Cost Effectiveness of Solid State Lighting

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Midstream Lighting Program Manager
Presentation Overview

- ComEd Commercial & Industrial (C&I) Lighting Program LED Growth
  - Prescriptive
  - Midstream

- Utility Energy Efficiency Program Requirements
  - Cost-Effectiveness (TRC)
  - Program Evaluation

- LED Market Development & Program Management Challenges
ComEd Profile

Quick Facts

- Service Area: 11,300 square miles
- Customers: 3.8 million electric
- Employees: Nearly 6,000
- 2011 Revenues: $6,056 million
- 2011 Assets: $22,653 million
- Substations: 1,300
- Distribution & Transmission Power Lines: more than 70,000 miles
LED Lighting Systems Growth (Fixtures)  
Prescriptive/Custom Program

**Energy Saved**

- **PY4** – 7% of gross load reduction (includes induction lighting)
- **PY5** – 9% of gross load reduction
- **PY6** – 30% of gross load reduction

**Budget $ (MM)**

- **PY4** – $1.6 MM Paid (includes induction lighting)
- **PY5** – $1.9 MM Paid (5.4% of total)
- **PY6** – $7.0 MM Paid (20% of total)
LED Lighting Growth (Lamps)
C&I Midstream Program

**Products Incented**

- **PY4** – 60,000 lamps paid
- **PY5** – 215,000 lamps paid (17% of total)
- **PY6** – 325,000 (est.) lamps paid (26% of total)

**Energy Saved**

- **PY4** – 2% of gross load reduction
- **PY5** – 27% of gross load reduction
- **PY6** – 41% of gross load reduction (est)
Determining Cost Effectiveness of LED
Total Resource Cost-Benefit (TRC) Test

- Most-Used Utility EE Cost-Effectiveness Criteria
- Combines Utility and Customer Economics
- Economics of LED vs. Baseline Alternative
  - Based on incremental measure cost (difference between measure and what would otherwise be installed)
- Cost and Benefit Components Include…
  - A measure’s estimated energy (and peak) savings
  - Incremental capital, installation, operating and maintenance cost savings
  - Non-Energy Benefits (value of avoided carbon emissions in Illinois)
  - Utility program costs

- All Determined Over the Measure Lifetime (i.e., Life-Cycle)
Determining Cost Effectiveness of LED
Total Resource Cost-Benefit (TRC) Test

- TRC needs to be **1 or higher** to qualify for incentives as a single measure
- $1 investment delivers minimum of $1 return over measure life
- The longer the measure life, the higher the TRC (max 7 years)
- TRC of **Less than 1** does not necessarily stop the project but requires rationale to proceed
Program Management Process

Program Planning

Program Implementation

Program Evaluation

- TRC Test Screens for Cost-Effectiveness
- Sets Program Parameters
- Structure Incentives to drive participation
- Proactively Educate Trade Allies to Maximize Program Use
- Ensure that Program as a Whole Passes TRC Test
- Post Program Impact NTG
- Determines Effectiveness of Incentive Investment
LED Market Development

Accelerate the Market Conversion to Higher Efficiency Lighting

Influence Customer/Market Decision-Making with Incentives

Deliver High Net to Gross
LED Market Strategy

- Support Emerging Tech While Maintaining Integrity of Stakeholder Value
- Balance Market Demand with Financial Benefits to Utility Ratepayers
- What Will Move the Customer/Market?
- Control Systems incorporated with LED
  - Often move conversion projects from NO-GO to GO
  - How to fairly value and compensate for control systems (E,M&V)
- Acknowledging that LED may not be the best solution for every application
LED Program Management Challenges

- Managing Cost Effectiveness as much Art as Science
- First cost or LED compared to baseline still high (one for one)
- Building codes making baselines more efficient
- Full load delta watts for fluorescent replacements very narrow
- Projects often require incremental investment to make numbers work

- Impact of advanced control systems on program design
  - Managing and quantifying load reduction delivered through controls
  - Will the end result match the pre-application estimates
  - Create equitable yet effective EM&V process
Profile of a Desirable LED Project

- High delta wattage between baseline and replacement
- Long operational hours for baseline lighting system
- Potential for luminaire reduction on project
- Reduction of peak kWh usage
- Control Systems incorporated into project
- Utility incentive likely to influence decision
- Project payback within 7 years
Profile of an Undesirable LED Project

- Low delta watts between baseline and replacement product
- Short hours of operation for baseline system
- One for One luminaire replacement
- Reduction of Off Peak kWh usage
- Uncontrolled – All On/All Off (User Dependent)
- Payback longer than 7 years
Project Profiles

- **Commercial Project**
  - 4000 Annual Hours of Operation
  - One for One Replacement
  - Assuming Fixture Replacement was Inevitable (Calculate based on Incremental Measure Cost)

- **Warehouse Project**
  - 6500 Annual Hours of Operation
  - One for One Replacement
  - Lighting System Conversion (Calculate based on Total Cost)

- **Exterior Project (Car Dealership)**
  - 4380 Annual Hours of Operation
  - Fixture Reduction (100 to 70)
  - Lighting System Conversion (Calculate based on Total Cost)
Determining the Baseline System

- Baseline determination is important because it defines the load reduction that a utility can claim on projects.
- What lighting system would be used without utility program involvement.
- Typically baseline is existing system for Exterior and Interior HID to LED conversions.
- For many commercial interiors baseline may be what would be installed to meet code.
LED vs. Incumbent Options
Market Comparison

<table>
<thead>
<tr>
<th>Application</th>
<th>Incumbent Lighting</th>
<th>Maintenance</th>
<th>Uniformity</th>
<th>Controllability</th>
<th>Color Quality</th>
<th>Energy Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Lot</td>
<td>HID</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Warehouse</td>
<td>HID</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Warehouse</td>
<td>LFL</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Office Building</td>
<td>LFL</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

- HID is easy to beat with LED – Poor uniformity, incompatible with controls, poor lumen maintenance
- LFL competes well against LED without controls – High efficacy, long life, great color quality
- LED is superior to all lighting technologies when used with controls
# Commercial Lighting LED Application

<table>
<thead>
<tr>
<th>100 Fixtures One for One Replacement</th>
<th>Baseline System Wattage (85W, 3 Lamp, T8 Parabolic)</th>
<th>LED System Wattage (47W Lay-in)</th>
<th>LED System Wattage with Controls (38% Reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Installed Cost (Incremental Cost)</td>
<td>$15,000</td>
<td>$26,500 ($11,500)</td>
<td>$30,475 ($15,475)</td>
</tr>
<tr>
<td>Energy Cost Savings Over Baseline</td>
<td>$1,064</td>
<td>$1,564</td>
<td></td>
</tr>
<tr>
<td>Simple Payback without Incentives</td>
<td>10.81 Years</td>
<td>7.35 Years</td>
<td></td>
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<tr>
<td>Simple Payback With Incentives</td>
<td>9.02 Years</td>
<td>5.78 Years</td>
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</tbody>
</table>

LED Incentive $0.50 per watt reduced. Controls incentive $0.12 per watt controlled.
## Warehouse Lighting LED Application

<table>
<thead>
<tr>
<th>100 Fixtures (One for One Replacement)</th>
<th>Baseline System Wattage (458W HID Highbay)</th>
<th>LED System Wattage (200W Highbay)</th>
<th>LED System Wattage with Controls (38% Reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Installed Cost</td>
<td>$17,500</td>
<td>$54,000</td>
<td>$62,100</td>
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<tr>
<td>Energy Cost Savings Over Baseline</td>
<td></td>
<td>$11,739</td>
<td>$15,197</td>
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<tr>
<td>Simple Payback without Incentives</td>
<td></td>
<td>4.6 Years</td>
<td>4.08 Years</td>
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<tr>
<td>Simple Payback With Incentives</td>
<td></td>
<td>3.5 Years</td>
<td>3.07 Years</td>
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</tbody>
</table>

**LED Incentive $0.50 per watt reduced. Controls incentive $0.12 per watt controlled**
## Exterior LED Lighting Application
(100 – 1000W Metal Halide to 70 – 500W LED)
Replace Existing

<table>
<thead>
<tr>
<th></th>
<th>Baseline System Wattage (100 - 1000W Metal Halide)</th>
<th>LED System Wattage (Full Load) (70 – 500W LED)</th>
<th>LED System Wattage with Controls (77% Reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Installed Cost</td>
<td>$45,000</td>
<td>$89,250</td>
<td>$102,637</td>
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<tr>
<td>Energy Cost Savings Over Baseline</td>
<td>$24,980</td>
<td>$27,339</td>
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<tr>
<td>Simple Payback without Incentives</td>
<td>3.57 years</td>
<td>3.75 Years</td>
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<tr>
<td>Simple Payback With Incentives</td>
<td>2.1 Years</td>
<td>2.27 Years</td>
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</tbody>
</table>

LED Incentive $0.50 per watt reduced. Controls incentive $0.12 per watt controlled.
Market Observations

- Controls have greatest positive impact on payback on commercial luminaire projects with highly efficient incumbent.
- Controls have lesser impact payback on exterior projects (due to high initial first cost).
- Product costs in the market continue to fall which is dramatically accelerating program activity.
- Challenge to Continue to Influence Market Given:
  - Rapid Market Movement and Technology Change
  - Cost-Effectiveness Criteria (TRC>1.0)
  - Variable LED Value Proposition by Application
- PY7 Improvements Include Controls Program Enhancements
More Market Observations

- In commercial office market, LED luminaires will first displace architectural linear fluorescent category.

- Decision to move towards LED is not solely based upon economics; quality of light and user experience major contributor.

- LED lamp market continues to grow but there are still many issues that have yet to be solved.

- Utility customer experience with these products is very important (we act as advocates for EE).
THANK YOU