use them.

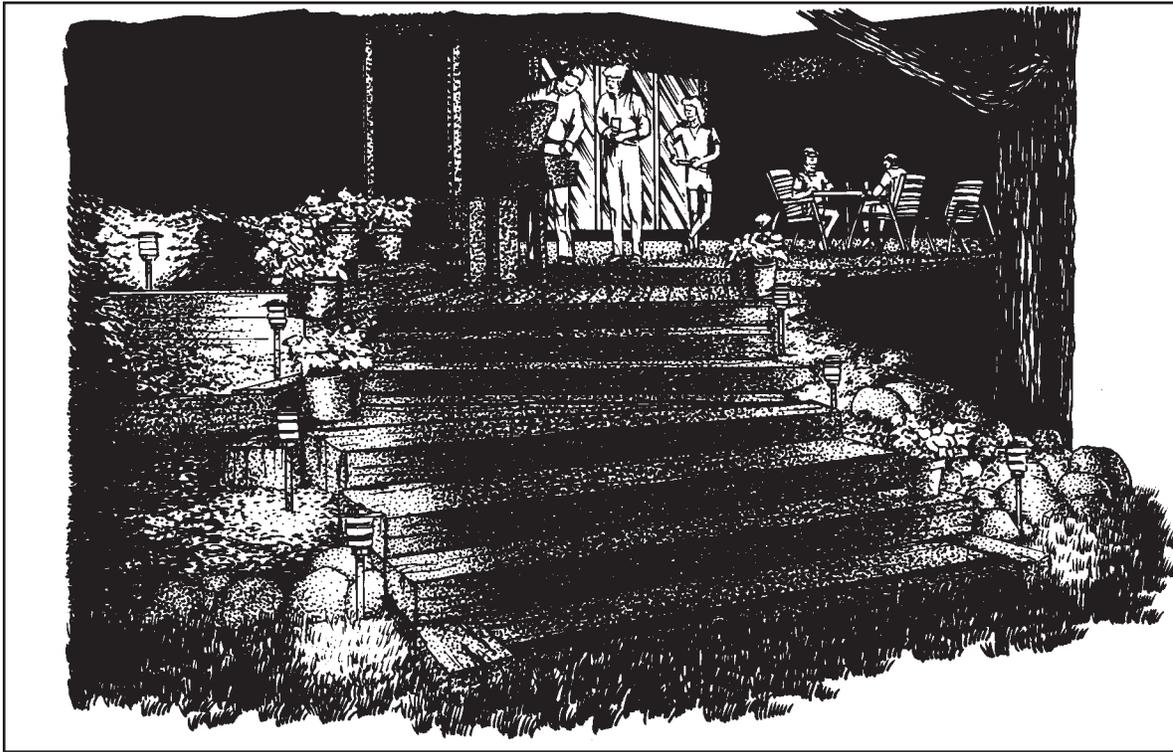
Low-voltage incandescent or tungsten-halogen lamps are popular for landscape lighting because of their safety (less shock hazard), low energy cost, and they are easy to install. They run on a 12 volt current rather than the standard 120 volts and operate off transformers, similar to doorbells. You can choose among tier lights, mushroom lights, floodlights, or high and low walk lights, many of which come mounted on stakes that push into the ground. Put these lights on motion detectors or programmable timers to limit their on-time and energy consumption.

PAR lamps are available in 120 volt spot and flood lights appropriate for outdoor lighting. Look for the tungsten-halogen which provide more light, last longer, and consume less power than regular incandescent reflector lamps.

Insect lights just don't work! Designed to trap and kill insects (specifically mosquitoes), they would seem a good choice for an outdoor light in Minnesota. Unfortunately, these lights usually attract mosquitoes in such large numbers that the kill rate is ineffective. Ultraviolet and blue wave lengths attract insects – yellow repels them. High pressure sodium lights, with their golden yellow hues, would be a good choice. Or, any bulb with a yellow coating or a fixture with a yellow lens would also work as a repellent.

Gas lights with mantles that are heated with natural gas are sometimes still used for outdoor decorative lighting, although state law currently forbids installing any new gas lamps. These lamps give out very little light for the energy consumed. Also, the cost of operating a gas lamp is expensive (four to 16 times as much as incandescents) since the lamp is on 24 hours a day. If you already have a gas light, it would be more economical to convert it to an incandescent fixture by purchasing a low voltage conversion kit with photocell.

High pressure sodium lamps (HPS), characterized by a “golden” or yellow colored light, provide a highly efficient means to light wide areas, such as yards and building perimeters, and are a good replacement for older “blue-green” mercury vapor



Tip:

Enhance the beauty, safety and security of your property with energy efficient outdoor lighting.

High pressure sodium lighting is a good highly efficient replacement for your outdoor lighting.

lighting. Recently, fixtures have been developed for high pressure sodium lights that mount on the sides of outdoor buildings – which would be a good choice for lighting areas around garages, barns or other out buildings. In animal production barns it is important to use fixtures rated for high humidity and damp conditions.

Photovoltaic cells directly convert sunlight into electrical energy. Photovoltaic (PV) light systems collect and store energy from the sun, then use the energy to produce light at night. They are most useful as an outdoor summertime light, especially for those who would otherwise have to pay for extending electrical wiring into their yards or to a remote site. Although, be aware that all PV light kits are not created equal. Before purchasing, make sure the operating characteristics are compatible with Minnesota winter temperatures and the intended use.

Lighting Controls are useful outdoors as well as indoors.

- Automatic timers allow you to set lights to go off and on at specific times.
- Photocell controls, sensitive to natural light levels, will automatically turn lights on at dusk and off at dawn.

- Security spot lights turn on and off when someone steps in and out of its range.

All controls must be protected from the weather. Be sure to check operating temperature range before installing any outdoor lighting equipment. Higher quality products often include circuitry which compensates for Minnesota's temperature ranges.

Seal recessed lighting fixtures to prevent air leaks

Heated indoor air leaking through unsealed recessed light fixtures causes numerous problems, in addition to heat loss. When warm air leaks into the unheated attic, water condenses and can drip back onto the light fixture and ceiling. The heated air, by creating warm spots on the attic roof, also can cause ice dams along the roof eaves. Air leaks in ceiling fixtures also can contribute to the loss of needed combustion air, contributing to dangerous backdrafting of the furnace and water heater. All recessed light fixtures are not created equal. IC rated recessed lights can have an airtight box built around them, then covered with insulation. Proper insulation is very important. For recommended measures to ensure air tightness, contact the Energy Information Center.

Common Replacements

Pole-mounted fixtures to replace older mercury vapor heads:

Mercury vapor	HPS	Light output (lumens)
250 watt	150 watt	14,400
175 watt	100 watt	8,850
100 watt	50 or 75 watt	3600-5600

Replacements for entrance, wall-mounted, or decorative post-top lighting:

Incandescent	HPS	Light output (lumens)
500 watt	100 watt	8,850
300 watt	70 watt	5,600
200 watt	50 watt	3,600
135 watt	35 watt	2,000

Lighting types and how they work

Incandescent means “glowing with heat.” Light is produced when the electric current heats the bulb’s filament. The bulbs are usually made of clear or frosted glass, screw into a “medium base” socket, generally last from 750 to 1000 hours, and emit a warm white light.

Reflector lamps (R-lamps), most often seen in recessed ceiling or track lighting fixtures, are incandescents, halogen or compact fluorescent with the bulb partially coated with aluminum or silver to direct more light out of the bulb. An improved version, with more precise reflectors, is the PAR lamp (parabolic aluminized reflector). They are available in spot or flood light versions and are also used outdoors for security or decorative lighting.

Tungsten-halogen is another type of incandescent that provides a whiter light and a higher light-output over time than regular incandescents. Unlike earlier versions, the new T-H lamps will operate on standard household current (120 volts) and screw into standard sockets. The new bulb design, encasing the tungsten filament within a glass capsule, has also eliminated the health risks associated with ultraviolet radiation.

Fluorescent lamps produce light by activating light-emitting phosphors. The electric current flowing between the electrodes at each end generates ultraviolet radiation, which in turn excites the phosphors coating the inside of the tube. Since this produces very little heat for the amount of light produced, they are more efficient. All fluorescent lights require a ballast to convert ordinary

household current to the high voltage needed to start and maintain the light. Magnetic ballasts are heavier and will flicker at start-up, while electronic ballasts are lighter and provide an “instant on” feature. When operated properly, fluorescent lamps will last from 9,000 to 20,000 hours.

High intensity discharge (HID) lamps produce light by passing an electric current through gas under pressure. Because they can operate throughout a wide temperature range they are often used for outdoor security lighting. Mercury vapor lights, known for their blue-green color, have been used for outdoor lighting since the 1930s. They are being superseded, however, by high pressure sodium lamps which produce a golden colored light and are very efficient.

Lighting Do's and Don'ts

Don't use “long life” incandescent bulbs – they may last longer, but put out much less light than a regular incandescent, while still consuming the same amount of electricity. In places where changing a bulb is difficult and a long life lamp is desired, consider a compact fluorescent which lasts ten times longer than a standard incandescent.

Do purchase energy-efficient incandescent bulbs instead of the standard 60, 75 and 100 watt bulbs. They will save 5 to 10 watts per bulb with little or no change in light output.

Don't use devices containing “diodes” (coin sized disks that install into lamp sockets) that claim to increase the life of a bulb. With these devices, light output drops dramatically, and they may pose a safety hazard since they cause an electrified portion of the lamp base to be exposed.

Don't purchase expensive “full spectrum” fluorescent lamps which exaggerate the benefits of ultraviolet light. Currently there are no products on the market made to fit standard household fixtures which provide the suggested therapeutic value offered by true full-spectrum lights.

Do make sure your fixtures have been tested for safety and listed by an independent agency, such as UL or ETL. Look for one of these designations on the fixture before purchasing.

Do check the light output in “lumens” on the package when you buy different brands of bulbs.

Some off-brands may have a lower purchase price, but provide less light output.

Do ask for the new “air tight” fixtures when purchasing new recessed ceiling fixtures. They will greatly reduce air leakage (and heat loss) through the ceiling.

Where to buy efficient light bulbs:

- Check at discount retail department stores, home improvement centers and hardware stores – let the managers know you’re interested. There’s nothing like demand to stimulate supply.
- Most commercial lighting supply houses, which supply lamps to businesses, will also sell to the public. Look in the yellow pages under “Lighting.”
- Check with your local electric utility. Many either sell efficient light products or offer rebates as part of a conservation program that can delay or eliminate the need for new power plants.

Where to find more information:

- *Planning and Designing Lighting*, Edward Efron (1986)

An excellent book for anyone interested in setting up an efficient, attractive lighting system. Easy to understand with excellent photographs and illustrations.

- Basic how-to guides from Time/Life, Ortho or Sunset

These guides provide a good explanation of basic lighting concepts and selection of light sources.

- For individual help with lighting design, check with a lighting specialty store where they often have trained designers on staff – although be aware that energy efficiency may not be their top priority. Look under “Lighting Consultants” in the yellow pages.

These manufacturers have design information for consumers available on their web pages.

<http://www.sylvania.com/>
<http://www.lighting.philips.com/>

The Lighting Resource
P.O. Box 48345
Minneapolis, MN 55448-0345
<http://www.lightresource.com/>

Lighting Research Center
School of Architecture,
Rensselaer Polytechnic Institute
Troy, NY 12180
<http://www.lrc.rpi.edu/>