



Conducting a Lighting Audit

FACT SHEET

N.C. DIVISION
OF POLLUTION
PREVENTION AND
ENVIRONMENTAL
ASSISTANCE

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BACKGROUND

When attempting energy savings, lighting is probably the first place in a facility to look for savings because changes are usually easy, inexpensive and have a quick payback period. The first step is to assess current lighting conditions. Measuring current conditions against calculated upgrades will present the expected savings. Understanding current lighting conditions and needs will aid in determining applicable opportunities and recommendations.

ASSESS EXISTING CONDITIONS

To conduct a lighting audit you will first need basic lighting information, such as the number of lights, their location, and their time in use to help you understand the current energy use attributed to lighting in the facility. This information will help you understand how much you are currently spending and the potential savings available from lighting efficiencies. Use the worksheet at the end of this document to assess your current lighting conditions.

ASSESS OPPORTUNITIES FOR INCREASING LIGHTING ENERGY

Determine if the following opportunities exist for a given location. Each checkbox represents an opportunity for energy savings followed by suggestions on how to best take advantage of the opportunity.

- Turn off lights in unoccupied areas.
 - Post reminder stickers to turn off lights when leaving the area.
 - Install time switches or occupancy sensors in areas of brief occupancy and remote areas (warehouses, storage areas, etc.).
 - Rewire switches so that one switch does not control all fixtures for multiple work areas.
 - Ensure wall-switch timers function properly.

- Determine if existing lighting levels are higher than recommended levels. Use a light meter to measure light levels and consult the Illuminating Engineering Society of North America (IESNA) illumination standards.
 - Reduce lighting levels where appropriate.
 - Reduce lighting hours.
 - Employ uniform or task delamping to reduce power and lighting.

**CONSIDERATIONS FOR
SELECTING A LAMP**

Use the following criteria to determine whether the lamp selection is compatible with lighting needs for a given location.

- Light output
- Input wattage
- Efficacy/efficiency
- Cost
- Rated life
- Size
- Color rendering/temperature
- Brightness
- Start time and temperature
- Dimming capability
- Requirements of additional equipment (ballast)
- Electrical, physical and operational characteristics of light, ballast and controls [ballast, effects on other equipment, total harmonic distortion (THD)]
- Ability to handle both typical and atypical operational conditions (break in power)
- Maintenance required
- Presence of computer or other systems that could be affected by harmonic effects

- Review outside lighting needs.
 - Eliminate outdoor lighting where possible and where safety and security are not compromised.
 - Manually turn off lights.
 - Replace burned out lamps with lower wattage lamps.
 - Replace exterior incandescent lights with more efficiency lights such as high pressure sodium (HPS) or metal halide (MH).
 - Install photoelectric or motion sensors where light needs are intermittent.
 - Ensure existing sensors function properly.
- Install more efficient ballasts.

Ballasts typically have a long life; therefore, replacing ballasts that are still working can be one of the most cost- effective energy improvements.

 - Upgrade old ballast as lamps are replaced.
 - Pre-1979 ballasts are incompatible with 34-watt energy savings lamps. This combination will result in a decrease in lamp life of up to 50 percent.
 - This could include conversion to electronic ballasts and T-8 lamps.
 - Install electronic ballasts.
- Remove unneeded lamps (delamp).
 - Remove fluorescent lamps controlled by magnetic ballasts in pairs since they are operated and wired in pairs (two fluorescent lamps from a four-lamp fixture). With electronic ballasts, each lamp is controlled individually. Some facilities have seen an energy savings of more than 30 percent or more from this action.
 - Remove unnecessary tubes and replace them with “dummy” tubes that draw little current and provide the effect of uniform lighting.
 - Disconnect ballasts, as the ballast will continue to use energy when the fixture is switched on.
- Install more efficient lighting.
 - Replace incandescent lamps in offices, workrooms, hallways, etc. with compact fluorescent lamps (CFLs).
 - Use single incandescent lamp of high wattage instead of two or more smaller lamps of combined wattage. Efficiency of incandescent lamps increases as lamp wattage increases.
 - Replace non-decorative incandescent lamps with fluorescent or high intensity discharge lamps.

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- Replace standard fluorescent lamps and ballasts with T8 and matching electronic ballasts (switching from fluorescent to high-efficiency fluorescent can save 10 to 30 percent in energy costs).
 - Replace fluorescent lamps with more efficient HPS lamps.
 - Replace mercury vapor lights with higher efficiency MH or HPS lamps.
 - Employ more effective lighting settings.
 - Lower fixtures or use a lamp extender to increase illumination on a given area.
 - Install reflectors or lenses to spread out and focus light (specular reflectors can improve efficiency by up to 17 percent in fluorescent lights).
 - Use light-colored paint on walls.
 - Ensure the layout of room is conducive to light and that light obstructions do not exist.
 - Follow a regular a maintenance schedule.
 - Establish a regular inspection and cleaning schedule for lamps and fixtures.
 - Establish a group relamping schedule to replace lamps as they burn out, usually done at 70 percent of rated lamp life. Group relamping will cut down on both energy and labor costs. Energy is still consumed while lumen output of fluorescent lamps decreases with age.
 - Replace yellow or hazy lens shading with new acrylic lenses that do not discolor.
 - Clean room surfaces such as tables, walls, etc. to remove dirt, increasing reflectivity.
 - Use daylighting effectively.
 - Locate workstations with high illumination needs adjacent to windows.
 - Turn off lights when daylight is sufficient.
 - Install light sensors/dimming equipment that automatically compensate for natural light variance.
 - Clean windows and skylights.
 - Reschedule housekeeping duties to operate during the day so additional after-hours lighting is not needed.
 - Upgrade exit signs with the help of an expert.
 - Retrofit by replacing incandescent lamps with CFLs.
 - Retrofit by replacing incandescent lamps with light-emitting diode (LED) lamps, which use one-tenth the electricity of incandescent lamps and have a lifespan of more than 100,000 hours.
 - Replace old exit signs with new LED signs.
 - Remove unnecessary lighting in beverage machines.
 - Train staff, especially housekeeping staff, on lighting policies/efficiency.

- Post lighting schedules that display necessary hours of use for lights so that staff members know when turning off lights is appropriate.

CALCULATE THE SAVINGS

For each change use the following formulas to calculate annual savings:

(____ watts x ____ hours per day x ____ days per year) / 1,000 wh/kWh = ____ kilowatt hours (kWh)

____ kWh x cost per kWh per year = ____ total annual kWh charges saved by this change.

Additional tools are available to calculate potential energy savings, environmental improvements and payback for upgrade conversions. These include:

- *Lighting Efficiency Upgrade Tool* (<http://landofsky.fp.skyrunner.net/wrp/Interactive%20Lighting%20Sheets/LightingLinksPage.htm>); and
- Energy Star's *ProjectKalc* (www.energystar.gov/index.cfm?c=business.bus_projectkalc)

For a more extensive list of energy audit tools consult the Electronic Self-Audit tools compiled by the Waste Reduction Partners at http://landofsky.fp.skyrunner.net/wrp/Other_Resources_files/resources_audits.htm.

POLLUTION PREVENTION SAVINGS

Upgrading a typical four-lamp, 2-foot by 4-foot fixture from a magnetic ballast and 34 watt T-12 lamps to a partial output electronic ballast and 32 watt T-8 saves 43 watts. Based upon an average 3,000 annual operating hours, upgrading 35 fixtures would reduce carbon dioxide emissions from the power plant equivalent to that of removing a car from the road. The payback on this investment would be 2.74 years at a rate of 8 cents/kWh.

As another comparison, if every household in North Carolina were to substitute two compact fluorescent lamps for their incandescent lamps, the pollution reduction would be equivalent to removing 77,000 cars from the road.

RECYCLING TIPS¹

Potential Hazardous Substances

Some pre-1979 ballasts contain PCBs, which are categorized as hazardous waste and require proper disposal. Ballasts manufactured after 1979 are required to be clearly marked "no PCBs." The Toxic Substances Control Act (TSCA) regulations allow for intact, non-leaking ballasts to be disposed of in a landfill. The Environmental Protection Agency (EPA) encourages additional disposal preparation. The Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), also known as "Superfund," which also regulates non-leaking PCB-containing ballasts, requires notification when disposing of a pound or more of PCBs in a 24-hour period (roughly 12 to 16 fluorescent ballasts) by contacting the National Response Center at (800) 424-8802. Leaking PCB-containing ballasts must be incinerated at an EPA-approved incinerator.

¹ Lighting Waste Disposal. Lighting Upgrade Manual. Environmental Protection Agency Green Lights Program. September 1998. [http://yosemite1.epa.gov/Estar/business.nsf/attachments/wastedi.pdf/\\$file/wastedi.pdf](http://yosemite1.epa.gov/Estar/business.nsf/attachments/wastedi.pdf/$file/wastedi.pdf)

Fluorescent and HID lamps contain a small amount of mercury and could be classified as hazardous waste under the Resource Conservation and Recovery Act (RCRA). According to RCRA, fluorescent and HID lamp generators are responsible for determining whether the lamps are hazardous. CERCLA requires notification to the National Response Center at (800) 424-8802 for disposal of mercury-containing lamps exceeding one pound or more of mercury (roughly equivalent to 11,000 four-foot fluorescent lamps) in a 24-hour period.

Under CERCLA, persons and generators of hazardous substances could be held liable for response costs if a release or threat of release of a hazardous substance to the environment.

Recycling Options

Non-leaking PCB-containing material and mercury containing fluorescent and HID that have been determined not to be hazardous waste can be recycled. EPA's Green Lights Lighting Upgrade Manual provides a list of recyclers for each.

Many states have developed regulations for PCB-containing ballasts and mercury beyond the federal requirements. Check with your state environmental department to determine applicable laws and disposal requirements.

ADDITIONAL RESOURCES

Energy Efficient Lighting: A Manual for Conservation. Energy/Preventive Maintenance Cost Reduction Program. Energy Division, N.C. Department of Commerce, and the Industrial Extension Service, N.C. State University.

How to Reduce Your Energy Costs: The Energy Efficiency Guide for Business, Industry, Government and Institutions. The Vermont Department of Public Service, Energy Efficiency Division. Third Edition. For a free copy call (888) 921-5990.

Lighting Upgrade Technologies, Lighting Upgrade Manual. EPA Green Lights Program. U.S. Environmental Protection Agency. September 1998. http://www.cleanaircounts.org/resource_package/A_Book/EE_Lighting/manual/technolo.pdf

Lighting Maintenance, Lighting Upgrade Manual. EPA Green Lights Program. U.S. Environmental Protection Agency. January 1995. [http://yosemite1.epa.gov/Estar/business.nsf/attachments/maint.pdf/\\$file/maint.pdf](http://yosemite1.epa.gov/Estar/business.nsf/attachments/maint.pdf/$file/maint.pdf)

Lighting Waste Disposal, Lighting Upgrade Manual. U.S. Environmental Protection Agency Green Lights Program. September 1998. [http://yosemite1.epa.gov/Estar/business.nsf/attachments/wastedi.pdf/\\$file/wastedi.pdf](http://yosemite1.epa.gov/Estar/business.nsf/attachments/wastedi.pdf/$file/wastedi.pdf)

U.S. Department of Energy Building Technologies Program - Lighting
<http://www.eere.energy.gov/buildings/components/lighting/index.cfm>

Waste Reduction Partners, Division of Pollution Prevention and Environmental Assistance and Land of Sky Regional Council. Electronic Self-Audit Tools, http://landofsky.fp.skyrunner.net/wrp/Other_Resources.htm

TriState Generation and Transmission Association Inc. Lighting Systems
<http://tristate.apogee.net/>

Lighting Resource Center. Light Guides. <http://www.lightsearch.com/resources/lightguides/index.html>

Working Draft Lighting Assessment Tool. Land-of-Sky Regional Council/N.C. Division of Pollution Prevention and Environmental Assistance. June 2003. For draft copy, contact Terry Albrecht, Waste Reduction Partners at (828) 251-6622.

EXISTING CONDITIONS ASSESSMENT WORKSHEET

For each lighting location, use the following information to guide answers to the questions below. Not every topic will be relevant to every location.

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| Location of lights _____ | Hours per week the fixture is in operation _____ |
| Number of fixtures _____ | Weeks per year the fixture is in use _____ |
| Type of fixture _____ | Presence of reflectance in room _____ |
| Spacing between fixtures _____ | Layout and dimensions of room _____ |
| Type of lamp in fixture _____ | Structural obstructions (beams, partitions) _____ |
| Number lamps per fixture _____ | Maintenance schedule _____ |
| Watts per fixture _____ | Safety and security measures required _____ |
| Type of ballast _____ | Typical and likely atypical conditions _____ |
| Number of lamps per ballast _____ | Presence of automatic timers _____ |
| Watts per ballast _____ | Electricity cost per kilowatt hour (kWh) _____ |
| Desired light level (based on tasks or other) _____ | Electricity demand charges _____ |
| Fixture condition _____ | |
| Fixture mounting height _____ | |
| Availability of daylight _____ | |



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