Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Seattle City Light

LED Streetlight Program Case Study

March 22, 2012

Vicki Marsten
Streetlight Engineering Supervisor

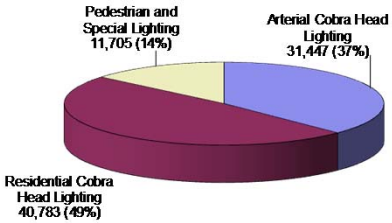
Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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)

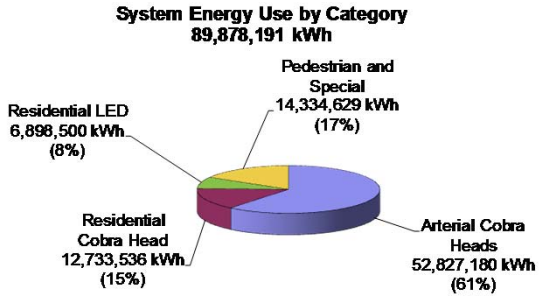
Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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



Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Current SL System Energy Use by Category



Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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

5

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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)

6

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Research and Engineering

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

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

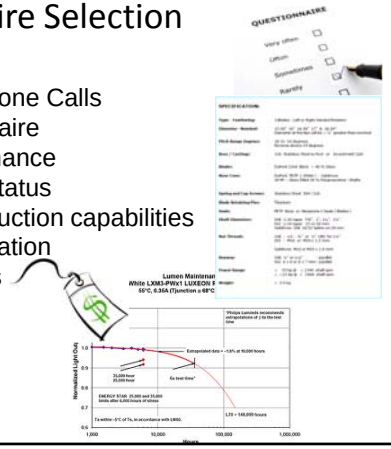
Review Typical Seattle Roadway

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

Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

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



Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

Luminaire Selection Outcome

150 Manufacturers
- Initial Phone Contact
- Internet Research

40 Manufacturers
- From Questionnaire
- Specifications Review

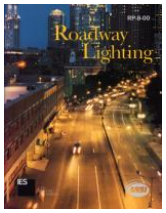
5 Manufacturers
- Manuf. Experience
- Price
- Availability

Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

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



Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

Photometric Analysis

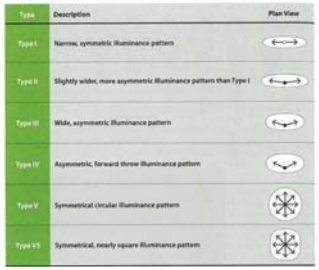
Computer Simulation

- Luminaire Characteristics
  - Type II & III distributions

Type II - greater pole spacing less light trespass

(New BUG rating has come out – Backlight, Uplight, Glare)

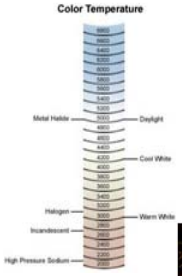
  - Multiple Wattages tested



Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Photometric Analysis Outcome

5 Manufacturers

- Luminaire Selection

2 Manufacturers 2 Luminaires Each

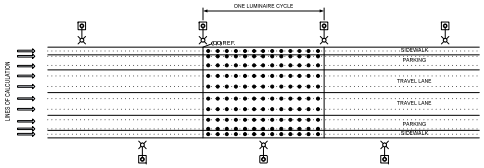
- Photometric Performance
- Further Price Review

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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



Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Field Evaluation

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

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Field Evaluation Outcome

3 Manufacturers

- Field Deployment

1 Manufacturer Failed

- Water inside housing

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Economic Analysis

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

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

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Current Pilot Sites

Residential

- Capitol Hill
- South Park
- West Seattle
- Genesee Hill

Arterial

- 2nd Ave
- Cherry St

Structures

- West Seattle Swing Bridge
- University Bridge

19

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Community Outreach

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

20

Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

Implementation

- Jorge Carrasco, SCL Superintendant, Approval
- Mayors Office Support and Approval
- City Council Budget Approval

Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

LED SL Program Savings - Residential Streets

Residentail LED Installations				
	Units Converted	Savings Per LED	Monthly Savings	Annual Savings at end of period
2010 Installations	5000	$ 4.90	$ 24,500.00	$ 294,000.00
All Residential Streets Installed:	41000		$ 200,900.00	$ 2,410,800.00
Annual System Management & Cleaning Costs				$ (520,000.00)
Total Projected Savings at end of 2014:				**$ 1,890,800.00**

22

Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

2010 LED Expenditures

DESCRIPTION	COSTS
Labor	$665,000
Materials – City Funded	$800,000
Materials – ARRA Funded	$1,000,000
Total Project Cost	**$2,465,000**

23

Municipal Solid-State STREET LIGHTING CONSORTIUM — Sponsored by the U.S. Department of Energy

Challenges

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

24

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

LED Next Steps

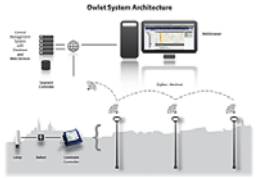
- Developed an LED Luminaire Specification
- 2012 – Residential LED Conversion – 12,000 units
- ARTERIAL PILOTS
  - West Seattle Bridge – I-5 to 35th Ave SW
    (SCL | SDOT | Consortium | PNNL Partnership)
  - 15th Ave NW -
    NEEA Acuity Study with Clanton Associates and Virginia Tech
  - Belltown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

25

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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



26

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

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

27

Municipal Solid-State STREET LIGHTING CONSORTIUM
Sponsored by the U.S. Department of Energy

Seattle City Light – LED Street Lighting Program

March 22, 2012

Thank You…! Questions?

Vicki Marsten

Vicki.Marsten@Seattle.gov
http://seattle.gov/light/streetlight/

28