LED STREETLIGHTS
OVERVIEW

Update on current technology and progress in Massachusetts

September 21, 2016
LED OUTDOOR APPLICATIONS

LED

COBRA HEAD

High Pressure Sodium

POLE MOUNT

BOLLARDS

GAS STATION CANOPY LIGHTING
TECHNOLOGY COMPARISON

- LEDs are typically at least 50% more efficient than the technologies they replace.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Average Efficacy (lumens/watt)</th>
<th>Color Temperature Range °K</th>
<th>Color Rendering</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED</td>
<td>120+</td>
<td>2700 - 7500</td>
<td>Excellent</td>
</tr>
<tr>
<td>Induction</td>
<td>80</td>
<td>3000 - 6500</td>
<td>Good</td>
</tr>
<tr>
<td>High Pressure Sodium</td>
<td>75</td>
<td>2200</td>
<td>Poor</td>
</tr>
<tr>
<td>Metal Halide</td>
<td>60</td>
<td>4200</td>
<td>Fair</td>
</tr>
<tr>
<td>Mercury Vapor</td>
<td>50</td>
<td>4000</td>
<td>Fair</td>
</tr>
</tbody>
</table>
LUMEN MAINTENANCE IS IMPORTANT

- Light output degrades over time – 4175 hrs/yr is typical
- The lamp should be replaced at 65% of initial output

Some technologies degrade faster than others

- Metal Halide
- High Pressure Sodium
- LED
- Induction
STREETLIGHT 10 YEAR OPERATING COST COMPARISON

- Typical cobra head streetlights
- Includes fixture cost, electricity, and maintenance

![Bar chart showing cost per fixture by light output and type of lighting (LED, High Pressure Sodium, Metal Halide)]
IMPROVED CONTROLS

► Traditional Streetlight Control:
  - Photocell with lights on from dusk-dawn
    • 4,175 annual full load hours

► New LED control capability
  - Scheduled Dimming - after 10 pm in neighborhoods
    • 3,737 annual full load hours
    • Saves ~11% over traditional controls
  - Scheduled Off – during late night hours
    • 2,715 annual full load hours
    • Saves 35% over traditional controls

- LED controls can be used to account for lumen degradation

Source: National Grid RI streetlight tariff
ADVANCED FEATURES

► Networked LED streetlights can:
  - Self-report maintenance issues
  - Track and report energy use
  - Allow for fixture tuning to meet local needs
    • Cambridge MA programmed light levels by neighborhood through LED dimming controls

► Additional Options
  - Extend cellular coverage
  - Detect / triangulate gunshots
  - Identify parking spaces / issue tickets
  - Mark evacuation routes
NIGHTTIME LIGHTS AND HEALTH

► Increased interest in impacts of night light on human health and the environment
► Any light sources can have issues
► LEDs present challenges and offer solutions
► Issues include:
  − Glare can impact vision
  − Blue light can have health effects
  − Over-illumination disrupts sleep
  − Light trespass impacts the night sky and neighbors
**CHOOSE THE RIGHT COLOR FOR THE APPLICATION**

- Los Angeles streetlight conversion improved visibility and reduced crime rate

  ![High Pressure Sodium](image1) ![LED](image2)

- Lamps with warm color temperatures minimize health impacts and are suitable for residential areas

  ![HPS CCT=2200 K](image3) ![Cool white LED CCT=4000 K](image4) ![Warm white LED CCT=2700 K](image5)
STREETLIGHT RATES

► Streetlight energy use is **not metered**

► Flat rates established by technology and wattage
  - Different rates for utility vs municipal owned lights due to maintenance costs
    - Maintenance is built into the rate for utility owned
    - For Municipally owned, town/city provides maintenance and pays utility only for energy in flat rate

► “Typical Rate”
  - 250 watt nominal high pressure sodium cobra head = $102.31/year*

  - * National Grid, 2010 company owned roadway rate
LED STREETLIGHT RETROFIT RESULTS

LED streetlight retrofits deliver 50-80% energy savings

<table>
<thead>
<tr>
<th>City</th>
<th>Los Angeles, CA</th>
<th>Boston, MA</th>
<th>Portland, OR</th>
<th>Cambridge, MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streetlights Replaced (n)</td>
<td>150,000</td>
<td>38,838</td>
<td>55,100</td>
<td>7,000</td>
</tr>
<tr>
<td>Annual Savings</td>
<td>$5,300,000</td>
<td>$4,250,000</td>
<td>$2,000,000</td>
<td>$500,000</td>
</tr>
</tbody>
</table>

Additional savings from advanced controls
BARRIERS TO LED CONVERSION

► New utility owned streetlight tariffs – under development
► Issues with transferring ownership from utilities to municipalities
  ▶ Towns may not have the $$ for purchase
  ▶ Towns may not want maintenance responsibility
► Citizen concerns about LED technology
LED STREETLIGHT CONVERSIONS IN MA

► Cape Light Compact and Unitil (Fitchburg) have retrofitted all streetlights to LED

► The City of Boston (Eversource) is working towards replacement of all 64,000 electric lights by 2017

► Big Dig 25,000 tunnel lights are scheduled for replacement with LEDs

► National Grid territory: many municipal owned conversions are happening through ESCOs

► Eversource-WMECO territory: opportunity for upgrades

► Opportunities for company owned streetlights pending rate approval
THANK YOU