Seattle City Light
LED Streetlight Program Case Study
March 22, 2012

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Streetlight Engineering Supervisor

Program Goals

- Reduce energy use by 40% - Actual 48%+
- Lower maintenance costs (only lens cleaning during fixture life, no relamping, longer life photoelectric cell)
- Improve Customer Service (increased reliability of the fixture, fewer outages)

SCL Street Lighting System Background
Types by Use
84,000 Total Fixtures

Current SL System Energy Use by Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy Use (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential LED</td>
<td>6,896,520 (5%)</td>
</tr>
<tr>
<td>Residential Cobra Head</td>
<td>12,733,530 (15%)</td>
</tr>
<tr>
<td>Arterial Cobra Heads</td>
<td>52,827,180 (61%)</td>
</tr>
<tr>
<td>Pedestrian and Special</td>
<td>14,334,829 (17%)</td>
</tr>
<tr>
<td></td>
<td>89,878,191 kWh</td>
</tr>
</tbody>
</table>
The Plan

- **Stage 1** - Replace 41,000 Streetlights on existing poles in Residential areas beginning in 2010
- **Projected Cost**: $24 million ($18 million, actual)
- **Acquire Funding**:
  - Utility funding | Customer billed
  - $1 million ARRA EECBG Grant

Research and Engineering
Locate Pilot Sites
Choose Luminaires to test
Install Luminaires
Perform Illuminance Field Measurements
Conduct Customer Survey

**COMPLETED**

Phase 1 - 2010 Replaced 6k of the 41,000 Residential Streetlights w/in LED – Zone 3
Phase 2 - 2011 Replace Additional 12k Residential Streetlights w/in LED – Zone 4
(18,000 Total by end of year)

Review Typical Seattle Roadway

- Typical 32 foot cross-section
- Luminaire mounting height (25’ to 30’)
- Light pole spacing (150 feet)
- Tree Conflicts
Luminaire Selection

- Internet Research & Phone Calls
- Manufacture Questionnaire
  - Photometric performance
  - “Made in America” status
  - Manufacturers’ production capabilities
- Manufacturers’ Specification
- LM 79 & LM 80 Reports
- Pricing

Luminaire Selection Outcome

150 Manufacturers
- Initial Phone Contact
- Internet Research

40 Manufacturers
- From Questionnaire
- Specifications Review
- Manuf. Experience
- Price
- Availability

5 Manufacturers

Photometric Analysis

Computer Simulation

- Based on the IES RP-8-00, Table 2
  (American National Standard Practice for Roadway Lighting)
  - Average maintained illuminance values.
    - 0.4 foot candles (Seattle 0.7 foot-candles)
  - Uniformity ratios (average/minimum).
    - 6:1 with a minimum of 0.2 foot-candles allowed

Photometric Analysis

Computer Simulation

- Luminaire Characteristics
  - Type II & III distributions
    - Type II - greater pole spacing less light trespass
      (New BUG rating has come out – Backlight, Uplight, Glare)
    - Multiple Wattages tested
Photometric Analysis

Computer Simulation

- Color temperature 4000°K to 6000°K
  - Keyed in on 4000°K to 4300°K
    (Based on input from Stage 1 & Lighting Lab install)
- 350 to 525 milliamps operating current
  - Cooler operation to extend life of fixture

Photometric Analysis Outcome

- 5 Manufacturers
- Luminaire Selection
- 2 Manufacturers
  - 2 Luminaires Each
- Photometric Performance
- Further Price Review

Field Evaluation

Methodology
- Before and after comparison
- Field Testing Methodology based on RP-8-00
- Field measurements made with sled mounted light meter for efficient and fast data collection
- Testing conducted on clear nights with no clouds or moon

Photometrics

Before (HPS)
- Illuminance levels of existing HPS system exceeded RP-8-00 minimums
- Uniformity for HPS did not meet RP-8-00

After (LED)
- Illuminance levels exceeded RP-8-00 minimums
- Illuminance levels of the LED fixtures exceeded HPS system levels
- Uniformity for LED did not meet RP-8-00
Field Evaluation Outcome

- **3 Manufacturers**
- **1 Manufacturer Failed**
  - Field Deployment
  - Water inside housing

Economic Analysis

- **Base luminaire** - 100 W HPS Cobra Head
  - 25% failure rate
  - 30,000 hour lamp life
  - Maintenance cycle 4 years
- **Comparison Luminaires** - 39 to 142 Watt LED
  - 10% failure rate
  - 50,000 hour LED life
  - Maintenance cycle 7 years

- Life Cycle - 15 years (assumed)
- Energy Rate - $0.053/kWh
- Rebate - $0.23/kWh saved

Current Pilot Sites

- **Residential**
  - Capitol Hill
  - South Park
  - West Seattle
  - Genesee Hill
- **Arterial**
  - 2nd Ave
  - Cherry St

Structures

- West Seattle Swing Bridge
- University Bridge

Community Outreach

- Pilots in Specific Neighborhoods
- Questionnaire to Every Household
- Noted Major concerns and adjusted fixture selection
Implementation

- Jorge Carrasco, SCL Superintendent, Approval
- Mayor's Office Support and Approval
- City Council Budget Approval

2010 LED Expenditures

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COSTS</th>
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</thead>
<tbody>
<tr>
<td>Labor</td>
<td>$665,000</td>
</tr>
<tr>
<td>Materials – City Funded</td>
<td>$800,000</td>
</tr>
<tr>
<td>Materials – ARRA Funded</td>
<td>$1,000,000</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td><strong>$2,465,000</strong></td>
</tr>
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LED SL Program Savings - Residential Streets

<table>
<thead>
<tr>
<th>Units Converted</th>
<th>Savings Per LED</th>
<th>Monthly Savings</th>
<th>Annual Savings at end of period</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>$4.90</td>
<td>$24,500.00</td>
<td>$294,000.00</td>
</tr>
</tbody>
</table>

All Residential Streets Installed: 41,000

- $200,900.00
- $2,410,800.00
- ($520,000.00)

Total Projected Savings at end of 2014: $1,890,800.00

Challenges

1. Community Acceptance
   - Quality of Light
   - Light Distribution
2. Lack of Standards – No ones ever done this before...
3. Historical Design Practices
LED Next Steps

- Developed an LED Luminaire Specification
- 2012 – Residential LED Conversion – 12,000 units
- ARTERIAL PILOTS
  - West Seattle Bridge – I-5 to 35th Ave SW
    (SCL | SDOT | Consortium | PNNL Partnership)
  - 15th Ave NW - NEEA Acuity Study with Clanton Associates and Virginia Tech
  - Belltown – including adaptive controls
- Arterial Fixture Selection – Initiated in Fall of 2011
- Arterial Conversion Target - Begin Year 2013

New Technology Goals

- Remote Monitoring
  - Ability to get real time/ metered power usage for each light
  - Immediate notification of streetlight malfunctioning
  - Quicker response time for repair
- Adaptive Controls
  - Ability to dim or brighten streetlights to meet vehicular and pedestrian demands
  - Set scenes for events and time of day
  - 20%+ Additional energy savings

Why LED Street Lighting for Seattle?

“LED street lighting has proven to be a significantly better light source in terms of expected maintenance, energy efficiency, and quality of light.”

Edward Smalley, Seattle City Light

Seattle City Light – LED Street Lighting Program

March 22, 2012

Thank You…! Questions?

Vicki Marsten

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http://seattle.gov/light/streetlight/