LEDs for Low-Income Residences

Presentation to LIFE Conference
May 29, 2014
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Lighting Research Center,
Rensselaer Polytechnic Institute
Agenda

- Introduction to LRC
- LEDs
- Other lighting efficiency options
- Resources and education
Lighting Research Center

Advancing the effective use of light, thereby creating a positive legacy for society and the environment.

Founded in 1988

30,000 sq. ft. near NVLAP-accredited Rensselaer campus testing laboratory

40-60 concurrent projects in field and lab

NVLAP-accredited testing laboratory

35 full-time faculty and staff

Research & education revenue = $6 M/year

15 graduate students

http://www.lrc.rpi.edu
LED availability

- **ENERGY STAR qualified:**
  - 3,800 LED bulbs
  - 3,300 LED fixtures
  - Mostly residential products

- **DesignLights Consortium qualified:**
  - 4,300 LED bulbs (linear fluorescent replacements)
  - 41,600 LED fixtures
  - Commercial products

As of May 2014
# Retrofit applications

<table>
<thead>
<tr>
<th></th>
<th>Halogen</th>
<th>CFL</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Retail price</strong></td>
<td>$1.50</td>
<td>$2</td>
<td>$12</td>
</tr>
<tr>
<td><strong>Life</strong></td>
<td>1,000 h</td>
<td>12,000 h</td>
<td>25,000 h</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>43 W</td>
<td>13 W</td>
<td>11 W</td>
</tr>
<tr>
<td><strong>Payback Period</strong></td>
<td>N/A</td>
<td>0.1 yr</td>
<td>1.5 yr</td>
</tr>
<tr>
<td><strong>Cost of Ownership</strong></td>
<td>$9/year</td>
<td>$2/year</td>
<td>$3/year</td>
</tr>
</tbody>
</table>
Retrofit applications

- Situations that favor LEDs over CFLs
  - Downlights & other directional applications
  - Difficult-to-reach locations
  - Circuit with dimmer
  - Light quality
  - Cold temperatures
  - Child’s room
  - Frequent switching

- Situations that favor CFLs over LEDs
  - High temperatures
New construction: Upgrade to T8 or LED?

**T12 Troffer**
- 2x F40T12, parabolic troffer
- Fixture flux (mean) 3200 lm
- Input power 99 W
- Fixture opt. efficiency 74%
- Luminaire efficacy 32 lm/W
- Lamp life 20,000 hours

**T8 Retrofit**
- 2x F28T8, ballast
- Fixture flux (mean) 3330 lm
- Input power 49 W
- Fixture opt. efficiency 74%
- Luminaire efficacy 67 lm/W
- Lamp life 40,000 hours

**LED Retrofit Kit**
- Fixture flux (mean) 3400 lm
- Input power 44 W
- Fixture opt. efficiency 100%
- Luminaire efficacy 77 lm/W
- L70 life > 50,000 hours

- **Upfront Cost:** $49
- **Electricity Cost:** $21.46/yr
- **Relamping Cost:** $3.29/yr
- **Energy Savings:** 51%
- **Cost Savings:** $25.11/yr
- **Payback Period:** 2 yrs

- **Upfront Cost:** $255
- **Electricity Cost:** $19.27/yr
- **Relamping Cost:** $0
- **Energy Savings:** 56%
- **Cost Savings:** $30.59/yr
- **Payback:** 8.3 yrs

*LED: Cree CR24 upkit with 4000 lumens*
*Assume 12h per day. COE: $0.10/kWh*
*Equipment prices as of Sept. 2013*
New construction applications

- Situations that favor LED luminaires
  - Layered lighting design
  - Dimming
  - Cold temperatures
  - Frequent switching

- Situations that favor other luminaires
  - High ambient light levels
Selecting LEDs

- **Match:**
  - Type of bulb or fixture
  - Match light output (in lumens or lm) of current lighting
    - Illuminance on application area (in footcandles or lux) is better
  - Correlated color temperature (CCT) in Kelvin (K)
  - Size
  - UL rating
Selecting LEDs

- **Consider:**
  - Efficacy
  - Compatibility with dimmers
  - Warranty
  - CRI
  - ENERGY STAR label
  - Thermal conditions
  - Replace bulb with fixture

![Efficacy Comparison Chart]

*Data collected 2012*
Potential lighting issues to avoid

- **General**
  - Low light levels
  - Glare
  - Mismatched or inappropriate CCT
  - Poor color rendering
  - Improper control commissioning

- **LED-specific**
  - Thermal management
  - Heavier product may sag
  - Difficult to predict life of product “system”
  - Potential for color shift

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Lighting controls

- **Occupancy sensors**
  - Auto on and off
  - Best for common areas with little sense of ownership
  - Use with bi-level switching in stairwells

- **Vacancy sensors**
  - Manual on, auto off
  - Best for private areas

- **Manual switches**
  - Inexpensive energy savings for new construction
  - Consider wireless solutions for retrofits & plug-in fixtures
Light distribution

- Task/ambient lighting
  - Put more light where it’s needed for tasks
  - Reduce light in other areas
    - For navigation
    - Avoid gloomy look
    - Avoid big contrast
Resources and education

- ASSIST’s The Lighting Field Guide: Upgrading to LEDs for Multi-family Housing
Resources and education

- Lighting Patterns for Homes website
  - http://www.lrc.rpi.edu/patternbook
- Includes multi-family
- Calculators
- Lighting and equipment guidance
Resources and education

- LED lighting for contractors interactive video
  - http://www.lrc.rpi.edu/resources/JSFlash/LEDforContractors/LEDForContractorsv20.html
- Requires broadband and Flash player
Resources and education

- Upgrading incandescent bulbs interactive video
  - http://www.lrc.rpi.edu/resources/JSFlash/lampupgradewitnessode.html
- Requires broadband and Flash player
Resources and education

- Residential lighting seminar
  - Discounts for NY residents
- One-day, hands-on training

[QR Code]

NYserda Energy Research & Development Authority

Lighting Research Center

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Thank you