Electric lighting accounts for more than a third of the average electric bill for existing commercial buildings. You should not have to pay such high electric costs for lighting in your new building - much of the expense can be avoided with a smart design using daylighting and efficient electric lighting choices.

**Lighting shouldn't be an afterthought.** Lighting is an integral part of new construction projects and should be considered in the initial stages of design.

Envelope design fundamentally affects available daylighting available through windows and skylight and, thereby, the amount of electric lighting needed. The design of the HVAC system is also affected by lighting needs. Higher wattage lighting means a bigger cooling load and larger HVAC systems.

**Seek good advice.** SEDAC recommends including qualified lighting design professionals in an integrated approach to the whole building design for optimal equipment selection, layout, and control. You can also take advantage of SEDAC’s services for new construction. Contact us at sedac.org for design reviews and help finding incentive funding.

Do I need a lighting designer? Lighting plans and specifications are often produced by electrical engineers, who may base their work on electrical requirements and code standards alone. Alternately, an interior designer assigned to lighting design may select fixtures for their decorative qualities alone, without recognizing the energy impact of their choices.

A professional lighting designer -- specifically one who specializes in sustainable lighting design -- brings both technical and aesthetic skills to the table. In addition, a professional lighting designer knows how to integrate the lighting layout with the envelope and HVAC.

This trio of skills helps minimize operational costs for lighting (both maintenance and energy costs) over the life of the building.

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The Smart Energy Design Assistance Center performs energy assessments on various building types. Each building type has different energy requirements. SEDAC's Energy Smart Tips help building operators identify energy cost reduction measures.

SMART ENERGY DESIGN ASSISTANCE CENTER
PROVIDING EFFECTIVE ENERGY STRATEGIES FOR PUBLIC AND PRIVATE BUILDINGS IN ILLINOIS
8 STEPS TO A SUCCESSFUL LIGHTING PROJECT

#1: IDENTIFY NEEDS

What are the functional requirements? Work with the designer to document the expected uses of the spaces in your building. Be as specific as possible. Designers use the information to determine the right level of light for each area. Difficult visual tasks (like reading small print or working with fine tools) require more light than general computing tasks, which in turn require more light than walking.

What are the occupant’s special needs? In addition to the basic functional requirements, consider if your building occupants have particular lighting needs. As we age, for example, we need extra light but also become more sensitive to glare and less adaptable to high-contrast light.

What are the aesthetic considerations? Lighting plays a large role in the overall look and feel of a place. Come up with adjectives that describe the look you want.

#2: TARGET REDUCED LIGHTING POWER DENSITY

Once you know what you need in a lighting design, select a goal for the overall Lighting Power Density (LPD) of the building. LPD is measured in Watts per square foot. LPD is calculated by adding up the wattage of all the building's fixtures (whether they are redundant or not), and dividing by the square footage. LPD provides a good metric for comparing different lighting designs.

The Illinois Energy Conservation Code (IL ECC) governs the maximum allowable LPD for interior and exterior lighting, but the lighting industry can do far better than what the code allows. Lower LPDs are desirable as long as light levels are adequate for safety and meet the user’s needs. SEDAC recommends that you target a percentage below the code-allowed LPD. For example, 30% below code is quite reasonable.

#3: COORDINATE WITH THE ARCHITECT & HVAC ENGINEERS

Get your lighting designer working with the architect as early as possible. The overall lighting result will be far better if they collaborate.

Designs by the architect that include south facing orientations, narrow floor plates, high ceilings, and open sections will allow more usable daylight into the building and bring a corresponding reduction in electric lighting demand, if daylight controls are included.

Finishes selected by the architect also dramatically affect the amount of electric light needed. Make sure the lighting designer has input on reflectance and colors of the interior.

The lighting designer should also work with the HVAC engineers early on. Efficient lighting lowers cooling loads and reduces the size of the HVAC systems that the engineers will need to specify.

#4: SELECT LAMP TYPES & FIXTURES

Get more light for less wattage. Direct your designer to select efficient lamps (aka bulbs) and fixtures. There are two items that affect the efficiency of an individual light fixture before you apply lighting controls of any kind:

1) The efficacy of the lamp, or how much light (in lumens) is produced per watt of power by the lamps inside the fixture. A 60W incandescent and a 10W LED both produce around 800 lumens of light. The 10W LED has a much higher efficacy.

2) The efficiency of the fixture, or how much of the light produced by the lamp actually escapes the fixture.

Should we go LED? Light emitting diode (LED) fixtures can save a lot of energy. But, this relatively new competitor in the lighting market is undergoing rapid development - so be careful. Have your designer check the U.S. Department of Energy CALiPER website for performance reports on any fixtures you are considering: http://www1.eere.energy.gov/buildings/ssl/caliper/default.aspx. LEDs can have other cost benefits including longer life/ lower maintenance costs; reduced heat load/ lower cooling costs; and the ability to use low-voltage power supply to the fixtures, reducing installation costs.

Other qualities to look for in lamps: In addition to high lumens per watt, your designer should favor lamps with long lamp life and a high color rendering index (CRI). The CRI value tells you how well you can see color under a certain light (100 is the best) and is an important quality to balance. For example, the yellow sodium lights in older parking lots are very efficient, but have terrible CRI.


**Discuss these items with your lighting professional or engineer.**

### #5: CHOOSE LIGHTING CONTROLS

Basic lighting control must now be implemented in **every** new building design by code (ASHRAE 90.1 2010). Discuss which methods best match your future occupants’ needs:

1. Daylight sensors that reduce electric lighting in response to available daylight.
2. Occupancy sensors that respond to people arriving and leaving.
3. Vacancy sensors that allow users to turn on lights manually, then turn lights off automatically when nobody is present.
4. Dimming or bi-level switches that reduce light levels in stairwells (when no one is present) while maintaining the light level necessary for safety.
5. Programmable lighting controls that have customizable schedules to turn lights on at desired times, and turn lights off after hours.
6. Building automation system (BAS) integrated lighting controls.

### #6: INCLUDE COMMISSIONING

Engaging a commissioning agent will help ensure you get what you ask for and that your lighting works according to the designer’s plan. An agent will develop a plan, then carry out commissioning that includes lighting system activation and functional testing of sensors.

If your project budget doesn’t allow for lighting commissioning, take advantage of support offered by controls manufacturers.

### #7: MAINTAIN EFFICIENCY

Once your lighting design is up and running, your building ops staff will have the task of keeping lighting fixtures and controls in proper operation. The building operator must be your ally in achieving energy efficiency. In addition, occupant education will go a long way in ensuring that lighting controls operate as designed. Clear labels by wall controls are key to avoiding user frustration, and they reduce the likelihood of users subverting efficiency features.

### #8: SAVE ENERGY COSTS - THE BOTTOM LINE

Your energy bill for electricity includes base monthly fees, plus a unit cost per kilowatt-hour of electricity consumed. You can reduce the second part through efficiency. The unit **kilowatt-hour** equals one kilowatt (1,000 Watts) operating for one hour. For example: Ten 100 Watt bulbs burning for 1 hour would use one kilowatt-hour of electricity, which would cost around $0.10.

Here’s an example of what lighting efficiency can do. For a 50,000 sf office, with a light level of 30 footcandles (typical for an office), and lights that operate for 4,439 hours (also typical), we figure the annual cost of running the lighting for three designs:

- **Basic to-code design**: LPD: 0.9 Watts/sf, Controls: Meets code  
  
  \[
  0.9 \text{ W/sf} \times 50,000 \text{ sf} \times 4,439 \text{ hrs} \times \$0.10/\text{kWh}/1,000 = \$19,976 \text{ per year}
  \]

- **Reduced lighting power density design**: LPD: 0.6 Watts/sf, Controls: Meets code  
  
  \[
  0.6 \text{ W/sf} \times 50,000 \text{ sf} \times 4,439 \text{ hrs} \times \$0.10/\text{kWh}/1,000 = \$13,317 \text{ per year (30% savings = $6,659 annual savings)}
  \]

- **Addition of aggressive controls**: LPD: 0.6 Watts/sf, Controls: Beyond code, reducing run hours by 30%  
  
  \[
  0.6 \text{ W/sf} \times 50,000 \text{ sf} \times 3,107 \text{ hrs} \times \$0.10/\text{kWh}/1,000 = \$9,322 \text{ per year (50% savings = $10,654 annual savings)}
  \]

**HAVE WE GOT YOUR ATTENTION?** Of course, the reality of lighting is usually more complex than this example implies. But the savings potential is real and compels building owners to consider this key idea:

**To save lighting energy, you must BOTH reduce the fixture wattage AND reduce run hours as much as possible.**

Projected energy cost savings could be used to offset initial increased cost of advanced lighting controls! Exceptions? Yes, some fixtures need to run 24 hours a day for safety reasons (exit signs and lights). And, yes, some facilities require most lighting to be operational 24 hours a day because they are occupied round-the-clock (hospitals, police stations, and fire stations, etc). Even in these cases, however, light fixtures are available that can be dimmed when there is enough daylight or when no one is around.

The rest of the lighting can be controlled by occupany, vacancy, or daylight sensors.

The energy code already mandates inclusion of control strategies for much of the lighting in your new building. Be sure your designer optimizes the control strategies for all of your building’s lighting, even where not code-required. In the end, you—the owner or operator—will have the charge of ensuring controls are used and maintained throughout the life of the building.
THE NEW WAY TO SHOP FOR LAMPS

The Lighting Facts label on lamp packaging allows consumers to easily compare lamps for brightness, operating cost, life, and color, as well as energy used. The Energy Labeling Rule, enforced by the Federal Trade Commission since 2011, is expected to foster lumen (brightness) measurement instead of wattage (energy use). Remember: energy efficient lamps produce an equivalent amount of light (lumens), but with much lower power requirements (wattage).

CHECKLIST FOR BUILDING OWNERS

Double check these items in design and ensure implementation during construction to decrease future maintenance and energy costs.

- Maximized use of daylighting
- Lowest possible lighting power density
- Lighting needs met for each space
- Selection of energy efficient lighting equipment
- Proper lighting controls
- Commissioning of lighting equipment & controls

AVOID THESE COMMON PITFALLS

- Dark colored interiors and furniture
- Overlit or underlit spaces
- Multiple fixtures connected via one switch
- Too many different lamp types
- Lighting controls too complicated for users & maintenance staff

NEED HELP WITH OUTDOOR LIGHTING?

Read SEDAC's Energy Smart Tips for Outdoor Lighting
http://smartenergy.illinois.edu/pdf/EST_Outdoor-Lighting.pdf

ENERGY SMART RESOURCES FOR NEW CONSTRUCTION

Visit the SEDAC New Construction Program website at NC.sedac.org
And for more resources and reading go to NCtips.sedac.org

SEDAC
WHO WE ARE

SEDAC is sponsored by the Illinois Department of Commerce and Economic Opportunity in partnership with investor-owned utilities to achieve energy efficiency savings in buildings throughout the State of Illinois.

SEDAC is an applied research program at the University of Illinois at Urbana-Champaign.

SEDAC works in collaboration with the 360 Energy Group.

SEDAC PROGRAMS

- Energy Assessment
- Public Sector Retro-Commissioning
- New Construction Design Assistance
- Public Sector New Construction Incentive Review
- Public Housing Efficient Living
- Training and Outreach
- Energy Incentive Guidance

STOP THE WASTE!

The Lighting Facts label on lamp packaging allows consumers to easily compare lamps for brightness, operating cost, life, and color, as well as energy used. The Energy Labeling Rule, enforced by the Federal Trade Commission since 2011, is expected to foster lumen (brightness) measurement instead of wattage (energy use). Remember: energy efficient lamps produce an equivalent amount of light (lumens), but with much lower power requirements (wattage).