Member Case Studies:
LED Street Lighting Programs in Algona, (IA), Asheville, (NC), & Boston (MA)

DOE Solid-State Lighting Webinar | Date: May 8, 2013

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Moderated by:
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Seattle City Light
About The Consortium - Background

- Created by the U.S. Department of Energy (DOE) in March 2010 using American Recovery and Reinvestment Act (ARRA) funding
- Supported by the DOE GATEWAY program
- Intended to be an educational resource on Solid-State street lighting and associated technology for those involved in lighting streets and other outdoor public areas.
- As an independent resource, the Consortium is available to help those unfamiliar with LED technology identify important issues and how to begin the evaluation process
- ...and to help accelerate adoption of SSL technology in the nations street lighting systems

MSSLC@Seattle.gov | www.ssl.energy.gov/consortium.html
Our Vision

- Accelerate the adoption of high performance solid-state street and area lighting by leading end-user collaboration in the areas of performance, evaluation, application, and standardization.

Our Mission

- Increase **KNOWLEDGE** around the performance, quality, and application of SS Street Lighting.
- Develop a national **STRUCTURE** to provide oversight and guidance on the evaluation of SSL for public areas.
- Influence national **STANDARDIZATION** of benchmarks, classification, design, and performance criteria. Set standard benchmarks.
Membership

Primary Type Organizations Participating
374

- Municipality, 218
- Utility, 63
- Non-municipal Government, 46
- Municipally Owned Utility, 47
Save the Date for Upcoming Webinars:

1. Adaptive Street Lighting Controls
   Part 1: Experiences and Benefits - June 11, 2013
   Part 2: Reviewing the Consortium’s Model Specification - June 12, 2013
3. City of Los Angeles Case Study – over 140,000 converted! - September 18, 2013
   □ Download past event presentations: [www.ssl.energy.gov/consortium.html](http://www.ssl.energy.gov/consortium.html)

Save the Date for MSSLC Annual Meeting:
When: September 11, 2013
Where: Phoenix, AZ - JW Marriott Desert Ridge Resort
Stay Tuned for Registration Details!
LED Streetlight Retrofit Project

John Bilsten
Algona Municipal Utilities
General Manager
MSSLC Webinar
May 8, 2013
• Located in North Central Iowa – 2 Hours north of Des Moines, IA and 3 Hours south of Minneapolis/St. Paul, MN
• Population: 5,560
• Electric, Water and Communications Utilities owned and operated by Algona Municipal Utilities
• Street Lighting operated and maintained by Algona Municipal Utilities and funded by the City of Algona
Algona Project Goals

• Reduction in energy and maintenance cost
• Improvement in lighting quality
• High quality LED lighting with 10 year warranty
  – Design by lighting expert – Mike Lambert
• Best cost for fixture
  – IAMU Joint Purchase Project – Anne Kimber, Joel Logan, Jonathan Roberts (IAMU staff)
Algona Project

- Partnership with IAMU and Mike Lambert for design, procurement and LED expertise
- Collaboration between Algona Municipal Utilities and the City of Algona
- AMU provided up front funding, labor, and project management (0% interest loan)
- The City of Algona will pay back the project cost over six (6) years
Project Funding

• ½ of the project cost (labor/materials/design/procurement) was funded through a EECBG – Energy Efficiency Conservation Block Grant

• ½ of the project cost (labor/materials/design/procurement) was funded by Algona Municipal Utilities.
Challenges for Algona

• Variety of fixtures and claims:
  • Vendor pressure
  • Up-front price deterrent
  • Need for accessible technical resources for good roadway lighting practices:
    • Lack of local expertise – staff
    • Upfront cost
    • Community interest
More Challenges

• EE CG timeline- all fixtures had to be installed by July 31, 2012
• Luminaires must meet Buy American standards
• Algona had to demonstrate that the luminaires had a simple pay back within the life of the fixture
• Algona wanted confidence that community would accept project: luminaires will provide improved lighting
  – Community input – test area
Idea for LED retrofit joint purchase

IAMU and Mike Lambert (independent Lighting Consultant)

–Develop RFP process on behalf of municipal utilities for LED retrofit of high pressure sodium cobra head luminaires

–Advantages:
  • Assist participants to meet EECBG grant requirements
  • Independent process with technical assistance to evaluate proposals
  • Provide economies of scale

–Tool: the new DOE MSSLC Model Specification
Street Lighting energy efficiency:

For small communities, street lighting on average is 26% of municipal energy consumption, here’s one example:

A street lighting project is one of the most visible energy efficiency projects a community can undertake, and the cost savings benefit all.
RFP for joint purchase

- **Why?** Quality, grant requirements, state regulations, lower prices and economies of scale

- **How?**: modified DOE MSSLC Model Specification (material version), publicize widely in plan rooms, independent lighting consultant for evaluation

- **Timeline?** 1 month from issue of RFP to selection of Bidder.
RFP Results: Quoted Prices with low bid set to “1”

<table>
<thead>
<tr>
<th>LED Fixture Replacing:</th>
<th>Mean Bid Price</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 W HPS</td>
<td>$361.53</td>
<td>$80.84</td>
</tr>
<tr>
<td>150 W HPS</td>
<td>$492.52</td>
<td>$66.13</td>
</tr>
<tr>
<td>250 W HPS</td>
<td>$645.57</td>
<td>$98.17</td>
</tr>
</tbody>
</table>

Results today: 20 cities in joint purchase, several repeat purchases, 1,800 fixtures installed. Now at second (lower) price point.
Algona Project Results

– 447 LED lights installed in Algona.
– Luminaires expected to result in annual energy savings of approximately 234,254 kWh (42% savings)
– Life expectancy greater than 20 years
– Project funds invested expected to realize a simple payback well within the life of the fixture based on energy savings alone.
– Luminaires expected to yield significant annual operation and maintenance savings for the participating communities
Algona, Before
Algona, After
**LED Retrofit Project Summary for:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Costs (Fixture cost, warranty, consulting fee, photo-controls, estimated installation labor)</td>
<td></td>
<td>$288,815</td>
</tr>
<tr>
<td>Total Fixtures Ordered Thru Purchase</td>
<td></td>
<td>447</td>
</tr>
<tr>
<td>150W HPS - 104W LED Replacements</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>250W HPS - 104W LED Replacements</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>250W HPS - 176W LED Replacements</td>
<td></td>
<td>364</td>
</tr>
<tr>
<td>Annual kWh Savings</td>
<td></td>
<td>234,254</td>
</tr>
<tr>
<td>Annual Energy Cost Savings*</td>
<td></td>
<td>$18,740</td>
</tr>
<tr>
<td>Estimated kWh Savings at 70000 Hr</td>
<td></td>
<td>3,743,782</td>
</tr>
<tr>
<td>Estimated Energy Cost Savings at 70000 Hr</td>
<td></td>
<td>$502,157</td>
</tr>
<tr>
<td>Estimated Payback Period (Energy Savings Only)</td>
<td></td>
<td>15.4</td>
</tr>
<tr>
<td>Estimated Payback Period (Includes maintenance savings)</td>
<td></td>
<td>9.2</td>
</tr>
</tbody>
</table>

*Estimate based on the following rate ($/kWh): $0.080
Key factors in Algona’s success:

- Support of City Council and Board of Trustees - Willing to embrace change
- Knowledge of municipal energy consumption
- 2008 Iowa requirement for EE goals and EE projects
- Knowledge that the cost of avoiding a kWh is cheaper than the cost of purchasing a kWh
- Stimulus funding enabled Algona to take a (small) risk on new technology
- A Lighting Designer (LC) able to answer individual technical problems for the group
- Great timing: decreasing prices for LED luminaires and large scale installations examples in California
- Technical background and integrity of DOE MSSLC resources which were being released concurrently with our project
Maggie Ullman
Sustainability Director
City of Asheville
North Carolina
May 8th, 2013
1. Why LED streetlights?
2. LED Rates
3. Business Case for LEDs
4. Lessons learned
2007 - Created a Citizen Sustainability Committee

2008 - Established the Office of Sustainability

2008 - Carbon footprint reduction policy of 2% per year

2009 – Adopted Sustainability Master Plan

2011 - Doubled policy to 4% per year

2011 - Created the Green Capital Improvement Funding Program
Streetlights are a large part of our carbon footprint. LED’s are a great option to reduce our energy use.
• Asheville served by Duke Energy Progress (investor owned utility)

• Flat streetlight rate per fixture

• Included in rate: capital investment, energy, maintenance
New Rate Choices

Customer Owned LED Rate

- Flat rate per fixture
- City purchases and owns
- Utility installs and maintains

Con: large upfront investment
Pro: lowest rate option, 5 yr ROI

Company Owned LED Rate

- Flat rate per fixture
- Utility purchases, installs, maintains, and owns

Con: highest rate option
Pro: City doesn’t own fixtures
<table>
<thead>
<tr>
<th>Cost Benefit Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO2 Reduction</strong></td>
</tr>
<tr>
<td><strong>Project Costs</strong></td>
</tr>
<tr>
<td><strong>Total Fixtures</strong></td>
</tr>
<tr>
<td><strong>Annual Savings</strong></td>
</tr>
<tr>
<td><strong>Energy Savings</strong></td>
</tr>
<tr>
<td><strong>Return on Investment</strong></td>
</tr>
</tbody>
</table>
Financial Goal: Cash Flow Positive
Financial Plan

1. Borrowed
   - Green Capital Improvement Program
     - $2 M
     - Reinvested
       - LED Installation
         - $400K
       - 12 mo Utility Savings
         - $180K
         - Debt Service on Loan
           - $220K
           - $2 M
Technology Price Change

In 18 months

- 34% average price drop
- ROI dropped by 1.4 yrs
• Need to bundle borrowing package with other projects that can be collateralized

• Need to dedicate time to monitoring and verifying savings so projections turn to actuals

• Need to create long term plan for managing new capital

• Need to dedicate time to customer service during installation process
8,000 fixtures city wide

120 complaints; 0.02% streetlight complaint rate

40 resulting in shields

20 in fixture removals

#1 Complaint= TOO BRIGHT
3400 K Color Temp Fixtures

Old High Pressure Sodium

New LED
Outstanding Challenges

1. Need better shield option
   • Need to shield from ALL directions
   • Need easier field install

2. Realistic LED Rates
   • Maximize Gov't borrowing rates
   • Reflect technology cost reductions
   • Reflect reduced maintenance costs
Thank You!

Maggie Ullman
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Boston’s Ongoing LED Street Lighting Initiative

May 8, 2013

Glenn Cooper
Director of Street Lights
City of Boston
Boston’s Street Lights

- 64,000 electric street lights
  - Mercury Vapor (42,000 as of 2010)
  - High Pressure Sodium (22,000 as of 2010)

- Mercury Vapor lights phased out NEPAct

- Streetlights accounted for 18% of the GHG emissions from Boston municipal operations

- Spend $8 million annually on electricity and $1.3 million on gas
• The Opportunity

• Replacement of High Pressure Sodium, Mercury Vapor, and Incandescent Light with LED lighting technology
Light Emitting Diode

- One of the most efficient light sources to date.
- Negligible lumen depreciation over same period of Mercury Vapor lights.
- Lamp Life 60,000 hours plus.
- Minimal light loss due to design of LED chips.

Mercury Vapor

- Least energy efficient of the HID lamp family.
- High lamp depreciation over the life of the lamp.
- Lamp life 24,000 hours.
- Design of MV luminaire results in up to 30% initial light loss.
• Over 90% of light emitted is utilized to light roadway therefore can use lower wattage luminaires
• Better color rendering for identifying objects
• All streets satisfy ANSI/IESNA RP-8-00 National Standards for Roadway Lighting, accounting for:
  • Type of roadway
  • Area classification
  • Pavement type
  • Pedestrian conflict
  • Roadway width
  • Luminaire height
• Timeline
  • 2009
    – Pilot LED program in 2009 in section of the Boston Common and Jamaica Plain
    – Feasibility analysis of LED technology and life cycle costs from the PWD Street Lighting Division, Environment & Energy Services Cabinet and the Clinton Climate Initiative
• **Timeline**

• **2010**
  – NSTAR rebate agreement reached to convert Mercury Vapor fixtures to LED
  – 2,800 fixtures converted on residential streets in Brighton, Jamaica Plain, East Boston and South Boston

• **2011**
  – Wide-scale installation of 12,000 additional MV fixtures throughout City
  – New fixtures allowed for replacement of higher wattage units on arterial streets & areas of public safety concern

• **2012**
  – complete remaining 8,200 cobrahead fixtures throughout the City (MV and HPS)
  – Begin converting MV Acorn and Rectilinear fixtures
• 2013
  – Complete Conversion of Mercury Vapor Acorn fixtures (completed March 2013)
  – Begin conversion of 5,500 Mercury Vapor Rectilinear (Shoebox) fixtures on residential streets City wide

• 2014
  – Complete conversion of 5,500 Mercury Vapor fixtures
  – Begin Conversion of 4,500 High Pressure Sodium Vapor Rectilinear on residential and intermediate roadways city wide
  – Begin Conversion of 5,800 High Pressure Sodium Vapor Acorns on Commercial roadways.

• 2015
  – Begin and complete conversion of Pendant Style luminaires on Commercial Roadways throughout the City. Program anticipated to be completed by end of Calendar Year 2015
• Planning for a Large-Scale Retrofit (2010)

• Developed performance-based specifications
  – Met with several LED luminaire manufacturers some well known some were emerging companies
  – Reviewed several luminaire choices and developed specifications based on the best features of all luminaires reviewed including but not limited to:
    » Combine with existing units in service
    » Compatible with multiple mounting arms in range of 1 ¼” to 3” arms
    » Ease of installation
    » Lightweight
    » Most efficient in regards to energy consumption
    » Specified companies that have a history in the development and Manufacture of LED lighting units (5 years minimum)
• Planning for a Large-Scale Retrofit (2010)

Bids for first units installed

• Bids called out for units that would be equivalent for Mercury Vapor units that were being converted. Units to be converted to LED were 175, 250 and 400 Watt Mercury Vapor

• Vendors bid according to what was specified.

• Pricing was extraordinarily low

• Unit did meet Specifications and did meet RP 8 for the roadway we initially were going to install units.
• **Lessons Learned (2010)**
  
  • Specifications refined to be more detailed
    
    – Utilize IES RP8 guidelines to ensure that streets are properly lighted, based on:
      
      – Roadway Type
      – Pavement Type
      – Luminaire height above roadway
      – Luminaire spacing
      – Setback, etc.
      – Defined uniformity
      – Defined Light loss factor
    
    – Fortunately, we did not have to re-advertise the first LED bid. Two of the three units on the bid met IES RP 8 guidelines for the streets we intended on converting
• Project Implementation Continued (2011)
  • All areas of the city were included in this conversion. Residential and Commercial streets were converted during this second phase
  • Specifications for second bid were again performance based but were quite specific
    • Follow RP8 Guidelines giving Vendors who bid specific details on streets to be lighted. Details were worse case scenarios to ensure proper lighting levels. Vendors who did not provide all material requested in bid were rejected
    • Units bid had to be approved by The Design Lighting Consortium to be eligible for utility rebate
    • Limited drive current to ensure long LED life
    • Testing (In situ) was provided as part of the bid to back up manufacturers claim of LED life. Testing performed by Independent testing Laboratories.
• Project Implementation 2012
• Conversion of decorative Mercury Vapor Acorn Street Lights in all areas of the City of Boston.
  – Historic South End, Charlestown included in conversion
  – Follow RP8 Guidelines giving Vendors who bid specific details on streets to be lighted. Design was refined to eliminate light trespass
    • Units bid had to be approved by The Design Lighting Consortium to be eligible for utility rebate
    • Limited drive current to ensure long LED life
Acorn Luminaire used in Conversion 2012
Rectilinear Replacement
  – Out with the old

Rectilinear Replacement
  - In with the new
Typical LED Installation
Columbia Rd. at Annabel Street - Dorchester
Example Installations

Centre Street at Perkins Street – Jamaica Plain
Comparison of LED vs. HPSV Lighting

Dorchester Avenue at West Fourth Street – South Boston
• Future Considerations
  
  – Networking street lights to allow Public safety (Police, Fire) to allow them to turn lights on and off or increase or decrease output as required. Reporting of light or lights out on a given streets to decrease patrols and increase efficiencies in the Department for maintenance
  
  – Install smart photocells that will last, according to the manufacturer, as long as LED unit is in service
  
  – Update Specifications as RP-8 and TM-21 guidelines are modified to level the playing field for all LED Luminaire manufacturers
• Environmental Impacts

**Boston LED Streetlight Project**

- **LED installations begin**
- **5.1 million kWh saved in 2011**
- **10.2 million kWh projected savings in 2012**
• Employment Impacts
  – Fixtures are manufactured per City of Boston requirements in Pennsylvania, Minnesota and California
  – 16,000 work hours to date (est. 19,000 by end of phase 1)
  – Installation done by AFSCME union members, who have been ~16% cheaper than private contractor bids
• Financial Impacts (Cobrahead Conversion)

• Total Project Cost:
  Materials: $6.8 million
  Installation: $742,000 (projected)
  # of units Installed – 23,000

• NSTAR Incentive: $3.8 million

• City of Boston Cost: $3.7 million

• Annual Energy Savings     Annual Maintenance Savings
  $2.8 million               $150,000 (est.)

• This Project Paid for itself in less than 1.5 years
• Financial Impacts (City Wide) LED Project

  • Anticipated Completion Date (2015)
  • Total Project Cost:
    Materials: $18.8 million
    Installation: $1.8 million (projected)
    # of units projected to be installed – 38,000
  • Annual KWH Energy Savings  Annual Maintenance Savings
    25 Million KHW ($3.3 Million per Year)  $500,000.00 (est.)

• This Project Pays for itself in less than 5.6 years
• Questions?

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Thank You!...Questions

www.ssl.energy.gov/consortium.html

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