

■ Office Lighting Checklist

- Replace T-12 Lamps and Magnetic Ballasts with T-8 Lamps and Electronic Ballasts**

All T-12 lamps and magnetic ballasts should be replaced with tri-phosphor T-8 lamps and low ballast factor electronic ballasts. Tri-phosphor T-8 lamps use less energy and produce better quality light than standard T-12 lighting systems. Electronic ballasts with low ballast factors ($BF < 0.85$) can reduce lighting system energy use by as much as 40%. Specify tri-phosphor T-8 lamps with a color temperature of 4,100 Kelvin.
- Replace Standard T-8 Lamps with Low Wattage T-8 Lamps and Low Ballast-Factor Ballasts**

Tri-phosphor low wattage T-8 lamps use less energy than standard 32-W T-8 lamps. Electronic ballasts with low ballast factors ($BF < 0.85$) can reduce lighting system energy use by as much as 30%. If the lighting levels of the current T-8 lighting system are higher than the recommendations provided above, standard T-8 lamps should be considered for replacement with tri-phosphor low wattage T-8 lamps and/or low ballast-factor electronic ballasts should be installed.
- Install Perimeter Dimming Ballasts**

Dimming electric lights in locations where daylight is sufficient for working purposes can significantly reduce energy use. All lamps and ballasts within 10 ft to 20 ft of the perimeter envelope should be capable of dimming and connected to a daylight sensor. Typical fluorescent dimming systems provide continuous dimming from 100% to 1%–10% of light output. In addition, it is important to look for opportunities to install light louvers on south facing windows and lower blinds to increase daylight contributions.
- Install Low Wattage Screw-In Lamps**

Compact fluorescent lamps (CFLs), light-emitting diodes (LEDs), and low wattage halogen lamps use significantly less energy for similar light outputs compared to standard incandescent lamps. All incandescent and standard halogen lamps should be replaced with CFLs, LEDs, or low wattage halogen lamps.
- Optimized Interior Security Lighting**

Interior security lighting should be maintained at a maximum of 1 fc to 5 fc during unoccupied times in hallways, and turned off in traditional office space during normal business hours. Non-security fixtures should be controlled by occupancy sensors.
- Replace Exit Signs with LED Exit Signs**

Light-emitting diode (LED) exit signs typically use 5 W or less and can save significant amounts of energy when compared to standard incandescent exit signs. All incandescent and compact fluorescent exit signs should be replaced with LED exit signs that meet building and fire code requirements.
- Replace Incandescent Recessed Can Fixtures with LED or CFL Lighting**

LED and CFL lighting use less energy, have dimming capability, and are good retrofit options for recessed can fixtures. All incandescent recessed can fixtures should be replaced with LED or CFL lighting.

- Replace Incandescent and Fluorescent Cooler/Freezer Lights with LED Lighting**
LED lighting uses less energy, can be dimmed, and produces more light in cold environments. All incandescent lamps in coolers/freezers should be replaced with LED lighting.
- Replace/Install Under-Cabinet and Task Lighting**
Task lighting can reduce the general area lighting requirements and significantly reduce energy consumption. Under-cabinet and task lighting should be installed in conjunction with an appropriate reduction in general area lighting.
- Install Occupancy Sensors in Bathrooms, Conference Rooms, and Private Offices**
Occupancy sensors can significantly reduce light usage during unoccupied times. Occupancy sensors should be installed in all bathrooms, conference rooms, private offices, exterior environments with intermittent occupancy, and other appropriate spaces.
- Install Central Lighting Controls**
Central lighting controls can significantly reduce the operating time of current lighting circuits. Central lighting controls should be installed and commissioned according to the various occupancy schedules.
- Reduce Lighting Levels on Over-Lit Spaces**
Maintain code recommended lighting levels in all spaces. If some areas are over-lit, de-lamp fixtures or install lower ballast-factor ballasts to reduce the lighting levels and conserve energy.
- Replace Linear Fluorescent “Milky White” Lens with Clear Acrylic Prismatic Lens**
A clear acrylic prismatic lens allows approximately 90% of the light to pass through with a more even distribution of light. Replace all milky white or yellowed lenses with a clear acrylic prismatic lens. These older lenses can block 20% to 40% of the light output.
- Install Metallic Reflectors**
In older fixtures, if the existing metal reflector is severely degraded or missing, installing new metallic reflectors can significantly increase light output. If this is the case, a lamp can typically be removed or a ballast with a lower ballast factor can be installed. When installing metallic reflectors it is important to ensure the reflector isn't causing glare or decreasing uniformity.
- Install Bi-Level Switching**
When retrofitting the lighting system within a space, look for opportunities to install bi-level switching. This gives the user the ability to reduce the number of lamps or fixtures turned on to illuminate the space.
- Redesign of a Space**
When a building is going to through a major modernization, look for opportunities to redesign the entire lighting system. Try to use an indirect/direct or fully indirect fixture with revised fixture spacing to reduce lighting power densities and provide for more uniform light distribution. Although indirect fixtures can provide for more uniform light distribution, they can also require more fixtures for the same work-plane illuminance. It is important to provide as many small zones that can be individually controlled through occupancy sensors as possible.

■ High Bay Lighting Checklist

- Replace High Pressure Sodium Lamps and Ballasts with Pulse Start Metal Halide**
Replacing standard HPS lamps with pulse start metal halide lamps and ballasts can reduce energy use while improving color rendition. Pulse start metal halide lamps and ballasts can use existing HID fixtures, making the replacement less costly than putting in fluorescent lamps. Specify replacement pulse start metal halide lamps and ballasts that are compatible with existing fixtures.
- Replace HID Magnetic Ballasts with Electronic Ballasts**
Electronic HID ballasts offer better lumen and color maintenance than magnetic HID ballasts. Electronic HID ballasts are also dimmable to 50% of max output, allowing for occupancy or daylight controls.
- Replace HID Lamps and Fixtures with T5HO Fluorescent Lamps**
By replacing HID lamps and fixtures with more efficient T5HO fluorescent lamps reduces energy use by 25% to 60% while maintaining light levels. This solution is preferred to replacing HID lamps with pulse start metal halide lamps, but is more costly because the fixtures must be replaced in addition to the lamps. Specify 54-W T5HO linear fluorescent lamps. In addition, high bay fluorescents allow for occupancy sensor-based control that isn't possible with HID fixtures.
- Replace HID Lamps and Fixtures with High Performance T-8 Fluorescent Lamps**
Replacing HID lamps and fixtures with more efficient T-8 fluorescent lamps reduces energy use by 25% to 60% while maintaining light levels. This solution can be preferred to replacing HID lamps with T5HO lamps, especially for long cycle times (3+ hours) and low-temperature environments. Specify 32-W T-8 high performance linear fluorescent lamps with a lamp efficacy of 90+ nominal lumens/watt and electronic ballasts.
- Install Daylighting Apertures or Devices**
By using daylighting and lighting controls together, energy consumption can be reduced by 40% to 60%. Look for opportunities to install skylights with a skylight-to-floor area ratio of 3% to 5%, or install side-lighting panels.
- Install Lighting Controls**
Lighting controls that dim or switch electric lights in response to daylight can allow energy savings of 40% to 60%. This can be done with sensors placed locally, inside the space, or globally, with sensors placed outside and tied to a main control system. Specify a five-minute time delay to avoid cycling caused by rapidly changing sky conditions.

Install Occupancy Sensors

In spaces with highly intermittent occupancy, occupancy sensors can reduce lighting energy consumption by more than 50%. The sensors can be either infrared or ultrasonic, detecting heat and movement respectively. Using both will provide better coverage and prevent false triggering. Occupancy sensors should be installed on all applicable high bay fluorescent lighting systems.

Replace HPS/HID Garage Lighting with LED lighting

LED garage lighting can reduce the energy usage of standard garage lighting up to 50%. All high-pressure sodium (HPS)/high intensity discharge (HID) garage lighting should be replaced with low wattage LED lighting.

Replace Outdoor Parking and Street Lights

Current LED technologies can reduce outdoor parking/street light energy consumption by up to 60%. All HPS or HID lamps with magnetic ballasts should be replaced with a low wattage LED lighting system.

Install LED Exit Signs

LED exit signs use 80% to 90% less energy than old exit signs. New LED exit signs cost from \$20 to \$90 per sign. The selected sign should provide the proper luminance to meet all building and fire code requirements.

Consider Other Emerging Technologies

- Hybrid solar lighting
- Wireless lighting controls