Energy Efficiency Solutions Using LED Lighting for General Lighting Applications

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Quiz
What do you already know about best practices for LED lighting?

1. Which of the following is a reason to use LED lighting?

2. Correlated Color Temperature (CCT) references the “warmth” or “coolness” of what color light?

3. Which of the following is the recognized authoritative reference on the science and application of lighting?
Presentation Overview

- What is LED lighting?
- Typical Specification Parameters
- Physical Characteristics
- Life Cycle Costs
- LED Lighting Myths
- LED Lighting Applications
- ActOnEnergy® Incentives and Online Store Offerings
- Case Studies
Why Use LED Lighting?

- Reduces energy costs
- Reduces maintenance costs
- Reduces cooling costs
- Convenient features
- Ideal for power cycling
- Durable
What are LEDs?

LED stands for Light-Emitting Diode.

LEDs are small light sources that become illuminated by the movement of electrons through a semiconductor material. LEDs can be integrated into all sorts of products, such as flashlights, light bulbs, headlights, and integrated light fixtures.
What are LEDs?

Low-Powered LEDs

LEDs used to draw attention to something, such as:

- an exit sign
- a green power button on a computer
- a red blinking light on a video camera
What are LEDs?

**High-Powered LEDs**

LEDs used to illuminate an area - uses multiple LEDs chips inside a fixture to produce white light. Blue LEDs are typically covered with phosphor coated lens which results in white light.
The LED consists of a chip of semiconducting material doped with impurities to create a \textit{p-n junction}.

When voltage is applied, electrons and holes flow into the junction. When an electron meets a hole, it falls into a lower energy level, and releases energy in the form of light.
Comparing LEDs to Other Lighting

**Incandescent bulbs** create light by passing electricity through a metal filament until it becomes so hot that it glows. Incandescent bulbs release 90% of their energy as heat.

**In a CFL**, an electric current is driven through a tube containing gases. This reaction produces ultraviolet light that gets transformed into visible light by the fluorescent coating (called phosphor) on the inside of the tube. A CFL releases about 80% of its energy as heat.

**LED lighting** products use light emitting diodes to produce light very efficiently. The movement of electrons through a semiconductor material illuminates the tiny light sources we call LEDs. A small amount of heat is released backwards, into a heat sink, in a well-designed product; LEDs are basically cool to the touch.
What industry do you work in?
Please type your response into chat.
Light Module

Luminaire

LED Lighting System Components

Driver

Occupancy Sensor/Dimmer
LED Characteristics

- Efficacy
- Fixture Efficiency
- L70
LED Characteristics

**CCT** (Correlated Color Temperature)

<table>
<thead>
<tr>
<th>Name</th>
<th>Appr. Munsell</th>
<th>Appearance under daylight</th>
<th>Swatch</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCS01</td>
<td>7.5 R 6/4</td>
<td>Light grayish red</td>
<td></td>
</tr>
<tr>
<td>TCS02</td>
<td>5 Y 6/4</td>
<td>Dark grayish yellow</td>
<td></td>
</tr>
<tr>
<td>TCS03</td>
<td>5 GY 6/8</td>
<td>Strong yellowish green</td>
<td></td>
</tr>
<tr>
<td>TCS04</td>
<td>2 G 6/6</td>
<td>Moderate yellowish green</td>
<td></td>
</tr>
<tr>
<td>TCS05</td>
<td>10 BG 6/4</td>
<td>Light bluish green</td>
<td></td>
</tr>
<tr>
<td>TCS06</td>
<td>5 PB 6/8</td>
<td>Light blue</td>
<td></td>
</tr>
<tr>
<td>TCS07</td>
<td>2.5 P 6/8</td>
<td>Light violet</td>
<td></td>
</tr>
<tr>
<td>TCS08</td>
<td>10 P 6/8</td>
<td>Light reddish purple</td>
<td></td>
</tr>
<tr>
<td>TCS09</td>
<td>4.5 R 4/13</td>
<td>Strong red</td>
<td></td>
</tr>
<tr>
<td>TCS10</td>
<td>5 Y 8/10</td>
<td>Strong yellow</td>
<td></td>
</tr>
<tr>
<td>TCS11</td>
<td>4.5 G 6/6</td>
<td>Strong green</td>
<td></td>
</tr>
<tr>
<td>TCS12</td>
<td>3 PB 3/11</td>
<td>Strong blue</td>
<td></td>
</tr>
<tr>
<td>TCS13</td>
<td>5 YR 8/4</td>
<td>Light yellowish pink</td>
<td></td>
</tr>
<tr>
<td>TCS14</td>
<td>5 GY 4/4</td>
<td>Moderate olive green (leaf)</td>
<td></td>
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</tbody>
</table>

**CRI** (Color Rendering Index)
LED Lighting Performance Verification

- IESNA - The Illuminating Engineering Society of North America
- LED Lighting Test Standards
  - LM-79 – “Electrical and Photometric Measurements of Solid-State Lighting Products”
  - LM-80 – “Measuring Lumen Maintenance of LED Light Sources”
  - TM-21 – “Projecting Long Term Lumen Maintenance of LED Light Sources”

A Word of Caution:
- B50 - the time by which 50% of the product's population will fail
- MTTF (Mean Time To Failure) or MTBF (Mean Time Between Failure).
- B50 is not necessarily the same as MTTF!
  This difference can be significant in comparing total cost of competitive lighting systems
Do you currently use any LED lights, including LED Exit signs, in your business or facility?

A. Yes
B. No
C. I don’t know
LED Lighting Myths

LED products last forever
LED Lighting Myths

LED lights don’t give off any heat
LED Lighting Myths

LED lights are not bright enough and have poor light quality
LED Lighting Myths

LED products are all basically the same in terms of quality
LED Lighting Myths

LED lights provide the best lighting solution for all applications
LED Lighting Trends

- Increased lumen output/reduced cost
- Greater standardization in LED lighting products
- Consolidation in LED lighting industry
- OLED – Organic Light Emitting Diode
LED Information Resources

Energy Star web site – provides a listing of LED lighting products that meet Energy Star performance criteria


Design Lights Consortium – provides a listing of LED lighting products for lighting categories not covered by Energy Star

http://www.designlights.org/

LED Lamp Locator – a searchable database of LED lighting products on the market

http://www.ledlamplocator.com/
<table>
<thead>
<tr>
<th>LED Lamps</th>
<th>BPL81</th>
<th>Replace 100W or less incandescent or halogen lamp</th>
<th>ENERGY STAR qualified, OR meets all of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum efficacy of 40 lumens/watt</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum 25,000 hour rated life at L₇₀</td>
</tr>
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<td></td>
<td></td>
<td>Minimum CRI of 75 or more</td>
</tr>
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<td></td>
<td>3-year warranty on LEDs and drivers</td>
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<td></td>
<td></td>
<td></td>
<td>UL-listed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$10/lamp</td>
</tr>
<tr>
<td>LED Recessed Down Lamps</td>
<td>BPL84</td>
<td>Replace 60-100W incandescent lamps</td>
<td>ENERGY STAR qualified, OR meets all of the following:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LED recessed downlight &lt;= 18 watts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum efficacy of 40 lumens/watt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum 25,000 hour rated life at L₇₀</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Minimum CRI of 75 or more</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>3-year warranty on LEDs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3-year warranty on drivers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$10/fixture (Cannot be combined with ActOnEnergy On-Line Store purchase)</td>
</tr>
<tr>
<td>Exterior Lighting</td>
<td>BPL50</td>
<td>Replacement of exterior HID fixtures such as mercury vapor, high pressure sodium, and metal halide</td>
<td>Must have electronic ballast</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Fixtures must be controlled by exterior photocell or time clock</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>UL-listed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If the new lights are LEDs, the lights must be on one of the following lists:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ENERGY STAR2 ENERGY STAR qualified commercial LED lighting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DLC1 Design lights consortium solid state lighting QPL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ameren Delivery Service rate customers DS-2, DS-3, and DS-4 are all eligible for this measure. DS-5 customers are eligible only if the exterior lighting is not Ameren owned.</td>
</tr>
</tbody>
</table>
| Interior LED Lamps and Fixtures | BPL67 | • May replace any type of bulb/fixture, but if a project is already eligible under BPL81, 84, 93, or 50, those measures must be used instead of this one. | • 3-year warranty on drivers  
• UL-listed  
Eligibility for LED luminaries is limited to products that appear on any one of the following qualified product lists: ("Source of Eligibility" - as required on the Incentive Calculation tab - is the underlined text)  
ENERGYSTAR1 ENERGY STAR qualified LED light bulbs http://www.energystar.gov/index.cfm?fuseaction=iledl.display_products_html  
ENERGYSTAR2 ENERGY STAR qualified commercial LED lighting http://www.energystar.gov/index.cfm?fuseaction=ssl.display_products_com_html  
DLC1 Design lights consortium solid state lighting QPL http://www.designlights.org/solidstate.about.QualifiedProductsList_Publicv2.php (click on the "DesignLights Consortium Qualified Products List" link for the Excel spreadsheet)  
DOE1 Department of Energy 2010 Lighting For Tomorrow winners http://www.lightingfortomorrow.com/. Winners from previous years available by clicking the appropriate year on the left hand side of the page and choosing the "winner press release" link.  
DOE2 Department of Energy 2010 or Next Generation Luminaires winners (http://www.ngldc.org/) Winners for the current year are available by clicking the "winners page" link on this homepage, and winners for previous years are available by choosing the year on the left hand side of the page (you can download a press release or choose by type from the list that shows up on the page).  
Other fixtures/lamps may be considered for Custom incentives, please call for assistance. | $0.40/watt reduced |
| LED Exit Signs | BPL78 | • Retrofit of existing incandescent or fluorescent fixture only | • LED, T-1 or Electroluminescent Exit Signs  
• Signs may be one or two-sided | $20/Sign  
(Cannot be combined with ActOnEnergy On-Line Store purchase) |
| LED Exit Sign Retro-fit Kit | BPL82 | • Must be retrofitting an incandescent exit sign | • Maximum total wattage of replacement 6-watts  
• UL-listed | $10/Kit  
(Cannot be combined with ActOnEnergy On-Line Store purchase) |
## ActOnEnergy Incentives for LED Lighting

<table>
<thead>
<tr>
<th>Glass Door LED Cooler/Freezer Lighting</th>
<th>BPL93</th>
<th><strong>Requirements</strong></th>
<th><strong>Incentive</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerated case lighting, replacing T-8, T-10, and or T-12 fluorescent lamps with LED lighting</td>
<td>To be installed on low- and medium-temperature main coolers and freezers; or, low- and medium temperature reach-in coolers and freezers (-10 through +41 degrees F)</td>
<td>$25/door</td>
<td></td>
</tr>
<tr>
<td>Qualifying LED lighting system must replace existing five-foot equivalent fluorescent lighting in existing low-temperature or medium-temperature display cases. watts.</td>
<td>Equipment must be on the Design lights consortium (DLC1) solid state lighting QPL. <a href="http://www.designlights.org/solidstate/about/QualifiedProductsList_Publicv2.php">http://www.designlights.org/solidstate/about/QualifiedProductsList_Publicv2.php</a> (click on the “DesignLights Consortium Qualified Products List” link for the Excel spreadsheet)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Five-year warranty on LEDs and drivers</td>
<td>UL-listed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glass Door LED Cooler/Freezer Lighting Controls/Sensors</th>
<th>BPL94</th>
<th><strong>Requirements</strong></th>
<th><strong>Incentive</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>New installation or replacement of failed control</td>
<td>To be installed on low- and medium-temperature main coolers and freezers; or, low- and medium temperature reach-in coolers and freezers (-10 through +41 degrees F)</td>
<td>$12/sensor</td>
<td></td>
</tr>
<tr>
<td>Wall, ceiling, or case- mounted controls</td>
<td>Wall, ceiling, or case- mounted controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Must control at least 70 watts</td>
<td>Must control at least 70 watts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor must reduce LED operation by at least 30% time. Please call us if your sensor is “hi/lo” to discuss eligibility.</td>
<td>Sensor must reduce LED operation by at least 30% time. Please call us if your sensor is “hi/lo” to discuss eligibility.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ActOnEnergy Online Store

• LED products available at low-cost with free shipping!

**Philips EnduraLED™ A19**
- Watts: 12.0
- Lumens: 800
- Efficacy: 64 lm/w
- Life: 50,000 hours
- Dimmable: Yes
- Color: 3000K
  - $22.99
  - $19.95

**Philips EnduraLED™ PAR30**
- Watts: 12
- Lumens: 650
- Efficacy: 55 lm/w
- Life: 50,000 hours
- Dimmable: Yes
- Beam angle: 22 degrees
- Color: 3000K
  - $59.99
  - $49.95

**Cree C85 Downlight Module**
- Base: Medium
- Watts: 12.0
- Lumens: 575
- Efficacy: 47.7 lm/w
- Life: >50,000 hours
- Dimmable: Yes
  - $99.00
  - $89.75

**TCP Red LED Exit Sign Bulbs**
- 2.7 watts, 10 footcandles
  - $2.99
  - $2.50

**Sylvania UltraLED PAR20**
- Watts: 8
- Lumens: 355
- Efficacy: 43.7 lm/w
- Life: 50,000 hours
- Dimmable: Yes
- Beam angle: 25 degrees
- Color: 3000K
  - $16.99
  - $15.00

**Philips EnduraLED™ PAR38**
- Watts: 17
- Lumens: 680
- Efficacy: 51.7 lm/w
- Life: 50,000 hours
- Dimmable: Yes
- Beam angle: 22 degrees
- Color: 3000K
  - $99.99
  - $89.95

**Cree LRS Downlight Module**
- Watts: 10.8
- Lumens: 670
- Efficacy: 61.9 lm/w
- Life: >50,000 hours
- Dimmable: Yes
  - Colors: warm white
    - $129.99
    - $119.95

**TCP Red Exit Sign with Battery**
- 2 watts, double-sided
  - $25.95
  - $23.75

LED Lighting
Case Study #1

- Furniture store – 49,000 sq-ft
- Installed 340 LED lights
- Total incentive - $3,400
- Projected lighting energy cost reduction - 75%
- Total project cost - $15,300
- Projected payback - 26 months
LED Lighting Case Study #2

• Automotive Service Center
• Installed exterior LED fixtures
• Total incentive - $5,800
• Projected lighting energy cost reduction – 77%
• Total project cost – $13,200
• Projected payback – 23 months
LED Lighting Case Study #3

• Restaurant – 4,500 sq-ft
• Installed 60 LED lights
• Total incentive - $600
• Projected lighting energy cost savings - $450/yr
• Total project cost - $2040
• Projected payback – 4.5 years
Click here to see lighting incentives.
Light Your Way To Big Savings

Lighting Incentives

Lighting accounts for 20% to 50% of the average business’ electricity consumption. On the bright side, that means you can enjoy significant savings—year after year—by making simple lighting improvements.

Cash incentives are available for a variety of Lighting projects, including:
- Replace T12s with high-performance T8 or T5 lamps
- LED exit signs
- Interior LED lighting
- Highbay lighting replacements
- Exterior lighting for canopies and garages
- T-8 to T-5 relamp and reballast
- Permanent lamp/fixture removal

How to Get Cash Incentives

It’s simple to get started. Download the application guide and application and you can:
- Get general information on the program
- View answers to frequently asked questions
- Determine eligibility
- Get details on cash incentives
- Apply for incentives (pre-approval required for requests exceeding $10,000)
- Submit required final paperwork to the Ameren Illinois ActOnEnergy Business Program

Click here to apply for lighting incentives.
Click here to find a Contractor who is an ActOnEnergy Program Ally.
What is the most useful or interesting thing you learned today?

Type your response into the Chat window.
Final Quiz

What do you already know about best practices for energy efficiency for lighting?

1. Which of the following is a reason to use LED lighting?

2. Correlated Color Temperature (CCT) references the “warmth” or “coolness” of what color light?

3. Which of the following is the recognized authoritative reference on the science and application of lighting?
Resources

- Yoelit Hiebert:
  Yoelit.H.Hiebert@saic.com
- Website: ActOnEnergy.com/Business
- Phone: 1.866.800.0747
- Fax: 1.309.677.7950
- Email:
  ActOnEnergyBusiness@Ameren.com
Questions?