COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

APPLICATION OF KENTUCKY UTILITIES	**)**	
COMPANY FOR AN ADJUSTMENT OF ITS	**)**	**CASE NO.**
ELECTRIC RATES AND FOR CERTIFICATES	**)**	**2016-00370**
OF PUBLIC CONVENIENCE AND NECESSITY	**)**	

RESPONSE OF KENTUCKY UTILITIES COMPANY TO SECOND REQUEST FOR INFORMATION OF LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT DATED FEBRUARY 7, 2017

FILED: FEBRUARY 20, 2017

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **Daniel K. Arbough**, being duly sworn, deposes and says that he is Treasurer for Louisville Gas and Electric Company and Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Daniel K. Arbough

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 10th day of February 2017.

(SEAL)
Notary Public

My Commission Expires:
JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **Robert M. Conroy**, being duly sworn, deposes and says that he is Vice President – State Regulation and Rates for Louisville Gas and Electric Company and Kentucky Utilities Company, an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Robert M. Conroy

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 30th day of February 2017.

(SEAL)
Notary Public

My Commission Expires:
JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **Christopher M. Garrett**, being duly sworn, deposes and says that he is Director – Rates for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Christopher M. Garrett

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 10th day of February 2017.

(SEAL)
Notary Public

My Commission Expires:
JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **John P. Malloy**, being duly sworn, deposes and says that he is Vice President – Gas Distribution for Louisville Gas and Electric Company and Kentucky Utilities Company, an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

John P. Malloy

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 30th day of January 2017.

Notary Public (SEAL)

My Commission Expires:
JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **Valerie L. Scott**, being duly sworn, deposes and says that she is Controller for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that she has personal knowledge of the matters set forth in the responses for which she is identified as the witness, and the answers contained therein are true and correct to the best of her information, knowledge and belief.

Valerie L. Scott

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 10th day of February 2017.

Notary Public (SEAL)

My Commission Expires:
JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **William Steven Seelye**, being duly sworn, deposes and states that he is a Principal of The Prime Group, LLC, that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

William Steven Seelye

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 13th day of February 2017.

(SEAL)
Notary Public

My Commission Expires:
JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **John K. Wolfe**, being duly sworn, deposes and says that he is Vice President - Electric Distribution for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

John K. Wolfe

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 30th day of February 2017.

Notary Public (SEAL)

My Commission Expires:
JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 1

Responding Witness: Robert M. Conroy / William S. Seelye

Q-1. Please refer to Table 2 of William Seelye's testimony. On pages 6-7 of his testimony, Seelye states that "KU is proposing higher percentage increases for rate classes that have low rates of return and lower percentage increases for rate classes that have higher rates of return." Please confirm that the proposed percentage of revenue increase from lighting service and restricted lighting service is higher than (a) residential service, (b) time-of-day secondary service, and (c) all electric schools, all of which have lower rates of return than the lighting service and restricted lighting service classifications. Explain why KU deviated from its desire to have higher percentage increases for rate classes that have low rates of return and lower percentage increases for rate classes that have higher rates of return with respect to lighting classifications.

A-1. Yes, the proposed increase for Lighting Service and Restricted Lighting Service is higher than Residential Service, All Electric Schools, and TOD Secondary. The Company is proposing a higher increase for Lighting Service and Restricted Lighting Service because of the higher risk of property damage for lighting equipment under these rates and because of the higher administrative burden of carrying inventory for lighting equipment. Street and outdoor lights have a higher incident of vandalism and damage than other utility property. Furthermore, the Company must carry inventory for each light type even when customer interest in lighting equipment is in decline. Consequently, the Company has a significant inventory risk in providing service under these rates.

KENTUCKY UTILITIES COMPANY

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Question No. 2

Responding Witness: John P. Malloy / William S. Seelye

Q-2. Please refer to KU's response to LFUCG 1-3 and Attachment 2 to LFUCG 1-28. In response to LFUCG 1-3, KU suggests that it has not performed an analysis calculating the percentage increase that would be assigned to LFUCG based on KU's proposed increases to its lighting rate classifications. Attachment 2 to LFUCG demonstrates that KU has performed at least four different analyses calculating the impact on lighting customers, including LFUCG, based on different possible proposals.

a. Please perform the analysis necessary to verify and confirm LFUCG's assertions identified in LFUCG 1-3.

b. If KU's calculations for the percentage of total income KU receives for lighting from LFUCG and percentage of proposed increase derived from LFUCG are different than LFUCG's calculations, please provide all data, formulas, and calculations on which KU relies.

c. Please justify the disproportionate allocation of proposed increase whereby one customer with less than 20% of KU's lights is responsible for more than 50% of KU's proposed revenue increase.

A-2.

a. The Company has not performed an analysis calculating the percentage increase that would be assigned to LFUCG. Therefore, the Company is unable to verify LFUCG's assertions. The four analyses calculating the impact on lighting customers referenced in the question above were based on current tariff pricing and relates to the effect consolidation of rate codes would have on lighting customers.

b. Not applicable.

c. The Company has not performed an analysis that can confirm LFUCG's assertion that one customer with less than 20% of KU's lights is responsible for more than 50% of KU's proposed revenue increase. Nevertheless, the proposed

lighting rates were based on a cost analysis for each type of light, with rates for some lights receiving a higher increase than others because of the higher cost. Thus, it is possible for a customer with multiple lights to receive a higher increase than the overall increase for the class, but the purpose of the Company's proposal is not to advantage or disadvantage any given customer; rather, it is to rebalance the rates for individual lights so they more accurately reflect the cost of providing service.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 3

Responding Witness: Counsel / Valerie L. Scott

Q-3. Please refer to KU's response to LFUCG 1-22.

a. Please identify what services EEI provides for the dues KU pays.

b. Please identify what services EEI provides for payments KU makes for lobbying activities.

c. Identify the specific issues on which EEI lobbies.

d. Identify to whom EEI lobbies on each specific issue.

A-3.

a.-b. See attached.

c.-d. Objection. The portion of dues related to lobbying activities is irrelevant to the subject matter of this proceeding, namely setting new base rates for KU beginning July 1, 2017. All such cited expenses, to the extent any were chargeable to or incurred by KU, were below the line and were not included in test years used for setting rates. In addition, the forecasted test year in this proceeding includes no such expenses, which are below the line to the extent any are chargeable to or incurred by KU. When KU filed its Schedule F-1 as part of Tab 59 of its Application related to dues for the base period and forecasted period, it identified that a portion of the EEI dues were not sought to be recovered in rates.

EEI 2016 Results in Review

- Established an industry-wide **cyber mutual assistance program** in coordination with the **Electricity Subsector Coordinating Council**—more than 70 companies already are participating.
- Applied the procedures and tools put in place following Superstorm Sandy—including the National Response Event framework, the ESCC-government partnership, and cross-sector coordination—to streamline response and restoration efforts during **Hurricane Matthew**.
- Successfully advocated for the FCC to allow member companies to use **robocalls** and text messages to communicate with customers about service-related matters—critical during Hurricane Matthew.
- Secured policies, including FAA reauthorization legislation, that expand opportunities for members to use **unmanned aircraft systems** and beyond-visual-line-of-sight operations to remotely inspect and monitor energy infrastructure and speed restoration—drones were used during Hurricane Matthew response.
- Facilitated the sharing of mutual assistance resources during Hurricane Matthew using EEI's new web-based resource allocation tool, **RAMP-UP**.
- Expanded and enhanced industry efforts to share and transport **transformers and other critical equipment** during an emergency.
- Secured protections against **disclosure of critical infrastructure information** in the final DOD authorization bill directing DHS to develop a strategy for protecting against EMP and GMD threats.
- Successfully advocated for legislation to allow states to implement EPA's **coal ash rule** through a permit program.
- Promoted the **industry's solar leadership** and advocated for equitable **distributed generation** policies, including rate alternatives that reform **net energy metering**.
- Led a coalition in strong opposition to the **King-Reid amendment**, which would have dictated how state NEM programs should work.
- Shaped **NARUC's rate design manual**, emphasizing the value of the energy grid and the need for rate reform.
- Continued to engage with the **Critical Consumer Issues Forum** on a range of issues, including smart cities.
- Supported **FERC Order 825**, an important first step in improving price formation in the RTO/ISO markets.
- Created a **Generation Task Force** on issues related to preserving a balanced energy mix.
- Led efforts to address **disclosure and divestiture** issues related to carbon and advocated against changes to the SEC disclosure rules.
- Developed guidelines for voluntary **ESG reporting** to meet investor and stakeholder needs.
- Obtained a CFTC Order to retain the current $8 billion ***de minimis*** **threshold** until December 31, 2018, and a favorable final rule on margin requirements for **uncleared swaps**.
- Successfully achieved favorable IRS guidance that provides greater and more timely access to **nuclear decommissioning reserve funds**.
- Secured legislation reauthorizing the **Toxic Substances Control Act** that achieves the industry's goals of preserving existing regulation of PCBs.
- Worked with EPA and other stakeholders to improve the **Waters of the U.S. rule**, including obtaining an important NARUC resolution.
- Worked with individual member companies to improve EPA's state-specific **regional haze implementation rules**.
- Participated in **COP-22** to highlight member company efforts to increase the use of clean energy and reduce GHG emissions.
- Signed a new MOU with federal agencies to facilitate member companies' ability to perform rights-of-way **vegetation management** on public lands.
- Led industry outreach regarding OMB guidance implementing the infrastructure permitting provisions of the **FAST Act**.
- Successfully encouraged FERC to recognize the sensitivity of **access to NERC data** on generation, transmission, and protection-system performance and to commit to protecting that information.
- Successfully advocated that both House and Senate Appropriations Committees pass fiscal year 2017 bills to fund **LIHEAP**.
- Worked with organized labor to advocate that OSHA delay enforcement of certain provisions of the agency's final **workplace injuries and illnesses rule**.
- Promoted the industry's **fleet electrification initiative** and helped to develop guiding principles to promote **EVs and charging infrastructure**.
- Created a new **energy storage** practice and member company taskforce to guide policy advocacy and to facilitate wider deployment of energy storage technologies by members.
- Joined the World Wildlife Fund and the World Resources Institute in documenting the results of an 18-month effort to meet **corporate buyers' desire for clean energy**.
- Successfully advocated for DOD authority to extend the term length of **Utility Energy Services Contracts** from the arbitrarily set length of 10 years to 25 years.
- Corrected a long-standing error in DOE's **codes and standards** process that penalized zero-emitting generation sources.

Results in Review *(cont.)*

- Launched a broad **education and advocacy strategic initiative** to highlight the industry's transformative leadership; educate key audiences about the industry's work to deliver the energy future customers want; and secure positive policy outcomes.
- Led a customer-focused research project to effectively position the industry for the future by creating a common **lexicon** that is clear and credible.
- Led a multi-faceted campaign to launch the first **Utilities United Against Scams Day**, focused on exposing the tactics scammers use to steal money from utility customers and on educating customers—more than 90 operating companies participated.
- Through **We Stand For Energy**, educated and united electricity customers and industry stakeholders and advocated for smart energy solutions to ensure safe, reliable, affordable, and clean energy.
- Partnered with AGA and NEI as **America's Energy Program** to drive the conversation about our nation's energy future during the Republican and Democratic National Conventions.
- Hosted the **Congressional Black Caucus** during its annual legislative conference—EEI Chairman Tom Fanning highlighted industry priorities.
- Partnered with organized labor on the ninth annual **National LAMPAC meeting and regional LAMPAC meetings** and participated in the 39th IBEW International Convention.
- Supported the Institute for Electric Innovation's sixth annual **Powering the People** event, focusing on how new technologies, public policies, and customer expectations are driving industry transformation.
- Supported IEI's **National Dialogue Series**, bringing together electric and technology company senior executives to discuss the digital grid, data analytics, and clean energy.
- Hosted the first **International Utility Executive Summit** and released a book that features 20 essays from leading experts on the outlook and opportunities for energy in Asia.
- Led a U.S. delegation to the **2016 International Electricity Summit** in Sintra, Portugal.
- Working with the **Center for Energy Workforce Development**, continued to promote workforce development and STEM education and to implement career pathways for veterans, women, youths, and transitioning adults.
- Supported CEWD and its member associations and labor unions in partnering with DOE, DOL, DOD, and Veterans Affairs on the inaugural **Veterans in Energy National Leadership Summit**. VIE provides transition, retention, and professional development support to the growing number of military veterans working in the energy industry.
- Showcased how members are creating the innovative partnerships, clean energy and infrastructure projects, and game-changing technologies customers want at EEI's **2016 Annual Convention**.

2017 Outlook

- New Administration, new Congress, new state policymakers
- Ongoing focus on smarter energy infrastructure, clean energy, customer solutions
- Comprehensive tax reform legislation
- Increased focus on cybersecurity and other critical infrastructure security issues, including EMP
- Continued expansion and utilization of cyber mutual assistance program
- Maintain the ESCC and government-industry partnership
- Continued focus on spare equipment and transformer transportation processes
- Ongoing enhancements of the NRE framework and RAMP-UP software tool
- NERC's GridEx IV—November 15 and 16
- Ongoing advocacy for policies that support an all-of-the-above energy mix
- Ongoing transition of the generation fleet
- Energy market price reforms to properly value generation assets
- Range of distributed energy resource issues—distributed generation, microgrids, energy storage
- Major telecommunications legislation—issues such as spectrum access and pole attachments
- Range of energy infrastructure issues—potential for major infrastructure legislation
- Ongoing focus on ESG issues and reporting framework
- STB reform bill implementation and rulemakings related to coal rail rates and service
- Range of environmental policy issues—regional haze, ozone NAAQS, HAPs, coal ash, ESA reform, WOTUS rule, water regulations
- Regulatory proceedings and rulemakings impacting extraction of natural gas
- Implementation of FAST Act infrastructure permitting provisions
- Continued FERC advocacy on key reliability issues
- Advocacy at FERC for compensatory ROEs
- Continued leadership to advance electrification
- Continued focus on commercial operation of small UAS
- CCIF regional summits on smart cities
- Implementation of smart cities action plan
- Expansion of large customer customized product partnerships
- Ongoing focus on workforce development issues
- IEI Innovation and Technology Initiative and IEI National Dialogue series
- Ongoing dialogues between U.S. and international electric companies
- Release of industry jobs study
- EEI inaugural parade watch party—January 20
- EEI Welcome Back Congress event—February 1
- Annual EEI Wall Street briefing—February 8
- EEI Meet the Freshmen congressional education series
- 10th Annual National LAMPAC meeting—March 13
- Powering the People—March 15

EEI POWER BY ASSOCIATION 2016 Review

Highlights & Important Developments To Date

- EEI continues to develop the **Electricity Subsector Coordinating Council** as a model for industry-government partnerships. Among its activities, the ESCC:
  - Provides the E-ISAC with strategic guidance through the Member Executive Committee.
  - Convened the communications and financial services sector coordinating councils to develop a Strategic Infrastructures Coordinating Council to strengthen coordination capabilities across the three sectors.
  - Formed an EMP Task Force to support EPRI's EMP project and DOE's EMP action plan.
  - Aligned R&D efforts with DOE.
  - Participated in DOE's Clear Path IV Exercise to examine the challenges of responding to a catastrophic earthquake and tsunami in the Pacific Northwest.
  - Continued to roll out CRISP and other proprietary tools and technologies.
- EEI established an industry-wide **cyber mutual assistance program** in coordination with the ESCC and federal partners; nearly 60 companies already have signed on to participate.
- EEI continued to expand and enhance industry efforts to share and transport **transformers and other critical equipment** during an emergency.
- EEI applied lessons learned from Superstorm Sandy to **Hurricane Matthew**. The plans, procedures, and tools put in place following Sandy—including the National Response Event framework, the ESCC-government partnership, and cross-sector coordination—helped to streamline the response and restoration efforts during Matthew.
- EEI's newly developed, web-based resource allocation tool known as **RAMP-UP** facilitated the sharing of mutual assistance resources during Hurricane Matthew.
- EEI successfully advocated that the FCC interpret the Telephone Consumer Protection Act to allow electric and natural gas companies to use **robocalls** and text messages without the threat of litigation to communicate with customers about service-related matters. Companies in the path of Hurricane Matthew used robocalls to communicate with millions of customers.
- EEI advocated for policies that expand opportunities for members to utilize **unmanned aircraft systems** and beyond visual line of sight operation to remotely inspect and monitor energy infrastructure. Companies impacted by Hurricane Matthew were able to use UAS to inspect infrastructure, speeding restoration.
- Through a multi-state and national effort, EEI continues to promote our **industry's solar leadership** and to advocate for equitable policies for **distributed generation** that are transparent, avoid cost shifting, recognize the value of the energy grid and the importance of continued company operation of the distribution system, and address fixed-cost recovery, including rate alternatives that reform **net energy metering**. Among our efforts, EEI:
  - Led a coalition in strong opposition to the King-Reid amendment, which would have dictated how state NEM programs should work.
  - Helped member companies in numerous states work to recover grid costs and adjust NEM rates to avoid cost shifts among customers.
  - Responded to NARUC's draft rate design manual, emphasizing the value of the energy grid and the need for rate reform to end cost shifting and encourage better rate designs.
  - Represented industry views before the FTC during a workshop on competition and consumer protection.
  - Directly engaged with policymakers, consumer advocates, and other key stakeholders, including national and regional energy organizations and allies, to advocate for appropriate rate reform.
  - Highlighted the economic and environmental benefits of universal solar compared to private solar systems.
  - Worked to rebalance the public conversation through extensive earned media efforts.
  - Deployed a team of third-party experts who are able to engage in state proceedings, forums, policy conversations, and earned media.
  - Focused on increasing awareness of consumer education and protection issues.
  - Advocated for a reduction in aggregate rate subsidies to DG solar.

- In multiple forums, EEI continued to focus on **distribution system planning and cost recovery**, advocating that member companies should retain the ability to plan, build, own, and operate the energy grid.
- EEI continued to engage with the **Critical Consumer Issues Forum**; CCIF's new report presents consensus principles and a roadmap for meeting the energy needs of commercial customers and the underlying corporate objectives regarding sustainability, efficiency, and cost.
- EEI supported **FERC Order 825**, an important first step in improving price formation in the RTO/ISO markets.
- At the request of the Board, EEI created a **Generation Task Force** to address issues related to preserving a balanced energy mix.
- EEI led efforts to address **disclosure and divestiture** issues related to carbon by:
  - Advocating against changes to the SEC disclosure rules before Congress and the commission.
  - Establishing an ESG/Sustainability Member Group, Steering Committee, and Investor Working Group.
  - Developing a framework for voluntary industry ESG reporting to meet investor and stakeholder needs.
- EEI secured language in legislation reauthorizing the **Toxic Substances Control Act** that achieves the industry's goals of preserving existing regulation.
- EEI and USWAG supported the industry's implementation of and compliance with federal **coal ash regulations** and continued to advocate for legislation that would authorize state regulatory agencies to implement the federal coal ash rule.
- EEI worked with member companies to develop consensus-based comments on the **Clean Energy Incentive Program Design Details**. The CEIP is intended to encourage early carbon dioxide reductions by incentivizing new renewable energy and energy efficiency projects prior to the start of compliance with the Clean Power Plan.
- EEI used the time afforded by the Supreme Court's stay of the **Clean Power Plan** to continue educational efforts on various member-suggested carbon policy topics.
- EEI continued to work with EPA and other stakeholders to improve the **Waters of the U.S. rule**, including obtaining an important NARUC resolution, even while litigation proceeds.
- EEI is working with individual member companies to improve EPA's state-specific **regional haze implementation rules**.
- A new MOU between federal agencies and EEI facilitates member companies' ability to perform **rights-of-way vegetation management** on public lands.
- EEI's **advocacy before the CFTC** resulted in:
  - An Order to retain the current $8 billion *de minimis* threshold until December 31, 2018. Absent this Order, the threshold automatically would have been reduced to $3 billion on December 31, 2017.
  - A final rule on margin requirements for uncleared swaps that will save EEI companies billions of dollars in posted margins and will allow them to continue to negotiate with third parties.
  - A final rule exempting RTOs and ISOs from private rights of action under section 22 of the Commodity Exchange Act.
- EEI closely engaged with DOE and the Oak Ridge National Lab to provide industry input on a **proposed strategic transformer reserve**, which was mandated in last year's Fixing America's Surface Transportation Act. EEI will continue to provide input to DOE as it develops a final recommendation for Congress by December.
- EEI continued to lead industry efforts to work with FERC and NERC on **reliability issues**, including implementation of the FAST Act critical electric infrastructure information regulations, supply chain risk management for industrial control systems, and modifications to the NERC Critical Infrastructure Protection Cyber Security Standards.
- EEI succeeded in getting FERC to recognize the sensitivity of **access to NERC data** on generation, transmission, and protection-system performance and to commit to protecting that information using the commission's new FPA section 215A critical electric infrastructure information authority.
- EEI helped secure Senate passage of **broad energy legislation** that improves the permitting processes for pipelines, hydropower, and transmission facilities; includes workforce development and grid security provisions; and repeals a federal fossil fuel ban. EEI continues to promote industry priorities during the pending House-Senate conference.
- Both House and Senate Appropriations Committees passed fiscal year 2017 bills to fund **LIHEAP**, rejecting the President's budget, which would have cut funding by nearly $400 million.
- EEI worked with labor to advocate that OSHA delay enforcement of certain provisions of the agency's final **workplace injuries and illnesses rule**.
- EEI continued to promote the industry **fleet electrification initiative** and worked with the Obama Administration to develop guiding principles to promote **electric vehicles and charging infrastructure**.

2016 International Electricity Summit

EEI's leadership team led the U.S. delegation to Portugal. [L to R] EEI President Tom Kuhn; EEI Vice Chairman Greg Abel, Chairman, President and CEO, Berkshire Hathaway Energy; EEI Vice Chairman Pat Vincent-Collawn, Chairman, President and CEO, PNM Resources; EEI Chairman Tom Fanning, Chairman, President and CEO, Southern Company; EEI Vice Chairman Chris Crane, President and CEO, Exelon Corporation.

The 2016 International Electricity Summit, held in Sintra, Portugal, in September attracted leaders from the Australian Energy Council, Canadian Electricity Association, EEI, EURELECTRIC, Federation of Electric Power Companies of Japan, Regional Electricity Integration Commission (Latin America), and State Grid Corporation of China. Discussions focused on issues including climate change initiatives; decarbonization challenges and opportunities; electricity market reform; changing cost and price structures of retail markets; and a new role for distribution system operators.

- In an effort to support **equitable standards for electric trucks**, an EEI-led coalition of electric transportation allies succeeded in advocating for generous Advanced Technology Credits in the EPA/NHTSA final fuel economy and tailpipe greenhouse gas emissions standards rule for medium- and heavy-duty trucks for model years 2018–2027.
- EEI partnered with member companies and energy and environmental stakeholders to launch the **Community Storage Initiative** to help solve the industry's energy storage challenge.
- EEI joined the World Wildlife Fund and the World Resources Institute to release a new report that documents the results of an 18-month effort to meet **corporate buyers' desire for clean energy**.
- EEI continued to work with Department of Defense senior staff and member companies to finalize a strategic plan and identify energy solutions for **military installations**.
- In a significant victory for EEI member companies, DOD gained authority to extend the term length of **Utility Energy Services Contracts** from the arbitrarily set length of 10 years to a period of 25 years. Long advocated by EEI, this change will provide companies more opportunities to offer a wider variety of energy projects via the UESC funding mechanism.
- EEI launched a broad **education and advocacy strategic initiative** to highlight the industry's transformative leadership; educate key audiences about our work to deliver the energy future customers want; and secure positive policy outcomes. As part of this initiative, EEI:
  - Led a customer-focused research project, known as the Lexicon Project, to effectively position the industry for the future by creating a common lexicon that conveys compelling benefits in language that is clear and credible.
  - Briefed key congressional committees and caucuses, including the Blue Dog Coalition, Congressional Black Caucus, and Congressional Hispanic Caucus.
  - Expanded our education and outreach to key constituents, including NARUC, National Key Accounts customers, Wall Street, organized labor, the National Urban League, and state-focused organizations representing governors, mayors, attorneys general, state legislators, and other stakeholders.
- Through **We Stand For Energy**, EEI continues to educate and unite electricity customers and industry stakeholders across the country and to advocate for smart energy solutions to ensure safe, reliable, affordable, and clean energy.

Veterans In Energy Summit

Veterans in Energy Summit speakers included [L to R] Tom Farrell, Chairman, President and CEO, Dominion; Don Brandt, Chairman, President and CEO, Arizona Public Service; Mike Langford, National President, Utility Workers Union of America; EEI President Tom Kuhn; and EEI Chairman Tom Fanning.

Expanding on the successful Troops to Energy Jobs program launched under the leadership of then-EEI Chairman Tom Farrell in 2010, the Center for Energy Workforce Development and its member associations and labor unions partnered with the U.S. Departments of Energy, Labor, Defense, and Veterans Affairs to hold the inaugural Veterans in Energy National Leadership Summit in October. Veterans in Energy is a new national initiative with the goal of providing transition, retention, and professional development support to the growing number of military veterans working in the energy industry.

- During the Republican and Democratic National Conventions in July, EEI partnered with the American Gas Association and the Nuclear Energy Institute as **America's Energy Program** to drive the conversation about our nation's energy future and to ensure that energy issues remain an important part of the national agenda.
- More than 200 labor and EEI member company leaders participated in the ninth annual **National LAMPAC** meeting, highlighting labor-management cooperation.
- The Institute for Electric Innovation hosted its sixth annual **Powering the People** event in March, focusing on how new technologies, public policies, and customer expectations are driving transformation in the electric power industry.
- IEI launched a **National Dialogue Series**, bringing together electric and technology company senior executives to discuss issues such as the digital grid, data analytics, and clean energy.
- EEI's **International Programs** hosted its inaugural international utility executive summit in April and released a new book in October that features 20 essays from leading experts on the outlook and opportunities for energy in Asia.
- Working with the **Center for Energy Workforce Development**, EEI continued its efforts to promote workforce development and STEM education and to implement career pathways for veterans, women, youths, and transitioning adults.
- EEI's **2016 Annual Convention** showcased how EEI's member companies are creating the innovative partnerships, clean energy and infrastructure projects, and game-changing technologies customers want.

Former EEI Chairman Nick Akins, Chairman, President and CEO, American Electric Power, leads a conversation with Fox News Channel anchor Megyn Kelly during EEI's Annual Convention in June.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 4

Responding Witness: John P. Malloy / John K. Wolfe

Q-4. For the period of 2013 to present, please provide any internal and external business plans, presentations, marketing material, feasibility studies, lighting conversion financial analyses, customer economic studies, conversion financial models, and correspondence that was circulated within PPL Corporation and its subsidiaries as it relates to lighting. Your response should include, but not be limited to, internal reviews, communications, assessments, and presentations regarding the roll out or operations of LED lights.

A-4. See attached for responsive information in KU's possession. Certain requested information is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection

Subject	**RE: LED lighting discussion (LGE/PPL)**
From	Wynn, Brian [PPL]
To	Cummings, David
Sent	Thursday, September 22, 2016 3:15 PM

Hello David,

UPDATE – I have worked with our standards engineer to formulate a response. Your inquiry was accompanied by a separate note to our Director of Engineering - Ray Connolly (from Cordy Jordan). We have answered all the questions … the manager of Distribution Standards is reading it over before submitting it to Ray.

Please expect a reply soon and don't hesitate to reach out in the future.

Brian

From: David.Cummings[redacted]
Sent: Monday, September 19, 2016 2:18 PM
To: Wynn, Brian
Cc: Pancoast, Denis R; Benevides, Roberto
Subject: RE: LED lighting discussion (LGE/PPL)

Hello Brian,

How are you? Hope all is well.

As we discussed earlier this year, we are looking at the possibility of adding LEDs to our tariffs and have been discussing internally the potential risks to human health from LED lights as stated in the attached documents. One of the utilities in the attached Wall Street Journal article, Eversource Energy, has stated that they have installed the industry standard 4,000K light but are switching to 3,000K LEDs and that they will make modification or replacements as necessary to ensure the protection of public health and welfare related to possible health risks of LED.

Has PPL experienced any issues associated to LEDs, any customer complaints, plans to replace any of the LEDs PPL has installed related to this?

Thanks,
David

From: Wynn, Brian [PPL]
Sent: Wednesday, July 20, 2016 2:14 PM
To: Cummings, David
Cc: Pancoast, Denis R [PPL]; Benevides, Roberto [PPL]
Subject: LED lighting discussion (LGE/PPL)

Hello Dave,

I was happy to chat today regarding the LED tariff and PPLs implementation of the Lighting portal. Per our discussion, I have attached the presentations from the June 29 Lighting Workshop PPL hosted with municipal customers. I presented along with the PA DEP and Eaton (Cooper) Lighting. In addition to Roberto on the purchasing side, we also have a Standards engineer (Denis) with extensive lighting knowledge.

We are certainly very willing to consult on your effort to develop an LED lighting option in the LG&E tariff. Please don't hesitate to contact us.

Regards,

Brian Wynn, PMP
Project Manager, PPL EU
[redacted] office
cell

PPL Electric Utilities

LED Lighting Workshop

June 29, 2016

Welcome

- Introductions
- Internet
  - PPL Electrics Utilities

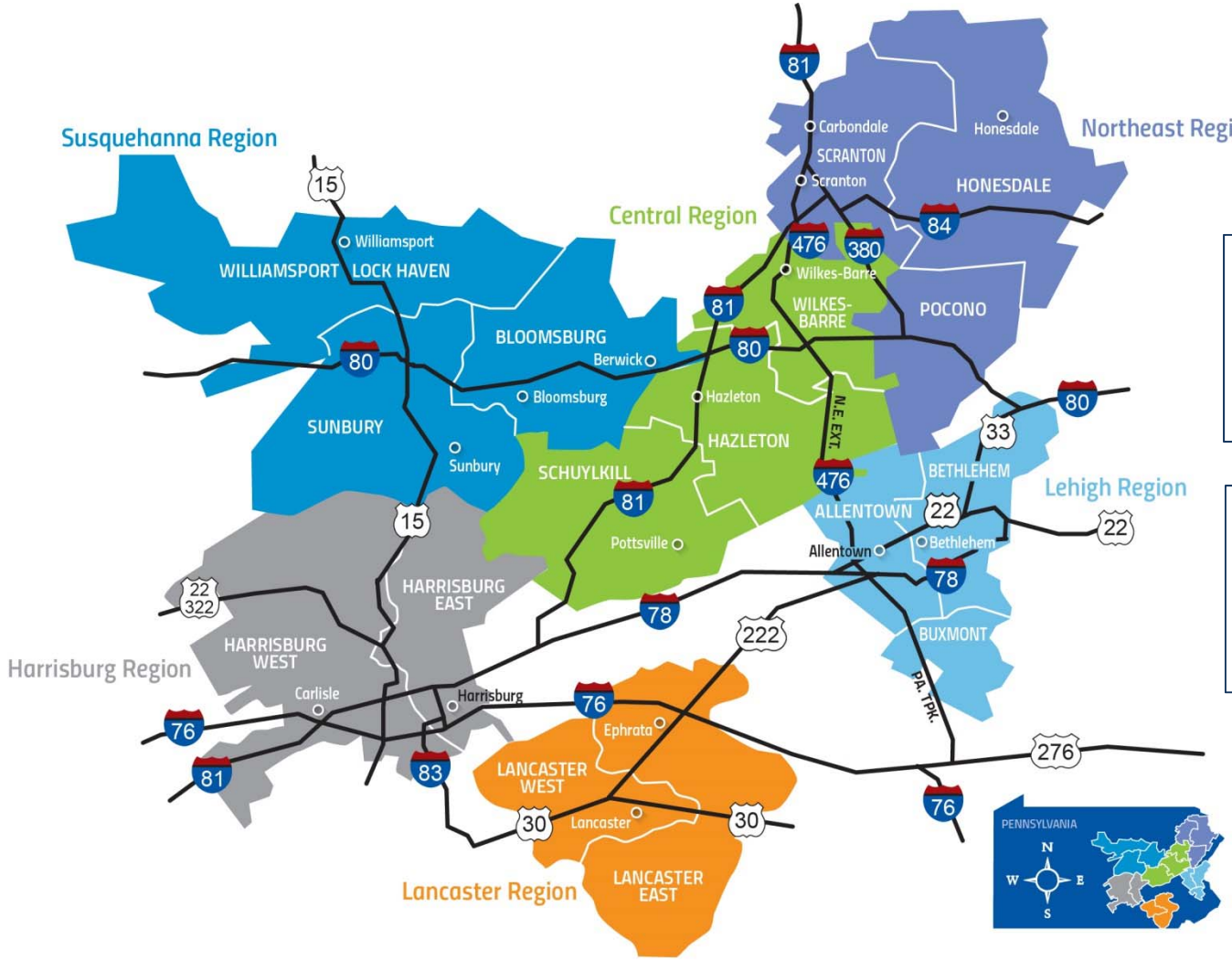
    https://www.pplelectric.com
  - LED Street & Area Lights

    https://www.pplelectric.com/at-your-service/led-street-and-area-lights.aspx
  - Tariff

    https://www.pplelectric.com/at-your-service/electric-rates-and-rules/current-electric-tariff.aspx

PPL Electric Utilities

Service Territory



50+ Municipal customers have requested >7,000 LED conversions

100 Area light customers have requested >230 LED conversions

PPL Electric Utilities

Lighting Options

- PPL offers street & area lights in:
  - LED (Light emitting diode) – refer to SA/SLE Tariffs
  - HPS (High pressure sodium) – refer to SA/SHS Tariffs

- LED lights provide
  - Higher efficiency
  - Energy savings (KWH)
  - “Dark Sky” light pollution improvement

PPL Electric Utilities

LED Option

- LED information online

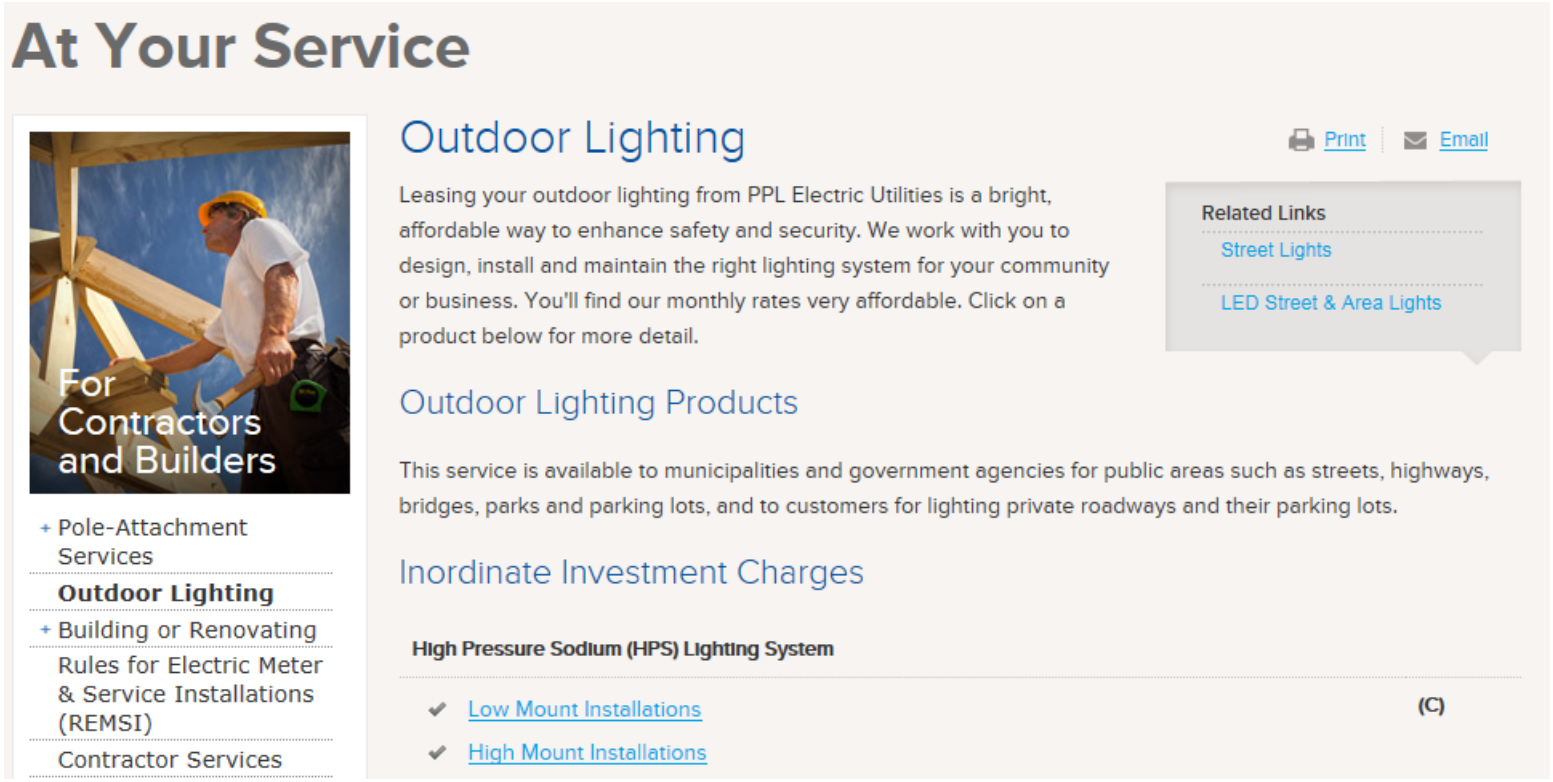
  https://www.pplelectric.com/at-your-service/led-street-and-area-lights.aspx

PPL Electric Utilities

HPS Option

- HPS information online

  https://www.pplelectric.com/at-your-service/for-contractors-and-builders/outdoor-lighting.aspx



PPL Electric Utilities

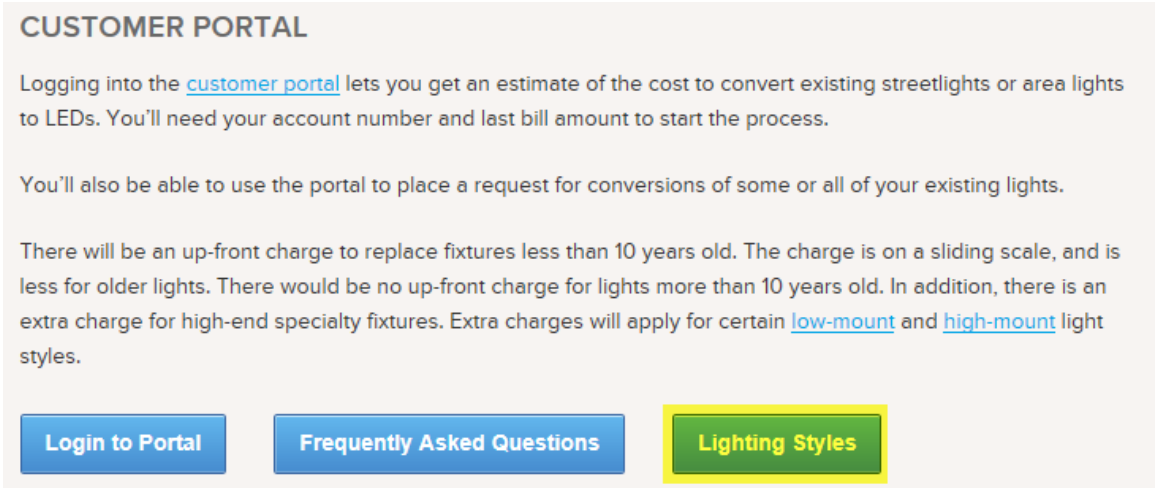
Considerations for LED Conversion

- Appearance
  - Light color – white light
  - Light style
- Rate Costs
  - Based on PPL Tariffs
- Up-front (1-time) Costs
  - IIC – Inordinate investment cost
  - LCC – Light change charge

PPL Electric Utilities

Light Styles

- Available Styles
  - Area
  - Street
    - Acorn
    - Cobra head
    - Shoe box
    - Traditional
    - Contemporary



PPL Electric Utilities

Street Light Details

Cobra Head - Overhead

LUMINAIRE:	Cobra head, gray
FIXTURE SIZE:	3,300 lumen (50 watt) 4,900 lumen (70 watt) 7,500 lumen (91 watt) 15,000 lumen (170 watt) 20,000 lumen (269 watt)
FIXTURE TYPE:	Light-Emitting Diode (LED)
BRACKETS:	2, 4, 6, 8, 12, 16 or 20 foot lengths
POLE:	Wood, 25-36 feet above ground, directly embedded 5 feet in the ground
ELECTRIC SUPPLY:	Overhead
RATE:	Wood pole overhead, Rate Schedule SLE Light-Emitting Diode (LED)

PPL Electric Utilities

Area Light Details

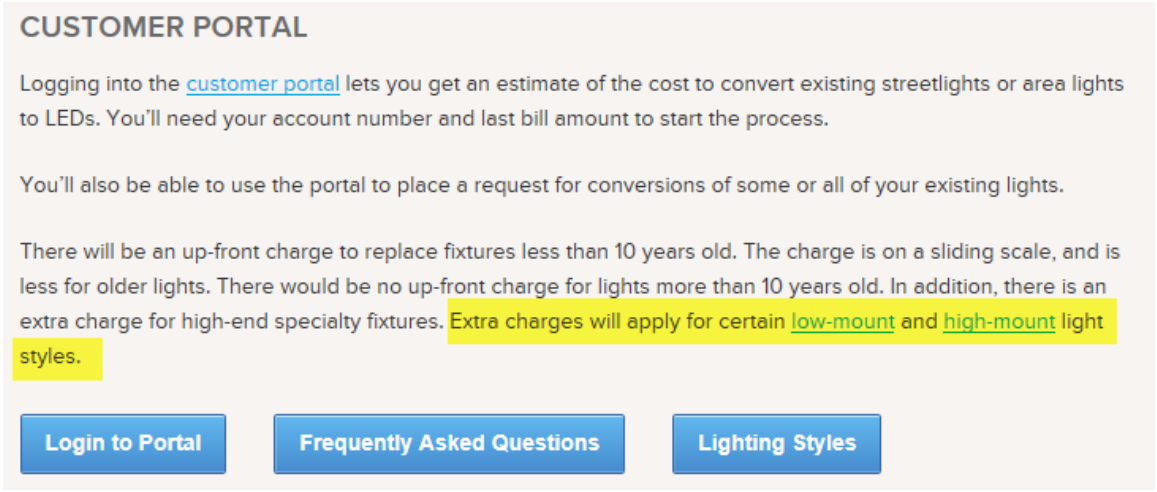
Area Light

LUMINAIRE:	Area light
FIXTURE SIZE:	4,300 lumen
FIXTURE TYPE:	Light-Emitting Diode (LED)
POLE:	Wood, 25 feet above ground
ELECTRIC SUPPLY:	Overhead
RATE:	Rate Schedule SA

PPL Electric Utilities

Research Costs - IIC

- IIC – Inordinate investment cost
  - Low mount
  - High mount



CUSTOMER PORTAL

Logging into the customer portal lets you get an estimate of the cost to convert existing streetlights or area lights to LEDs. You'll need your account number and last bill amount to start the process.

You'll also be able to use the portal to place a request for conversions of some or all of your existing lights.

There will be an up-front charge to replace fixtures less than 10 years old. The charge is on a sliding scale, and is less for older lights. There would be no up-front charge for lights more than 10 years old. In addition, there is an extra charge for high-end specialty fixtures. Extra charges will apply for certain low-mount and high-mount light styles.

Login to Portal | Frequently Asked Questions | Lighting Styles

PPL Electric Utilities

Research Costs - IIC

INORDINATE INVESTMENT CHARGES
HPS TO LED HEAD CONVERSION

Low Mount

LOW MOUNT INSTALLATIONS								
ELECTRIC SUPPLY			UNDERGROUND					LIGHT EMITTING DIODE LIGHTING SYSTEM
POLE HEIGHT, TYPE & COLOR			14'	14'	11'	13'	14'-4"	
LUMINAIRE TYPE	LUMINAIRE SIZE (LUMENS)	LUMINAIRE WATTAGE (WATTS)	Round Fiberglass Black or Gray	Round Spun Alum or Black Metal Spun Al	Boulevard Fiberglass Green or Black	Boulevard Fiberglass Green or Black	Square Fiberglass Bronze	
TRADITIONAL	70W Equivalent		$0	$0	$0	$0		
	100W Equivalent		$0	$0	$0	$0		
CONTEMPORARY	70W Equivalent		$0	$0	$0	$0		
	100W Equivalent		$0	$0	$0	$0		
ACORN	70W Equivalent			$662	$662	$662		
	100W Equivalent			$722	$722	$722		
VICTORIAN (Gas Replica) NOT AVAILABLE	70W Equivalent			**N/A**	**N/A**	**N/A**		
	100W Equivalent			**N/A**	**N/A**	**N/A**		
SHOE BOX (Rectangular)	70W Equivalent						$26	
	100W Equivalent						$79	
SHOE BOX Additional luminaire on a pole	70W Equivalent						$284	
	100W Equivalent						$348	

Notes:

1. Based on current tariff.
2. Refer to SPI-14C and SPI-4I for other charges.
3. Inordinate excavation costs (rocks, etc.) are charged to the customer.
4. Restoration of sidewalks, paved surfaces, etc. are customer responsibilities.
5. Inordinate costs are dated and subject to change depending on labor & material costs.
6. One for one replacement on all street light types. (Example: HPS Traditional - LED Traditional).

PPL Electric Utilities

Research Costs - IIC

High Mount

INORDINATE INVESTMENT CHARGES
HPS TO LED HEAD CONVERSION

HIGH MOUNT INSTALLATIONS											
ELECTRIC SUPPLY			OVER-HEAD	UNDER-GROUND	UNDERGROUND						LED EMITTING DIODE LIGHTING SYSTEM
BILL CODE			01	07	04		04		04		
POLE HEIGHT, TYPE & COLOR			30-40'	25'	28'	32'	28'	32'	28'	32'	
LUMINAIRE TYPE	LUMINAIRE SIZE (LUMENS)	LUMINAIRE WATTAGE (WATTS)	Wood Pole	Fiberglass Green	Aluminum Natural Spun		Steel Green or Black		Aluminum / Steel Square Bronze		
COBRA HEAD	70W Equivalent		$0	$0							
	100W Equivalent		$0	$0	$0		$0				
	150W Equivalent		$0		$0	$0	$0	$0			
	250W Equivalent		$0		$0	$0	$0	$0			
	400W Equivalent		$0			$0		$0			
SHOE BOX (Rectangular)	70W Equivalent										
	100W Equivalent								$79		
	150W Equivalent								$207	$207	
	250W Equivalent								$280	$280	
	400W Equivalent									$370	
BILL CODE			6	NA	6	6	6	6	6	6	
Additional luminaire on a pole	70W Equivalent		$0								
	100W Equivalent		$0		$0				$348		
	150W Equivalent		$0		$0	$0			$422	$422	
	250W Equivalent		$0		$0	$0			$344	$344	
	400W Equivalent		$0			$0				$370	

Notes:

1. Based on current tariff.
2. Refer to SPI-14C and SPI-4I for other charges.
3. Inordinate excavation costs (rocks, etc.) are charged to the customer.
4. Restoration of sidewalks, paved surfaces, etc. are customer responsibilities.
5. Inordinate cost are dated and subject to change.
6. One for one replacement on all street light types. (Example: HPS Cobrahead - LED Cobrahead)

PPL Electric Utilities

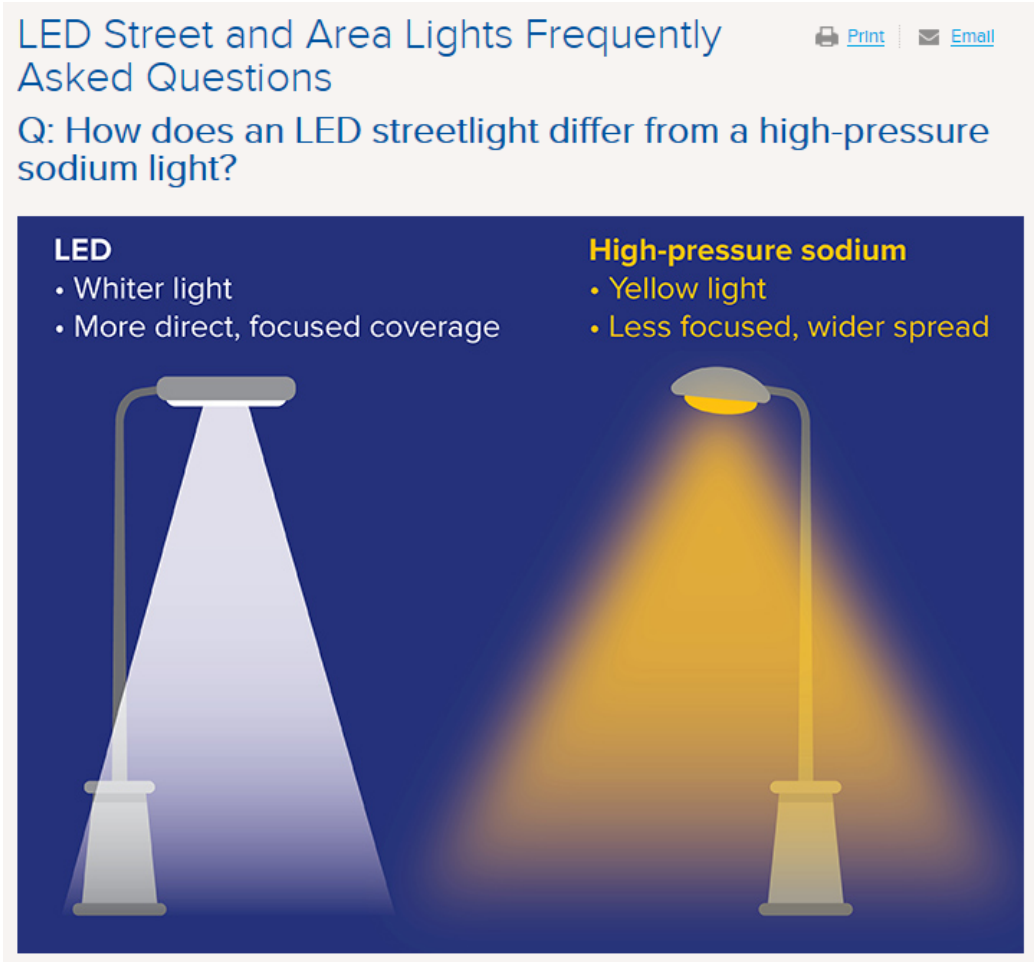
Research Costs - LCC

- LCC – Light change charge
  - Age charge applies to each pole in account

1 Year	$203	6 Years	$176
2 Years	$195	7 Years	$174
3 Years	$193	8 Years	$172
4 Years	$187	9 Years	$171
5 Years	$179	10 Years	$168

PPL Electric Utilities

Frequently Asked Questions



- FAQ Online

  https://www.pplelectric.com/at-your-service/led-street-and-area-lights/led-street-and-area-lights-frequently-asked-questions.aspx

PPL Electric Utilities

Lamp Lumen/Wattage Comparison

- Existing Light

Mercury Vapor (MV)				
SM Rate	LUMEN Size	Lamp Watts	Total Watts *	Annual KWH **
MV	3,350	100	137	589
MV	6,650	175	214	920
MV	10,500	250	299	1,286
MV	20,000	400	474	2,038
MV	34,000	700	808	3,474
MV	51,000	1,000	1,117	4,801

High Pressure Sodium (HPS)				
SHS Rate	LUMEN Size	Lamp Watts	Total Watts *	Annual KWH **
HPS	5,800	70	83	358
HPS	9,500	100	119	512
HPS	16,000	150	175	754
HPS	25,500	250	316	1,360
HPS	50,000	400	496	2,134

- Converted LED Light

Light Emitting Diode (LED)				
SLE Rate	LUMEN Size	Fixture Watts	Total Watts *	Annual KWH **
LED	2,600	36	36	155
LED	3,300	50	50	228
LED	3,800	53	53	226
LED	4,900	70	70	312
LED	7,500	91	91	398
LED	15,000	170	170	742
LED	20,000	269	269	1,150

*Total Watts includes the Lamp/Bulb and the Ballast for Mercury Vapor (MV) and High Pressure Sodium (HPS)

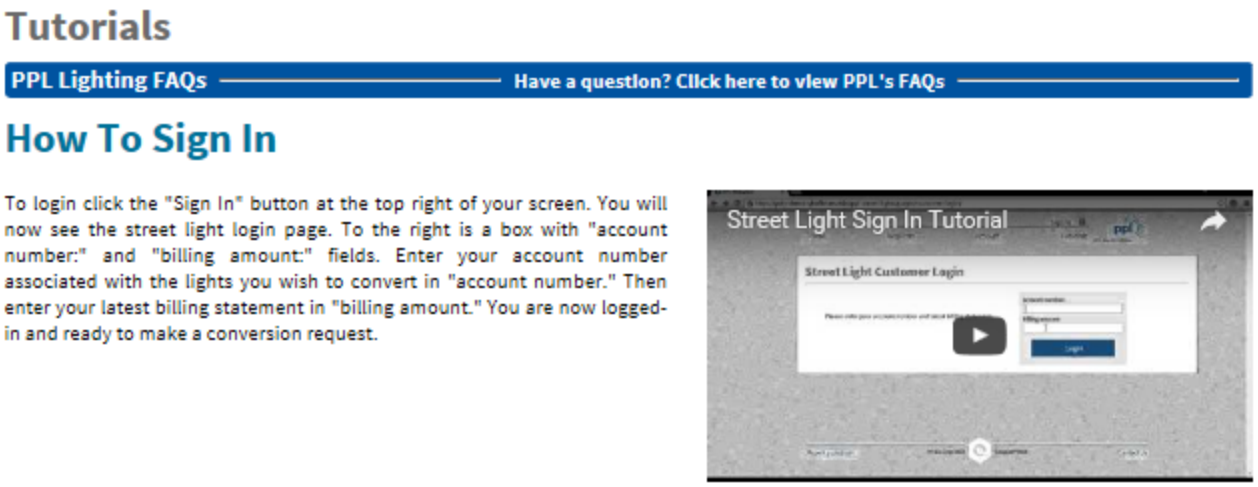
**Annual kWh is calculated by taking total watts then dividing by 1000 and multipling by 4300 hrs /yr
Ie. HPS, 9500 Lumen, 100 Lamp : (119 Watts / 1000 k) X 4300 hrs/yr = 512 kWh/yr

PPL Electric Utilities

Initiate Conversion Process

- Use the Street Light Customer Login
  https://katapultwebservices.com/ppl/streetlights/customer-login/

- Utilize the Tutorial page
  https://katapultwebservices.com/ppl/streetlights/tutorials/

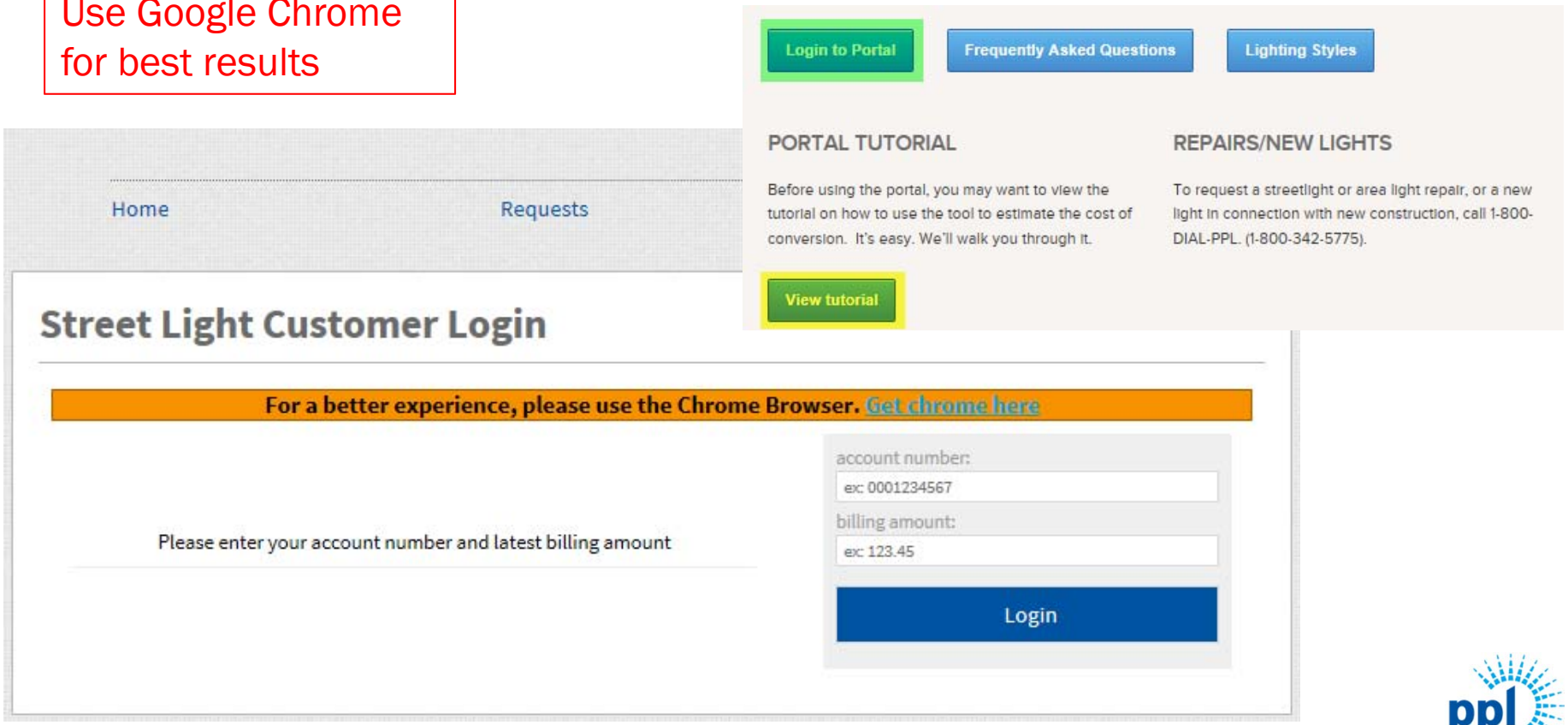


PPL Electric Utilities

LED Customer Portal

- Please have your last PPL electric bill handy for login

Use Google Chrome for best results



PPL Electric Utilities

Full Conversion

Enter energy shopping rate

– Full LED Conversion Scenario

If you are shopping for your energy, enter your rate here: (This defaults to PPL's Price to Compare) $ 0.07491 /kWh

Current street light bill estimate:

Bill Code	Lumens	Lamps	KWH	(Total)	Gen+Trans Charge	(Total)	Dist Charge	(Total)	Total Charge
1	25500	7	113.300	793.100	$ 8.49	$ 59.41	$ 20.18	$ 141.26	$ 206.62
Estimated Current Totals:		**7**		**793.100**		**$ 59.41**		**$ 141.26**	**$ 200.67**

Post LED conversion bill estimate:

Bill Code	Lumens	Lamps	KWH	(Total)	Gen+Trans Charge	(Total)	Dist Charge	(Total)	Total Charge
1	15000	7	61.800	432.600	$ 4.63	$ 32.41	$ 22.59	$ 158.13	$ 193.76
Estimated Current Totals:		**7**		**432.600**		**$ 32.41**		**$ 158.13**	**$ 190.54**

LED Conversion Scenario Summary:

Click any of the items below to expand

convert all of the lights on this account to LED, here are the estimated average and savings you can expect based upon the energy rate above. These averages etermined from an estimated one year cycle.

- Total Upfront Cost Estimate: 2.00
- Estimated Average Monthy Costs: 0.54
- Estimated Average Monthly Difference: $ -10.14

Lights: 7

Estimated Monthly Difference: 360.5 kWh $ -10.14

IIC Cost: $ 0.00

LCC Cost: $ 1232.00

Negative # show savings

Savings are not guaranteed

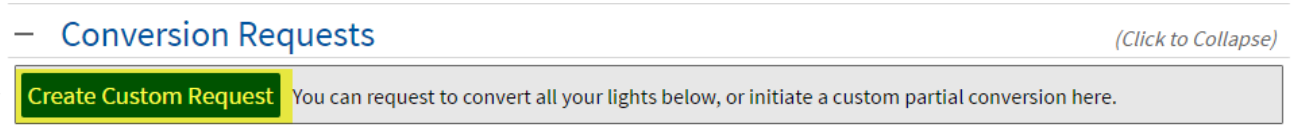
Click to provide definition

demo

PPL Electric Utilities

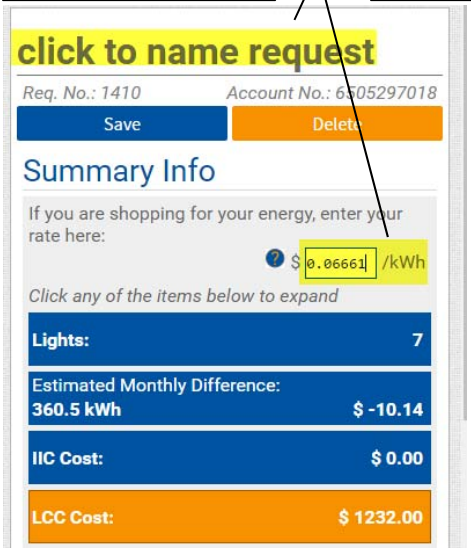
Partial Conversion

Press create button

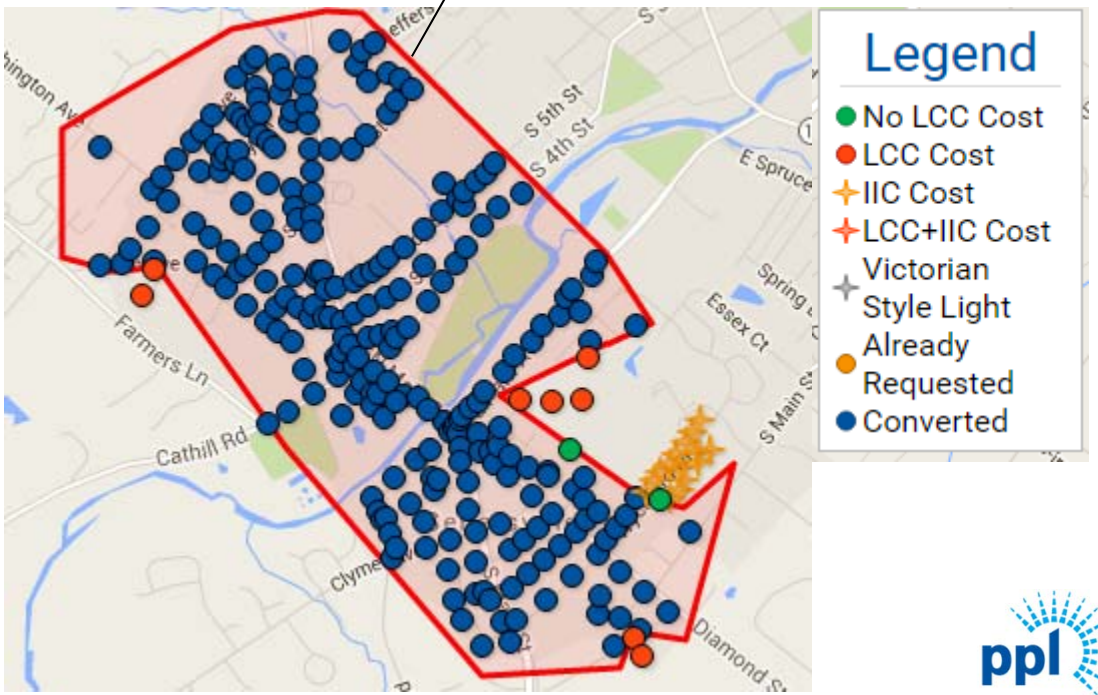


Enter request name

Enter energy shopping rate



Use map and polygon to customize conversion



demo

Savings are not guaranteed

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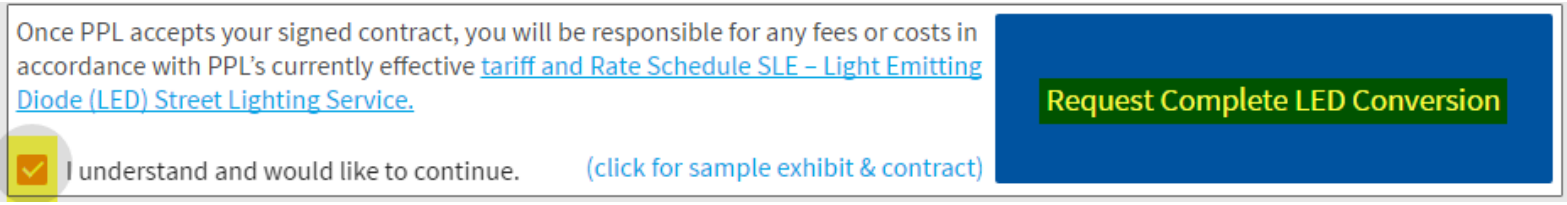
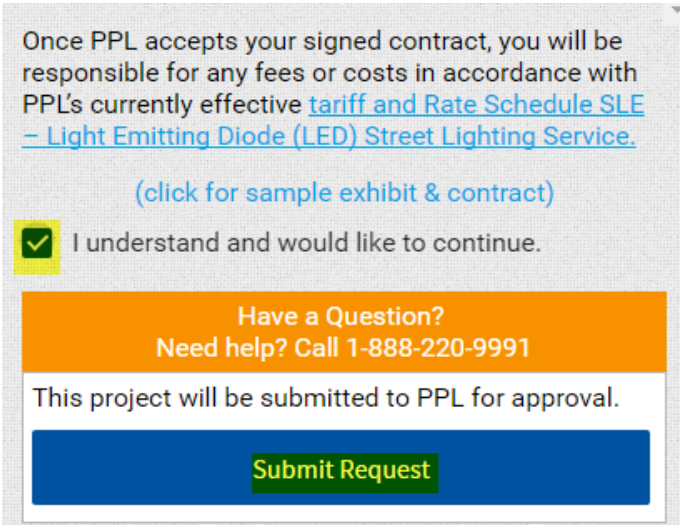
Submission

- When ready to request a Full conversion, accept responsibility for fees, review the Tariff, and press Request button



- When ready to request a Custom conversion, accept responsibility for fees, review the Tariff, and press Request button



PPL Electric Utilities

Contracts, Costs, & Timing

- **Area light** conversions have no contract & no up-front costs
  - Conversion will start in approximately 40 days
  - Commitment = 5 years

- **Streetlight** conversions for Municipalities require a contract and resolution
  - Work is scheduled upon receipt signed contract, and fees (if applicable)
  - Construction will start in approximately 70 days
  - Large jobs may require billing via separate accounts (those spanning billing cycles)
  - Commitment = 15 years

PPL Electric Utilities

Construction Crews

- PPL's contractor **ALS** (American Lighting and Signalization) will perform the conversion work in the field
- Municipalities may be contacted to coordinate access and traffic
- Residential customers may be contacted for access (if applicable)
- Please direct all contractor related question to PPL

PPL Electric Utilities

- Contact Us
  - Municipal – Business Accounts 1-888-220-9991, Option 4
  - Residential – Customer Contact Center 1-800-DIAL-PPL (1-800-342-5775)

Brian Wynn, Lighting Program Manager, PPL Electric Utilities
610-774-5740
bwynn@pplweb.com

Thank you for your time!

PPL Electric Utilities


Street Lighting Rate Schedules

LED Street Lights Workshop for Municipal Customers of PPL Electric

June 29, 2016

Tariff 101

- Tariff definitions
- Understand street lights charges & billing
- Understand the current rates and options
- Review and compare the new LED rate schedules

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Tariff 101

- Tariff – schedule of prices
- Compilation of rules and terms that define the relationship between the EDC and customer
  - Service territory
  - Terms of service
  - Rate schedules
  - Rider charges
- All changes must be approved by the PA PUC
- Find all tariffs here: www.puc.state.pa.us

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Tariff 101

- Rate Schedules
  - Define the specific charges
  - Based on customer classification, type of use, primary vs. secondary voltage
  - Residential, commercial, large industrial

pennsylvania
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Tariff 101

- PPL Electric Rate Schedules
  - RS - Residential Service
  - GS-1 - Small General Service - Sec. Voltage
  - GS-3 - Large General Service - Sec. Voltage
  - LP-4 - Large General Service - 12 KV
  - LP-5 - Large General Service - 69 KV or Higher
  - LPEP - Power Service to Electric Propulsion
  - SA - Private Area Lighting
  - SM(R) - Mercury Vapor Street Lighting
  - SHS - High Pressure Sodium Street Lighting
  - SLE Light Emitting Diode Street Lighting
  - SE - Energy Only Street Lighting Service
  - TS(R) - Municipal Traffic Signal Lighting Service

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Tariff 101

Your Street Lights Bill has Two Components

#1) <u>Distribution charges</u>

- Flat “lease” rate, same each billing period
- Specific to each type/wattage of light offered
- Covers purchase, installation, maintenance, profit, electric delivery, etc…
- Any changes must be PUC-approved

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Tariff 101

#2) Energy charges (electric supply)

- The cost of the electricity consumed by the lights
  - Includes generation & transmission
- Each fixture has a *calculated* kWh rating for the billing period that will be billed each month (no meter)
- Each kWh will be billed at either:
  - Alternate supplier rate
    - » kWh x electric supply cost ($/kWh)
  - Default rate
    - » Per fixture generation & transmission charges

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PPL Electric Utilities

Pay/Manage your account online at pplelectric.com

Questions? Please call our Business Accounts help line by Sep 9. 1-888-220-9991 Opt 4
businessaccounts@pplweb.com

4343621 Street Lighting

Bill Acct. No.	Due Date	Amount Due
36201-01003	Sep 9, 2015	$1,845.76

Your Electric Usage Profile

Billing Summary (Billing details on back)

Balance as of Aug 7, 2015	$0.00	
Charges:		
Total Distribution Charges	$1,471.21	
Total Generation & Transmission Charges	$374.55	
Total Current Charges	$1,845.76	
Amount Due By Sep 9, 2015		**$1,845.76**
Account Balance		$1,845.76

How To Shop For Electricity

You can choose the company that supplies your electricity.
Visit **papowerswitch.com** or **www.oca.state.pa.us** for supplier offers.
If you are shopping, know your contract expiration date.

Here's the information you need to shop:
Bill Account Number: **36201-01003** Rate Schedule: **SHS**
Current Supplier: **Liberty Power Holdings**

PPL Electric Utilities price to compare for your rate is $0.08982 per kWh.
This changes the 1st of June and December.

Manage Your Account

Pay Your Bill		Online Options (pplectric.com)
Online:	Visit **pplelectric.com**	- Report an outage/check outage status
Phone:	Call 1-800-342-5775	- Make a payment, view your bill and usage history.
Mail:	Use envelope provided	- Sign up for alerts.
Card:	MasterCard, Discover, Visa or debit, call 1-800-672-2413 **(service fee applies)**	- Enroll in paperless billing, automatic bill pay, budget billing.
		- View your rate schedule at: **pplelectric.com/rates**

Correspondence:
Customer Services, 827 Hausman Road, Allentown, PA 18104-9392

Other important information on the back of this bill →

Your Message Center

- With paperless billing, you can receive and pay your PPL Electric Utilities bills online. The process is free, quick, convenient and secure. To learn more or sign up, visit **pplelectric.com**.
- Before digging around your home or property, you should always call the state's One Call notification system to locate any underground utility lines. You can do this by simply dialing 811, which will connect you to the One Call system. Be safe and call 811 before you dig.
- Save postage and late charges - sign up for Automated Bill Payment.

Billing Details - (Bill Acct. 36201-01003)

Previous Balance	$1,784.47	
Payment Received Jul 17, 2015 - Thank You!	-$1,784.47	
Balance as of Aug 7, 2015		$0.00
Charges for - PPL Electric Utilities		
General Service Rate: SHS for Jul 2 - Aug 4		
Distribution Charge	1,398.22	
Smart Meter Rider	0.24	
Competitive Enhancement Rider	0.04	
System Improvement Charge at 4.51%	63.57	
PA Tax Adj Surcharge at -0.13300000%	-1.96	
Act 129 Compliance Rider	10.12	
Storm Damage Expense Rider	0.98	
Total Distribution Charges		$1,471.21
Total Generation & Transmission Charges (see Supplier Billing Details page)		$374.55
Amount Due By Sep 9, 2015		**$1,845.76**
Account Balance		$1,845.76

General Information

Generation prices and charges are set by the electric generation supplier you have chosen. The Public Utility Commission regulates distribution rates and services. The Federal Energy Regulatory Commission regulates transmission prices and services.

PPL Electric Utilities uses about $20.74 of this bill to pay state taxes and about $86.80 is used to pay the PA Gross Receipts Tax.

Bill Codes	
1	Overhead Supply - Wood Pole
2	Overhead Supply - Metal Pole
3	Underground Supply - Low Mounting
4	Underground Supply - High Mounting
6	Multiple Unit - Additional Luminaire
7	Underground Supply - Wood Pole
8	Customer Owned Equipment - Energy & Maint.

Understanding Your Bill

Act 129 Compliance Rider - Monthly charge to recover costs for energy efficiency and conservation programs approved by the PUC.

Storm Damage Expense Rider - Monthly charge to recover certain costs to make repairs after major storms.

Competitive Enhancement Rider - Monthly charge to recover costs to support shopping for retail electricity supply.

Distribution Charge - Monthly charge to recover costs of local equipment used to deliver electricity from high-voltage transmission lines (see Transmission Charge) and safely step down voltage for use in your home or business.

System Improvement Charge - Monthly charge to recover costs for improving, repairing and replacing equipment that delivers electricity to your home or business.

***Federal I.D. 23-0959590**

kWh (Kilowatt-hour) - A measure of how much electricity your household uses. One kilowatt-hour equals the amount of electricity used by ten 100-watt lights left on for one hour.

Smart Meter Rider - Monthly charge to recover costs associated with the smart meter programs approved by the PUC.

State Tax Adjustment Surcharge - Monthly charge or credit to reflect changes in various state taxes. The surcharge may vary by bill component.

PPL Electric Utilities

Pay/Manage your account online at pplelectric.com

Questions? Please call our Business Accounts help line by Sep 9.
1-888-220-9991 Opt 4
businessaccounts@pplweb.com

Bill Acct. No.	Due Date	Amount Due
36201-01003	Sep 9, 2015	$1,845.76

Distribution Charge:

Bill Code	Lumens	Number of Lamps	kWh per Lamp	Total kWh	Price per Lamp	Total Charge
01	25500	8	99	792	$18.793	$150.34
01	9500	98	37	3626	$12.282	$1203.64
01	5800	4	26	104	$11.060	$44.24
Total		110		4522		$1398.22

ppl
PPL Electric Utilities

Supplier Billing Details

Bill Acct. No.	Due Date	Amount Due
36201-01003	Sep 9, 2015	$1,845.76

These are the generation and transmission charges from your supplier(s). If you have questions, please contact the supplier that served you during that period.

LibertyPower
Powered Together

For questions on these charges, please contact this supplier at:

Phone:
1-866-769-3799

Liberty Power Holdings
Customer Services
1901 WEST CYPRESS CREEK ROAD
SUITE 600
FORT LAUDERDALE, FL 33309

Charges for - Liberty Power Holdings

Generation & Transmission Charges for Jul 2 - Aug 4

GROSS RECEIPTS TAX	20.85	
STATE SALES TAX	21.20	
ENERGY CHARGE-4522kWh@0.073529 PER kWh	332.50	
Total Liberty Power Holdings Charges		$374.55

Total Generation & Transmission Charges: $374.55

PPL Electric Utilities

Pay/Manage your account online at **pplelectric.com**

Questions? Please call our Business Accounts help line by Sep 4.
1-888-220-9991 Opt 4
businessaccounts@pplweb.com

Bill Acct. No.	Due Date	Amount Due
42600-86006	Sep 4, 2015	$889.59

Your Electric Usage Profile

Billing Summary

(Billing details on back)

Balance as of Aug 4, 2015	**$0.00**
Charges:	
Total Distribution Charges	$705.23
Total Generation & Transmission Charges	$184.36
Total Current Charges	$889.59
Amount Due By Sep 4, 2015	**$889.59**
Account Balance	$889.59

How To Shop For Electricity

You can choose the company that supplies your electricity.
Visit **papowerswitch.com** or **www.oca.state.pa.us** for supplier offers.
If you are shopping, know your contract expiration date.

Here's the information you need to shop:
Bill Account Number: **42600-86006** Rate Schedule: **SHS**
Current Supplier: **PPL Electric Utilities**

PPL Electric Utilities price to compare for your rate is $0.08982 per kWh.
This changes the 1st of June and December.

Manage Your Account

Pay Your Bill		Online Options (pplectric.com)
Online:	Visit **pplelectric.com**	- Report an outage/check outage status
Phone:	Call 1-800-342-5775	- Make a payment, view your bill and usage history.
Mail:	Use envelope provided	- Sign up for alerts.
Card:	MasterCard, Discover, Visa or debit, call 1-800-672-2413 **(service fee applies)**	- Enroll in paperless billing, automatic bill pay, budget billing.
		- View your rate schedule at: **pplelectric.com/rates**

Correspondence:
Customer Services, 827 Hausman Road, Allentown, PA 18104-9392

Other important information on the back of this bill →

Your Message Center

- Before digging around your home or property, you should always call the state's One Call notification system to locate any underground utility lines. You can do this by simply dialing 811, which will connect you to the One Call system. Be safe and call 811 before you dig.

Billing Details - (Bill Acct. 42600-86006)

Previous Balance	$889.59	
Payment Received Jul 17, 2015 - Thank You!	-$889.59	
Balance as of Aug 4, 2015		$0.00
Charges for - PPL Electric Utilities		
General Service Rate: SHS for Jul 2 - Aug 4		
Distribution Charge	671.18	
Smart Meter Rider	0.09	
Competitive Enhancement Rider	0.04	
System Improvement Charge at 4.51%	30.47	
PA Tax Adj Surcharge at -0.13300000%	-0.94	
Act 129 Compliance Rider	3.99	
Storm Damage Expense Rider	0.40	
Total Distribution Charges		$705.23
Generation & Transmission Charges for Jul 2 - Aug 4		
Transmission Charge	15.35	
Generation Charge	169.00	
Capacity and Energy		
PA Tax Adj Surcharge at 0.00800000%	0.01	
Total Generation & Transmission Charges		$184.36
Amount Due By Sep 4, 2015		**$889.59**
Account Balance		$889.59

General Information

Generation prices and charges are set by the electric generation supplier you have chosen. The Public Utility Commission regulates distribution rates and services. The Federal Energy Regulatory Commission regulates transmission prices and services.

PPL Electric Utilities uses about $12.54 of this bill to pay state taxes and about $52.48 is used to pay the PA Gross Receipts Tax.

Bill Codes	
1	Overhead Supply - Wood Pole
2	Overhead Supply - Metal Pole
3	Underground Supply - Low Mounting
4	Underground Supply - High Mounting

Understanding Your Bill

Act 129 Compliance Rider - Monthly charge to recover costs for energy efficiency and conservation programs approved by the PUC.

Storm Damage Expense Rider - Monthly charge to recover certain costs to make repairs after major storms.

Competitive Enhancement Rider - Monthly charge to recover costs to support shopping for retail electricity supply.

Distribution Charge - Monthly charge to recover costs of local equipment used to deliver electricity from high-voltage transmission lines (see Transmission Charge) and safely step down voltage for use in your home or business.

System Improvement Charge - Monthly charge to recover costs for improving, repairing and replacing equipment that delivers electricity to your home or business.

***Federal I.D. 23-0959590**

Generation Charge - Monthly charge to recover the cost of the production or purchase of electricity.

kWh (Kilowatt-hour) - A measure of how much electricity your household uses. One kilowatt-hour equals the amount of electricity used by ten 100-watt lights left on for one hour.

Smart Meter Rider - Monthly charge to recover costs associated with the smart meter programs approved by the PUC.

State Tax Adjustment Surcharge - Monthly charge or credit to reflect changes in various state taxes. The surcharge may vary by bill component.

Transmission Charge - Monthly charge to recover the cost of moving electricity over high-voltage transmission lines from generation facilities to PPL Electric Utilities' distribution lines (see Distribution Charge).

Bill Acct. No.	Due Date	Amount Due
42600-86006	Sep 4, 2015	$889.59

6	Multiple Unit - Additional Luminaire
7	Underground Supply - Wood Pole
8	Customer Owned Equipment - Energy & Maint.

Default service customers will have these charges:

Distribution Charge:

Bill Code	Lumens	Number of Lamps	kWh per Lamp	Total kWh	Price per Lamp	Total Charge
01	16000	2	55	110	$13.691	$27.38
01	9500	20	37	740	$12.282	$245.64
01	5800	36	26	936	$11.060	$398.16
Total		58		1786		$671.18

Transmission Charge:

Bill Code	Lumens	Number of Lamps	kWh per Lamp	Total kWh	Price per Lamp	Total Charge
01	16000	2	55	110	$0.469	$0.94
01	9500	20	37	740	$0.319	$6.38
01	5800	36	26	936	$0.223	$8.03
Total		58		1786		$15.35

Generation Charge:

Bill Code	Lumens	Number of Lamps	kWh per Lamp	Total kWh	Price per Lamp	Total Charge
01	16000	2	55	110	$5.171	$10.34
01	9500	20	37	740	$3.516	$70.32
01	5800	36	26	936	$2.454	$88.34
Total		58		1786		$169.00

HPS vs. LED Rates

Fixture (assume cobra on wood pole)	Initial Lumen rating	Distribution Rate (pre-1/16 rate shown for comparison)	Monthly energy cost Gen. & Trans.	Monthly total cost per fixture not incl. rider charges
70W HPS	5800 L	$12.45 ($11.29)	$1.99	$14.44
100W HPS	9500 L	$13.67 ($12.28)	$2.85	$16.52
250W HPS	22500 L	$20.19 ($18.79)	$7.55	$27.74
400W HPS	50000 L	$25.78 ($24.93)	$11.85	$37.63
50W LED	3300 L	$13.03	$1.25	$14.28
70W LED	4900 L	$14.24	$1.73	$15.97
91W LED	7500 L	$16.06	$2.21	$18.27
170W LED	15000 L	$22.59	$4.12	$26.71
269W LED	20000 L	$28.94	$6.39	$35.33

Area Lights
HPS vs. LED

Fixture (assume cobra on wood pole)	Initial Lumen rating	Distribution Rate (pre-5/15 rate shown for comparison)	Monthly energy cost Gen. & Trans.	Monthly total cost per fixture not incl. rider charges
9500L HPS	9500 L	$13.40 ($12.28)	$3.57	$16.97
4300L LED	4300 L	$13.40	$0.84	$14.24

Comparison of Distribution Costs between 100W HPS and Assumed LED Replacement for each EDC

Fixture	Penelec (50W LED)	West Penn (50W LED)	Penn Power (50W LED)	Met Ed (50W LED)	PPL (70W LED)*	Duquesne (43W LED)	PECO (53W LED)
100W HPS	$7.44	$10.12	$10.74	$10.56	$13.67	$12.61	$18.85
LED replacement	$5.89	$5.52	$5.25	$6.87	$14.24	$11.16	$31.51
Distribution Cost difference	-$1.55	-$4.60	-$5.49	-$3.69	+$0.57	-$1.45	+$12.66
% Change in Dist. Cost	-21%	-45%	-51%	-35%	+4%	-12%	+67%
Cumulative distribution costs for the LED fixture over an assumed 25 year life of fixture	$1,767	$1,656	$1,575	$2,061	$4,272	$3,348	$9,453

Comparison of Energy & Distribution Costs between 100W HPS and LED Replacement Rates for each EDC

(Assume $0.08/kWh energy cost)

Fixture	Penelec (50W LED)	West Penn (50W LED)	Penn Power (50W LED)	Met Ed (50W LED)	PPL (70W LED)	Duquesne (43W LED & $0.04/kWh)	PECO (53W LED)
100W HPS	$11.44	$14.20	$14.42	$14.24	$16.98	$14.61	$22.45
LED Replacement	$7.33	$6.96	$6.69	$8.31	$16.25	$11.76	$32.95
Monthly Cost difference	-$4.11	-$7.24	-$7.33	-$5.93	-$0.73	-$2.85	+$10.50
% Change in Cost	-36%	-51%	-54%	-42%	-4%	-20%	+%47

Steps to Start the LED Transition Process

- The ball is in your court!!
- Assess what you've got (read your bill)
- Identify preliminary savings
  - PP&L Customers: Street Light Portal
  - View inventory from portal (eliminate any?)
  - Identify potential upfront costs
  - Understand ordering process
- Contact utility representative

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Other Lighting Costs

- Municipal-owned street lights
  - Business districts
  - Historic districts
  - Metered
- Outdoor area lights
  - Parks/common areas
  - Parking lots/garages
  - Maintenance/treatment plants, etc.

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION


Geoff Bristow
Regional Energy Program Manager
PA DEP
814-332-6681
gbristow@pa.gov

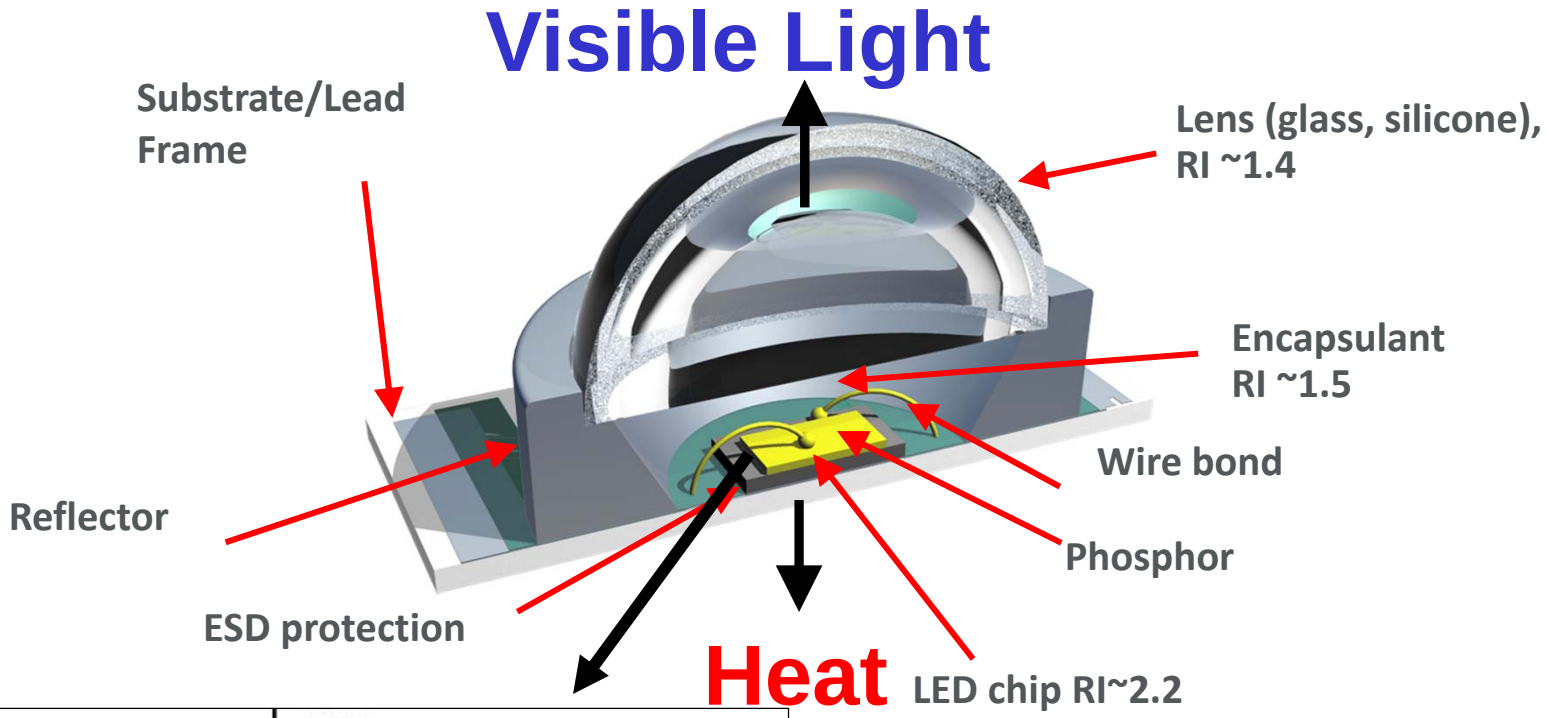
LED Lighting

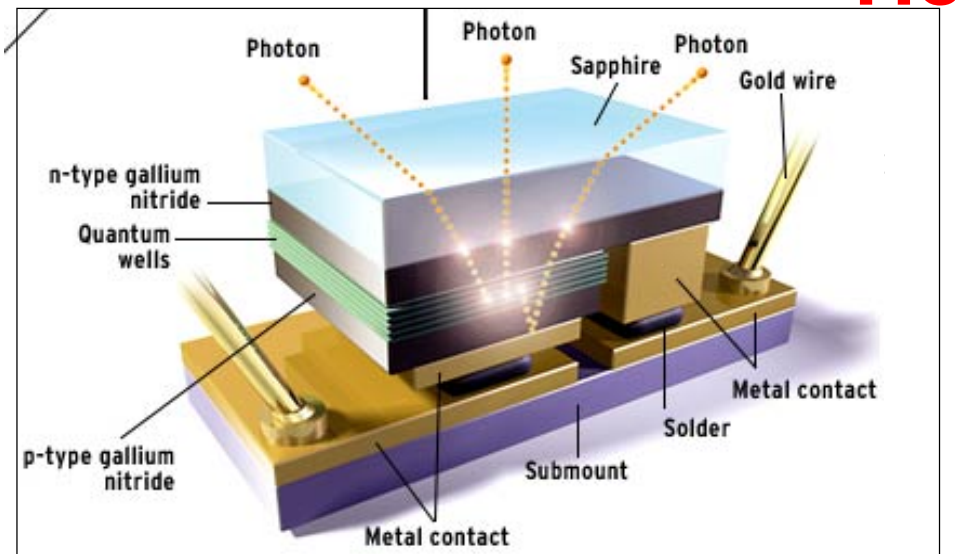
The What and Why

Powering Business Worldwide

Cooper Lighting by EATON

Typical Lighting-class LED Package



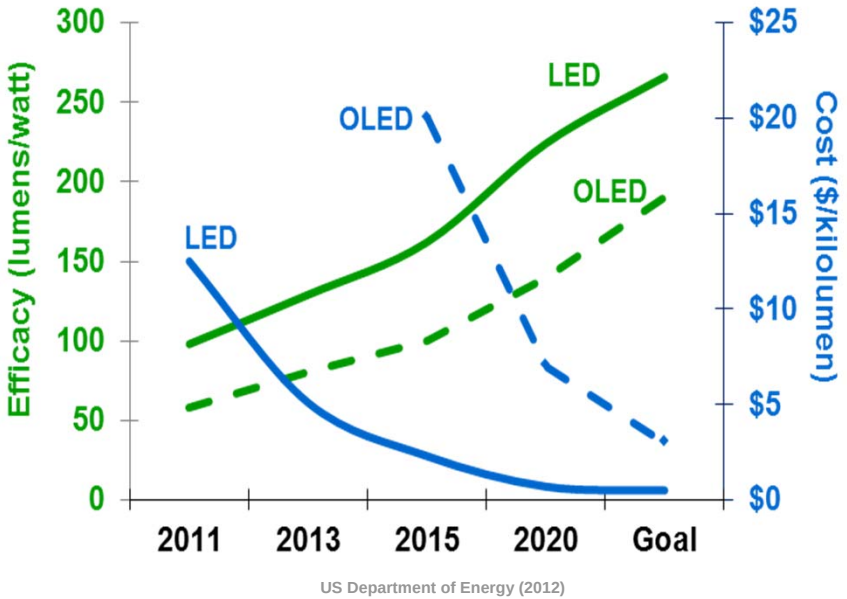


Benefits of LED Fixtures

- Typically does not “burn out”, only degrades slowly over a long period of time
- A lower color variance and shift over time compared to metal halide (+/- 275K CCT
- No mercury content
- Precise optical control with more choices
- Instant on/off

LED Dynamics/Adoption

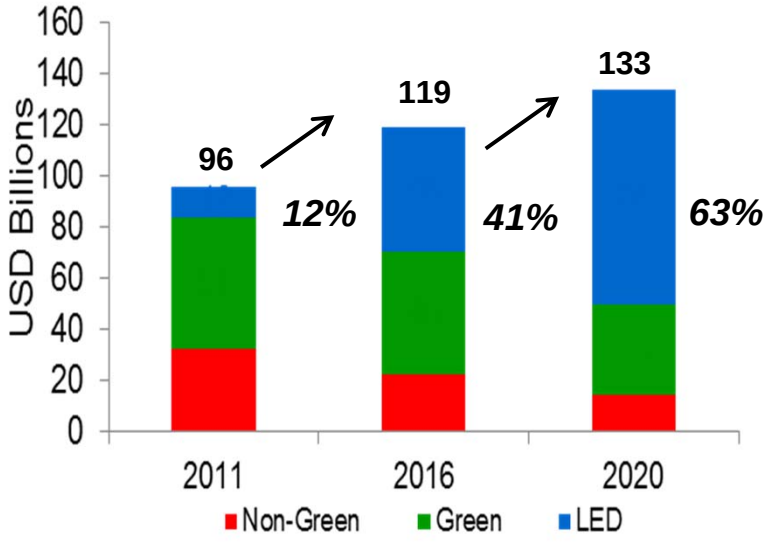
White LED Components



US Department of Energy (2012)

- **2016 efficiency ~50% better than 2012**
- **2016 efficiency is 170-200 LPW**

Light Source by Technology



* 2012 McKinsey Report: "Lighting the Way: Perspectives on the Global Lighting Market"

2012 assumptions have increased 3X Projections

How Long Did You Say It Will Last?

11 hours per night

341 hrs./mth.

12 Months = 4092 hrs./yr.

5 years = 20,460 hrs.

10 years = 40,920 hrs.

15 years = 61,380 hrs.

20 years = 81,840 hrs.

30 years = 122,760 hrs.

EATON
Powering Business Worldwide

Cooper Lighting by EATON

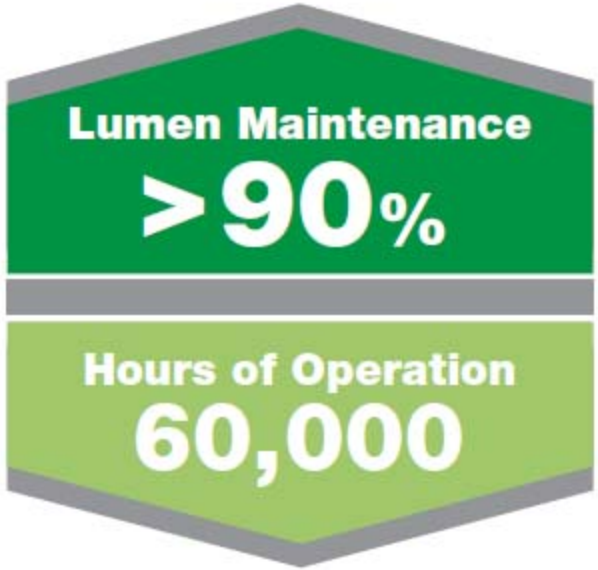
Do LED's do well in heat?

Lumen Multiplier

Ambient Temperature	Lumen Multiplier
0°C	1.02
10°C	1.01
25°C	1.00
40°C	0.99
50°C	0.97

Lumen Maintenance

Ambient Temperature	TM-21 Lumen Maintenance (60,000 Hours)	Theoretical L70 (Hours)
25°C	> 94%	> 350,000
40°C	> 93%	> 250,000
50°C	> 90%	> 170,000

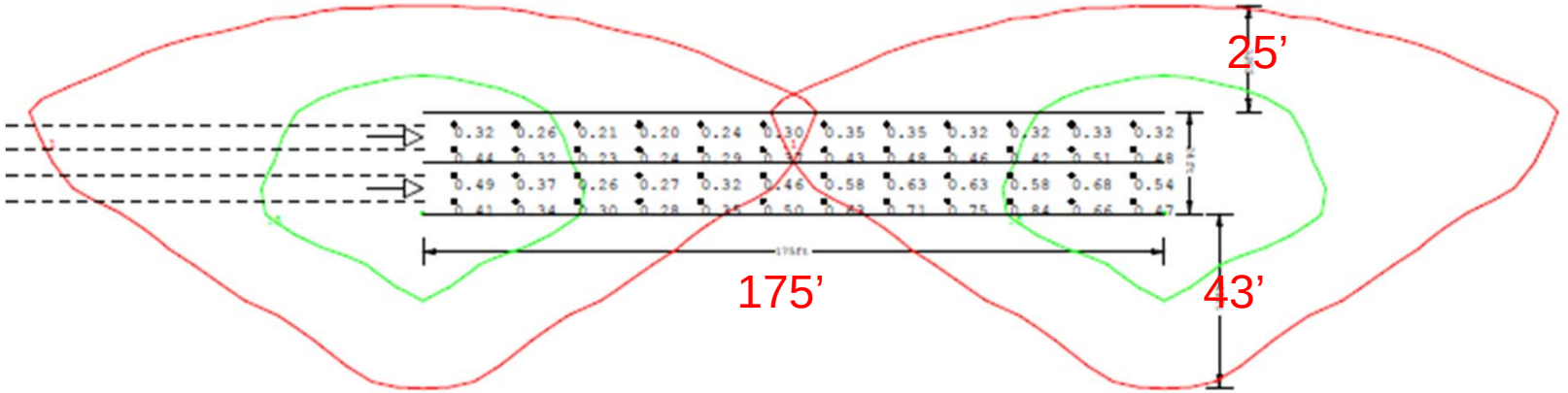


NOTE: Compliant with IESNA TM-21

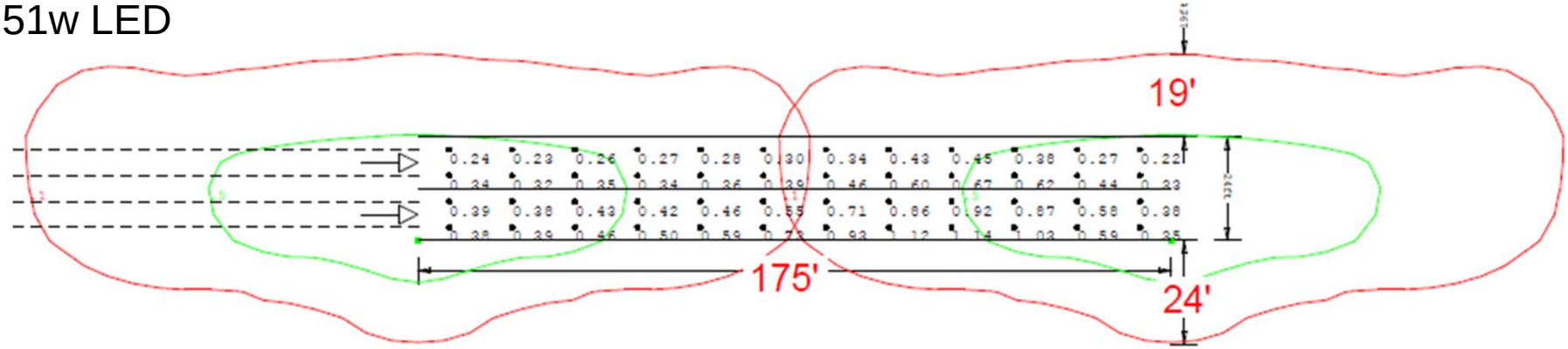
EATON
Powering Business Worldwide

What's Existing to What's Available

100w HID



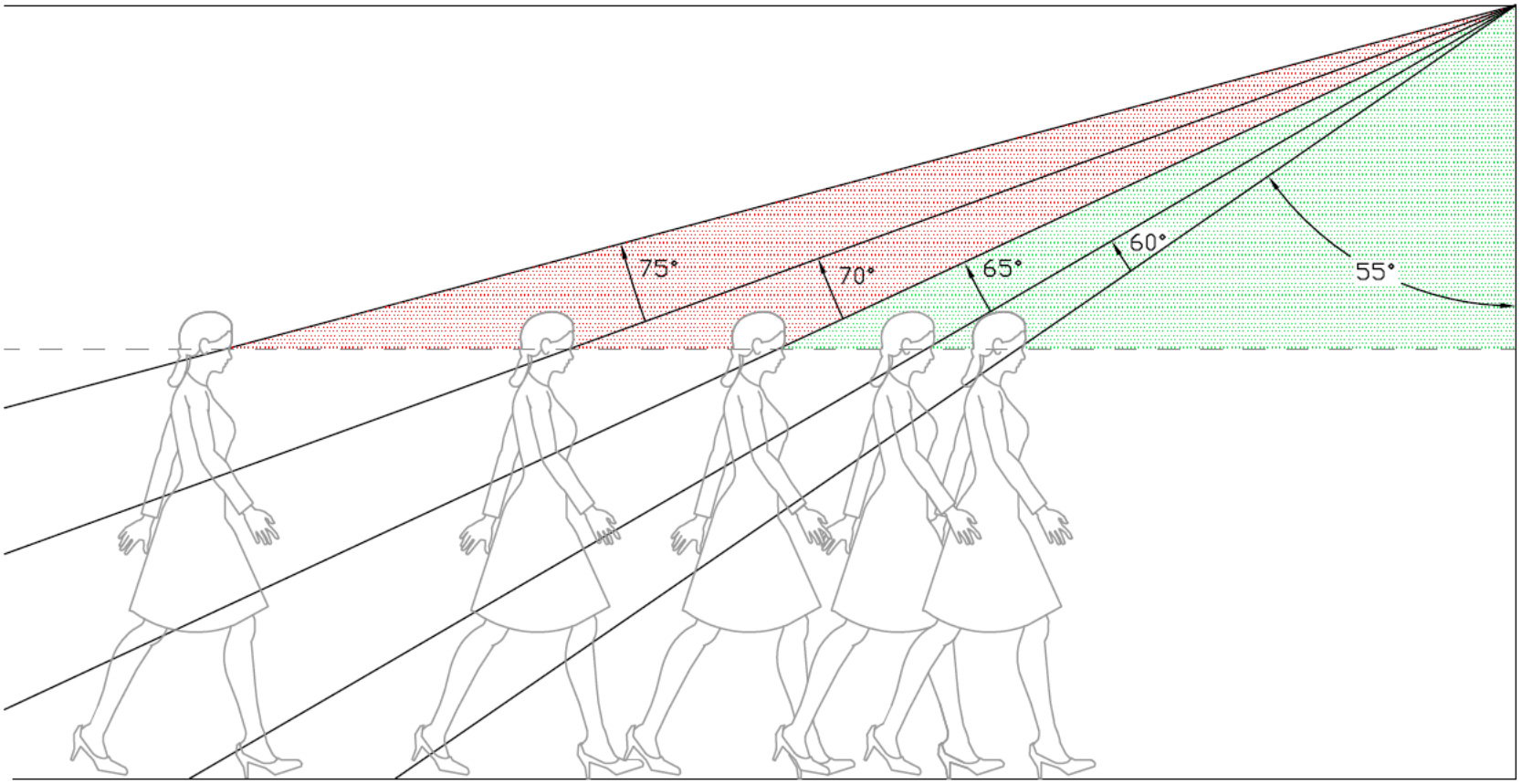
51w LED



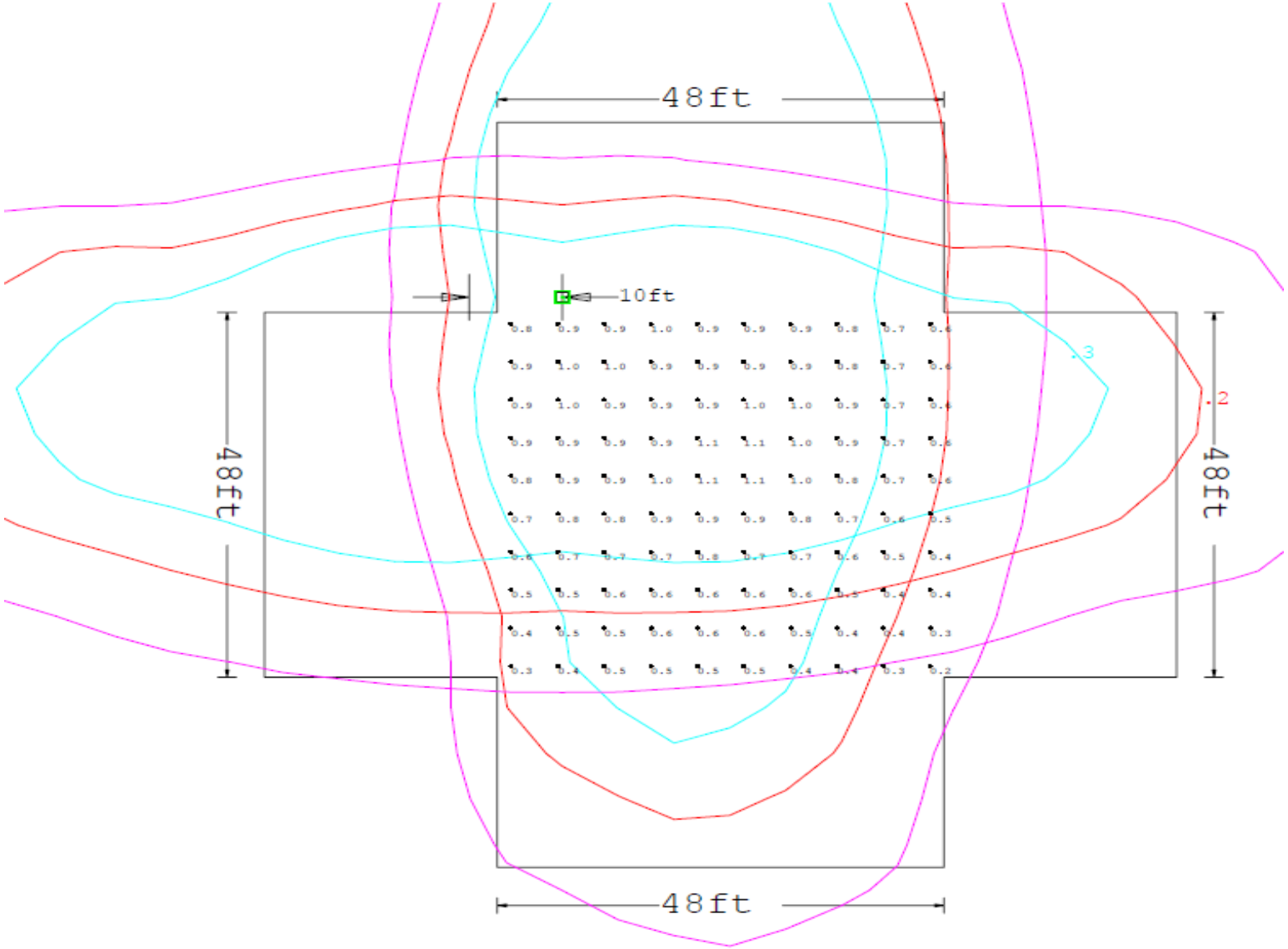
2000K, 20CRI light source with poor optical distribution

Visual Comfort-Is Glare an issue with LED?

Light at 65° and above directly enters the eye. The anatomy of the forehead and eyebrow begin to shade the eye at 65° and below.



LED Means Control-Rotating Optics



Subject	**RE: LED lighting / PPL feedback**
From	Cummings, David
To	Wynn, Brian [PPL]
Sent	Tuesday, October 11, 2016 2:40 PM

Thank you!

From: Wynn, Brian [PPL]
Sent: Tuesday, October 11, 2016 11:02 AM
To: Cummings, David ; Jordan, Cordy ; Jarrah, Bashar S [PPL] ; Pancoast, Denis R [PPL]
Cc: Gelatko, Stephen J [PPL] ; Connolly III, Raymond M [PPL]
Subject: RE: LED lighting / PPL feedback

All,

Further on the topic of the AMA policy statement, there will be a webinar on October 20th:

Since the AMA report came out on the health effects of outdoor LED lighting, there has been a vigorous discussion and debate on various fronts. As a result, Jim Brodrick from the U.S. Department of Energy is offering a webinar on October 20th. Please forward the information below to your customers (cities, consultants, etc.) who may be interested in this topic or are concerned about the AMA report. Here is the information with a link to the registration page:

October 20 Webinar: Get the Facts on LED Street Lighting
LED street lighting has been in the news a lot lately, in the wake of the American Medical Association (AMA) issuing community guidance that cited the potential for increased blue-wavelength light in the night sky resulting from the ongoing conversion of high-pressure sodium street lighting to LED. The applicability of that guidance, however, critically depends on the accuracy of a number of underlying assumptions and other relevant factors that, unfortunately, are not covered in the AMA document.
On October 20, DOE will host a webinar to examine key issues related to the concerns raised by the AMA, sorting fact from misinterpretation and what we know from what we don't know. The material covered is based on a DOE presentation last month at the Illuminating Engineering Society's 2016 Street and Area Lighting Conference, and will:

- **Address the issues underlying the AMA concerns and their applicability to LED street lighting**
- **Provide essential background context related to exposure to light at night**
- **Review activities currently being supported by DOE's Solid-State Lighting Program to fill in existing knowledge gaps.**

Presented by Bruce Kinzey of Pacific Northwest National Laboratory, the webinar will be held on October 20 from 1:00 – 2:00 p.m. EDT, and will include a 30-minute presentation followed by a 30-minute live Q&A session.

Additional information about the webinar can be found on the registration page.

Regards,

Brian Wynn, PMP
Project Manager, PPL EU
[redacted] office
cell

From: Wynn, Brian
Sent: Friday, September 23, 2016 11:53 AM
To: Cummings, David M; Jordan, Laquata Joyce
Cc: Connolly III, Raymond M; Jarrah, Bashar S; Pancoast, Denis R; Gelatko, Stephen J
Subject: LED lighting / PPL feedback

Cordy & David,

PPL EU Distribution Standards and Lighting Program Management are writing to provide responses on your recent LED inquiries. Both your inquiries centered around LED Color Temperature and the June 14, 2016 AMA health warnings for LED street lighting.
http://www.ama-assn.org/ama/pub/news/news/2016/2016-06-14-community-guidance-street-lighting.page

Technical Responses to AMA

There have been thoughtful technical responses to the AMA policy statement. IES (Illuminating Engineering Society), LRC (Lighting Research Center), and DOE (Department of Energy) have all weighed in – these folks are the subject matter experts. The bottom line guidance is that lighting products must be matched to the use case. The AMA acknowledges the energy savings from LED technology, but wants to control the amount of "blue light" which has been equated to 3000K color temperature.

http://ies.org/emails/2016/june/ama-response.html
http://energy.gov/eere/ssl/articles/get-facts-led-street-lighting
http://www.lrc.rpi.edu/resources/newsroom/pr_story.asp?id=320

What is PPL using now? Future?

PPL has used 4000K LED streetlights since the LED option went into effect in the new tariff on January 1, 2016. This is the current industry standard as was offered by every supplier in the RFP process. PPL's area light offering (nema open, 'barn light') is actually 5000K. YTD in 2016 PPL has converted 8,300 streetlights to LED at 4000K. This represents 8% of our streetlight plant which 102,000 lights. PPL also has 35,000 area lights, but only 1% have been converted to LED.

After attending fall EEUOLC (Eastern Electric Utility Outdoor Lighting Council), PPL endeavored to investigate the impact to switch to 3000K LED streetlights. We are at the beginning of our review. Our supplier Eaton (Cooper) indicated we can order 3000K lights in Q4 2016 at no change in price.

We have not had an customer complaints specifically mentioning Color Temperature (4000K). We have had the occasional customer complaint for excess light, which required the installation of a house-side shield. At this time we have no plans to change 4000K lights for another color temperature. We do plan to vet the 3000K option and may change in 2017.

What are other Utilities using now? Future?

All but one utility that attended the September EEUOLC meeting will stay with 4000K lights for the time being. Utilities staying with 4000K are Alabama Power, Duke, Florida PL, & Gulf Power. Appalachian Power (AEP) is in the same boat as LGE-KU – working on the creation of an LED tariff.

Georgia Power (GP) was already in the process of changing to 3000K street lighting with the AMA policy statement was released. GP is in the middle of a huge LED conversion project – they have converted 150K of 400K lights. They are the leader in EEUOLC in this regard. Along with FPL, GP is also the leader in intelligent lighting controls.

I hope this begins to answer your questions on LED lighting. Our team is happy to share best practices and assist in whatever way we can as you work to create an LED tariff. Denis and I would like to extend an open invitation to hold conference call(s) to assist and provide support.

Best Regards,

Denis Pancoast (Standards/Tariffs)
Brian Wynn (Program Mgmt)

The attachment is Confidential and provided under seal in a separate file in Excel format.

The attachment is being provided in a separate file in Excel format.

New York State Energy Research and Development Authority

Street Lighting in New York State: Opportunities and Challenges

Final Report

December 2014

Revised January 2015

Report Number 14-42

nyserda
Energy. Innovation. Solutions.

NYSERDA's Promise to New Yorkers:

NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

Mission Statement:

Advance innovative energy solutions in ways that improve New York's economy and environment.

Vision Statement:

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

Core Values:

Objectivity, integrity, public service, partnership, and innovation.

Portfolios

NYSERDA programs are organized into five portfolios, each representing a complementary group of offerings with common areas of energy-related focus and objectives.

Energy Efficiency and Renewable Energy Deployment

Helping New York State to achieve its aggressive energy efficiency and renewable energy goals – including programs to motivate increased efficiency in energy consumption by consumers (residential, commercial, municipal, institutional, industrial, and transportation), to increase production by renewable power suppliers, to support market transformation, and to provide financing.

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Helping to stimulate a vibrant innovation ecosystem and a clean energy economy in New York State – including programs to support product research, development, and demonstrations; clean energy business development; and the knowledge-based community at the Saratoga Technology + Energy Park® (STEP®).

Energy Education and Workforce Development

Helping to build a generation of New Yorkers ready to lead and work in a clean energy economy – including consumer behavior, youth education, workforce development, and training programs for existing and emerging technologies.

Energy and the Environment

Helping to assess and mitigate the environmental impacts of energy production and use in New York State – including environmental research and development, regional initiatives to improve environmental sustainability, and West Valley Site Management.

Energy Data, Planning, and Policy

Helping to ensure that New York State policymakers and consumers have objective and reliable information to make informed energy decisions – including State Energy Planning, policy analysis to support the Regional Greenhouse Gas Initiative and other energy initiatives, emergency preparedness, and a range of energy data reporting.

NYSERDA Record of Revision

Document Title
Street Lighting in New York State: Opportunities and Challenges **November, 2014**

Revision Date	Description of Changes	Revision on Page(s)
December 2014	Original Issue	Original Issue
January 2015	Revised Section 4: Status of New York State Utility-Owned Street Lighting Rates	Page 18-19
January 2015	Added resource to Section 5.2	Page 20
January 2015	Added information to Appendix	Page A-3

Street Lighting in New York State: Opportunities and Challenges

Final Report

Prepared for:

New York State Energy Research and Development Authority

Albany, NY

Marilyn Dare
Project Manager

Prepared by:

Energy and Resource Solutions

North Andover, MA

Todd Winner

Project Manager

and

Optimal Energy

Bristol, VT

Gabe Arnold

Project Manager

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Table of Contents

List of Figures

List of Tables

Summary

This report presents the results of an initial analysis of the potential savings and barriers associated with upgrading existing municipal street lighting throughout New York State to solid-state light-emitting diode (LED) technology.

Jurisdictions around the country have already begun to realize the benefits associated with upgrading to LED street light technologies. Cities such as Boston, Los Angeles, New Orleans, and Seattle have already completed large-scale conversions of their streetlights. Although there is some LED street lighting activity across New York State, there are no clear options and mechanisms for enabling and facilitating systematic strategies to capture cost-effective opportunities in the State.

S.1 Project Objective

The objective of this project was to understand the opportunity (e.g., benefits, costs, and obstacles) for New York State to transition street lighting from conventional incandescent and high intensity discharge (HID) lighting systems to high efficiency LED lighting. To understand the impact and to develop a roadmap for this transition, this project:

- Developed an estimate of the existing municipal street lighting inventory in New York, in number and type of technology.
- Determined the expected energy and maintenance savings that might be realized by converting to LED lighting.
- Identified the regulatory, technical, informational, and financial barriers associated with large-scale transition to LED lighting.
- Dissected the only currently available utility LED tariff in New York to better understand the street lighting tariff options and trade-offs.

S.2 Project Approach

The overall project approach focused on identifying the magnitude of the opportunity, the financial costs and benefits, and the barriers that need to be addressed. Street lighting tariffs in New York were reviewed. LED-specific tariffs were compared to tariffs for conventional technologies, as well as to LED tariffs offered outside of New York. Although LED street lighting is now a well-established technology, the current state of product development was also explored.

A systematic approach was used to estimate the total number of existing municipal streetlights. Data was collected from several municipalities and the results were extrapolated to estimate the statewide totals. This same approach was used to estimate the current mix of technologies and wattages installed. Recent street lighting projects from around the country provided a wealth of information regarding product, installation labor, and maintenance costs and savings from conversions of conventional street lighting technologies to LED.[1] All of this data was utilized to predict net energy and cost savings impacts of a statewide street lighting strategy.

S.3 Summary of Conclusions

The overall conclusion of this study was that a statewide LED street lighting strategic engagement would greatly benefit New York State for three reasons:

- Taxpayers would benefit from lower municipal street lighting expenditures.
- Utilities and municipalities would benefit from reduced maintenance.
- The population in general would benefit from the significant contribution made toward meeting climate impact goals.

Project conclusions included the following:

- Approximately 1.4 million municipal streetlights across the State have the potential to be addressed by a strategic street lighting strategy. This number includes both utility-owned (approximately 74% of the estimated inventory when excluding New York City) and customer-owned streetlights.
- The potential energy savings resulting from replacing all of these fixtures with equivalent LED fixtures is estimated to be 524 GWh annually.
- The financial savings from energy savings,are estimated to be nearly $28 million per year.
- Savings from reduced maintenance is estimated to be $67 million per year.
- Adding advanced controls where appropriate could add $2.2 million in savings.
- The total annual savings potential, assuming municipal ownership for all existing street lights, is estimated to be over $97 million statewide, as illustrated in Table S-1.

Table S-1. New York Statewide Savings Potential (assumes 100% municipal ownership)

Measure	Annual Energy Savings (MWh)	Annual Energy Cost Savings ($ Million)	Annual Maintenance Savings ($ Million)	Total Annual Cost Savings ($ Million)	Total Installed Cost ($ Million)
LED Retrofit	523,995	$ 27.93	$ 67.05	$ 94.97	$ 435.87
Advanced Controls	41,991	$ 2.24	$ -	$ 2.24	$ 41.41

[1] Actual results in New York State may vary depending on ownership, tariff rates, the existing streetlight technology being replaced, the LED replacement fixtures selected, municipal street lighting standards, etc.

Additional conclusions were:

- The State of New York via the Office of General Services has potential to exercise buying power to negotiate attractive pricing for LED products.
- The majority of New York municipalities are currently unable to pursue LED street lighting conversions with the majority of their streetlights due to lack of cost-effective rate tariffs offered by the utilities for LED technology. A coordinated effort is needed to establish tariffs that represent the economic advantages of LED lighting.
- Technical lighting expertise is needed to ensure effective and successful implementation.

S.4 Future Considerations

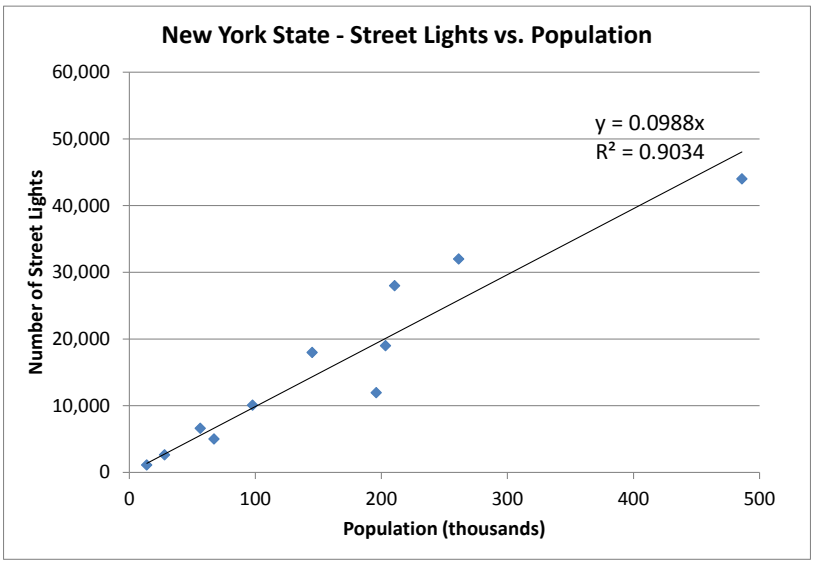
If New York State decides to implement a coordinated statewide LED street lighting program, the following steps would be critical to establishing a successful program:

1. Engage regulators and utilities to accelerate discussion and development of street light tariffs.
2. Produce a guide for municipalities that provides guidance on LED street lighting conversions utilizing best practices from other municipalities that have completed projects.
3. Offer independent technical assistance for LED street lighting.
4. Investigate, develop, and offer LED tariffs and leasing options.
5. Identify benefits/impacts of aggregated purchases (i.e., multiple year procurements, multiple jurisdictions, hybrid deals, etc.), including pricing discounts, enhanced warranties and/or other services provided by manufacturers and service providers.
6. Consider the use of Energy Efficiency Portfolio Standard or Clean Energy Fund to support these steps or | a portion of the capital cost of street lighting upgrades.
7. Explore the opportunity for financing through ESCOs, NY Green Bank, or other avenues. Streetlights can be a prime candidate for financing due to their long service life and municipal/government ownership.
8. Identify funding opportunities available through federal and/or regional programs.

1 Street Lighting Inventory for New York State

Approximately 1.4 million municipal streetlights illuminate New York State and consume more than 990 GWh annually.[2] Streetlight inventory data from 12 cities and towns in the State account for more than 453,000 individual streetlights, and these data were analyzed to estimate the statewide population of streetlights. Detailed inventory data was collected for five cities: New York City, Rochester, Yonkers, Syracuse, and Albany. Total street light counts were collected for an additional seven locations including the cities of Buffalo, Mt. Vernon, and Oneonta and the towns of Brookhaven, Huntington, Union, and Vestal. As shown in Figure 1-1, street light count and population were plotted for each location:

Figure 1-1. Existing New York State Street Light Quantities vs. Population



As shown in Figure 1-1, a strong correlation exists between population and the number of installed streetlights. This relationship, coupled with population data for New York State, was used to estimate the number of streetlights installed statewide.

[2] Municipal streetlights are streetlights that are paid for by municipalities. They may be either owned by the municipality or owned by the utility. They do not include privately funded street lights on private roads or nonmunicipal streetlights that may be paid for by other government or non-government entities such as college or university campus streetlights, street lights on prison roadways that may be the responsibility of the Department of Corrections, or bridge/tunnel lighting in some areas that is the responsibility of the Port Authority. However, many of the findings and recommendations of this report are applicable to all streetlights in New York.

To date, no previous statewide estimates of the total street light inventory in New York State have been published. A 2011 report developed for the U.S. Department of Energy (DOE) attempted to estimate the total number of streetlights installed nationwide.[3] The DOE analysis divided streetlights into two groups: "street lights" illuminating local and collector roads and "highway lights" illuminating interstates, freeways, and expressways. Using this simple population-weighted scaling approach, the results would equal approximately 3.3 million streetlights installed in New York State.

Although there is significant variation between the total street light estimate developed in this study and the estimate adapted from the DOE analysis, it should be noted that the DOE analysis relied on only 25 local government inventories to represent the entire U.S. These inventories may not be representative of jurisdictions in New York State. Furthermore, the DOE analysis divided streetlights into two groups: "streetlights" that illuminate local and collector roads and "highway lights" that illuminate interstates, freeways, and expressways, so the methodology used to estimate the number of lights differed between the two studies. Total streetlights were estimated using a population-based approach somewhat similar to that used for this study, whereas highway lights were estimated using data on the total lit mileage of highways in the U.S. and the typical highway light spacing. However, the majority of highway lights in New York State are the responsibility of the municipality in which they are located and are thus reflected in the inventories of those municipalities. Therefore, using this approach may in fact double-count streetlights installed along highways. Recognizing the deficiencies in the initial DOE analysis, the DOE, through the Municipal Solid-State Street Lighting Consortium (MSSLC), was in the process of developing a new inventory of streetlights installed nationwide as this study was being completed for NYSERDA. The results are now available and help inform overall street light inventories.[4]

The predominant lamp technology in existing streetlights in the State is high pressure sodium (HPS). Research for this report shows that nearly 89% of all existing street lights in the State are equipped with HPS technology.[5] Mercury vapor, incandescent, and metal halide lamps make up the majority of the remaining 11% of existing streetlights. Figure 1-2 presents the distribution by lamp technology, and Figure 1-3 gives the distribution of HPS lamps by wattage bin. Although a small number of LED streetlights are now installed in New York, the percentage of the total is insignificant. No evidence was found to support induction lighting or low-pressure sodium in current use for street lighting.

[3] U.S. Department of Energy. 2011. *Energy Savings Estimates of Light Emitting Diodes in Niche Lighting Applications*. Prepared by Navigant Consulting, Inc., http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/nichefinalreport_january2011.pdf

[4] See http://www1.eere.energy.gov/buildings/ssl/pdfs/msslc_inventory-phase1.pdf.

[5] NYC, which uses only HPS technology, is omitted from the analysis, the statewide share of HPS street lights drops only slightly to 86%.

Figure 1-2. Existing New York State Street Light Technology Distribution

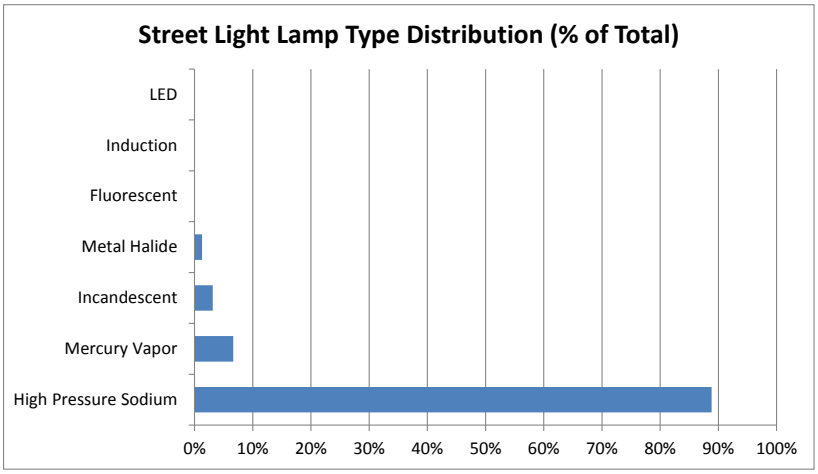
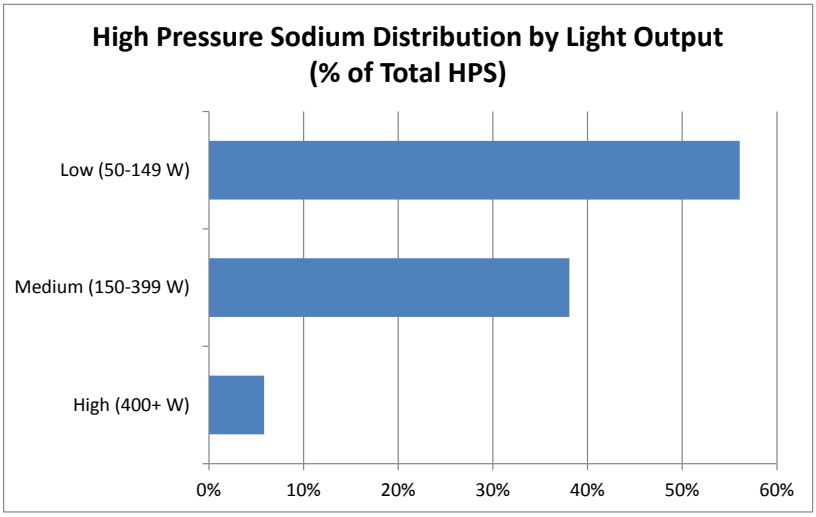


Figure 1-3. Existing New York State HPS Street Light Wattage Distribution



The five detailed inventories received from New York, Rochester, Yonkers, Syracuse, and Albany were used to establish the statewide lamp technology distribution. For analysis purposes, all cities and towns in New York State were distributed into small, medium, and large bins based on total population. For each population bin, the available streetlight inventories for cities within that bin were weighted by population and used to estimate lamp technology distributions for all cities within that bin statewide. Because of New York City's unique characteristics, it was not sorted into the aforementioned bins but instead considered separately using the actual inventory provided. Because no inventory data was obtained for small locales (i.e., towns with populations of less than 10,000), streetlight inventories for all towns in the state of Rhode Island with populations less than 10,000 were used as a proxy. Despite their individual size, towns with populations less than 10,000 account for 802 of the 1,010 cities, towns, and reservations in New York state and represent nearly 13% of the total New York State population.

Of the street light inventories obtained, only three reported the type of fixture. Typical fixtures are the cobrahead style (Figure 1-4) and shoebox styler (Figure 1-5). While these inventories are insufficient to develop a statewide distribution by fixture type, it is noted that New York City, representing 20% of total statewide streetlights, reported that 92% of all street lights were of the cobrahead type.

Figure 1-4. Example of a cobrahead-style street light

Figure 1-5. Example of a shoebox-style street light

1.1 Estimated Savings and Associated Costs

LED street lighting represents an enormous potential opportunity for both energy and total cost savings. If all of the streetlights identified in the inventory were owned by municipalities, replacing or retrofitting all existing street lighting with energy-efficient equivalent LEDs would save approximately 524 GWh annually. To achieve those savings, the total retrofit cost (i.e., total fixture cost and installation labor) is estimated to be approximately $436 million.[6] Installing advanced controls enabling streetlight dimming for some portion of the night could save an additional 42 GWh annually with a total installed cost of $41.4 million.[7] Table 1-1 provides a simplified analysis of the estimated energy and cost savings if all streetlights in New York State were municipally owned and retrofitted to LEDs.

It should be noted that the total annual cost savings are based on economics assuming municipal ownership of streetlights and the ability for municipalities to realize discounted volume pricing for LED fixtures. However only 26% of the estimated streetlight inventory is under municipal ownership. Cost savings for utility-owned streetlights may be different depending on the rates developed by utilities which would include amortization of capital costs, cost of money, and other factors included in tariff rates.

Table 1-1. New York Total Savings and Cost Projections (assumes 100% municipal ownership)

Measure	Annual Energy Savings (MWh)	Annual Energy Cost Savings ($ Million)	Annual Maintenance Savings ($ Million)	Total Annual Cost Savings ($ Million)	Total Installed Cost ($ Million)
LED Retrofit	523,995	$ 27.93	$ 67.05	$ 94.97	$ 435.87
Advanced Controls	41,991	$ 2.24	$ -	$ 2.24	$ 41.41

[6] Based on results from street lighting retrofit/replacement projects from across the United States. Actual results in New York State may vary depending on ownership, the existing street light technology being replaced, the LED replacement fixtures selected, level of volume discounts offered, municipal street lighting standards, etc. See Appendix for sources of LED fixture costs and energy savings

[7] Energy savings and cost associated with installation of adaptive controls found in the following sources:
http://cltc.ucdavis.edu/sites/default/files/files/publication/siminovitch-streetlighting.pdf
http://www.etcc-ca.com/sites/default/files/OLD/images/pge_0913_san_jose_efficient_street_light_report_final.pdf

1.2 Estimated Energy Savings

To estimate the energy savings potential for a statewide municipal LED retrofit, all streetlights were first grouped into bins by lamp technology type and wattage. As informed by the individual inventories, a conservative baseline wattage was established for each bin. For example, for the 100–149 W HPS bin,[8] the baseline wattage was assumed to be 100W. In general, the detailed street lighting inventories presented street light counts including lamp type and nominal wattage. To account for ballast losses, these nominal wattages were converted to actual connected wattages using typical ballast loss assumptions. Next, an average percentage of wattage reduction per fixture (typically 52.5% or 55%, based on savings identified in case studies) was applied to each bin depending on the size of the fixture. Finally, 4,161 estimated annual operating hours were applied to determine energy savings for each bin.[9] The savings for all bins were summed to develop the estimated statewide annual savings. The analysis conservatively omits savings for existing incandescent, induction, and fluorescent fixtures as these represent a small percentage of the overall technology distribution and are not well grouped around common wattages. Further, for analysis purposes, new street light installations are not considered and all existing fixtures are assumed to be the cobrahead type.

Savings were estimated for advanced controls by first assuming that only 30% of existing street lights in New York State are appropriate for controls. This assumption reflects the fact that there are both practical and aesthetic barriers to implementing dimming controls on all streetlights. The California Lighting Technology Center estimates 30–50% savings are achievable based on available data.[10] The analysis conservatively assumes a 30% savings factor. These factors were applied to the estimated post-LED retrofit statewide street light energy consumptions to estimate control savings.

1.3 Estimated Installed Costs

Similar to the approach used to estimate energy savings, costs for the LED retrofit were estimated assuming an appropriate total installed cost (i.e., total fixture costs and installation labor) for each wattage bin. For example, the 100–149 W HPS bin assumes a total retrofit cost of $281 per fixture based on the average cost observed for this range of sizes from recent case studies and market reports. The cost assumptions are further described in Section 3-4.

[8] The street light inventory data was leveraged to develop more discrete wattage bins than those presented in Figure 2-3. For example, the "Low (50-149 W)" bin for HPS street lights was further disaggregated to three separate bins (i.e., 50-69 W, 70-99 W, and 100-149 W). This enabled a more accurate estimate of energy savings potential.

[9] The annual operating hours assumption of 4,161 represents the simple average of the deemed annual street light operating hours used by the six investor-owned utilities in NYS, as presented in their respective street light tariffs.

[10] Siminovitch, M. 2010, "Taking the Long View on LED Street Lighting," *LD+A Magazine.*

Costs for advanced controls were estimated assuming $100 installed cost per fixture. A 2009 adaptive controls demonstration project in San Jose cited a per-fixture cost of $119.[11] Estimating $100 in this report assumes purchasing power associated with a statewide effort, which would reduce total costs.

1.4 Estimated Energy Cost Savings

As of January 2014, only one of the New York State investor-owned utilities currently offers an established utility-owned tariff for LEDs, making it difficult to predict **total** energy cost savings, given that 74% of the inventory is utility-owned. This hypothetical energy cost savings analysis assumes costs consistent with energy delivery charges from customer-owned tariffs from each investor-owned utility.[12] First, customer-owned tariffs were reviewed to determine the appropriate energy delivery charges for each utility in the State. Next, the cities and towns in the State were sorted into their respective utility service territories. Finally, the appropriate rate was applied to the energy savings for each city and town.

1.5 Estimated Operation and Maintenance Cost Savings

Using a simplified approach, operation and maintenance savings for customer-owned street lights were estimated at $50 per fixture annually based on typical replacement lamp costs, labor costs, and re-lamping frequency over the life of the LED street light[13] as compared with HPS. **Note that for utility owned and/or maintained equipment, the customer will not realize these operation and maintenance savings under current tariffs.** However, this exercise is useful to estimate the potential cost savings assuming that customer choice is expanded to include LED tariffs.

[11] Energy Solutions. 2009. "Pacific Gas and Electric Company Emerging Technologies Program, Application Assessment Report 0913, LED Street Lighting and Network Controls, San Jose, CA."

[12] Investor-owned utilities include Central Hudson, ConEdison, National Grid, New York State Gas & Electric, Orange and Rockland, and Rochester Gas and Electric

[13] Maintenance savings from the reviewed case studies ranged from $20 to $124 per streetlight per year. To refine the estimate, the costs to purchase and install HPS lamps and ballasts and the frequency of lamp/ballast replacements over the life of an LED fixture were used to estimate operating and maintenance savings. The results of this analysis were informed by the case study findings to arrive at the $50 per fixture annual savings. Actual maintenance savings may vary depending on a municipality's street light maintenance schedule for cleaning and replacement, the technology being replaced, the LED replacement fixtures selected, etc.

2 Street Lighting Technical Opportunities

Virtually all types of existing street lighting can be replaced with LED lighting technology that will result in a host of benefits to New York State municipalities and ratepayers. These benefits include:

- Reduced energy use and costs.
- Reduced maintenance and costs.
- Enhanced visibility and safety.
- Greater perceived security.
- Reduced light pollution and protection of night sky visibility.

Figure 2-1. LED street lights can help to reduce light pollution, due to their inherent directionality

Source: https://flic.kr/p/4V4AcM Used with permission (https://creativecommons.org/licenses/by-sa/2.0/legalcode)

2.1 Performance Characteristics

As noted in Table 2-1, the latest generation LED street lights can meet or exceed the performance characteristics of all other incumbent technologies. Table 2-1 provides the typical performance characteristics of various street lighting technologies, including LEDs.

Table 2-1. Performance Characteristics of Common Street Light Technologies[14]

Technology	Efficacy (Net)[a]	Cost	Optical Control[b]	Color Rendering (CRI)	CCT	Life	Ease of Control[c]
High pressure sodium	High	Low	Low - medium	Very low (20-25)	Very warm (≤ 2,100K)	Medium - high (15,000 - 25,000 hrs)	Low
Metal halide	Medium - high (21-34 lm/W)	Low	Low - medium	Medium (60-75)	Warm - cool (3,000K-4,200K)	Low - medium (5,000 - 15,000 hrs)	Low
Mercury vapor[d]	Low (10-17 lm/W)	N/A[d]	Low - medium	Low (20-50)	Cool - very cool (4,000K-6,000K)	Medium - high (15,000 - 25,000+ hrs)	Low
Induction	Medium - high (36-64 lm/W)	Medium - high	Low	High (70-80)	Cool - very cool (3,500K-6,500K)	Very high (50,000 - 100,000 hrs)	Medium
LED	High - very high (36-90 lm/W)	Medium - very high	High	High (70-90)	Warm - cool (2,700K-5,700K)	Very high (50,000 - 100,000 hrs)	High

Notes: CCT= correlated color temperature; K = °Kelvin

a) Net efficacy refers to delivered efficacy, which takes into account optical losses within a fixture.

b) Optical control refers to the ability of a fixture to direct the light emitted onto the desired surface accurately and evenly

c) Ease of control refers to the ability of a fixture to be easily turned on and off or dimmed using street lighting control systems

d) Mercury vapor is no longer available for new street lighting purchases due to a federal efficiency standard that prohibits its manufacture and sale.

2.2 Energy Savings

Energy savings resulting from the installation of LED street lights can be attributed to several factors including:

- Higher net efficacy
- Improved optical control
- Improved visibility with "white" light

For many applications, such as the replacement of cobra-head fixtures, LED street lights often have higher net efficacies than other technologies, meaning that more light is directed out of the fixture per watt than with most conventional technologies. Because of these higher net efficacies, LED fixtures are capable of producing comparable light levels at lower wattages.

LED street lights often have better optical control, thereby reducing or eliminating the wasted light that spills beyond the surface intended to be lit (including light directed into the night sky). For example, better optical control can reduce or eliminate the overlighting that often occurs directly beneath an HPS street light fixture. This improved optical control can also result in more uniform light distribution. Although it is still necessary to meet recommended

14 Clinton Climate Initiative. 2010. *Street Lighting Retrofit Projects: Improving Performance while Reducing Costs and Greenhouse Gas Emissions;* Independent research of current manufacturer data, including cut sheets and other published specifications.

illuminance levels for various roadways, in some cases the more uniform distribution from LED street lights can allow for greater energy savings. A common mistake is to size or compare LED replacements to other light sources solely based on the lumen output of the fixture. When sizing an LED streetlight, the improved optical control must be taken into account in order to maximize energy savings and reduce LED cost.

Finally, the bluish-white spectral content (i.e., cooler color temperature) of LED light sources can offer improved visibility and energy savings benefits compared to traditional light sources with a more yellow-orange color content, such as with HPS. These benefits occur only at low light levels, referred to as "mesopic" light levels, which are applicable to street lighting applications. The Lighting Research Center at Renssaeler Polytechnic Institute in New York State has been an industry leader[15] in identifying and understanding these benefits and enabling adoption by industry standards organizations such as the Illuminating Engineering Society (IES). When applying IES guidelines,[16] LED street lights can provide equivalent visibility as HPS street lights at lower light levels and lower wattages.

When all of these factors are taken together, LED street lights may use 45-70% less energy than existing HPS street lights, which represent the majority of street lights currently installed state-wide. Savings may be even greater when LED street lights are replacing mercury vapor or incandescent fixtures. Table 2-2 provides the average energy savings of LED street lights compared to various sizes of HPS street lights, based on recent case studies of installations across the country[17] (see Appendix).

Table 2-2. Typical Energy Savings Associated with Replacing HPS with LED

Variable	Light Output		
	Low	Medium	High
Base technology	70 W HPS	150 W HPS	400 W HPS
Base input wattage (W)	90	190	455
LED % wattage savings range vs. base	45%-65%	45%-65%	45%-70%
Avg wattage savings	55.0%	55.0%	57.5%
LED equivalent range (W)	32-54	67-114	137-273
LED avg equivalent (W)	40.5	85.5	193.4
LED light output (lm)	2251 to 5827	3756 to 12019	9706 to 26665

15 Lighting Research Center at RPI. 2008. "Mesopic Street Lighting Demonstration and Evaluation Final Report,".

16 IES. TM-12-12: Spectral Effects of Lighting on Visual Performance at Mesopic Lighting Levels.

17 Actual results in New York may vary depending on the existing street light technology being replaced, the LED replacement fixtures selected, municipal street lighting standards, etc.

2.3 Maintenance Savings

Street light maintenance can be costly. Replacing a lamp, ballast, or photocell often requires a bucket truck, specially trained electricians, and, potentially, traffic control. All of these costs combined can amount to hundreds of dollars per component replacement. When used in conjunction with long-life electronic drivers and photocells, LED street lights can significantly reduce maintenance costs by reducing or eliminating the need to change failed bulbs, ballasts, and/or photocells, typically done on an annual basis for HPS systems. Periodic cleaning of streetlights will still be necessary, depending on fixture design and local conditions (Figure 2-2). Thus, the savings can vary widely depending on current practices and costs. Based on recent case studies,[18] LED street lights are estimated to save $50 per fixture per year in relamp/reballast and other maintenance costs.

Figure 2-2. Replacement of lamps typically requires the use of a bucket truck, which can be costly

LED lighting systems include drivers, which serve a similar function to that of HID ballasts. Some LED streetlight manufacturers have worked with LED driver manufacturers to develop drivers with lifetimes that coincide with the lifetime of their LED streetlights (e.g., 50,000-100,000 hours). Additionally, common warranties for HPS ballasts were observed to be between 2-5 years,[19] where LED street light manufacturers are developing warranties of 5-10 years for their respective products. Cities that have completed large-scale LED street light conversions including Seattle and Los Angeles have reported LED driver failure rates much lower than failure rates of HID ballasts. A strong specification to ensure long-life drivers and photocells is essential to fully realize the maintenance savings of LED technology.

[18] Actual maintenance savings may vary depending on a municipality's street light maintenance schedule for cleaning and replacement, the technology being replaced, the LED replacement fixtures selected, etc. Sample of maintenance cost references (see appendix for full list of sources): http://www.darien.il.us/government/minutes/2013/Council/130304/Supporting%20Documentation/AttachmentB-2013StreetLightMaint.pdf; http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2011_gateway-msslc_sacramento.pdf, p. 8.1.

[19] HPS ballast warranties reviewed include those offered by GE, Osram-Sylvania, and Advance

2.4 Current LED Street Light Costs

The cost of LED street lights can vary widely depending on the make and model selected, the light output of the fixture, the construction of the fixture (i.e., whether components are replaceable), as well as the quantity of fixtures purchased and whether any discount for bulk purchases is provided. However, prices for these fixtures have dropped dramatically over the past several years and continue to do so. For example, some replacement LED street lights for residential roadways are now available for less than $100.[20] Decorative post-top LED decorative fixtures have higher prices and greater cost variations due to the range of aesthetic designs, different light distribution requirements that necessitate a more complex product solution, and lower economies of scale due to the fact there are far fewer decorative streetlights than cobrahead streetlights.

The most important factor that affects fixture cost is the light output. Typically, higher light output means greater cost. Table 2-3 presents the range of costs for LED street lights by size (light output) and type (cobrahead fixture or decorative retrofit kit) based on actual costs from recent case studies and market research.

Retrofit costs for existing decorative fixtures are listed, as opposed to new fixture costs, because retrofit opportunities represent the vast majority of the potential LED street light projects in New York. Although new and complete LED cobrahead replacement fixtures are a cost effective option, new and complete LED decorative fixtures typically incur a cost premium due to the materials and design associated with these types of fixtures. Retrofit kits (including the LED module and driver) for existing decorative street lights typically represent a more cost-effective solution rather than replacing the entire fixture, and are more likely to be used. An overview of the corresponding simple paybacks for these types of products can be found in Section 3-6.

Table 2-3. Typical LED Street Light Retrofit and Replacement Costs

LED Fixture Type	Light Output					
	Low (<50W)		Medium (50W-100W)		High (>100W)	
	Min	Max	Min	Max	Min	Max
Decorative retrofit kit	$350	$615	$550	$950	$750	$1,450
Cobrahead fixture	$99	$225	$179	$451	$310	$720

The range of fixture and retrofit kit costs in Table 2-3 for each of the three light output ranges primarily reflects the range in costs for comparable fixtures across manufacturers, as well as the potential cost reduction resulting from volume pricing for these fixtures.[21]

[20] "Cree Introduces Industry's First $99 LED Street Light as a Direct Replacement for Residential Street Lights," *The Wall Street Journal*. August 6, 2013.

[21] Sources for LED fixture costs can be found in the Appendix.

By taking advantage of current market prices, leveraging aggregate purchases to large-scale street light installations, and implementing best practice product selection and procurement strategies from other jurisdictions, it is expected that the typical cost per fixture can adhere to the low end of the cost range presented in Table 2-3.

2.5 Future LED Street Light Cost

The cost of LED street lights has been decreasing rapidly as the technology matures. For example, Seattle City Light (SCL) in Seattle, Washington, has been in the process of a phased LED street light replacement project since 2009. Each year, the cost of equivalent LED street lights has fallen significantly. Table 2-4 tracks the decline in cost of a 70-W LED cobrahead street light used by the city of Seattle, which replaced a 100 W HPS cobrahead fixture.

Table 2-4. SCL Example of LED Street Light Cost Reduction over 4-Year Period[22]

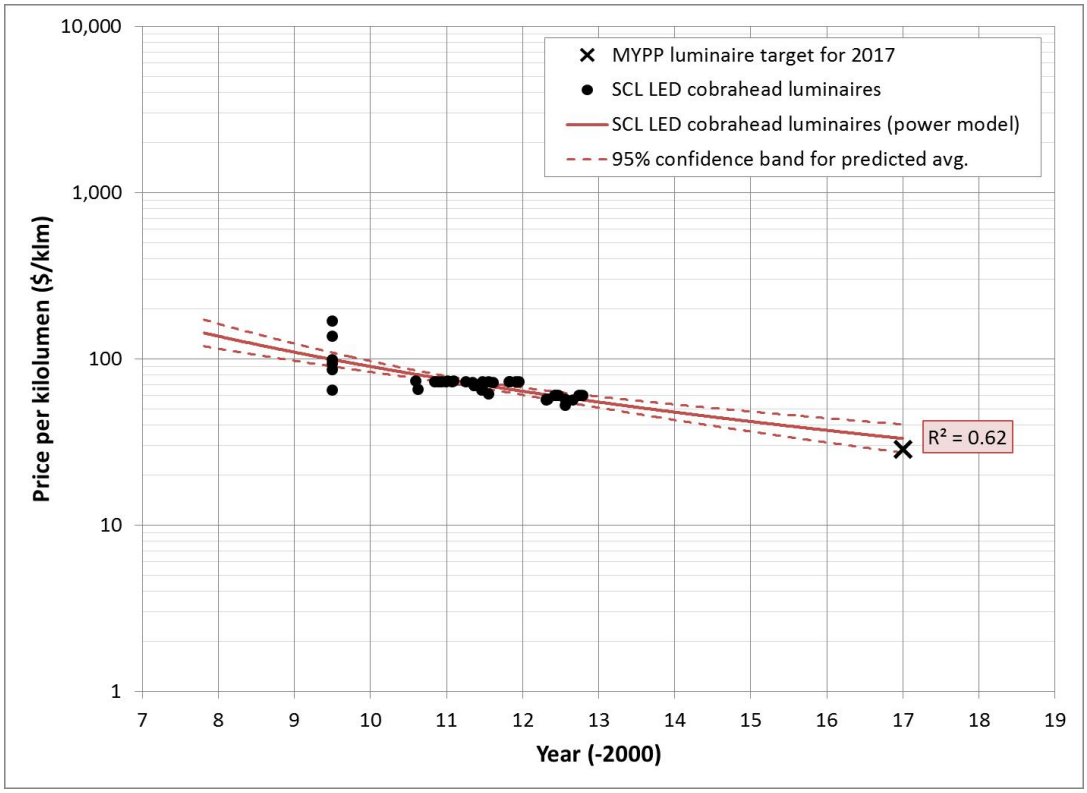
Seattle streetlight experience (for purchases of 2,000+ units)

Fall 2009	Spring 2010	Fall 2011	Winter 2012	Spring 2013
$369	$288	$239	$204	$179

As the technology matures, the price reductions are expected to slow and follow a logarithmic curve. Figure 2-3 is reprinted with permission from a 2013 DOE report regarding SCL's street lighting efforts shows the historical and predicted pricing trend for LED street lights.

22 U.S. DOE., "MSSLC: Shaping the Future of Street Lighting," September 2013, pg. 5. Per correspondence from Carol Anderson, Seattle City Light, pricing dropped slightly in Summer 2013 to $172.

Figure 2-3. Seattle City Light (SCL) LED Street Light Pricing Trend[23]



If Figure 2-3 is applied to the City of Seattle's current fixture cost data, the street light that cost Seattle $179 in 2013 is predicted to cost approximately $125 in 2017.

2.6 Economics of an LED Street Light Retrofit or Replacement

Retrofitting or replacing existing street lights with LEDs can be very cost-effective, especially at scale with conventional "cobrahead" street lights, which make up the vast majority of the installed base. Based on data and analysis from recent case studies, the simple payback of replacing an existing cobrahead street light with an equivalent LED fixture can be between less than four years to up to eight years, before any energy efficiency program administrator (PA) incentives are applied. Decorative fixture retrofits are not always as cost-effective, with paybacks approaching nine years or greater, not taking into account energy efficiency incentives.[24]

[23] MYPP = Multi-Year Program Plan. Figure is reprinted with permission from U.S. DOE, "SSL Pricing and Efficacy Trend Analysis for Utility Program Planning," October 2013, pg. 32

[24] To calculate simple payback, a distribution charge of $.055 was used, which was an average rate derived from a review of New York State IOU tariffs. The analysis does not account for the cost of money.

With PA incentives included, some jurisdictions have realized simple paybacks of between one and three years. Table 2-5 provides a range of simple paybacks (without PA incentives) expected for street light retrofits for various fixture sizes and types.

Table 2-5. Retrofit/Replacement Projects: Current Expected LED Street Light Simple Paybacks[a]

Fixture Type	Light Output					
	Low (<50W)		Medium (50W-100W)		High (>100W)	
	Min	Max	Min	Max	Min	Max
Decorative	14.2	20.2	14.1	21.3	12.5	18.6
Decorative kit	9.7	15.1	10.7	17.0	8.9	16.0
Cobrahead	3.6	5.6	4.0	7.7	3.9	7.7

[a] Assumes no program administrator incentives. Does not account for cost of money.

2.7 Economics of LED Street Light Installations – Investor-Owned Utility Perspective

Simple payback is a relatively straightforward metric that can be used to put street light projects into understandable financial terms for streetlights owned by municipalities. However an investor-owned utility's economic perspective is different for the streetlights they own. As investor-owned businesses, utilities must consider the capital requirements and impact on revenues and earnings. Any large-scale conversion of utility-owned streetlights will require a large amount of utility capital. Although this capital is ultimately recouped over time through rates, it can have a near-term negative impact on a utility's financial position. Furthermore if the corresponding LED rate offered by the utility to support the conversion is less than the rates offered for the other technologies that are replaced, the utility's revenue will decrease. Both of these factors may have a negative impact on the utility's financial standing, and can therefore be of concern to utility executives, regulators, and investors.

3 Barriers and Challenges

Despite all of the benefits provided by LED street lighting technologies, significant barriers must be overcome before municipalities can act upon these opportunities. These barrier categories include:

- Regulatory – The lack of options or financially attractive rates offered by utilities for LED street lighting.
- Financial – The capital cost of purchasing and/or upgrading street lights.
- Technical – The technical expertise needed to design or assist in a street lighting upgrade.

Although energy efficiency programs in general have a lot of experience addressing economic and technical barriers of energy efficiency, the unique regulatory barriers make implementing LED street lighting projects particularly challenging. Understanding these barriers requires an understanding of street light ownership and rate structures.

3.1 Street Light Ownership and Utility Tariffs

Streetlights are either owned by the utility customer (including municipalities, towns, cities, etc.) or by the utility. Depending on fixture ownership, there are significant differences in the operational costs, potential savings, options, and the barriers a utility customer will face in pursuing a street light upgrade. An estimated 59% of New York State's municipal streetlights are owned by the utilities and the remaining are owned by municipalities.[25] This number is heavily influenced by the fact that New York City owns all of its streetlights; if the city is omitted, the percentage of utility-owned street lights increases to 74%.

3.2 Utility-Owned Street Lights

When streetlights are owned by the utility,[26] the street lighting service is typically provided through a rental/leasing arrangement in which the utility company retains ownership of the equipment and is responsible for maintenance. The utility customer pays a fixed monthly charge for this service, but does not acquire the ownership or build equity in assets for the streetlights.

When streetlights are owned by the utility, the customer's choice of street light technologies is limited to the utility's current options as defined by the approved rates and tariffs. While utilities generally offer several options for street lighting technologies, as of January 2014, only one New York State utility, Orange and Rockland (O&R), offers an

[25] This estimate was developed using broad assumptions of ownership based on utility territory. For National Grid, RG&E, Orange & Rockland, NYSEG, and Central Hudson, it is assumed that 90% of the streetlights within their respective service territories are utility-owned. PSEG-LI assumes that 50% of streetlights are utility-owned. For Con Edison and all municipal utilities, it is assumed that 100% of streetlights are customer-owned. These assumptions were informed by collected inventories and available literature, but they should only be interpreted as preliminary estimates. Additional data from the utilities would be required to improve the accuracy of the estimate.

[26] For New York State excluding New York City, the estimate is approximately 74% of the streetlights.

LED option within their utility-owned street light tariff. This is important because if a jurisdiction chooses to reduce the cost of their streetlights through a more energy efficient LED option, but does not own their street lights, it will not be able to choose LEDs unless a specific LED street light option and corresponding rate is offered.

The lack of LED implementation options or cost-savings opportunities for utility-owned streetlights has led to legislation in Massachusetts, Rhode Island, and Maine to allow jurisdictions to purchase street lights from their utility so they have the option to replace their street lights if they choose to do so.

3.3 Customer or Municipality-Owned Street Lights

In contrast to utility-owned streetlights, customers, and municipalities that own their street lights[27] may choose any technology that complies with basic technical specifications, freeing them to choose more energy efficient technologies that the utility may not otherwise offer. Furthermore, when customers own their own lights they may upgrade the equipment at any time. In unmetered situations, the customer or municipality typically provides manufacturer specification sheets and other documentation to inform the utility of the expected electricity usage of the streetlights. The utility then develops a fixed monthly rate based on estimated consumption.

Because of the increased flexibility offered when customers own their streetlights, as well as the potential for significant cost savings, a small number of New York State municipalities[28] have purchased their street lighting systems from the local electric utility company. In other states, this practice is more widespread. In Massachusetts, more than 75 out of a total of 351 municipalities have purchased their streetlights from the utility with many more in process. Where these buyouts have occurred, municipalities have reported substantial cost reductions. However, it is the utility company's option to sell the street lighting systems so the potential for cost savings will depend on many factors, including timing, scale, and negotiations with the utility. A 2007 audit by the New York State Comptroller found that if the five audited jurisdictions bonded to buy their street lighting systems instead of leasing their street lighting equipment from their local electric utility, they could save over $13 million over the term of the 20-year bonds.[29] As noted previously, several states including Massachusetts, Rhode Island, and Maine have passed legislation that requires utilities to allow street light system purchases by municipalities.[30]

Given that customers who own their streetlights are able to access the opportunities afforded by LEDs, albeit often with rates for nonmetered assets, overcoming the regulatory barriers with utility-owned street lights is currently the biggest obstacle to overcome.

27 As noted earlier, this is estimated to be approximately 25% of the total street lights in New York State when excluding New York City.

28 Penfield, NY purchased their street lights from Rochester Gas and Electric in 1995. Union, NY purchased their street lights from NYSEG in 1998.

29 Office of the New York State Comptroller. 2007. "Street Lighting Cost Containment."

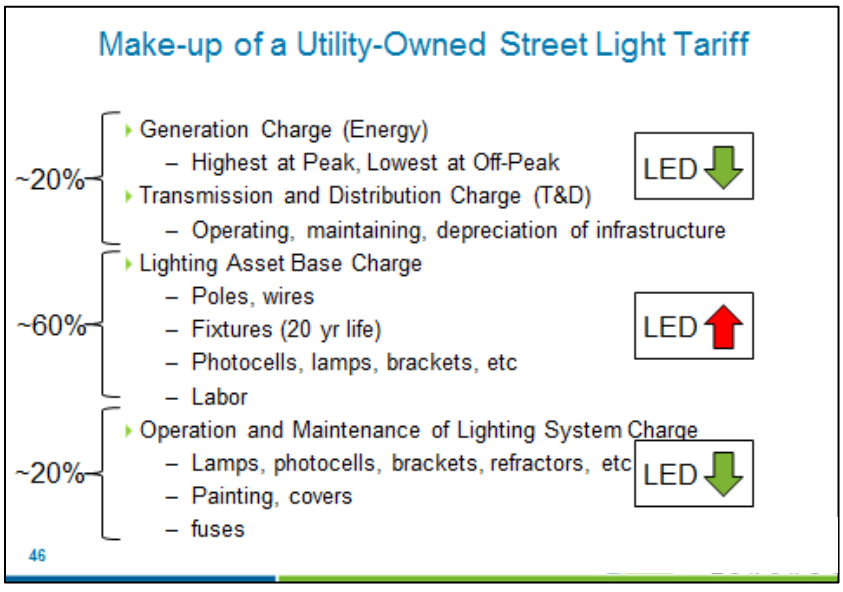
30 Massachusetts Restructuring Utility Industry Act, Chapter 164, Section 34a, 1997. Rhode Island Municipal Street Light Investment Act, 2013. Maine Energy Cost Reduction Act, 2013.

4 Status of New York State Utility-Owned Street Lighting Rates

As of January 2014, O&R is the only New York State investor-owned utility (IOU) that offers an LED rate for utility-owned street lighting. Other IOU municipal customers who do not own their street lights are currently unable to achieve an LED street light conversion via utility tariffs. Interestingly, if a jurisdiction in O&R's territory decided to convert from HPS to LED, the total monthly charge would be 12% higher for the LED fixture.

Street lighting rates are complex and can be challenging to dissect. As shown in Figure 4-1, a general industry rule-of-thumb, the 60-20-20 rule, says that 60% of a street lighting rate is made up of the capital required to install the street light (including equipment costs), 20% is made up of the energy cost including transmission and delivery, and the remaining 20% is allocated for ongoing streetlight maintenance.[31] This breakdown means that while LED fixtures will save on energy and maintenance costs, some or most of these cost savings could be negated if rates are based on a selection of higher cost LED fixtures. This can be seen when breaking down and comparing O&R's rates for HPS and LED fixtures.

Figure 4-1. Breakdown of Common Utility-Owned Street Light Tariff



[31] Stevens, M., 2012. "Investor Owned Utility Financial Perspective." Presented at the August 2012 Municipal Consortium LED Street Lighting Workshop, Boston, MA.

4.1 Analyzing Orange and Rockland's LED Rate

O&R's current tariff[32] contains two LED options: a 70W and 100W rate. Both rates identify the expected lumen output, total wattage, and delivery charge for each option. For this analysis, as shown in Table 4-1, the rates for the 70W HPS and 70W LED options were compared. The monthly rate for the LED fixture is greater than the HPS, yielding an estimated monthly charge for the LED fixture that is 12% greater than the HPS fixture it is intended to replace.

Table 4-1. Analysis of Existing O&R Street Light Rates

	Current O&R Rate 70W HPS	Current O&R Rate 70W LED	ERS/Optimal Estimated LED Rate
Street Light Cost	$71	$531	$150
Watts Used (with ballast/driver)	108	74	43
Monthly Rate for lamp type	$14.56	$19.39	$12.39[b]
Estimated monthly charge[a]	$25.96	$29.27	$20.88[b]

[a] Equals Monthly Rate plus other fixed charges plus variable charges times monthly kWh; see Appendix for assumptions and rates.

[b] A rough estimate only. A specific analysis using O&R's rate methodology would be required to determine the actual rate.

A review of the capital cost assumptions for LED fixtures in these rates found the costs to be substantially higher than what is currently reflected in the market.[33] In addition, the use of a 70W LED fixture in the rate appears to be oversized (i.e., too high a wattage and potentially too much light) compared with the HPS fixture it was intended to replace. A common misconception is that a replacement LED fixture should be selected based solely on lumen output relative to the existing fixture. For a number of reasons, including the improved optical control of LED fixtures and the perceived brightness with higher color temperature light sources, a lower wattage replacement that still meets recommended illuminance levels may be more appropriate and cost-effective. It should be noted that identifying appropriate replacements may call for additional technical analyses and planning. That being said, updated cost assumptions and the selection of a lower wattage fixture, where appropriate, could yield an LED tariff rate that provides an O&R customer as much as a 24% cost savings over an HPS fixture, as shown in the comparison of O&R's rates to a revised estimated LED rate in Table 4-1.

[32] O&R Case 11—E-0408 dated 6/15/12, leaf 283. O&R submitted a rate case filing in November 2014 that will modify the rates used in this discussion.

[33] Estimates in RS Means for LED streetlights are almost double that observed in case studies.

5 Future Considerations

The barriers to the street lighting energy efficiency opportunity are regulatory, technical, and financial. Each barrier will require a specific approach to be addressed successfully. Of these barriers, the most significant is the regulatory barrier: the lack of rate tariffs or financially attractive rates for LED street lighting, especially with utility-owned streetlights. For many jurisdictions in New York State, these regulatory barriers must be addressed before the jurisdiction will face the technical and financial barriers.

5.1 Addressing Regulatory Barriers

The following are options for addressing regulatory barriers:

- Engage New York State regulators and utilities regarding current and proposed tariff options and barriers.
- Propose strategies/methods for developing and/or adjusting LED tariffs to better reflect current market realities and promote efficiency.
- Complete more in-depth research into tariff models found in New York State. Explore financial mechanisms that may motivate utilities to develop tariffs and streetlights to expand customer choice and LED options.
- Publish a report on the street lighting energy efficiency opportunity to equip stakeholders with knowledge. Stakeholders must understand the issues and opportunities.

5.2 Addressing Technical and Educational Barriers

The following are options for addressing technical and educational barriers:

- Develop and publish a guide for LED street light upgrades for use by jurisdictions and municipalities. This guide will include guidance on how to specify the appropriate fixture to ensure high-quality and long-lasting installations. The guide will address technical issues such as selection of LED fixtures for a given application and avoiding over-lighting roadways along with potential technical issues such as comparative component failure rates, etc. The guide will also outline a process for conversions using best practices from other jurisdictions. The Lighting Research Center and the Municipal Solid-State Street Lighting Consortium (MSSLC) recently developed similar guides, which can be used as either a reference or as the framework for future publications:
    - Sustainable Roadway Lighting Seminar (http://www.nyserda.ny.gov/Cleantech-and-Innovation/Transportation/Transportation-Research/Transportation-Reports)
    - U.S. Department of Energy Municipal Solid-State Street Lighting Consortium (MSSLC) Model Lighting Specification (http://energy.gov/eere/ssl/model-specification-led-roadway-luminaires)
    - Examples of guides in other states include the following:
      Efficiency Vermont - http://www.efficiencyvermont.com/docs/for_my_business/lighting_programs/StreetLightingGuide.pdf
      Massachusetts Metropolitan Area Planning Council - http://www.mapc.org/system/files/bids/Retrofit%20Streetlights%20with%20LEDs.pdf

- Identifying appropriate LED replacements for existing fixtures may call for additional technical analyses and planning beyond the capabilities of local jurisdictions. Assist jurisdictions with the technical aspects of street light conversions, such as establishing baseline inventories, design and technical assistance, etc. This assistance may also include presentations, webinars, and other one-on-one outreach to keep jurisdictions and other stakeholders apprised of current market information and best practices.

5.3 Addressing Financial Barriers

The following are options for addressing financial barriers:

- Identify benefits/impacts of aggregated purchases (i.e., multiple year procurements, multiple jurisdictions, hybrid deals, etc.), including pricing discounts, enhanced warranties, and/or other services provided by manufacturers.
- Consider coordination with New York State Office of General Services and entities responsible for street lighting purchase and procurement to specify and manage aggregated purchases.
- Consider the use of Energy Efficiency Portfolio Standard or Clean Energy Fund to support the above steps or a portion of the capital cost of street lighting upgrades. Support can be applied to reducing the cost of new LED fixtures and/or to pay the remaining depreciated cost of streetlights removed before utilities have recovered their costs.
- Explore the opportunity for financing through ESCOs or other similar means. Streetlights are a prime candidate for financing due to their potentially long service life and municipal/government ownership and/or operation.
- Research associated funding opportunities available through federal and/or regional programs.

Appendix: Data Sources and References

The following sources were used to determine fixture wattages, equivalencies, and costs (including fixture, material and labor costs). Only data from within the past year was referenced for LED fixture costs due to the rapid decline in the cost for this technology over the past several years.

- DOE gateway demonstration – Kansas City street light project (June 2013)
  - Replaced a range of HPS street lights, including 100 W – 400 W
  - Mean energy savings was 39%, often with lower light levels. Net increase in average efficacy is 15%
    http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2013_gateway-msslc_kc.pdf
- LA street light retrofit (July 2013):
  - Replaced a range of HPS street lights
  - Avg. LED fixture cost = $245 in 2012 (covers range of wattages)
  - Goal was 40% energy savings, achieved 63% savings
    http://www.forbes.com/sites/justingerdes/2013/07/31/los-angeles-completes-worlds-largest-led-street-light-retrofit/
    http://photos.state.gov/libraries/finland/788/pdfs/LED_Presentation_Final_June_2013.pdf
- Asheville, NC street light retrofit (May 2013)
  - Avg. fixture cost = $267 (7,583 installed @ $2,024,181)
  - Approximately 50% savings
    http://www.usdn.org/uploads/cms/documents/asheville-led-streetlights-and-green-capital-improvement-program-best-practices-case-study.pdf
    http://www.ashevillenc.gov/Portals/0/city-documents/sustainability/Webpage%20City%20of%20Asheville%20LED%20Street%20Light%20Program.pdf
- Iowa case studies
  - 41% – 63% energy savings over HPS (9 projects, 2 outliers = 29% and 78% savings)
  - Some fixtures intended to replace 150 W HPS were used to replace 400 W HPS due to the recognition that the existing illuminance in those areas was higher than necessary.
    http://archive.iamu.org/services/electric/efficiency/Street%20Lighting/StreetLightingHandbook.pdf
- Ann Arbor, MI case study (2011 – maintenance savings reference):
  - $124/year labor and materials to maintain/replace MH lamps
    http://www.a2gov.org/departments/systems-planning/energy/Documents/LED_Summary.pdf
- City of Los Angeles “Changing our Glow for Efficiency”, June 2013
  - 2009 - $432
  - 2010 - $298
  - 2011 - $285
  - 2012 - $245
    http://photos.state.gov/libraries/finland/788/pdfs/LED_Presentation_Final_June_2013.pdf

- Seattle, WA case study
- Field test results
- Economic analysis
  http://www.seattle.gov/light/streetlight/led/docs/SCL%20LED%20Consultant%20Report.pdf
- Tucson, AZ case study
  - Maintenance savings reference
  - $150 per HID lamp replacement
    http://www.tucsonaz.gov/files/ocsd/CMS1_037814.pdf
- Darien, Il case study
  - Maintenance cost reference (street light repair)
    http://www.darien.il.us/government/minutes/2013/Council/130304/Supporting%20Documentation/AttachmentB-2013StreetLightMaint.pdf
- DOE gateway demonstration – Sacramento, CA street light project (December 2011)
  - Referenced for maintenance and installation costs only
    http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2011_gateway-msslc_sacramento.pdf
- Loveland, CO – fixture costs (4/25/2013)
  - Cobrahead: $375 – $1,118
  - Decorative: $600 – $1,609
    http://www.ci.loveland.co.us/modules/showdocument.aspx?documentid=15201
- Orlando, FL article (October 2013)
  - LED fixture costs
  - LED equivalency info
    http://articles.orlandosentinel.com/2013-10-05/business/os-dark-sky-light-pollution-20131005_1_led-streetlights-orlando-utilities-commission-light-pollution
- DOE gateway demonstration – Central Park decorative post-top fixtures (Sept 2012)
  - Pg. 3.1 - maintenance costs
  - $111.60 per luminaire per year:
  - $65.60 for pole/fixture/ballast maintenance
  - $46.00 for lamp replacement
    http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_gateway_central-park.pdf
- DOE report – "SSL Pricing & Efficacy Trend Analysis for Utility Program Planning" (Oct 2013)
  - Page 32: $/klm trend for street lights (data from Seattle City Light)
    http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_trend-analysis_2013.pdf

TableA–1: Analysis of O&R Street Light Rates is based on the following example in which O&R's actual charges were applied according to the technology chosen.

Actual monthly costs may vary depending on the location of the street light and other factors (e.g., underground service, bracket type, etc.). The rates used, with the sole exception of the ERS/Optimal Estimated LED Monthly Rate, are based on the O&R tariff information found on the utility website: http://www.oru.com/aboutoru/tariffsandregulatorydocuments/newyork/index.html)

	Technology Choices and Charges		
Tariff Descriptions and Inputs	**O&R Current 70W HPS Rate**	**O&R Current 70W LED Rate**	**ERS/Optimal Estimated LED Rate**
Watts Used (with Ballast/driver)	108	74	43
Monthly Costs/Rates			
(1) Monthly Rate (Delivery Charge) – (fixed)	$14.56	$19.39	$12.39
(2) Additional charges (if applicable)			
Underground Service – (fixed)	$5.04	$5.04	$5.04
Fifteen Foot Bracket – (fixed)	$0.51	$0.51	$0.51
(3) Competitive Service, Municipal Undergrounding, Energy Efficiency Charges			
25. Energy Cost Adjustment (a) thru (e) variable)*	$0.00208	$0.00208	$0.00208
26. System Benefits Charge (variable)*	$0.00438	$0.00438	$0.00438
29. Transition Adjustment Charge (variable)*	$0.00077	$0.00077	$0.00077
(4) Temporary Surcharge/kWh (variable)*	$0.00549	$0.00549	$0.00549
(5) Merchant Function Charge/kWh (variable)*	$0.0049	$0.0049	$0.0049
(6) Billing and Payment Processing Charge- (fixed)	$1.02	$1.02	$1.02
(7) Market Supply Charge (variable)*	$0.08396	$0.08396	$0.08396
(8) Increase in Rates and Charges (variable depending on municipality)	0	0	0
Sum of all Variable Charges	**$0.10158**	**$0.10158**	**$0.10158**
***prices as of dates indicated by sourced documents**			
Application of Cost Variables (Assuming all Additional Charges apply)			
Assumes 440 Monthly Burn Hours			
kWh= (Total Wattage/1,000)*Monthly Burn Hours	47.52	32.56	18.92
Sum of Variable Costs (kWh times variable charges)	$4.8270816	$3.3074448	$1.9218936
Sum of Fixed Costs	$21.13	$25.96	$18.96
Sum of Total Monthly Charges	**$25.96**	**$29.27**	**$20.88**

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Street Lighting in New York State: Opportunities and Challenges

Final Report
December 2014
Revised January 2015

Report Number 14-42

State of New York
Andrew M. Cuomo, Governor

New York State Energy Research and Development Authority
Richard L. Kauffman, Chair | John B. Rhodes, President and CEO

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 5

Responding Witness: John P. Malloy

Q-5. Please refer to KU's response to LFUCG 1-28. Please describe to whom the presentations reflected in Attachments 1 and 2 were made.

A-5. Attachment 1 of response to LFUCG 1-28 was presented to various Managers and Directors of Distribution Operations and Customer Services. Attachment 2 of response to LFUCG 1-28 was presented to the Vice President of Customer Services and Directors of Customer Services.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 6

Responding Witness: John P. Malloy

Q-6. Please refer to KU's response to LFUCG 1-28. Page 5 of Attachment 1 identifies the number of in-active lights in KU's system as of October 31, 2015. Please describe how KU characterizes an "in-active" light.

A-6. An in-active light is a light that is not being billed. These lights may have either been removed or have been moved to a different installation because a different party wanted to take over the billing.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 7

Responding Witness: John P. Malloy

Q-7. Please refer to KU's response to LFUCG 1-28. On page 13 of Attachment 1, it states that KU has previously and currently conducts audits of lighting for cities within its system.

a. Please explain the purpose of these audits and summarize the results.

b. Please provide a copy of the audit and all underlying data for the audit of KU's lights within LFUCG.

c. Please provide a copy of all audits and underlying data for audits of KU's lights since January 2013.

A-7. a. The purpose of the audits are to map all city street lights in the Company's Geographic Information System and ensure correct billing of lights.

b. An audit has not been performed on LFUCG lights.

c. See attached. The second attachment is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.

Company	KU Audited	Date Audit Started	Date Audit Completed	CCS Light Count - Pre Audit	SW Light Count - Post Audit
Kentucky Utilities	Beattyville	5/24/2016	13/12/2016	287	264
Kentucky Utilities	Bedford	7/15/2015	6/15/2016	108	107
Kentucky Utilities	Bloomfield	4/6/2015	6/23/2015	103	117
Kentucky Utilities	Bonnieville	2/19/2016	6/16/2016	69	71
Kentucky Utilities	Bremen	6/25/2014	8/18/2014	41	43
Kentucky Utilities	Brodhead	1/22/2013	6/4/2013	114	108
Kentucky Utilities	Brooksville	9/19/2014	1/28/2015	119	107
Kentucky Utilities	Carrollton	12/1/2014	3/23/2015	391	417
Kentucky Utilities	Cave City	12/14/2014	8/24/2015	362	352
Kentucky Utilities	Clay	9/1/2012	10/3/2013	139	146
Kentucky Utilities	Crab Orchard	1/14/2015	8/26/2015	118	115
Kentucky Utilities	Eddyville	10/21/2015	4/8/2016	190	212
Kentucky Utilities	Elizabethtown	11/20/2012	6/3/2013	1992	2003
Kentucky Utilities	Flemingsburg	5/29/2014	1/28/2015	393	380
Kentucky Utilities	Fredonia	10/22/2015	1/11/2016	95	93
Kentucky Utilities	Golden Rainbow Mobile Home Park	10/15/2014	Not Available	13	13
Kentucky Utilities	Gratz	6/28/2016	11/2/2016	19	20
Kentucky Utilities	Greensburg	2/10/2015	10/24/2015	485	480
Kentucky Utilities	Hodgenville	7/21/2014	9/24/2014	393	380
Kentucky Utilities	Hustonville	8/5/2015	1/27/2016	73	73
Kentucky Utilities	Jamestown	9/1/2012	11/12/2013	418	414
Kentucky Utilities	Lakeview Heights	7/1/2015	1/27/2016	12	10
Kentucky Utilities	Lawrenceburg	1/23/2013	6/5/2013	853	862
Kentucky Utilities	Lebanon	10/13/2014	2/3/2015	489	518
Kentucky Utilities	Midway	9/10/2014	3/6/2015	200	187
Kentucky Utilities	Milton	5/5/2016	10/31/2016	43	36
Kentucky Utilities	New Haven	6/14/2016	11/14/2016	128	128
Kentucky Utilities	Perryville	8/5/2015	1/27/2016	114	107
Kentucky Utilities	Pineville	7/21/2014	1/23/2015	420	418
Kentucky Utilities	Pleasureville	10/11/2012	8/27/2013	91	92
Kentucky Utilities	Radcliff	4/7/2014	7/6/2014	767	782
Kentucky Utilities	Rockport	5/27/2015	12/30/2015	68	72
Kentucky Utilities	Russell Springs	8/15/2013	6/24/2014	924	690
Kentucky Utilities	Salt Lick	2/23/2016	Not Available	50	50
Kentucky Utilities	Sebree	1/19/2015	4/27/2015	155	152
Kentucky Utilities	Simpsonville	8/28/2014	1/28/2015	207	218
Kentucky Utilities	Taylor Trailer Park	10/16/2014	Not Available	2	2
Kentucky Utilities	Taylorsville	3/19/2015	6/23/2015	143	140
Kentucky Utilities	Uniontown	11/10/2014	1/28/2015	139	138
Kentucky Utilities	Upton	7/26/2016	8/17/2016	96	93
Kentucky Utilities	Versailles	3/28/2014	1/8/2015	649	673
Kentucky Utilities	Warsaw	7/15/2015	1/6/2016	208	196
Kentucky Utilities	West Point	2/3/2016	7/19/2016	127	113

The attachment is Confidential and provided under seal in a separate file in Excel format.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 8

Responding Witness: John P. Malloy

Q-8. Please refer to KU's response to LFUCG 1-28. Please provide a copy of the report by Northeast Energy Efficiency Partnerships entitled "LED Street Lighting Assessment and Strategies for the Northeast and Mid-Atlantic" that is dated January 2015, which is referenced on page 23 of Attachment 1.

A-8. See attached.

Northeast Energy Efficiency Partnerships

LED Street Lighting Assessment and Strategies for the Northeast and Mid-Atlantic

Northeast Energy Efficiency Partnerships
January 2015

LED Street Lighting Assessment and Strategies For the Northeast and Mid-Atlantic

Northeast Energy Efficiency Partnerships
January 2015

Acknowledgements

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About NEEP

Founded in 1996 as a non-profit, NEEP's mission is to serve the Northeast and Mid-Atlantic to accelerate energy efficiency in the building sector through public policy, program strategies, and education. Our vision is that the region will fully embrace energy efficiency as a cornerstone of sustainable energy policy to achieve a cleaner environment and a more reliable and affordable energy system. With an annual budget of $6 million, our work is supported by states, utilities, federal agencies, project fees, and private foundations.

About NEEP's High Performance Buildings Project

The High Performance Buildings Project has been developed to promote operational energy savings via municipal energy efficiency and high performance public building construction or retrofit throughout the region. NEEP's vision is that the work done today on High Performance Buildings will pave the way toward Zero Net Energy.

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

There are approximately 4.96 million municipal[1] street lights in the Northeast and Mid-Atlantic region using 3.17 TWh of electricity annually.[2] These street lights are composed primarily of High Pressure Sodium (HPS), Metal Halide (MH), and Mercury Vapor (MV) technology, but Light Emitting Diode (LED) technology is now capable of cost-effectively replacing traditional street light technologies. LEDs use less than half the energy consumed by traditional lights and last significantly longer. If all street lights in the region are converted to LED technology and combined with advanced controls,[3] 1.76 TWh of energy could be saved.[4] Throughout the region, cities like New York, Boston, and Philadelphia are converting their street lights to LEDs, yet significant technical, regulatory, and financial barriers to widespread conversion remain for most municipalities in the region.[5]

This report assesses the current status of LED street light conversion barriers in the Northeast and Mid-Atlantic region. It provides a quantitative analysis of the regional street lighting efficiency opportunity and a recommended strategy to address the barriers and achieve large scale conversion. Finally, the report provides information on activities and progress across the region to install LED street lighting.

Summary of Key LED Street Lighting Barriers and Recommendations
The barriers to LED street lighting conversions are technical, regulatory, and financial:

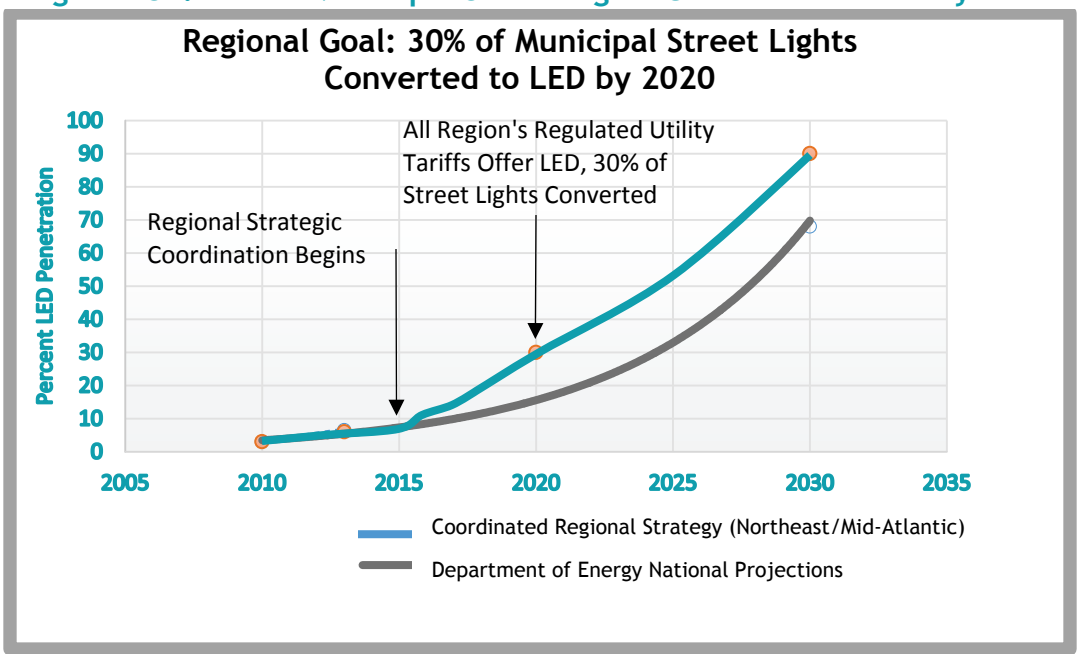
Barrier Type	Description
Technical	Many municipalities lack the resources and the technical expertise needed to design and implement successful LED street lighting upgrade projects.
Regulatory	Most utility tariffs in the region for utility-owned street lights do not offer LED technology and/or street lighting controls as options. This prevents most municipalities in the region from converting street lights to LED technology, installing street lighting controls, and receiving any economic benefit for doing so.

[1] Municipal street lights are street lights that are paid for by municipalities. They may be either owned by the municipality or owned by the utility. They do not include privately funded street lights on private roads or non-municipal street lights that may be paid for by other government or non-government entities (e.g., college or university street lights, street lights on prison roadways, or some bridge/tunnel lighting).
[2] The Northeast and Mid-Atlantic Region is composed of New York, Pennsylvania, New Jersey, Massachusetts, Maryland, Connecticut, Maine, New Hampshire, Rhode Island, Delaware, Washington D.C., and Vermont. Methodologies for arriving at this number discussed in Appendix B.
[3] In the context of street lights, advanced controls offer energy savings over the traditional photocell control because they allow for street lights to dim or turn off during off-peak hours and a network that can inform operators when a light has failed (et.al.).
[4] Savings estimates detailed in Table 1.
[5] This report focuses on the opportunities, barriers, status, and best practices surrounding LED street light conversion. While other high efficiency lighting technologies exist, LEDs have represented the vast majority of documented conversion projects in the region and have become the technology of choice for street lighting. However, many of the technical, regulatory, and financial issues described in this report can also be applied to other technologies.

Barrier Type	Description
Regulatory	The structure and assumptions used in some tariffs for utility-owned LED street lights result in little or no electricity bill savings compared to traditional HPS street light tariffs. In turn, this results in little or no cost savings to municipalities that opt for LED street lights.
Financial	Access to—and the cost of—capital to purchase street lights from the utility and/or to fund LED street light conversions is a significant barrier for municipalities. Further, municipalities that choose to purchase or convert utility-owned street lights before legacy street light systems have fully depreciated can face additional capital costs.

To address these barriers, we recommend a regional strategy with the goal to convert 30 percent of all municipal street lights to LED by 2020. This strategy includes overcoming the most significant regulatory and financial barriers in a manner that sets the stage for nearly 100 percent adoption by 2030 (i.e., market transformation) as shown in Figure ES1 below:

Figure ES1: 30% of Municipal Street Lights Converted to LED by 2020



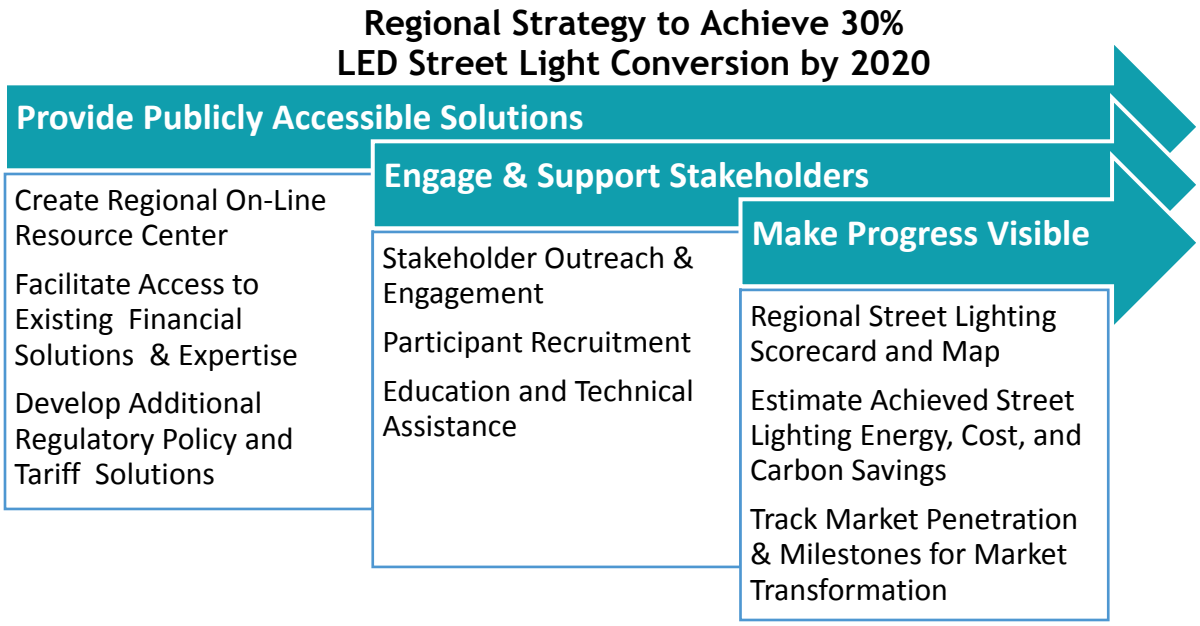
The core driver of this result is the adoption and implementation of street lighting tariffs that encourage LED conversions supported by complementary regulatory policies that address issues of stranded cost and other disincentives, as well as financial tools and strategies that reduce the cost of LED street lights. Indeed, if all states and utilities adopted such tariffs and policies by 2020, full market transformation could occur well before 2030.

This recommended regional strategy includes three key elements:

1. **Provide Publicly Accessible Solutions** - Identify, develop and make available solutions to overcome the known barriers to high efficiency municipal street lighting;
2. **Engage and Support Stakeholders** - Engage stakeholders and recruit and support states and municipalities to adopt these solutions to achieve municipal street light conversion goals; and
3. **Make Progress Visible -** Track and communicate progress across the region toward the goal of 30 percent conversion by 2020.

Figure ES2 below provides an overview of this strategy. The recommended strategy is described in detail in Section 5 of this report.

Figure ES2 – Regional Strategy to Achieve 30% LED Street Light Conversion by 2020



2. LED STREET LIGHTING BENEFITS

Recent advances in LED street lighting options present a unique opportunity for reducing a municipality's street lighting costs through energy and maintenance cost-savings, which translate into a reduced burden for municipal taxpayers. Also, energy efficient LED street lights reduce carbon emissions, improve visibility and public safety, and reduce light pollution.

LED Street Lighting Benefits

- ❑ Energy Cost-Savings
- ❑ Maintenance Cost-Savings
- ❑ Extended Lifecycle
- ❑ Reduced Carbon Emissions
- ❑ Reduced Light Pollution at Night
- ❑ Lighting Quality
- ❑ Greater Perceived Security

2.1. Cost-Savings Benefits

Street lighting can account for as much as 40 percent of a municipality's electric utility bill.[6] In many jurisdictions, this is a significant amount of the overall municipal budget. When compared against traditional street lights, LEDs can drastically lower energy usage and associated costs. For example, case studies show that municipalities can reduce their street lighting costs by as much as 65 percent when switching to LED street lights, and even more if they incorporate advanced lighting controls.[7] Such energy savings translate directly to savings for taxpayers. Furthermore, municipalities can also capture maintenance cost-savings associated with an LED street light's projected lifetime and diminished maintenance requirements, as compared to traditional street lights.[8] Maintenance savings—which equate to approximately $50 annually per fixture—can provide approximately twice the financial advantages available through energy savings.[9]

2.2. Additional Benefits

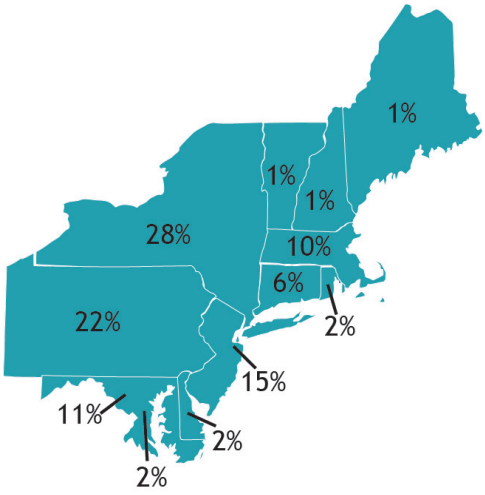
Investing in an LED street light conversion project provides benefits beyond reduced costs. Since LED street lights have a higher efficacy than previous lighting options, they result in lower carbon emission while performing the same task. Because LED street lights have improved optical control, less light is directed into the night sky, reducing light pollution. Observers often find the light from an LED street light, which has a better color rendering

[6] New York Department of Environmental Conservation. Energy and Climate. *Reduce Utility Bills for Municipal Facilities and Operations.* Accessed: 1/12/15. Available at: http://www.dec.ny.gov/energy/64089.html
[7] Gerdes, Justin. *"Los Angeles Completes World's Largest LED Street Light Retrofit."* (Citing a 63 percent overall energy savings for Los Angeles' LED Street light Project) (July 2013) Accessed: 1/12/15. Available at: http://www.forbes.com/sites/justingerdes/2013/07/31/los-angeles-completes-worlds-largest-led-street-light-retrofit/
[8] US Department of Energy Building Technologies Office. *Solid State Lighting Technology Fact Sheet.* (August 2013) (Stating that "LEDs have the potential to best other technologies in terms of longevity,") Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/life-reliability_fact-sheet.pdf
[9] New York State Energy Research and Development Authority. Street Lighting in New York State: Opportunities and Challenges. Page 7. (December 2014). Accessed: 1/12/15. Available at: http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Energy-Efficiency-Services/Street-Lighting-in-NYS.pdf

index and a broader spectrum than HPS lights, is brighter and improves visibility.[10] From a public safety perspective, LED light provides greater perceived security and has been reported to reduce crime rates.[11] Furthermore, maintenance costs associated with vandalism are reduced for LEDs street lights because their components are more durable than traditional high pressure sodium street lights.

3. OPPORTUNITY ANALYSIS

State Street Lighting Inventories as Percentage of Regional Opportunity



There are approximately 4.96 million municipal street lights[12] in the Northeast and Mid-Atlantic region using approximately 3.17 TWh of electricity annually. If all of these street lights are converted to LED technology, approximately 1.62 TWh of energy could be saved. Additional savings of at least 141 GWh are possible with the installation of street lighting controls.

Beyond energy savings, LED street lighting and controls provide opportunities for municipalities to greatly reduce the cost and the associated tax burden of providing street lighting service to their citizens and businesses. While cost savings for more efficient street lighting will vary by municipality, utility, and associated tariff charges, we conservatively estimate cost savings of more than $382.1 million annually are available across the region if all street lights are converted to LED and controls are installed on 30 percent of those lights.[13] Over 10 years, the potential savings approaches $4 billion. With municipal budgets across the region stretched thin, LED street lighting is an important solution to the financial challenges faced by municipalities. Table 1 provides estimates of the region's potential savings according to whether an LED conversion includes advanced controls. Table 2 provides a state-by state analysis of energy, maintenance, and cost savings.[14]

[10] US Department of Energy, Office of Energy Efficiency and Renewable Energy, Solid State Lighting Program. "*Light at Night: the Latest Science*." (November 2010) Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_whitepaper_nov2010.pdf

[11] Gerdes, Justin. Forbes.com. "*Los Angeles Saves Millions with LED Street Light Deployment*." (Citing an approximate 10 percent drop in nighttime crime rates after LED conversion) (January 2013) Accessed: 8/23/14. Available at: http://www.forbes.com/sites/justingerdes/2013/01/25/los-angeles-saves-millions-with-led-street-light-deployment/

[12] For a discussion of methodologies used in estimating the number of street lights, see Appendix B.

[13] This analysis assumes that only 30 percent of the existing streetlights throughout the region are appropriate for controls, due to both aesthetic and practical barriers. Controls-based savings for those lights were estimated to be 30 percent of energy usage, in accordance with a California Lighting Technology Center estimate of 30-50 percent savings as cited in Michael Siminovitch's essay "Taking the Long view on LED Street Lighting." Accessed: 1/12/15. Available at: http://cltc.ucdavis.edu/sites/default/files/files/publication/20100700-researchmatters.pdf

[14] For further discussion of estimates and methodologies, see Appendix B.

Table 1: Northeast and Mid-Atlantic Potential Savings and Cost Estimates

Measure	Annual Energy Savings (MWh)	Annual Energy Cost Savings ($ Million)	Annual Maintenance Savings ($ Million)	Total Annual Cost Savings ($ Million)	Total Installed Cost ($ Million)	Simple Payback Period (years)
LED Retrofit	1,622,036	$123.43	$247.86	$371.3	$1,392.96	3.75
Advanced Controls	141,035	$10.79	---	$10.79	$148.71	13.78
Retrofit and Controls	1,763,071	$134.22	$247.86	$382.09	$1,541.07	4.03

Table 2: State-by-State Savings and Cost Estimates

State	Number of Municipal Street Lights	Annual MWh Savings (LED Retrofits & Controls)	Annual Energy Cost Savings ($ Million)	Annual Maintenance Savings ($ Million)	Total Annual Cost Savings ($ Million)	Total Installed Cost ($ Million)
New York	1,386,000	566,111	$36.8	$69.30	$106.1	$431.05
Pennsylvania	1,070,109	358,674	$25.1	$53.50	$78.61	$332.80
Connecticut	312,140	104,621	$12.56	$15.60	$28.16	$97.08
New Jersey	763,137	255,784	$21.74	$38.16	$59.9	$237.34
Maryland	527,237	176,716	$10.6	$26.36	$36.96	$163.97
Massachusetts	496,000	166,247	$14.96	$24.80	$39.76	$154.26
Rhode Island	91,363	30,623	$2.76	$4.56	$7.32	$28.41
Delaware	77,940	26,124	$2.35	$3.90	$6.25	$24.24
District of Columbia	71,000	23,797	$1.9	$3.55	$5.45	$22.08
Maine	65,887	22,084	$2.03	$3.29	$5.50	$20.49
New Hampshire	65,297	21,886	$2.19	$3.26	$5.45	$20.3
Vermont	31,037	10,403	$1.04	$1.55	$2.59	$9.65

4. BARRIERS TO LED STREET LIGHT CONVERSIONS

Technical, *regulatory*, and *financial* barriers stand between the current street lighting landscape and the widespread adoption of LEDs by municipalities and we discuss each barrier in detail below.

4.1. Technical Barriers

Barrier: Many municipalities lack resources and the technical expertise needed to design and implement successful LED street lighting upgrade projects.

The field of available LED street lighting products has changed drastically in recent years. The industry has hosted a rapid advancement in lumen/watt efficacy, a rapid decrease in costs per unit, and a stunning proliferation of products and manufacturers in the marketplace. LED technology is vastly different from legacy street lighting technologies and requires new and different approaches in using it. With this, new tools and expertise are needed to successfully implement LED street lighting upgrade projects. Municipalities need expertise in how to evaluate street lighting systems; design new systems; procure high quality and reliable LED products; understand regulatory tariffs; and evaluate the economics of street lighting upgrades. Providing municipalities with tools, resources and expertise offers a significant opportunity regionally and nationally to accelerate adoption of LED street lighting.

4.2. Regulatory Barriers

Barrier: Most utility tariffs in the region for utility-owned street lights do not offer LED technology and/or street lighting controls as options. This prevents most municipalities in the region from converting street lights to LED technology, installing street lighting controls, and receiving any economic benefit for doing so.

Barrier: The structure and assumptions used in some tariffs for utility-owned LED street lights result in little or no electricity bill savings compared to traditional HPS street light tariffs, resulting in little or no cost savings to municipalities that opt for LED street lights.

A discussion of regulatory barriers requires understanding of: (1) street light ownership models; (2) utility tariffs; and (3) municipal purchase opportunities.

4.2.1 Street Lighting Ownership

Street lights may be owned by either the utility or the municipality. In both cases, the street lights and the service they provide are paid for by the municipality, but whether a municipality can install LED technology, and the cost savings they may realize for doing so, depends largely on which party owns the street lights.

4.2.2 Utility-Owned Street Lights

The majority of street lights in the region are utility-owned.[15] In this case, a utility purchases, owns, and depreciates the street light on its balance sheet while leasing the use of a luminaire to the customer for the purpose of street lighting. The customer, in most cases a municipality, pays a monthly charge that includes all costs associated with providing the street lighting service, which includes the cost of the energy distribution, transmission, and generation charges,[16] as well as a luminaire charge. The luminaire charge is an itemized charge that generally accounts for the cost of capital, the cost of the luminaire and associated equipment, and the cost of the luminaire's maintenance, amortized over the expected useful life of the asset. All of these charges are defined in a utility's street lighting tariff for utility-owned street lights.

Utility-Owned Street Lighting Tariffs

If an LED rate is not included in a company-owned street light tariff, then ***LEDs are unavailable to municipalities that provide street lighting service through that tariff.*** As of August 2014, approximately 30 percent of investor-owned utilities in the region offer LEDs within their company-owned tariffs. (Table A1, Appendix A).

When street lights are owned by the utility, the customer's choice of street light technologies is in most cases limited to the utility's offerings within the approved tariffs.[17] While utilities generally offer several options for street lighting technologies, they can be slow to develop offerings for newer technologies, as is the case with LEDs. As of August 2014, only 13 of 45 investor-owned utilities in the Northeast and Mid-Atlantic region offer LEDs within their utility-owned tariffs.

Rhode Island's Municipal Street Light Investment Act

Rhode Island enacted a 2013 law (Chapter 39-30) establishing formal procedures for municipalities to purchase their utility-owned outdoor lighting systems and directing electric distribution companies to file a tariff incorporating rates for customer-owned dimmable lighting.

Why have investor-owned utilities been slow to develop tariff offerings for LED technology?[18] While there are many factors—financial and otherwise—that may or may

[15] Howe, Dan. (et.al.) Rocky Mountain Institute. "Street Fight: LED Street Lighting the Newest Challenge to Old Utility Business Models" (November 2013) (Stating: "[I]n most cities around the country, the local electric distribution company provides overhead street lighting as a basic service at a flat monthly rate per light, which includes the light itself, maintenance, and electricity.") Accessed: 9/26/14. Available at: http://blog.rmi.org/blog_2013_11_26_Street_Fight. It's also important to note that according to data cited in this report's appendix, the majority of street lights in New York, Rhode Island, and near majority in Massachusetts are utility-owned.

[16] Distribution utility generation charges hinge upon whether the customer accepts that utility's standard offer generation rate. In the case of Vermont, which has not undergone electric industry restructuring, the transmission, distribution, **and** generation rates are predetermined by the distribution utility.

[17] New Jersey's Public Service Electric and Gas is a notable exception to this general rule, explicitly providing an equation for specialty equipment that it will purchase on behalf of a municipality.

[18] From a timing perspective, many utilities are only required to file new rate cases with their regulators every three years. This is a significant amount of time in the context of rapidly developing technology.

not motivate an investor-owned utility to develop LED tariff offerings, an LED tariff may reduce utility revenues and undermine fixed cost recovery. If a lower LED rate is developed by the utility and customers convert their street lights, the utility's revenues will decrease. Further if there is high demand for LED street lighting conversions due to the cost savings a utility-owned LED tariff may provide, the utility will face significant capital expenditures. While they will recover the capital expenditures over time through rates, the initial capital outlay can be very large and affect the utility's financial standing. To address this initial capital outlay issue, some utilities that have developed utility-owned LED tariffs that limit the number of conversions they can complete each year and have written that into the tariff. It is this combination of decreased revenue and capital outlay that can create disincentives for utilities to develop LED tariffs. What is needed to address these disincentives is a clear public policy mandate and an accompanying business model that works for utilities to offer and more actively promote LED street lighting.

A secondary reason utilities can be slow to invest in LED street lighting is that they can be penalized by regulators and/or customers for making investments in a new and unfamiliar technology if that technology does not perform as predicted. For example, if the utilities invest in LED street lights and they do not perform as expected, it could present a liability to the utility in the form of additional capital outlays to correct or replace malfunctioning street lights.[19] These additional costs could also lead to a finding that the utility investment in the technology was either not 100 percent economically used or useful (i.e. above market replacement cost) leading to some disallowed cost recovery and/or penalties for poor customer service. As LED technology continues to mature and prove itself, this particular impediment to utility adoption of LEDs has become less of a concern.

4.2.3 Customer-Owned (Municipally-Owned) Street Lights

Unlike municipalities with utility-owned street lights, municipalities that own their street lights are generally free to install any technology (e.g. LED) they would like and receive the full economic benefits of doing so. Under municipal ownership, the municipality is fully responsible for the purchase, operation, and maintenance of the street light and only pays the utility for the cost of energy to the street light. The municipalities may maintain the luminaires themselves or contract with a third-party or the utility for maintenance. Most municipalities in the region, however, do not own their street lights as municipal ownership of street lights is more common with large municipalities that have the resources to manage a street lighting system, while smaller municipalities tend to use utility-owned street lights. For this reason, most of the LED street lighting activity to date in the region has been with large municipalities.

[19] Inside Electric News. "*New LED Street Lights Fail in the Rain.*" (Describing the installation, removal, and reinstallation of 2,000 street lights in San Antonio to adjust a design flaw) Accessed 11/23/14. Available at: http://www.insideelectricnews.com/index.php/top-stories/manufacturers/5587-new-led-street-lights-fail-in-the-rain

4.2.4 Assessment of Utility-Owned LED Tariffs in the Region

Thirteen of the forty-five investor-owned utilities in the Northeast and Mid-Atlantic offer a utility-owned LED street light tariff.[20] The remaining utilities do not currently offer LED as an option. As a result, many municipalities cannot choose to install LED technology through a street light tariff.

However, a further challenge exists in that a portion of the 13 LED tariffs in the region provide little or no cost savings to municipalities compared to their existing street lighting rates. In some cases, the LED rate actually costs a municipality *more* than the less efficient and shorter-life high-pressure sodium rate municipalities are looking to replace. This is a critical issue because if a municipality does not receive adequate cost savings for converting to LED, an LED upgrade will not make economic sense.

How is this higher LED rate possible when cities across the region and country are cost-effectively replacing high pressure sodium street lighting with LEDs? The reason has to do with how some utility-owned street lighting tariffs are structured and the assumptions used within to calculate those rates. These structures and rates are examined below.

4.2.5 Examining Street Lighting Tariff Structures and Assumptions

A utility-owned LED street lighting rate is built from three components: the energy cost, the capital cost including the cost of the LED fixture, and the maintenance cost. The largest portion of the rate is the capital cost. All of these costs are bundled to a monthly charge that a municipality pays on their electric bill. Although LEDs reduce the energy and maintenance components of the rate, they increase the largest component of the rate: capital costs. Therefore, it is possible that the increased capital cost of the LED technology compared to other technologies can offset the energy and maintenance savings in the way that the rate tariff is designed, resulting in little or no cost savings to the municipality. Much depends on the assumptions used for reduced energy costs, potential maintenance savings, and the cost of the LED fixture. It is critical that the utility and regulators appropriately value the energy and maintenance savings while using up-to-date and competitive fixture cost assumptions to develop a rate that reflects the real potential for cost savings to municipalities.

4.2.6 Applied Tariff Structure Examination

As an example, one New York investor-owned utility developed a utility-owned LED rate in 2011 that is still in place today. This LED rate costs a municipality approximately 30 percent more than the comparable high pressure sodium rate. Research into the utility's assumptions revealed that the utility selected an LED street lighting fixture that provided 31 percent energy savings compared to high-pressure sodium with a fixture cost of $571. Research of recent case studies found that current comparable LED fixtures should provide 50-70 percent

[20] Public Service of New Hampshire and Connecticut Light and Power have LED tariffs pending publication and not included here. The PSNH tariff is based upon customer-contributed equipment, which becomes property of the utility once contributed. Additionally, Public Service Electric and Gas offers a flexible company-owned tariff that could be read to include LED technologies.

in energy savings with a fixture cost of between $113 and $350. If the utility revised their rate with current assumptions, the rate could be reduced from 30 percent more than the HPS rate to 10-15 percent lower than the HPS rate.

A comparison of high pressure sodium and LED rates for each utility in the region offering an LED rate is provided in Appendix A of this report.

4.2.7 Municipal Purchase of Street Lighting System from Utility

Due to the lack of LED rates or cost-savings provided by LED rates, many municipalities are looking to purchase their street lighting system from the utility so that it is no longer utility-owned. Whether this is a viable option varies by state and, in many cases, is at the discretion of the utility. In some states including Massachusetts, Rhode Island, and Maine, street lighting system purchases have been enabled by specific legislation that requires utilities to allow municipalities to purchase street lights and attain ownership. This has been an especially valuable tool in Massachusetts where more than 75 municipalities have purchased their street lights from the utility, and more than 37 of those have converted to LED. According to the Massachusetts Department of Energy Resources, LED conversion in 41 of Massachusetts municipalities has saved more than 28,885,287 kWh (almost 29 GWh) over a period of three years, resulting in over $7.6 million in efficiency program incentives.

4.3. Financial Barriers

Barrier: Access to and the cost of capital to purchase street lights from the utility and/or fund LED street light conversions is a significant barrier for municipalities. Further, municipalities that choose to purchase or convert utility-owned street lights before the street light asset has been fully depreciated will face additional capital costs.

A discussion of financial barriers slowing LED conversion requires examining: (1) common misconceptions regarding LED costs; (2) stranded assets associated with conversion; and (3) available sources of capital.

4.3.1 Common Misconceptions Regarding LED Costs

Two common misconceptions regarding LED costs can discourage prospective street light purchasers: (i) perceived high up-front costs; and (ii) the perceived ‘first-mover’ dilemma.

4.3.1.1 Perceived High Up-Front Cost of LED Technology

Decision-makers sometimes cite the cost of LED technology as the most significant roadblock toward prospective street light conversions. Yet, when examined on a life-cycle basis, reductions in energy usage and maintenance costs depict LED street light conversions as an attractive financial proposition even prior to the recent decline in LED cost. High quality LED

street lights are available from respected manufacturers for as little as $99.[21] Table 3 shows typical costs of an LED conversion based on recent case studies.

Table 3: Typical LED Street Light Retrofit Costs[22]

	Light Output					
	Low (<50W)		Medium (50W-100W)		High (>100W)	
Fixture Type	Min	Max	Min	Max	Min	Max
Decorative retrofit kit	$350	$615	$550	$950	$750	$1,450
Cobrahead fixture	$99	$225	$179	$451	$310	$720

4.3.1.2 Perceived First-Mover Dilemma

A utility or municipality may be hesitant to invest in LED street light conversions due to concerns about early adoption. These actors are cautious of a new technology's early cost-benefit ratio, which can be low until robust competition has a chance to decreases prices, improve energy savings, and improve overall product performance. This perceived first-mover dilemma can discourage or delay utility or municipal LED street light investments. However, when an analysis is performed that compares the operating cost savings of installing LED technology now to the product cost and energy cost savings if the technology is installed in the future, it is more economically beneficial to install the technology now. It will ultimately cost a municipality or utility more to wait. This is often referred to as the "cost-of-waiting".

Though economically it makes sense for municipalities and utilities to install LED technology right now, what further price reductions might we expect? A 2013 Department of Energy report notes that price reductions, which have followed a logarithmic curve, have begun to slow substantially and will be less significant than they have been in the past.[23] For example, Seattle City Light (SCL) in Seattle, Washington has been in the process of a phased LED street light replacement project since 2009. Each year, the cost of equivalent LED street lights has fallen significantly. Table 4 tracks the decline in cost of a 70 W LED cobrahead street light used by the city of Seattle, which replaced a 100 W HPS cobrahead fixture. In general, LED street light products are maturing with more competitive pricing for a range of product choices. While further product innovations and cost reductions are still possible, product costs today make LED replacements attractive investments - reducing the concern of missing out on future possible product improvements or cost reductions. More important now is the missed opportunity to reduce costs by re-lamping undepreciated legacy technologies with LED street lights.

[21] Reuters. *"Cree Introduces the Industry's First $99 LED Street Light as a Direct Replacement for Residential Street Lights,"* (August 2013) Accessed: 1/12/15. Available at: http://uk.reuters.com/article/2013/08/06/nc-cree-idUSnBw065147a+100+BSW20130806

[22] Supra, at note 9. Page 12.

[23] US Department of Energy Building Technologies Office: *"SSL Pricing and Efficacy Trend Analysis for Utility Program Planning."* (October 2013) Page 32. Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_trend-analysis_2013.pdf

Table 4: SCL Example of LED Street Light Cost Reduction over 4-Year Period[24]

LED Street Light Cost Reductions over 4-Year Period					
	2009	**2010**	**2011**	**2012**	**2013**
Seattle (Purchases of 2,000+ Units)	$369	$288	$239	$204	$179
Los Angeles	$432	$298	$285	$245	$141

4.3.2 Stranded Assets

Stranded asset costs are another obstacle in the shift to the widespread adoption of LED street lights. A stranded asset is an investment which seemed prudent at the time of purchase, but due to changing circumstances was unable to depreciate to the end of its useful life. In the context of LED street light conversions, conventional street lights installed within the last 20 years represent potential stranded assets because they may not be fully depreciated when municipalities seek to replace them with new LED technology. In the context of utility-owned equipment, most street lighting tariffs in our region require any municipality requesting technology conversion to compensate the utility for stranded asset costs related to the former luminaire. For most common types of street lights, this can amount to as much as $200 per fixture that must be paid to the utility before an existing street light can be replaced.

4.3.3 Capital Sources

Lack of capital or mechanisms for obtaining capital is another obstacle to municipal LED street light conversions. While many funding sources and mechanisms are available, not all are desirable and a municipality may not be aware of all available options. Municipalities can use funding sources such as bonds and operating budgets, as well as third-party funding sources such as tax exempt lease purchasing agreements, vendor financing, and energy savings performance contracts.

4.3.4 Municipal Bonds and Qualified Energy Conservation Bond Subsidies

Municipalities can self-fund an investment in LED street lights by issuing a bond. Bond issuances above a certain threshold (which varies by municipality) must be approved by voters and would require an information campaign to inform voters regarding the benefits of LED street lighting. One option for communities considering a bond issuance is the use of a Qualified Energy Conservation Bond (QECB).

A QECB is a type of taxable bond that can be issued by state, local, and tribal governments to finance energy conservation projects. QECBs are allocated to the states by the federal

[24] US DOE Energy Efficiency & Renewable Energy, "MSSLC: Shaping the Future of Street Lighting," Seattle Pricing Chart, Page 5. (September 2013) Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/brodrick_msslc-phoenix2013.pdf
Los Angeles numbers derived from 1/5/15 NEEP correspondence with Los Angeles Bureau of Street Lighting.

government according to population, with the expectation that each state will sub-allocate a portion of their QECBs to large local governments and municipalities (populations of 100,000 or more).[25] Federal subsidies for QECBs can reduce the bond's interest payment to below three percent, making them an attractive financing vehicle for municipally sponsored energy conservation projects.[26] QECBs can either be issued as direct payment bonds or tax credit bonds. Direct payment bonds offer the municipality a direct payment from the treasury to subsidize the bond interest, while tax credit bonds offer the bond holder a subsidy in the form of a tax credit.

A major barrier limiting the use of QECBs for small projects is the high transactions costs associated with their issuance.[27] No more than two percent of a bond's proceeds can be used to finance its cost of issuance.[28] Also, transaction costs may make small issuances harder to place with accredited investors. Nevertheless, some jurisdictions have been able to surmount the transaction cost barrier by pairing their issuances with other funds or bonds to buy down transaction costs covered by the issuance itself.[29]

QECBs have successfully been used by San Diego, CA and Richmond, CA to finance high efficiency street lighting projects.[30] In both instances, the QECBs were privately placed with a single qualified investor, and the transaction structured as a lease-purchase agreement where the investment is secured by investor-ownership of the lighting equipment until the debt is repaid.

4.3.5 Operating Budgets

Alternatively, a city with a large enough operating budget can fund the cost of a phased conversion through the energy and maintenance savings that result from a prior conversion phase. For example, the New York City Department of Transportation (NYCDOT) was able to use operational cost-savings resulting from a first phase of LED conversions to subsequently invest in additional LED street light conversions.[31]

[25] IRS Notice 2009-29. Qualified Energy Conservation Bond Allocations for 2009. Accessed: 1/12/15. Available at: http://www.irs.gov/pub/irs-drop/n-09-29.pdf
[26] Bellis, Elizabeth (et. al.). Energy Programs Consortium. *Qualified Energy Conservation Bonds (QECBs)*. Page 6. Accessed: 1/12/15. Available at: http://energy.gov/sites/prod/files/2014/06/f16/QECB_memo_12-13-13.pdf.
[27] *Id*.
[28] 26 USC 54A (e)(4)
[29] *Supra*, at note 25
[30] Lawrence Berkeley National Laboratory. *Using QECBs for Street Lighting Upgrades: Lighting the Way to Lower Energy Bills in San Diego*. (July 2012) Accessed: 1/12/15. Available at: http://energy.gov/sites/prod/files/2014/06/f16/street-lighting-qecb.pdf
[31] US Department of Energy. *New York: Self-Funding*. (Date Unknown). Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/financing_nyc-brief.pdf

4.3.6 Third-Party Funding Sources

An abundance of third-party funding sources are available for LED street lighting conversions. For example, tax exempt lease purchasing arrangements, vendor financing, energy savings performance contracts and global management performance contracts enable municipalities to obtain equipment without up-front capital, and instead pay for LED conversions over a period of time based on projected energy cost-savings. **A major access barrier for such financing options is that most third parties will not finance the retrofit of a small facility or number of lights.** For this reason, it is better for small municipalities to aggregate with other small municipalities for investment in street lighting conversion. Such aggregation methods have been successfully utilized in Iowa[32] and Massachusetts.[33] In some locales, utility efficiency program incentives are another source of third-party funding for LED street light conversions. For example, the city of Boston funded its LED street light conversion in part with NSTAR incentives of $0.20 for each kWh of energy saved annually. This provided approximately $142/luminaire or 26 percent of the project's costs.[34]

Metropolitan Area Planning Council Street Lighting Program

The Metropolitan Area Planning Council is a Massachusetts non-profit that guides municipalities through the LED street light conversions process, including street light buybacks, the energy performance contracting process, and Massachusetts' statewide procurement process.

[32] US Department of Energy, Building Technologies Program. *Iowa Municipalities Unite to Save Energy with LED Street Lighting*. (November 2012). Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/iowa-muni_brief.pdf
[33] Metropolitan Area Planning Council. LED Street Lighting. Accessed: 1/12/15. Available at: http://www.mapc.org/led-street-lighting
[34] US Department of Energy. *Boston: Grants and/or Rebates*. Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/financing_boston-brief.pdf

5. A Regional Strategy to Overcome Municipal Street Lighting Conversion Barriers

As communities continue to explore the adoption of LED street lights there is good news: here in the Northeast-Mid-Atlantic region viable solutions already exist to overcome the technical, regulatory, and financial barriers. For every barrier, there is at least one state, utility, municipality, or organization that has developed a creative solution to overcome that barrier. Appendix A provides an overview of what states are doing in this arena.

The news is encouraging but the reality is that these barriers will continue to impede broad adoption of cost-effective LED street lights without a concerted regional initiative to "champion" a regional conversion goal and connect stakeholders with solutions to achieve it. Such an effort should build on the success of US DOE's High Performance Outdoor Lighting Accelerator (HPOLA) and Municipal Solid-State Street Lighting Consortium (MSSLC) which address these issues on a national scale.[35] Selecting the Northeast-Mid-Atlantic region for such an effort makes sense given the high cost of electricity and state commitments to reduce carbon emissions through increased energy efficiency.

Recommended Regional Goal: 30% Conversion by 2020

To accelerate municipal LED street light conversions in the Northeast-Mid-Atlantic region, we recommend a regional initiative with the goal to convert 30 percent of the region's street lights to high efficiency LED by 2020. This would deliver more than 529,000 MWh energy savings annually, $114 million in cost savings, reduced light pollution, improved lighting quality, greater perceived security, and reduced carbon emissions. A strategy beginning in 2015 to achieve 30 percent conversion by 2020 could be accomplished with conversion commitments from 30 of the region's largest cities (population of 100,000+), plus conversion commitments from approximately 50 additional medium sized cities. While this goal is optimistic,[36] we believe it is achievable.[37]

To put this goal in perspective, Figure 1 compares US DOE's national LED street light penetration estimates and projections (i.e., the dark line) with the potential for increased penetration in the Northeast-Mid-Atlantic regional resulting from a coordinated regional

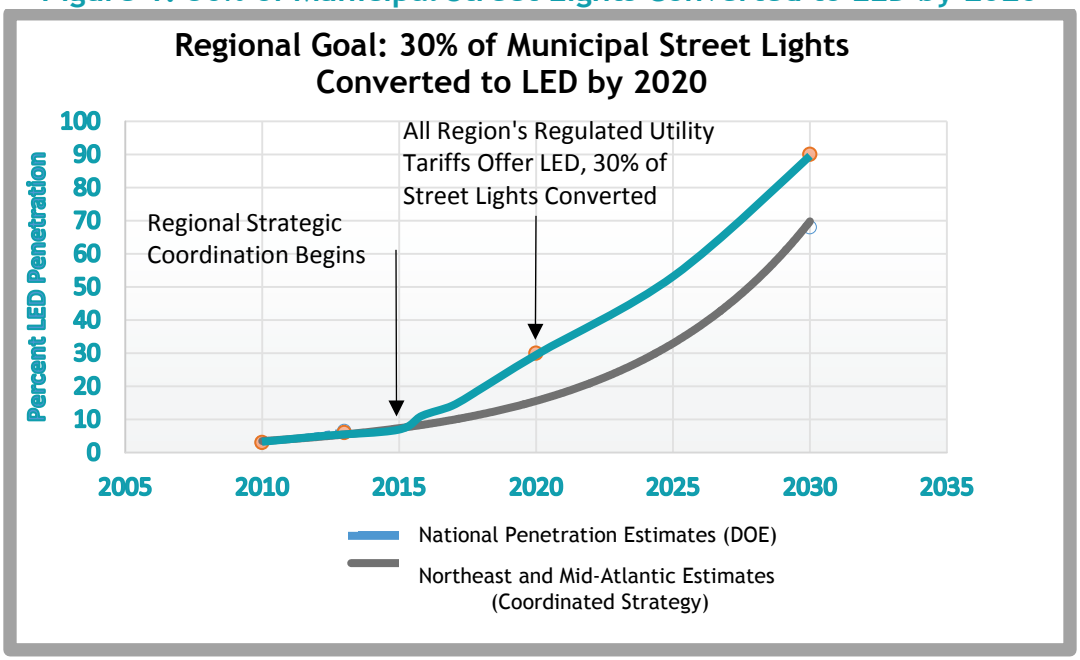
[35] The Department of Energy provides a trove of outreach materials through their MSSSLC and High Performance Street and Outdoor Lighting Accelerator. For example, the Department of Energy publishes a Model Specification for LED Roadway Luminaires V2.0 and Retrofit Financial Analysis Tool that can that can be used by municipalities to plan streetlight conversions. A regional strategy would leverage these—and other MSSSLC publications—in referring prospective participants to the High Performance Street and Outdoor Lighting Accelerator.

[36] US Department of Energy, Office of Energy Efficiency and Renewable Energy. *Solid State Lighting Research and Development: Multi-Year Program Plan. (*April 2014) Page 8, 13. (US DOE estimates 2013 area/roadway installed penetration at 7.1%, and projects 68% of all area, roadway, and highway lighting will be converted to LED by 2030) Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2014_web.pdf

[37] For example: There are approximately five million street lights in the region; therefore 30 percent of total inventories equates to roughly 1.5 million luminaires. If the region's 30 largest cities convert their lighting inventories to LED, they will have converted approximately one million luminaires; about 1/3 of these cities have already committed to conversion. If approximately 10 smaller cities within the region commit to conversion each year until 2020, the goal of 1.5 million luminaires will have been reached.

strategy (i.e., light blue line). As has been achieved in other market transformation efforts, we believe that achieving an installed penetration of 30 percent regionally will build a critical mass of momentum that will carry the region to achieve near complete conversion by 2030 compared to US DOE's national projection of 70 percent by 2030. For example, once tariffs and regulatory policies have been adopted by a state, they can be fully deployed across that state and provide an important model for other states to follow.

Figure 1: 30% of Municipal Street Lights Converted to LED by 2020

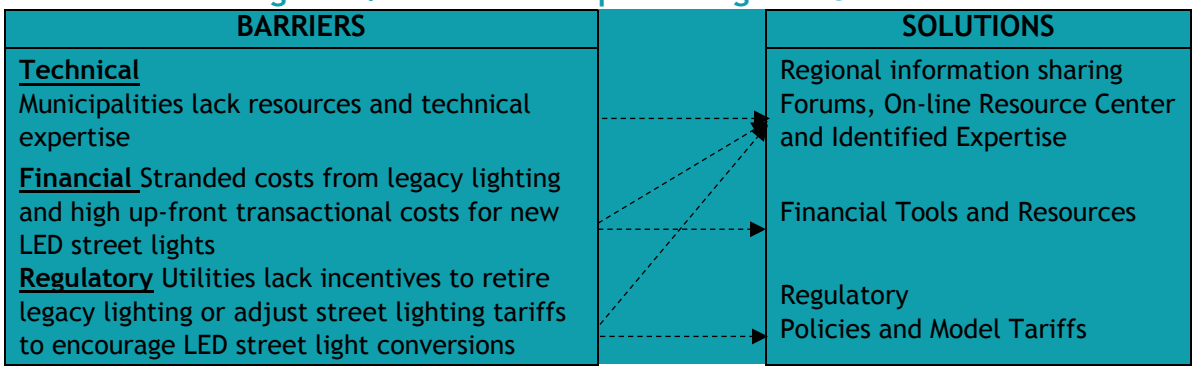


Recommended Regional Strategy: Identify Solutions, Engage Stakeholders/Recruit Participants, Track Progress

As articulated in section 4, the barriers to street light adoption are technical, regulatory, and financial. From a technical perspective, municipalities lack resources and expertise to understand and implement successful street lighting upgrade projects. From a regulatory perspective, utilities are slow to develop tariffs that offer LED or lighting controls and lack financial or regulatory incentives that would motivate them to do so. Financially, both utilities and municipalities are challenged by the high initial costs of LED technology and the stranded costs of legacy lighting that is replaced before it is depreciated. Solutions to address these barriers exist, and in some cases need further development.

Figure 2 Provides an Overview of Barriers and Proposed Regional Solutions.

Figure 2: Barriers & Proposed Regional Solution

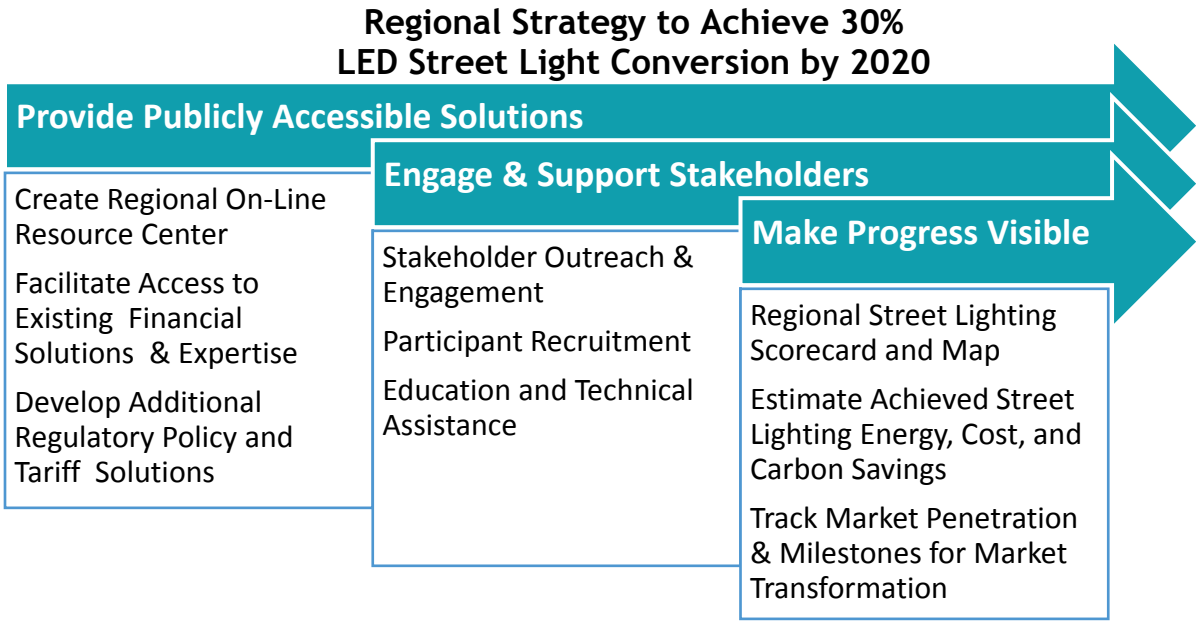


The need, opportunity and solutions exist across the region to overcome these barriers. In some cases additional solutions are needed (e.g., new regulatory policies and model tariffs). In all cases, solutions require supported dissemination and active stakeholder engagement to gain traction towards the regional goal.

Our recommended three-part strategy to achieve this includes:

1. Identify, develop and make available solutions to overcome the known barriers to high efficiency municipal street lighting;
2. Engage stakeholders and recruit and support states and municipalities to adopt these solutions to achieve municipal street light conversion goals; and
3. Track and communicate progress across the region toward the goal of 30 percent conversion by 2020.

Figure 3: Regional Strategy to Achieve 30% LED Street Light Conversion by 2020



Strategy Element 1: Provide Publicly Accessible Solutions

A primary element of the regional strategy is to transfer learning from across the region where states and municipalities have already overcome technical, regulatory, and financial barriers supplemented by the development of additional needed solutions – primarily targeted to financial, regulatory and tariff related barriers. Available solutions and related expertise should be made available through an on-line regional resource center with links to other relevant experience and resources available nationally (e.g., through US DOE efforts).

1. Create a Regional Online High Efficiency Street Lighting Resource Center

For nearly every adoption barrier, whether technical, financial, or regulatory, our research found that at least one state, utility, municipality, or organization in the region that has developed a creative solution to overcome it. However little of this information is disseminated beyond the local stakeholders that have implemented them. Connecting stakeholders across the region with these solutions is a high priority recommended strategy.

A major component of connecting stakeholders to these solutions is the development of a *Regional Online High Efficiency Street Lighting Resource Center* to convey best practices from across the region. With references and links to other relevant resources nationally, components of the *Online Resource Center* could include the following:

- Information about the Regional Goal, Initiative and Stakeholder Participation
- Regional Street Lighting News and Progress Updates
- Media and Communication Kits
- Case Studies and Exemplars of Successful Projects
- Links to Successful Utility Tariff Models
- Information on Successful Financing Methods
    - Bulk Purchasing Resources
    - Innovative Energy Services Models
    - Model Transactional Documents
        - Example RFQs and RFPs
- Links to all MSSLC and HPOLA Tools and Resources
    - Key Reports and Conversion Guidance Documents
    - Retrofit Analysis Tools
    - Model Specifications

2. Develop Regulatory Policies, Incentives & Tariffs to Encourage LED Street Light Conversions

Regulatory barriers and lack of LED and advanced controls tariff offerings remain among the largest hurdles to increased implementation of high efficiency street lighting. To overcome this we recommend that a team of experts be engaged through a stakeholder advised process to identify potential regulatory policies and tools that could encourage utilities to develop tariff offerings and support their municipal customers to implement upgrade projects at

scale. These constructs may include unique applications of cost trackers,[38] return on equity adders,[39] and non kWh based performance incentives and targets.[40] In developing these regulatory policies, tools and model tariffs, the team should engage key stakeholders including regulators and utilities as well as consumer advocates. If successful, adoption of such policies could financially motivate utilities to move forward with tariffs and encourage large-scale conversion – an outcome that could potentially convert the entire region in a few short years once the policies and tariffs are in place.

3. Facilitate Access to Financial Tools and Resources

Many municipal and utility stakeholders cite financial barriers as the largest hurdle to high efficiency street lighting conversion. While clearly advantageous on a lifecycle basis, initial costs of LED equipment are higher than incumbent technologies. Furthermore, costs stranded in legacy assets must be accounted for during conversion. This effort should seek to develop and/or leverage resources such as: (1) Utility Incentive Programs;[41] (2) Bulk Procurement Options;[42] and (3) Innovative Financing Models.[43] We recommend a stakeholder advised effort supported by experts to develop recommended guidance while leveraging existing financial tools and resources. Such development could be undertaken either as a regional effort as a task of an existing national effort (e.g., US DOE's MSSLC).

Strategy Element 2: Engage Stakeholders to Support Municipal LED Streetlight Conversions

Another key element of the regionally coordinated strategy is engaging key stakeholders to aid the development, review, dissemination, and implementation of recommended solutions

[38] Accelerating capital recovery for certain investments deemed as supporting the public good (e.g. streetlights) could help provide utilities with up-front capital necessary for conversion. This tactic is already used in several different venues including grid modernization efforts, advanced metering infrastructure, and emission control equipment. A similar strategy would allow utilities to earn an immediate return for construction work in progress within the realm of street lighting. This would enable utility bulk purchase of street lighting equipment in a manner that lowers purchasing costs through economies of scale.

[39] The Federal Energy Regulatory Commission provides incentives through the use of Return on Equity (ROE) adders. ROE adders increase the rate of return an investor would normally receive from ratepayers for investing their capital in a specific project or equipment. This market based incentive could potentially be applied in the field of street lighting by providing a slightly elevated return on investment for LED street lighting equipment.

[40] Weatherization goals are unique from typical efficiency program goals in that their performance targets are not based upon KWh saved, but rather number of homes weatherized. Borrowing from this field of utility incentives, a savvy incentive program could set annual goals for number of street lights converted and provide tiered performance incentives to a utility according to how far they surpass the baseline goal. Such incentives could be conditioned upon meeting traditional KWh-based program requirements.

[41] Drawing upon previous successes, the region's utilities and energy efficiency programs could be engaged to develop effective incentive offerings for street lighting conversions. For example, in Vermont regulators approved the use of energy efficiency incentives as a mechanism to buy-down a large portion of stranded costs associated with legacy street lighting systems. While not without controversy, this model eliminated much of the capital cost required of municipalities to convert street lights.

[42] Bulk procurement of LED street lighting equipment has become a popular tool for reducing conversion costs. Further, municipal aggregation presents the opportunity for smaller cities and towns to band together for purchase-price negotiation, as well as to explore other alternative procurement strategies.

[43] Lease-purchase agreements, municipal bonding options, infrastructure as a service, and other avenues are available for municipalities that own their street lights, or have an interest in their purchase. Further, innovative companies in the energy services field, such as Commons Energy, are incorporating the use of patient capital to complete projects in municipalities that previously had been unable to access to performance contracts.

to achieve the regional goal of 30 percent conversion by 2020. Stakeholder engagement can be accomplished through: (1) Outreach and Education; (2) Participant Recruitment; and (3) Connecting Participants with Technical Expertise. Such engagement should complement existing processes to engage communities to set and achieve energy efficiency, clean energy and carbon emission reduction goals.

1. Stakeholder Outreach and Engagement

A robust stakeholder outreach and engagement campaign is an essential tool to disseminate best practices to relevant regional actors. This campaign should leverage existing regional and national support networks to connect stakeholders and build productive working relationships, aligning policy, program, and market efforts toward advancement of high efficiency street lighting. Outreach to engage stakeholders should use multiple dissemination avenues, including social media, newsletter contributions, journal articles, and presentations at relevant conferences or events targeting community, state, and utility stakeholders.

Such a campaign should leverage the collective experiences of a regional working group to facilitate knowledge transfers, identify best practices, and scale up through combined efforts until regional street lighting inventories have reached a transformation tipping point of approximately 30 percent installed LED capacity.[44] To fulfill this purpose, the working group should communicate via monthly or bi-monthly calls, quarterly webinars, and annual in-person meetings. All webinars should be recorded and archived for dissemination via the Online Resource Center. Working group members should be representative of all actors in the conversion process, including state energy offices, municipal officials, energy advocates, regulators, utilities, and key national stakeholders such as DOE. The working group could use subgroups, or "leadership advisory committees", assisted by expert consultants to develop specific technical, regulatory, and fiscal solutions to overcome regulatory and financial barriers.

2. Targeted Participant Recruitment

In addition to the generalized outreach and education facilitated by the stakeholder group, the regionally coordinated strategy should target participant recruitment to reach a high efficiency lighting penetration rate of 30 percent by 2020.[45] Major street lighting stakeholders such as state departments of transportation and large municipalities can deliver opportunities to convert large inventories through a single point of contact. Likewise, those communities that have already demonstrated an interest in energy conservation or carbon

[44] To ensure widespread dissemination of best practices through municipal point-of-contact engagement, the working group should forge strategic alliances to facilitate member presentations at regional conferences, workshops, and events. The working group should align themselves with initiatives like the Department of Energy's High Performance Outdoor Lighting Accelerator (HPOLA), and regional members of membership groups like the Municipal Solid-State Street Lighting Consortium (MSSLC). It may work with groups such as the National Association of State Utility Consumer Advocates (NASUCA), the National Association of Regulatory Utility Commissioners (NARUC), and the National Association of State Energy Officials (NASEO).

[45] In this context, "Participants" are stakeholders that commit to converting their street lighting inventory and may or may not be part of the working group.

reduction strategies should also be targeted for recruitment.[46]

In the same way that communities currently engaged in energy conservation strategies could be targeted for street lighting outreach, street lighting conversion could be used as the cornerstone of a broader energy conservation strategy. Street lighting is one of the most visible opportunities for energy efficiency in any community. Often when a street lighting conversion takes place, news outlets document the conversion, elected officials hold press conferences, and the public is asked to provide input. A regionally-supported, community-based initiative could leverage the high visibility of street lighting to connect communities to other energy conservation strategies, including DOE resources such as the Better Buildings Initiative and Accelerators.

3. Technical Assistance and Education

In addition to technical assistance provided through the Regional Online Street Lighting Resource Center, the regional stakeholder working group could connect interested participants with local regulatory, technical, and financial expertise through a comprehensive stakeholder network. Further, the initiative can facilitate knowledge transfer by subject matter experts through webinars, presentations, peer exchanges, and case studies recorded and archived within the Regional Online Street Lighting Resource Center.

Strategy Element 3: Track, Measure and Make Progress towards Goals Visible

Tracking and measurement of progress toward the goal of 30 percent conversion by 2020 can support effective implementation of the regional strategy using tools such as: (1) a Regional Street Lighting Scorecard and Map; (2) Quantification of Street Lighting Energy, Cost, and Carbon Savings Estimates; and (3) Verification and Adjustment of LED Penetration Projections. These progress trackers could be disseminated to media outlets as well as provided to policymakers and other stakeholders to support achievement of the 2020 and long-term market transformation goals.

1. A Regional Street Lighting Scorecard and Map

To highlight the region's progress toward high efficiency street lighting, the online resource center could host and maintain a regional map focused on high efficiency street lighting to track: (1) Jurisdictions that have converted their inventories/committed to conversion; (2) Jurisdictions that have enacted laws enabling LED conversion; and (3) Utilities offering LED tariffs. To supplement the street lighting map, the initiative could produce an annual scorecard identifying champions amongst municipalities, regulators, energy offices, and utilities.

[46] Most importantly, the working group may identify stakeholders through regional and state-level groups such as State Energy Offices, Energy and Climate Action Groups, local municipal associations, and the Conference of Mayors. One potential avenue for recruitment might be through membership associations, such as the Urban Sustainability Director's Network.

2. Street Lighting Conversion Energy, Cost, and Carbon Savings Estimates

Quantifying the benefits of completed LED conversions will buttress arguments in favor of conversion for those municipalities considering high efficiency street lighting. While case studies provided by the DOE and MSSLC are an excellent resource in this respect, communities would benefit from knowledge of what their neighbors have saved, as well as cumulative savings within the region. Energy savings, cost savings, and carbon emission reductions from within the region should be identified for every participant completing a conversion and documented through case studies, as well as via a dashboard within the resource center.

3. LED Penetration Projections and Key Performance Indicators

This report projects that the region can achieve 30 percent conversion to high efficiency street lighting by 2020. While initial progress may be slow, we project that momentum for street lighting conversion will grow rapidly over the next five years. The penetration curve in Figure 1 and its associated projections will serve as a guidepost against which to measure progress, helping to determine the most efficient allocation of resources to achieve the regional goal.

In addition, the regional initiative should track progress by key performance indicators that relate to indicators of success relative to the 2020 goal and long-term market transformation such as those indicated below.

Key Performance Indicators Towards 30% Goal by 2020	
Strategy 1: Provide Publicly Accessible Solutions	1. Online Regional Resource Center is widely used and referenced by regional stakeholders to support streetlight conversions. 2. State regulators, utilities and consumer advocates adopt and use recommended regulatory policies, tools and model LED street light tariffs. 3. States and municipalities adopt and use financial solutions and resources to make undertake conversion to LED streetlights.
Strategy 2: Stakeholder Outreach and Engagement	1. 30 major and 50 medium-size municipalities adopt LED streetlight conversion goals and undertake programs to make significant progress by 2020. 2. Utilities propose and regulators adopt policies and tariffs that support accelerated municipal conversion to LED street lighting. 3. Municipalities participate in coordinated bulk procurement of LED street lights.
Strategy 3: Track and Make Progress Visible	1. Media outlets and stakeholders (e.g., state agencies, clean energy advocates) reference the Regional Street Lighting Conversion Map, Scorecard recognize or support LED street light conversion programs. 2. States and municipalities are publicly recognized for their commitments and progress to accelerate LED street light conversions.

Appendix A: State Analyses

There are 45 investor-owned utilities in the region, representing the vast majority of the street light conversion opportunities. 13 of these investor-owned utilities offer a utility-owned LED tariff. (Table A1)

Table A1: Northeast and Mid-Atlantic Investor-Owned Utilities Tariff Offerings

Investor-Owned Utilities and Utility-Owned LED Tariff Offerings			
State	**Investor Owned Utility**	**% State's Residential Customers**	**Utility-Owned LED Tariff**
CT	Connecticut Light & Power	75%	Pending
CT	United Illuminating	17%	Yes
DC	PEPCO	100%	No
DE	Delmarva Power	66%	Yes
MA	Massachusetts Electric Co. (National Grid)	43%	Yes
MA	NSTAR	34%	No
MA	Western Massachusetts Electric Co	7%	No
MA	Nantucket Electric Co	1%	No
MA	Fitchburg Gas and Electric	1%	Yes
MD	Baltimore Gas and Electric	47%	Yes
MD	Potomac Electric Power Co	21%	No
MD	Potomac Edison Co	11%	Yes
MD	Delmarva Power	9%	No
ME	Central Maine Power	77%	Yes
ME	Bangor Hydroelectric Co.	15%	No
ME	Maine Public Service Co.	4%	No
NH	Public Service of New Hampshire	70%	Pending
NH	Unitil	11%	No
NH	Liberty Utilities	6%	No
NJ	Public Service Electric and Gas	56%	No
NJ	Jersey Central Power and Light	27%	No
NJ	Atlantic City Electric Co.	14%	Yes
NJ	Rockland Electric Co.	2%	Yes
NY	Consolidated Edison	40%	No
NY	Niagara Mohawk Power Co.	20%	No
NY	Public Service Electric and Gas- Long Island	18%	No
NY	New York State Electric and Gas	10%	No
NY	Central Hudson Gas and Electric	4%	No
NY	Rochester Gas and Electric Co.	4%	No
NY	Orange and Rockland	2%	Yes
NY	Pennsylvania Electric Co	~0%	No
PA	Potomac Edison Co	27%	No
PA	PPL Electric	20%	No
PA	Western Pennsylvania Power Co.	14%	No
PA	Metropolitan Edison	10%	No

Investor-Owned Utilities and Utility-Owned LED Tariff Offerings			
State	**Investor Owned Utility**	**% State's Residential Customers**	**Utility-Owned LED Tariff**
PA	Pennsylvania Electric Co	10%	No
PA	Duquesne Light and Power	9%	Yes
PA	Pennsylvania Power co	3%	No
PA	UGI Utilities	1%	No
PA	Pike County Power Co.	~0%	Yes
PA	Citizens Electric	~0%	No
RI	Narragansett Electric Co. (National Grid)	99%	No
RI	Block Island Power Co.	~0%	No
VT	Green Mountain Power	39%	Yes
VT	Central Vermont Public Service (Legacy)	34%	Yes

Almost every state has legislatively enabled energy performance contracting, and some states encourage utilities to offer street lighting equipment for sale to interested purchasers. The region is also home to over 50 participants in the Department of Energy's MSSSLC, including two utility commissions, nine utilities, and 35 municipalities. (Table A2)

Table A2: Northeast and Mid-Atlantic MSSSLC Participants

Northeast and Mid-Atlantic MSSSLC Participants		
State	**Participant**	**Type**
CT	Northeast Utilities (CL&P)	Utility
CT	United Illuminating	Utility
CT	Groton Utilities	Utility
CT	City of Hartford	Municipality
CT	Town of Madison	Municipality
CT	Town of Manchester	Municipality
DC	District of Columbia DOT	Municipality
DC	Pepco	Utility
DC	Demonstration of Energy Efficient Developments (DEED)	Other
DC	US Air Force, Secretary of Air Force for Energy	Other
DE	City of Lewes	Municipality
MA	National Grid	Utility
MA	City of Holyoke Gas and Electric Department	Utility
MA	SELCO - Shrewsbury Electric	Utility
MA	Massachusetts Department of Energy Resources	Other
MA	Cambridge Community Development Dept	Other
MA	City of Boston	Municipality
MA	City of Woburn	Municipality
MA	Town of Acton	Municipality
MA	Town of Barnstable	Municipality
MA	Town of Easton	Municipality
MA	Town of Medfield	Municipality
MD	Maryland Department of the Environment	Other
ME	City of South Portland	Municipality

Northeast and Mid-Atlantic MSSSLC Participants		
State	**Participant**	**Type**
ME	City of Westbrook	Municipality
NH	New Hampshire Department of Transportation	Other
NH	City of Keene	Municipality
NH	Hollis Department of Public Works	Municipality
NJ	New Jersey Board of Public Utilities	Other
NJ	Township of Jackson	Municipality
NY	New York State Department of Public Service	Other
NY	Port Authority of NJ and NY	Other
NY	New York City Department of Transportation	Other
NY	Orange and Rockland	Utility
NY	Village of Sherburne Electric Light Department	Utility
NY	City of Corning	Municipality
NY	City of New Rochelle	Municipality
NY	City of Rochester	Municipality
NY	City of Schenectady Energy Advisory Board	Municipality
NY	Town of Amherst	Municipality
NY	Village of Croton-on-Hudson	Municipality
NY	Village of Great Neck Plaza	Municipality
NY	Town of Amherst	Municipality
NY	Village of Southampton	Municipality
PA	Delaware Valley Regional Planning Commission	Other
PA	City of Philadelphia	Municipality
PA	Borough of Ellwood City	Municipality
PA	Borough of St Lawrence	Municipality
PA	City of Sunbury	Municipality
PA	City of York	Municipality
PA	Lower Merion Township	Municipality
PA	Milford Township	Municipality
PA	Springfield Township	Municipality
PA	Whitehall Township	Municipality
RI	US Naval Undersea Warfare Center	Other
RI	Town of Barrington	Municipality
VT	Burlington Electric Department	Utility

A. Connecticut

Connecticut Street Light Summary	
Number of Street Lights:	312,140
Percent Region's Total Street Lights:	6 percent
Annual Street light Energy Usage:	192 GWh
Annual Potential Energy Savings:	96 GWh
Annual Potential Energy-Cost Savings:	$12.6 Million
Annual Potential Maintenance Cost-Savings:	$15.6 Million
LED Conversion Installed Costs:	$87.7 Million
Annual Potential Lighting Controls Energy Savings:	8.6 GWh
Annual Potential Lighting Controls Cost Savings:	$1.04 Million
Lighting Controls Installed Cost:	$9.36 Million

1. Tariff Status

United Illuminating, which carries roughly 17 percent of the state's street light opportunities offers a utility-owned LED street light rate. (Table A3) Connecticut Light and Power (CL&P), which carries roughly 75 percent of the state's street light opportunities, does not currently offer a utility-owned tariff, but evidence indicates that a pending rate case includes an LED tariff.[47]

2. Legislative Background

As mentioned in the body of this assessment, some states have enacted legislation requiring a utility to sell their street lighting equipment to an interested municipality. While Connecticut has not enacted such legislation, a 2005 Public Utility Commission decision directs CL&P (the state's largest utility) to make the purchase of street lighting equipment available to interested municipalities.[48] Such purchase can be staggered over a five year period. Also, Connecticut has a legislatively enabled energy savings performance contracting program for municipalities.[49]

[47] State of Connecticut Public Utilities Regulatory Authority. Docket No. 14-05-06. PFT of Kenneth B. Bowes. (June 9, 2014) Accessed 1/12/15. Available at: http://nuwnotes1.nu.com/apps/financial/nuinvest.nsf/0/05212330CECC6D8985257CF300521543/$FILE/201420CLpercent20CL&P20rate%20casepercent20ratepercent20case--distribution20resiliency%20testimonypercent20resiliencypercent20testimony.pdf

[48] Connecticut Department of Public Utility Control. Docket No. 04-01-01. DPUC Investigation in the Connecticut Light and Power Company's Street light Asset Plant Values, Accounting Practices, and Rates. (June 2005). Accessed: 1/12/15. Available at: http://www.dpuc.state.ct.us/FINALDEC.NSF/0d1e102026cb64d98525644800691cfe/781f166b5751fefd85257030006f45d2/$FILE/040101-063005.doc

[49] Public Act 11-80, Section 123. Connecticut Statutes on Energy-Savings Performance Contracting for State Agencies and Municipalities. Accessed: 1/12/15. Available at: http://www.ct.gov/deep/lib/deep/energy/lbe/CT_Enabling_Legislation.pdf

3. Notable Projects

A simple search revealed six jurisdictions have converted, are pending conversion, or have an interest in converting to LED street lights. These jurisdictions include Middletown, East Hartford, Plainville, New Haven, Stamford, and Pawcatuck. (Table A4)

4. Connecticut Street Light Request for Qualifications

Connecticut is unique in the region because the Connecticut Conference of Municipalities recently issued a Request for Qualifications (RFQ) regarding street light LED retrofit, management, and maintenance services.[50] The RFQ states that most Connecticut municipalities do not own their street lights and solicits assistance for towns who wish to purchase their street lights from CL&P.

This solicitation is important because it potentially offers municipalities the option to achieve efficiencies during the exchange with CL&P, standing as one voice and utilizing a centralized bargaining ambassador who likely will have a technical expertise that municipal representatives themselves do not possess. It also offers easily accessible economies of scale to municipalities who might participate in a volume purchasing agreement to procure equipment or maintenance and management services. Organizations like the Connecticut Conference of Municipalities exist in every state in the region. This is likely a widely replicable model that deserves close attention.

Table A3: United Illuminating HPS/ LED Rate Comparison

United Illuminating (Connecticut)[51]				
HPS Rate		**LED Rate**		
Lumen Rating	Annual Rate Per Light	LED Equivalent Lumen Rating	Fixture Wattage	Annual Rate Per Light
4,000	$85.06	3000 (50 W HPS Equivalent)	20	$99.74
5,800	$97.36	3300 (70 W HPS Equivalent)	43	$99.74
9,500	$129.50	5300 (100 W HPS Equivalent)	67	$155.12
16,000	$160.74	8400 (150 W HPS Equivalent)	106	$245.64
27,500	$208.37	10,500 (250 W HPS/MH Equivalent)	130	$265.37
50,000	$271.01	15,500 (400W HPS/MH Equivalent)	196	$398.25

[50] Connecticut Conference of Municipalities. RFQ#52014: Street light LED Retrofit, Management, & Maintenance Services. Accessed: 1/12/15. Available at: http://programs.ccm-ct.org/Resources.ashx?id=77b6c587-fada-4e9e-8e01-fb7916ce7a6c

[51] United Illuminating Rate Schedule. Accessed: 1/12/15. Available at: http://www.uinet.com/wps/wcm/connect/e1c9170040d8535ca7b9bfd2ce51850f/UI+Tariffs+Effective+January+1,+2011+(clean).pdf?MOD=AJPERES&CACHEID=e1c9170040d8535ca7b9bfd2ce51850f

Table A4: Notable Conversion Projects (Connecticut)

Connecticut LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
East Hartford	July 2014	Contemplating ESPC to convert 5,000 Street lights to LED [52]
Pawcatuck	February 2014	Replacing downtown street lights with LEDs to prevent vandalism [53]
Plainville	December 2013	Contemplating a No-Interest Loan from CL&P to convert 1,400 Street lights to LED[54]
Middletown	August 2013	Contemplating 5,000 light purchase, transition expired lights to LED[55]
New Haven	December 2012	2,000 of 10,300 total Street lights converting to LED [56]
Stamford	2008	LED Pilot program, replacing decorative street lights [57]

[52] Munoz, Hilda. Hartford Courant. "*Council Postpones Vote on LED Street light Contract.*" (July 2014) Accessed: 1/12/15. Available at: http://articles.courant.com/2014-07-16/community/hc-east-hartford-lights-0716-20140716_1_council-postpones-vote-new-lights-town-council

[53] Rovetti, Leslie. The Westerly Sun. "*Downtown Pawcatuck Light Poles Get New Covers and LEDs.*" (February 2014) Accessed: 1/12/15. Available at: http://www.thewesterlysun.com/news/latestnews/3607156-129/downtown-pawcatuck-light-poles-to-get-new-covers-and-leds.html

[54]Leukhardt, Bill. Hartford Courant. "*Plainville Gets Serious About New Electricity-Saving Street lights.*" (December 2013) Accessed: 1/12/15. Available at: http://articles.courant.com/2013-12-04/community/hc-plainville-led-lights-1205-20131204_1_no-interest-loans-led-lights-town-council

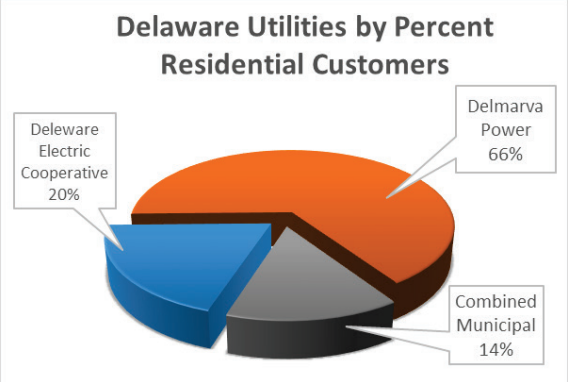
[55]Gecan, Alex. Middletown Press. "*Mayor Wants City to Buy Street Lights from CL&P.*" (discussing Middletown's prospective purchase of 5,000+ street lights and possible LED conversion) (August 2013) Accessed 1/12/15. Available at: http://www.middletownpress.com/20130813/mayor-wants-city-to-buy-street-lights-from-clp-for-115m-video

[56] MacMillan, Thomas. New Haven Independent. "2,000 Street lights on the Way." (December 2012) Accessed: 1/12/15. Available at: http://www.newhavenindependent.org/index.php/archives/entry/led_street lights_on_the_way/

[57] McKenna, Erin. Connecticut Department of Energy and Environmental Protection Press Release. "Governor Rell Honors Seven Connecticut Leaders for Innovative Efforts to Address Climate Change." (2008). Accessed 1/12/15. Available at: http://www.ct.gov/deep/cwp/view.asp?A=2711&Q=416204

B. Delaware

Delaware Street Light Summary	
Number of Street Lights:	77,941
Percent Region's Total Street Lights:	2 percent
Annual Street light Energy Usage:	48 GWh
Annual Potential Energy Savings:	24 GWh
Annual Potential Energy-Cost Savings:	$2.16 Million
Annual Potential Maintenance Cost-Savings:	$3.9 Million
LED Conversion Installed Costs:	$21.9 Million
Annual Potential Lighting Controls Energy Savings:	2.2 GWh
Annual Potential Lighting Controls Cost Savings:	$194,000
Lighting Controls Installed Cost:	$2.3 Million



1. Tariff Status

Delmarva Power, which is responsible for approximately two-thirds of Delaware's street lights, offers a utility-owned LED tariff containing a luminaire charge that is slightly higher than a comparable HPS. (Table A5) Delmarva's-customer owned tariff also explicitly provides an LED rate.

2. Legislative Background

Delaware has legislatively enabled an energy savings performance contracting program for municipalities and any municipality who owns their street lights could enter into a contract with an energy services company for LED conversion.[58] There is no record of legislation designed to encourage the municipal purchase of a utility-owned street lights.

3. Notable Projects

A simple search revealed no records of major street lighting projects in Delaware.

[58] 29 Del Laws § 6971

Table A5: Delmarva Power HPS/LED Rate Comparison

Delmarva Power (Delaware)[59]						
HPS Rate				LED Rate		
Lumen Rating	Watts (Nominal)	Annual Rate Per Light	Estimated Monthly Avg. kWh	Watts (HPS Equivalent)	Estimated Monthly Avg. kWh	Annual Rate Per Light
4,000	50W	$80.76	21	50W	8	$111.12
5,800	70W	$91.44	36	70W	15	$109.8
9,500	100W	$96.48	49	100W	19	$111.36
16,000	150W	$106.92	69	150W	30	$128.28
25,000	250W	$165.24	109	250W	38	$149.76
50,000	4000W	$195.36	164			

[59] Delmarva Power Electric Tariff. Accessed: 9/13/14. Available at: http://www.delmarva.com/uploadedFiles/wwwdelmarvacom/Content/Page_Content/My_Business/Master20tariff%20eff%2007percent20tariffpercent20effpercent2007-1-201420filed%2007percent20filedpercent2007-08-14.pdf

C. District of Columbia

District of Columbia Street Light Summary	
Number of Street Lights:	71,000
Percent Region's Total Street Lights:	1 percent
Annual Street light Energy Usage:	43.6 GWh
Annual Potential Energy Savings:	21.8 GWh
Annual Potential Energy-Cost Savings:	$1.7 Million
Annual Potential Maintenance Cost-Savings:	$ 3.55Million
LED Conversion Installed Costs:	$20 Million
Annual Potential Lighting Controls Energy Savings:	2 GWh
Annual Potential Lighting Controls Cost Savings:	$157,194
Lighting Controls Installed Cost:	$2.13 Million

1. Tariff Status

The District of Columbia is unique in the region because it faces no tariff-based barriers to implementing an LED conversion project. PEPCO is the only distribution utility in the District of Columbia, and its customer-owned tariff makes no mention of luminaire type. Therefore, LED luminaries would be permitted within the District of Columbia under the current tariff. The District Department of Public Works also publishes a GIS map containing the location of every street light.[60] This is a clear best practice which would streamline the conversion process in Washington D.C.

2. Legislative Background

The District has legislatively enabled energy performance contracting for municipalities.[61] A tariff for utility-owned equipment was not available. It is possible that all street lights in the District are customer-owned.

3. Notable Projects

A simple search revealed several LED initiatives including the Washington Metropolitan Transit Authority's 13,000 fixture parking garage replacement project, a 1,360 fixture project in 2012, a completed alley light conversion project, and an ongoing controversy over a contract for the Street Light Asset Management Program, which will convert 32,500 street lights over a period of two years. (Table A6) Also noteworthy is a Howard University study on street light conversions, focused on the District of Columbia.

[60] District of Columbia. Office of the City Administrator. Street Light GIS Map. Accessed 1/12/14. Available at: http://data.octo.dc.gov/Metadata.aspx?id=435
[61] D.C. Code § 8-1778.01

Table A6: Notable Conversion Projects (District of Columbia)

District of Columbia LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
District of Columbia	June 2014	Ongoing controversy regarding contract awards for Street light Asset Management Program to convert 32,500 street lights over a period of two years.[62]
WMTA	November 2013	WMTA replacing 13,000 parking garage fixtures to promote safety and efficiency[63]
District of Columbia	May 2012	DDOT teamed with Howard University for LED study,[64] then replaced 1,360 Alley Lights[65]

[62] District Department of Transportation Powerpoint. Accessed: 8/23/14. Available at: http://www.mwcog.org/uploads/committee-documents/aV1aW1hc20130918152241.pdf
[63] Washington Metropolitan Transit Authority (WMATA). Press Release. Metro to Overhaul Parking Garage Lighting for Safety, Efficiency. (November 2013) Accessed: 8/23/14. Available at: http://www.wmata.com/about_metro/news/PressReleaseDetail.cfm?ReleaseID=5613
[64] Arhin, Stephen (et.al.). Howard University Transportation Research Center. *"LED Energy Efficient Street Light Pilot Study."* Accessed: 8/23/14. Available at: http://www.scribd.com/doc/150596127/FINAL-EVALUATION-REPORT-LED-Energy-Efficient-Street light-Pilot-Study
[65] Reuters. *"Lighting Science Group Lights Up Washington D.C. With Ultra-Efficient LED Street Lights."* Accessed: 8/23/14. Available at: http://www.reuters.com/article/2012/05/14/idUS190060+14-May-2012+PRN20120514

D. Maine

Maine Street Light Summary	
Number of Street Lights:	65,887
Percent Region's Total Street Lights:	1%
Annual Street light Energy Usage:	40.5 GWh
Annual Potential Energy Savings:	20.3 GWh
Annual Potential Energy-Cost Savings:	$2.2 Million
Annual Potential Maintenance Cost-Savings:	$3.3 Million
LED Conversion Installed Costs:	$18.5 Million
Annual Potential Lighting Controls Energy Savings:	1.8 GWh
Annual Potential Lighting Controls Cost Savings:	$182,341
Lighting Controls Installed Cost:	$2 Million

1. Tariff Status

Maine's three investor-owned utilities account for approximately 95 percent of the state's street light opportunities, with a single utility—Central Maine Power Co—accounting for 77 percent of the opportunities. Central Maine Power Co offers a single utility-owned 50 Watt LED option within its street lighting tariff. (Table A7)

2. Legislative Background

Maine has legislatively enabled energy savings performance contracting for municipalities.[66] The state also recently passed a law requiring utilities to sell their utility-owned street lights to any municipality requesting a purchase.[67]

3. Notable Projects

A simple search revealed seven completed or pending LED conversion projects, including the jurisdictions of Kennebunk, Saco, Lewiston, Bangor, Brunswick Landing, and 105 light towers on I-295. (Table A8)

[66] 5 M.R.S.A. § 1770
[67] 35-A M.R.S.A. § 2518(6)

Table A7: Central Maine Power HPS/LED Rate Comparison

Central Maine Power (Maine)[68]							
HPS Rate				LED Rate			
Lumen Rating	Watts (Nominal)	Input Watts	Annual Rate Per Light	Lumens Rating	Watts (Nominal)	Input Watts	Annual Rate Per Light
3,600	50W	65	$131.88	4190	50	50	$248.64
5,670	70W	95	$130.68				
8,550	100W	130	$140.04				
14,400	150W	195	$166.32				
25,600	250W	300	$228.96				
45,000	400W	465	$290.76				

Table A8: Notable Conversion Projects (Maine)

Maine LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Lewiston	March 2014	Request for quotation for purchase of 120 LED Street lights[69]
I-295	June 2012	Retrofitting 105 high mast light towers on I-295[70]
Brunswick Landing	May 2012	Energy performance contract to replace parking lot lights and street lights[71]
Saco	February 2012	$71,000 of decorative retrofits for downtown [72]
Fort Fairfield	June 2011	Converted 174 Street lights to LED[73]
Kennebunk	June 2011	Retrofit of 50 Antique Lampposts[74]
Bangor	June 2009	Converted 300 downtown street lights to LED[75]

[68] Central Maine Power Schedule SL. Accessed: 1/12/15. Available at: http://www.cmpco.com/MediaLibrary/3/6/Content20Managementpercent20Management/Suppliers20And%20Partnerspercent20Andpercent20Partners/PDFs20and%20Docpercent20andpercent20Doc/sl.pdf
[69] City of Lewiston Purchasing Department. Request for Quotation. (March 2014) Accessed: 1/12/15. Available at: http://www.lewistonmaine.gov/DocumentCenter/View/4185
[70] LEDs Magazine. "*LED Modules Bring Energy Savings to High Mast Outdoor Lighting.*" (June 2012) Accessed: 1/12/15. Available at: http://www.ledsmagazine.com/articles/print/volume-9/issue-6/features/led-modules-bring-energy-savings-to-high-mast-outdoor-lighting-magazine.html
[71] Green Energy Maine. "*LED Street Lighting to Save Brunswick Landing $11k Per Year.*" (May 2012) Accessed: 1/12/15. Available at: http://greenenergymaine.com/blog/efficiency-conservation-posts/led-street-lighting-save-brunswick-landing-11k-year
[72] The Pepperrell Post. "*LED Lighting Conversions for Street Lights on Main Street.*" (February 2011) Accessed: 1/12/15. Available at: http://www.sacomaine.org/news/pparchives/1102-led.shtml
[73] Galm, Chris. US Department of Energy. "Maine Community Seeing Things in a New Light. (June 2011). Accessed: 1/12/15. Available at: http://energy.gov/articles/maine-community-seeing-things-new-light
[74] Atkinson, William. Public Power Magazine. "*LED Street Lighting: Worth the Investment?*" (July 2011) Accessed: 1/12/15. Available at: http://www.publicpower.org/Media/magazine/ArticleDetail.cfm?ItemNumber=32308
[75] Russel, Eric. Bangor Daily News. "*Bangor Street lights to be LED.*" (June 2009) Accessed: 1/12/15. Available at: http://bangordailynews.com/2009/06/24/news/bangor/some-bangor-street lights-to-be-led/

E. Maryland

Maryland Street Light Summary	
Number of Street Lights:	527,238
Percent Region's Total Street Lights:	10 percent
Annual Street light Energy Usage:	324.3 GWh
Annual Potential Energy Savings:	162.1 GWh
Annual Potential Energy-Cost Savings:	$9.7 Million
Annual Potential Maintenance Cost-Savings:	$26.4 Million
LED Conversion Installed Costs:	$148.2 Million
Annual Potential Lighting Controls Energy Savings:	14.6 GWh
Annual Potential Lighting Controls Cost Savings:	$875, 478
Lighting Controls Installed Cost:	$15.8 Million

1. Tariff Status

Two Maryland utilities, Potomac Edison and Baltimore Gas and Electric (BGE), offer utility-owned LED street light tariffs. These tariffs reach more than 55 percent of the state's street lighting inventory and each offer significant savings over similar high pressure sodium lighting options (Table A9 and Table A10)

2. Legislative Background

Maryland has legislatively enabled energy savings performance contracting.[76] The legislature also passed a 2007 law that required utilities to sell their streets lights to interested municipal purchasers.[77] Some ambiguities remain surrounding the buyback process,[78] but BGE—the state's largest utility—explicitly provides for street light buybacks within their tariff.

[76] Article 12, §301, Annotated Code of Maryland.
[77] Maryland General Assembly. Department of Legislative Services Fiscal and Policy Note. H.B. 729. *County and Municipal Street Lighting Investment Act*. Accessed 1/12/15. Available at: http://mgaleg.maryland.gov/2014RS/fnotes/bil_0009/hb0729.pdf
[78] Maryland General Assembly, Department of Legislative Services. County and Municipal Street Lighting Investment Act. "*Analysis.*" (Stating: In Maryland, Chapters 554 and 555 of 2007 authorized local governments to purchase and maintain street lighting equipment. A May 2007 letter from the Attorney General indicated that although the bills were approved for constitutionality, the bills must be administered properly to ensure the right to just compensation protected by the U.S. and Maryland constitutions. Just compensation must be provided before the government can take private property. The Acts provided for compensation based on fair market value, which is usually construed to mean just compensation. However, the Acts do not expressly provide for the amount of compensation to be determined by a jury, as required in the Maryland Constitution. The Attorney General noted that this does not render the bills invalid and that the Acts may be implemented in a constitutional manner by use of the local governments' condemnation powers to obtain possession of street lighting equipment when the electric company objects to a sale.")

3. Notable Conversion Projects

A simple search revealed six pending or completed LED conversion projects within the jurisdictions of Baltimore, Chevy Chase, Princess Anne, Middletown, Montgomery County, and the State Highway Administration. (Table A11)

Table A9: Baltimore Gas and Electric HPS/LED Rate Comparison

Baltimore Gas and Electric (Maryland)[79]					
HPS Rate			LED Rate		
Watts Nominal	Billing Watts	Annual Rate Per Light	Watts (HPS Equivalent)	Billing Watts	Annual Rate Per Light
100-150W	120-173	$136.92	100W	73	$131.76
150-250W	173-298	$540.00	150W	82-110	$148.92
250W	298	$215.16	200W	135-146	$187.12
400W	467	$237.24	250W	208	$211.08
1000W	1,130	$266.52	400W	258-275	$255.24

Table A10: Potomac Edison HPS/LED Rate Comparison

Potomac Edison (Maryland)[80]							
HPS Rate				LED Rate			
Lumen Rating	Watts (Nominal)	Annual Rate Per Light	Estimated Monthly Avg. kWh	Lumens	Watts (Actual)	Estimated Monthly Avg. kWh	Annual Rate Per Light
5,800	70W	$101.52	37	4,000	50W	18	$79.80
9,500	100W	$100.56	51	7,000	90W	32	$100.44
22,000	200W	$156.72	86	11,500	130W	46	$106.92
50,000	400W	$223.08	167	24,000	260W	91	$166.32

[79] Baltimore Gas and Electric Rate Schedule SL. Accessed: 1/12/15. Available at: http://www.bge.com/myaccount/billsrates/ratestariffs/electricservice/Electric20Services%20Rates%20and%20Tariffspercent20Servicespercent20Ratespercent20andpercent20Tariffs/P3_SCH_SL.pdf

[80] Potomac Edison (First Energy/Allegheny Power) Rate Schedule. Accessed: 1/12/15. Available at: https://www.firstenergycorp.com/content/dam/customer/Customer20Choicepercent20Choice/Files/maryland/tariffs/PotomacEdisonRetailTariff.pdf

Table A11: Notable Conversion Projects (Maryland)

Maryland LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Montgomery County	2015	Requiring county to contract with provider of LED lighting in 2015[81]
Middletown	March 2014	Proposed purchase of 7,000 street lights from Potomac Edison and replace with LED[82]
Princess Anne	March 2014	Request for bids to retrofit 48 street lights[83]
Chevy Chase	December 2013	Participating in 22 light PEPCO pilot program[84]
State Highway Administration	April 2013	Converting 18 miles of street lights on US 50.[85]
Baltimore	August 2012	Converted 8,000 of 70,000 street lights, 80 percent complete with first of three phases[86]

[81] Berliner, Roger. "*Summary of Earth Day Legislation Passed by the City Council*" (April 2014) Accessed: 1/12/15. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&ved=0CDkQFjAE&url=http%3A%2F%2Forigin.library.constantcontact.com%2Fdownload%2Fget%2Ffile%2F1102603838255-387%2FEarth%2BDay%2BLegislation%2BSummary%2B--%2BFINAL.pdf&ei=qlG0VOCNI4KZNry3gKgH&usg=AFQjCNHXt4dO-if5kAUtDpmdSonrCLxsIw&sig2=Q87LTUNqrweL6NUWBq719g&bvm=bv.83339334,d.eXY

[82] Wilson, Ike. Fredrick News-Post. "*Middletown Considers Street light Buyback Program.*" (March 2014) Accessed: 1/12/15. Available at: http://m.fredericknewspost.com/news/politics_and_government/middletown-considers-street light-buy-back-program/article_7cd0f241-256b-5799-a8d8-611e747f9a81.html?mode=jqm

[83] Town of Princess Anne. Request for Bids. (March 2014) Accessed: 1/12/15. Available at: http://www.townofprincessanne.com/pdf-2014/RFB-Retrofit-Feb-2014.pdf

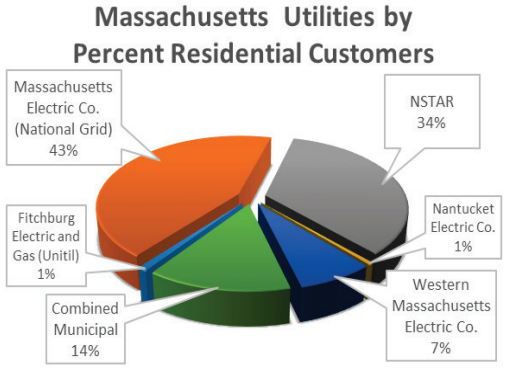
[84] Younes, Michael. Memo to Board of Managers. "*Update on Village Street light Improvements.*" (December 2013) Accessed: 1/12/15. Available at: http://www.chevychasevillagemd.gov/assets/PEPCO/LED20Streetpercent20Street lights.pdf

[85] Maryland Department of Transportation. "*State High Administration Begins Major US 50 Lighting Upgrades in Queen Anne's County*" Accessed: 1/12/15. Available at: http://www.marylandroads.com/pages/release.aspx?newsId=1483

[86] Anderson, Jessica (et. al.). The Baltimore Sun. "*City Converts Street lights to Energy-Saving LEDs.*" (August 2012) Accessed: 1/12/15. Available at: http://articles.baltimoresun.com/2012-08-16/news/bs-md-city-street-lights-20120816_1_leds-new-lights-light-pollution

F. Massachusetts

Massachusetts Street Light Summary	
Number of Street Lights:	496,000
Percent Region's Total Street Lights:	10 percent
Annual Street light Energy Usage:	305 GWh
Annual Potential Energy Savings:	152.5 GWh
Annual Potential Energy-Cost Savings:	$13.7 Million
Annual Potential Maintenance Cost-Savings:	$24.8 Million
LED Conversion Installed Costs:	$139.4 Million
Annual Potential Lighting Controls Energy Savings:	13.7 GWh
Annual Potential Lighting Controls Cost Savings:	$1.2 Million
Lighting Controls Installed Cost:	$13.9 Million



1. Tariff Status

Unitil, which accounts for less than 1 percent of Massachusetts' street light opportunities, is the only utility in the state that offers a utility-owned LED street light tariff. (Table A12) National Grid and Unitil both offer LED-specific tariffs for customer-owned equipment.

2. Legislative Background

Massachusetts has legislatively enabled energy savings performance contracting,[87] provided a mechanism for bulk purchasing, [88] and legally requires a utility to sell utility-owned street lights to a municipality that is interested in purchasing.[89]

3. Notable Conversion Projects

Massachusetts is unique in the region because a large number of municipalities have purchased their street lights and converted them to LEDs. At least 37 Massachusetts jurisdictions have converted their street lights to LED. (Table A13) According to the Massachusetts Department of Energy Resource, LED conversion in 41 of Massachusetts municipalities has saved more than 28,885,287 kWh (almost 29 GWh) over a period of three years, resulting in over $7.6 million in efficiency program incentives. A simple searched revealed documented conversions in at least 37 municipalities. (Table A13). Many of these conversions were accomplished through the efforts of two specific bodies, the Metropolitan Area Planning Council and Cape Light Compact.

[87] Mass. Gen. Laws ch. 25A, §11C.
[88] Mass. Gen. Laws ch. 25A, §11i.
[89] Mass. Gen. Laws ch. 164, §34A

4. Cape Light Compact Conversion Program

A member of the US Department of Energy's Solid State Street Lighting Consortium, Cape Light Compact is a non-profit energy efficiency program administrator located in Southeastern Massachusetts. Aside from administering energy efficiency programs, it also leverages community choice aggregation to increase the purchasing power of its customers and drive down electric rates. As of June 2014, Cape Light Compact had coordinated the conversion of approximately 14,000 street lights in 20 jurisdictions.[90] Community choice power aggregation should be explored by other municipalities who join together to purchase street lights and negotiate maintenance or management contracts.

5. Metropolitan Area Planning Council Conversion Program

The Metropolitan Area Planning Council is a non-profit regional planning council that aggregates communities seeking to purchase and/or convert their street lights to LEDs. They have coordinated the conversion or pending conversion of 58,000 lamps in 21 municipalities. Most notably, MAPC produces two guides which serve as an excellent resource for a community considering the purchase of their street lights,[91] or the conversion of legacy lighting to LED.[92]

Table A12: Unitil HPS/LED Rate Comparison

Unitil (Massachusetts)[93]			
HPS Rate		**LED Rate**	
Lumen Rating	Annual Rate Per Light	Lumen Rating	Annual Rate Per Light
3,300	$117.48	3,850	$101.64
9,500	$139.80	6,100	$120.48
20,000	$208.20	10,680	$150.96
50,000	$295.92	20,000	$243.24
140,000	$607.08		

[90] Cape Light Compact. LED Municipal Street light Project. Accessed: 1/12/15. Available at: http://www.capelightcompact.org/energy-efficiency/municipal/

[91] Metropolitan Area Planning Council. *Buy Back Street lights from Utility*. (September 2013) Accessed: 1/12/15. Available at: http://www.mapc.org/system/files/bids/Buy20Back%20Streetpercent20Backpercent20Street lights20from%20Utilitypercent20frompercent20Utility.pdf

[92] Metropolitan Area Planning Council. *Retrofit Street lights with LEDs*. (September 2013) Accessed: 1/12/15. Available at: http://www.mapc.org/system/files/bids/Retrofit20Streetpercent20Street lights20with%20LEDspercent20withpercent20LEDs.pdf

[93] Fitchburg Gas and Electric (Unitil) Schedule SR. Accessed: 1/12/15. Available at: http://unitil.com/sites/default/files/tariffs/E_dpu256_Summary_of_Rates_060114.pdf

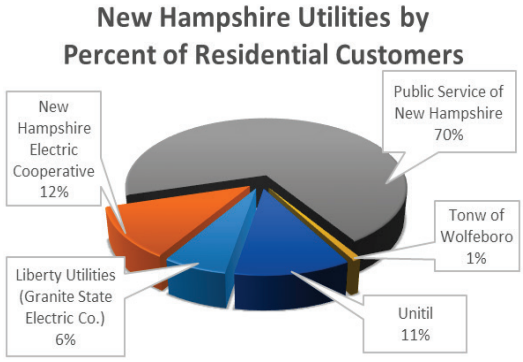
Table A13: Notable Conversion Projects (Massachusetts)

Massachusetts LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Cape Light Compact	Present	Has Coordinated the Conversion of 15,000 Street lights in 20 municipalities including: Hyannis, Dennis, Harwich, Chilmark, Chatham, Orleans, Brewster, Wellfleet, Truro, Provincetown, Mashpee, Cotuit, Edgartown, Oak Bluffs, Barnstable, Sandwich, W. Barnstable, Yarmouth, Falmouth, and Bourne. Conversions planned in: C-O-MM FD, Tisbury, and West Tisbury
Metropolitan Area Planning Council (MAPC)	Present	Has Coordinated the conversion or Pending Conversion of 58,000 Street lights in 21 municipalities including: Arlington, Chelsea, Natick, Woburn, Somerville, Sharon, Winchester, Swampscott, Winthrop, Gloucester, Hamilton, Melrose, Wenham, Beverly, Northampton, Salem, Lowell, Chicopee, Westfield, Malden, Brockton
Cambridge	Present	Replacing all street, park, and decorative lights with LED Fixtures, plus wireless controls for street lights[94]
Fitchburg	March 2014	Considering Conversion[95]
Holyoke	December 2013	Completed Second Year of Three Phase Project to Convert all Street lights to LED[96]
Greenfield	May 2013	Invitation to Bid for Conversion of 416 Fixtures to LED[97]
Newton	May 2013	26 pilot lights converted with plan to convert all 8,400[98]

[94]City of Cambridge Electric Department Website. Accessed: 1/12/15. Available at: http://www.cambridgema.gov/electrical.aspx
[95] Melanson, Alana. Sentinel Enterprise. "*Fitchburg Considers LED Lights.*" (March 2014) Accessed: 1/12/15. Available at: http://www.sentinelandenterprise.com/news/ci_25325595/fitchburg-considers-led-lights
[96] Holyoke Gas and Electric 2013 Annual Report. Page 1. (December 2013) Accessed: 1/12/15. Available at: http://www.hged.com/about/mission-vision/annual-reports/hgeannreport2013WEB.pdf
[97] Greenfield LED Street Lighting Project. Initiation to Bid. (October 2013) Accessed: 1/12/15. Available at: http://www.townofgreenfield.org/pages/greenfieldma_finance/purchasing/13-10IFBLEDStreet lightInstallation.pdf
[98] Jones, Trevor. Wicked Local. "*Newton Considering LED Lights Throughout the City.*" (May 2013) Accessed: 8/23/14. Available at: http://www.wickedlocal.com/x438184798/Newton-considering-LED-lights-throughout-city#axzz2UhrQqnOZ

G. New Hampshire

New Hampshire Street Light Summary	
Number of Street Lights:	65,267
Percent Region's Total Street Lights:	1%
Annual Street light Energy Usage:	40.2 GWh
Annual Potential Energy Savings:	20.1 GWh
Annual Potential Energy-Cost Savings:	$2 Million
Annual Potential Maintenance Cost-Savings:	$3.3 Million
LED Conversion Installed Costs:	$18.34 Million
Annual Potential Lighting Controls Energy Savings:	1.8 GWh
Annual Potential Lighting Controls Cost Savings:	$180,709
Lighting Controls Installed Cost:	$2 Million



1. Tariff Status

Accounting for approximately 70 percent of the street lights in New Hampshire, PSNH is the state's largest utility. A new customer-contributed[99] LED (EOL LED) tariff is currently pending publication, but a recent rate case regarding this tariff can provide some insight into the regulatory process.[100]

In August 2013, PSNH initially proposed an LED rate with a fixed monthly charge of $8.50 and a per watt charge of $.0139. The of City of Manchester filed a request to intervene on December 4th, 2013 and after discussions between PSNH and the City, each agreed to a fixed rate of 3.30 and a per-watt charge of $0.05, representing an overall decrease in the EOL LED rate. The parties also agreed that, on a pilot basis, the City would assume the maintenance responsibilities which are normally an obligation of the PSNH under rate EOL.

This example provides two takeaways: (1) Utilities may be skeptical of the low-maintenance and extended lifecycle claim of most LED manufacturers;[101] and (2) The City of Manchester was acting in its own interest, but also bargained with the utility to provide the reduced rate to all LED EOL customers outside of the city. This is likely a recommended best practice when discussing tariff revisions with a utility.

[99] Customer Contributed tariffs allow a municipality to choose their own lighting fixture, purchase that fixture, and provide it to the utility. The fixture becomes property of the utility, but the municipality receives their light free of any luminaire charge.
[100] New Hampshire Public Utilities Commission. Docket No. DE 12-248. *Petition to Amend Rate EOL to Include Light Emitting Diode Technology*. Settlement Agreement. Accessed: 1/12/15. Available at: http://puc.nh.gov/Regulatory/Docketbk/2013/13-248/LETTERS-MEMOS-TARIFFS/13-248202014percent202014-07-0120PSNH%20SETTLEMENT%20AGREEMENTpercent20PSNHpercent20SETTLEMENTpercent20AGREEMENT.PDF
[101] *id.* (Referencing a prior proposal which projected higher maintenance costs within the rate structure that the city of Manchester was able to circumvent by agreeing to take on maintenance responsibilities themselves)

2. Legislative Background

New Hampshire has legislatively enabled energy savings performance contracting for municipalities,[102] but has no law or precedent requiring a utility to sell its street lights to a municipal purchaser.

3. Notable Conversion Projects

A simple search found LED conversion projects pending or completed in Durham, Lebanon, Littleton, Manchester, and a bridge between New Hampshire and Maine. In the case of Lebanon, the Upper Valley Lake Sunapee Planning Commission is acting as project manager. [103] (Table A14) The New Hampshire Electric Cooperative no longer installs any lights except for LEDs.

Table A14: Notable Conversion Projects (New Hampshire)

New Hampshire LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Lebanon	March 2014	Lebanon possible community for Liberty Utilities LED street light pilot[104]
Portsmouth	March 2013	Portsmouth Illuminate the Memorial Bridge between New Hampshire and Maine.[105]
Durham	April 2012	EECBG funds to convert 234 street lights to LED [106]
Littleton	April 2012	Littleton Water and Light Developing LED Tariff[107]

[102] N.H. Rev. Stat. Ann. § 33:3; N.H. Rev. Stat. Ann. § 33:7-e;
See also, New Hampshire Town and City. Multi-Year Contracts: When and How Are They Authorized? (Discussing frequently asked questions regarding multi-year contracts, including performance contracts in New Hampshire.) (February 2009) Accessed: 8/23/14. Available at: http://www.nhmunicipal.org/TownAndCity/Article/274
[103] Upper Valley Lake Sunapee Regional Planning Commission. Request for Proposals. Municipal Street light Redesign and Policy Development, Lebanon, NH. (January 2014). Accessed: 8/23/14. Available at: http://www.uvlsrpc.org/files/9913/9005/7304/Lebanon_Street light_RFP_Jan_2014.pdf
[104] Lebanon City Council Agenda. *"Request by Lebanon Energy Advisory Committee: Letter of Support for Street light Design Project."* Accessed: 1/12/15. Available at: http://www.lebcity.net/BComm/agendas/City20Councilpercent20Council/2014/March2019,%202014percent2019,percent202014/2014-03-19-Item-9.A-LEACSupportltrLEDStreet lightProject.pdf
[105] Lumenistics Press Release. Accessed: 1/12/15. Available at: http://lumenistics.com/new-hampshire-bridge-project-promotes-energy-efficiency/
[106] Durham New Hampshire Energy Committee Webpage. *"Street Light Program Saves Energy, Money."* (April 2012) Accessed: 1/12/15. Available at: http://www.ci.durham.nh.us/boc_energy/energy-savings-town AND https://www.sylvania.com/en-us/innovation/case-studies/Pages/durham-nh.aspx
[107] Littleton Water and Light Meeting Minutes. (April 2012) Accessed: 1/12/15. Available at: http://www.littletonwaterandlight.org/minutes.php?rec=79&yr=2012

H. New Jersey

New Jersey Street Light Summary	
Number of Street Lights:	763,138
Percent Region's Total Street Lights:	15 percent
Annual Street light Energy Usage:	469.3 GWh
Annual Potential Energy Savings:	234.6 GWh
Annual Potential Energy-Cost Savings:	$19.9 Million
Annual Potential Maintenance Cost-Savings:	$38.1 Million
LED Conversion Installed Costs:	$214.4 Million
Annual Potential Lighting Controls Energy Savings:	21.1 GWh
Annual Potential Lighting Controls Cost Savings:	$1.8 Million
Lighting Controls Installed Cost:	$22.9 Million

1. Tariff Status

Two New Jersey utilities representing 12 percent of the state's street light opportunities offer an LED Tariff: Atlantic City Electric Co and Rockland Electric Co. (Table A15 and Table A16). Each rate presents significant savings over similar rates for high pressure sodium lamps. The contrast between the NJ Rockland Rate and the NY Orange and Rockland Rate should be noted, as the NJ is a vastly better opportunity for municipalities than the Orange and Rockland rate offered just over the border in NY.

New Jersey is unique in the region because Public Service Electric and Gas, one of the state's largest utilities, appears through their tariff to allow municipalities to request specialty street lights that the company will purchase and own, gaining a rate of return on their purchase as outlined explicitly within the tariff. Such a characteristic could serve as a best practice for composing a street lighting tariff accommodates advancements in technology.

2. Legislative Background

New Jersey has legislatively enabled an energy savings performance contracting system for municipalities,[108] but has no municipal street light buyback law.

3. Notable Conversion Projects

A simple search revealed LED street light project in Trenton, Camden, Jackson Township, Atlantic City, and the Holland Tunnel. (Table A17)

[108] P.L.2012, CHAPTER 55 Accessed: 1/12/15. Available at: http://www.njcleanenergy.com/files/file/ESIP20Law%20P%20L%20%202012%20c%20%2055percent20Lawpercent20Ppercent20Lpercent20percent202012percent20cpercent20percent2055.pdf

Table A15: Atlantic City Electric HPS/LED Rate Comparison

Atlantic City Electric (New Jersey)[109]						
HPS Rate				**LED Rate**		
Lumen Rating	Watts (Nominal)	Annual Rate Per Light		Lumen Rating	Watts (HPS Equivalent)	Annual Rate Per Light
3,600	50	$112.08		3,000	50	$105.72
5,500	70	$116.04		4,000	70	$104.40
8,500	100	$122.40		7,000	100	$106.08
14,000	150	$133.32		10,000	150	$124.20
24,750	250	$189.12		17,000	250	$147.00
45,000	400	$219.12				

Table A16: Rockland Electric HPS/LED Rate Comparison

Rockland Electric Company (New Jersey)[110] Note: Tariff denote Distribution Rate, not Luminaire Rate. Does not include transmission charge.							
HPS Rate				**LED Rate**			
Lumen Rating	Watts (Nominal)	Input Watts	Annual Distribution Charge	Lumens	Watts (Actual)	Input Watts	Annual Distribution Charge
5,800	70W	108	$101.16	5,890	70	74	$115.80
9,500	100W	142	$109.80	9,365	100	101	$142.32
16,000	150W	199	$133.68				
27,500	250W	311	$170.64				
46,000	400W	488	$276.60				

[109] Atlantic City Electric Tariff. Accessed: 1/12/15. Available at: http://www.atlanticcityelectric.com/uploadedFiles/wwwatlanticcityelectriccom/Content/Page_Content/My_Home/Choices_and_Rates/NJ20Tariff%20Section%20IV%20Effective%2006percent20Tariffpercent20Sectionpercent20IVpercent20Effectivepercent2006-01-2014.pdf

[110] Rockland Electric Company Rate Schedule. Accessed: 1/12/15. Available at: http://www.oru.com/documents/tariffsandregulatorydocuments/nj/electrictariff/SC4.pdf

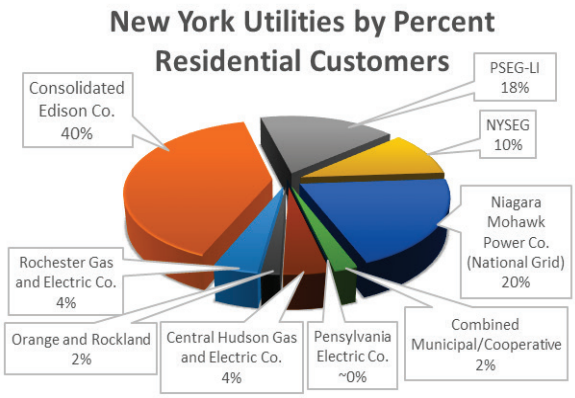
Table A17: Notable Conversion Projects (New Jersey)

New Jersey LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Atlantic City	December 2015	Plans to convert all 8,000 street lights to LED by 2016[111]
Port Authority	February 2013	Replacing 3,300 fluorescents in Holland Tunnel with LEDs[112]
Jackson Township	June 2012	Limited non-Tariff Street Lighting Service (LED SL) between Jackson Township and Jersey Central Power and Light[113]
Trenton	February 2011	Received EECBG funds for LED Retrofits[114]
Camden	November 2009	Received $750,000 EECBG to fund LED conversion.[115]

[111] Lemongello, Steve. Press of Atlantic City. "*Atlantic City Streets to Get Brighter Under New Lighting Program.*" (July 2014) Accessed: 1/12/15. Available at: http://www.pressofatlanticcity.com/news/breaking/atlantic-city-streets-to-get-brighter-under-new-lighting-program/article_7c8556e0-158f-11e4-9409-0019bb2963f4.html
[112] Lamb, Rich. CBS New York. "*Port Authority Replacing Holland Tunnel Lights with LEDs.*" (January 2013) Accessed: 1/12/15. Available at: http://www.nj.com/news/index.ssf/2013/01/holland_tunnel_getting_environ.html
[113] New Jersey Board of Public Utilities. Docket No. EO12030222. Accessed: 1/12/15. Available at: http://www.state.nj.us/bpu/pdf/boardorders/2012/20120618/6-18-12-2F.pdf
[114] US Department of Energy. Office of Weatherization and Intergovernmental Programs. EECBG/SEP Grantee TA Impact Statement. Accessed: 1/12/15. Available at: http://www1.eere.energy.gov/wip/solutioncenter/pdfs/eecbg_tap_impact_statement_trenton_nj_revised_0811.pdf
[115] Bob Menendez Office's Press Release. "*Menendez Announces $750,000 for Energy Efficiency in Camden City Through Program He Created.*" Accessed: 1/12/15. Available at: http://www.menendez.senate.gov/newsroom/press/menendez-announces-750-000-for-energy-efficiency-in-camden-city-through-program-he-created

I. New York

New York Street Light Summary	
Number of Street Lights:	1,386,000
Percent Region's Total Street Lights:	27 percent
Annual Street light Energy Usage:	970 GWh
Annual Potential Energy Savings:	523.9 GWh
Annual Potential Energy-Cost Savings:	$36.8 Million
Annual Potential Maintenance Cost-Savings:	$69.3 Million
LED Conversion Installed Costs:	$389.5 Million
Annual Potential Lighting Controls Energy Savings:	42.2 GWh
Annual Potential Lighting Controls Cost Savings:	$2.7 Million
Lighting Controls Installed Cost:	$41.6 Million



1. Tariff Status

New York is unique because it accounts for 27 percent percent of the region's street light opportunities, but only a single investor owned utility in the state offers a utility-owned LED tariff. The Orange and Rockland tariff, which applies to roughly 2 percent of the state's street lights, rates LED as more expensive than high pressure sodium. (Table A18)

2. Legislative Background

New York has legislatively enabled energy savings performance contracting for municipalities,[116] but has no statute requiring a utility to offer street light for purchase to a municipality. However, in 2009, the office of the NY State Comptroller issued a report noting that street light buybacks often cut municipal expenses and have a payback period of less than ten years.[117]

3. Notable Conversion Projects

A simple search revealed LED street light Projects in New York, Brookhaven, Yonkers, Binghamton, and Islip. (Table A19)

[116] N.Y. ENG. LAW § 9-103
[117] Office of New York State Comptroller. "Street Lighting Cost Containment." (2007) Accessed: 1/12/15. Available at: http://www.osc.state.ny.us/localgov/pubs/research/costsavingcontainment.pdf

Table A18: Orange and Rockland HPS/LED Rate Comparison

Orange and Rockland (New York)[118] Note: Tariff denotes Delivery Charge, not Luminaire Rate (likely includes transmission).							
HPS Rate				**LED Rate**			
Lumen Rating	Watts (Nominal)	Input Watts	Annual Distribution Charge	Lumens	Watts (Actual)	Input Watts	Annual Distribution Charge
5,800	70W	108	$174.72	5,890	70	74	$232.68
9,500	100W	142	$190.68	9,365	100	101	$257.40
16,000	150W	199	$226.56				
27,500	250W	311	$302.64				
46,000	400W	488	$423.96				

Table A19: Notable Conversion Projects (New York)

New York LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
New York	December 2016	Converting 250,000 Street lights to LED by 2017[119]
Yonkers	December 2014	Converting 12,000 Street lights to LED before 2015[120]
Binghamton	May 2014	Requesting Proposals to Convert 7,000 Street lights to LED[121]
Brookhaven	May 2013	Brookhaven Converting 2,500 street lights to LED[122]
Islip	May 2013	Converted 15,000 street lights to LEDs.[123]
Smithtown	December 2010	Converted 1000 street lights to LEDs[124]

[118] Rockland Electric Company Rate Schedule. Accessed: 1/12/15. Available at: http://www.oru.com/documents/tariffsandregulatorydocuments/ny/electrictariff/electricSC04.pdf

[119] New York City Press Release. "*Mayor Bloomberg and Transportation Commissioner Sadik-Khan Announce All 250,000 Street Lights in New York City Will Be Replaced With Energy-Efficient LEDs by 2017, Reducing Energy Consumption and Cost.*" (October 2013) Accessed: 1/12/15. Available at: http://www1.nyc.gov/office-of-the-mayor/news/343-13/mayor-bloomberg-transportation-commissioner-sadik-khan-all-250-000-street-lights-in#/0

[120] City of Yonkers Press Release. (July 2013) Accessed: 1/12/15. Available at: http://www.yonkersny.gov/government/mayor-s-office/priorities-initiatives/initiatives-/led-street-light-replacement-project

[121] City of Binghamton Press Release. "*Mayor David Announces Latest Initiatives to Improve Operations and Save Tax Payer Dollars.*" (May 2014) Accessed: 1/12/15. Available at: http://www.binghamton-ny.gov/mayor-david-announces-latest-initiatives-improve-operations-and-save-taxpayer-dollars

[122] Sampson, Christine. Port Jefferson Patch. "*Energy Efficient Lights Coming to Brookhaven Roads.*" (May 2013) Accessed: 1/12/15. Available at: http://patch.com/new-york/portjefferson/energy-efficient-street-lights-coming-to-brookhaven-roads_85848576#.U_5LTPldVUU

[123] Barton, Siobhan. Newsday. "*Islip Installs Thousands of Energy Efficient Street Lights.*" (May 2014) Accessed: 1/12/15. Available at: http://www.newsday.com/long-island/towns/islip-installs-thousands-of-energy-efficient-street-lights-1.8023700

[124] Gleberman, Monica. Times Beacon Record. "*Smithtown Town Installs New LED Street lights.*" Accessed: 1/12/15. Available at: http://www.northshoreoflongisland.com/Articles-i-2010-12-09-86352.112114-sub18241.112114-Smithtown-Town-installs-new-LED-street lights.html

J. Pennsylvania

Pennsylvania Street Light Analysis	
Number of Street Lights:	1,079,109
Percent Region's Total Street Lights:	21 percent
Annual Street light Energy Usage:	658.1 GWh
Annual Potential Energy Savings:	329 GWh
Annual Potential Energy-Cost Savings:	$23 Million
Annual Potential Maintenance Cost-Savings:	$53.5 Million
LED Conversion Installed Costs:	$300.7 Million
Annual Potential Lighting Controls Energy Savings:	29.6 GWh
Annual Potential Lighting Controls Cost Savings:	$2.1 Million
Lighting Controls Installed Cost:	$32.1 Million

1. Tariff Status

Two investor-owned utilities in Pennsylvania representing approximately 8 percent of the lighting stock offer a utility-owned LED tariff: Pike County Electric Co and Duquesne Light and Power. (Table A20 and Table A21) Metropolitan Energy and Penelec represent 20 percent of the lighting stock and offer a customer-owned tariff providing an LED rate.

2. Legislative Background

Pennsylvania has legislatively enabled energy savings performance contracting for municipalities.[125]

3. Notable Conversion Projects

A simple search found LED conversion projects under discussion, pending, or completed in 12 jurisdictions including: Pittsburgh, Bristol Township, West Nottingham, Horsham, Denver Borough, Allentown, Bethlehem, Tarentum, Perkasie, Abington, and Altoona. (Table A22)

4. Lessons from Richland, Pennsylvania

The City of Richland's experience with third-party street light contractors offers a lesson for similarly situated municipalities. In February 2009, city officials paid an energy consulting company $165,488 to facilitate the purchase of 160 street lights from their local utility and

[125] 73 PS § 1646.1-1646.8 Accessed: 1/12/15. Available at: http://www.portal.state.pa.us/portal/server.pt/community/guaranteed_energy_savings_manual_for_pennsylvania27spercent27s_government_organizations/9292

subsequent energy efficient conversion. After no action for several months, inquiries by city officials revealed that Municipal Energy's owners were in prison for having failed to fulfill a street light conversion in Bethlehem, Pennsylvania they had contracted for.[126] This lesson demonstrates the importance of due diligence when soliciting contractors for a third-party streetlight conversion project. Contractors should be thoroughly vetted by person or body with the technical knowledge necessary to understand the level of competence of a prospective contractor.

Table A20: Duquesne Light and Power HPS/LED Rate Comparison

Duquesne Light and Power (Pennsylvania)[127]					
HPS Rate			LED Rate		
Nominal Wattage	Nominal kWh Monthly Energy Usage	Annual Distribution Charge	Nominal Wattage	Nominal kWh Monthly Energy Usage	Annual Distribution Charge
70	29	$150.12	43	50	$133.92
100	50	$151.32	106	70	$153.84
150	71	$153.48			
250	110	$157.56			
400	170	$163.80			
1,000	387	$188.40			

Table A21: Pike County Electric HPS/LED Rate Comparison

Pike County Electric (Rockland Electric) (Pennsylvania)[128] Note: Tariff denotes Delivery Charge, not Luminaire Rate (likely includes transmission).							
HPS Rate				LED Rate			
Lumen Rating	Watts (Nominal)	Input Watts	Annual Distribution Charge	Lumens	Watts (Actual)	Input Watts	Annual Distribution Charge
5,800	70W	108	$260.16	5,890	70	74	$306.72
9,500	100W	142	$285.00	9,365	100	101	$376.44
16,000	150W	199	$323.64				
27,500	250W	311	$414.96				
46,000	400W	488	$546.48				

[126] Prall, Derek. "*Pennsylvania Township Scammed in Streetlight Deal.*" American City and County. (May 2013) Accessed: 1/12/15. Available at: http://americancityandcounty.com/facilities/pennsylvania-township-scammed-streetlight-deal
[127] Duquesne Light and Power Rate Schedule. Accessed: 1/12/15. Available at: https://www.duquesnelight.com/DLdocs/shared/ManageMyAccount/understandingMyBill-Rates/tariffHistory/Tariff24_94.pdf
[128] Pike County Electric Power (Orange and Rockland). Accessed: 1/12/15. Available at: http://www.oru.com/documents/tariffsandregulatorydocuments/pa/PikeElectricRateCaseFiling2014.pdf

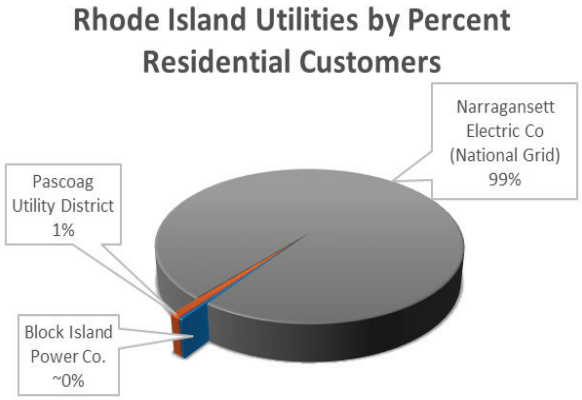
Table A22: Notable Conversion Projects (Pennsylvania)

Pennsylvania LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Denver Borough	Fall 2014	Planning purchase of 344 street lights from PPL, LED conversion[129]
Bristol Township	Fall 2014	Converting 4,259 street lights by fall 2014[130]
Bethlehem	October 2013	Converted 4,000 street lights to LEDs[131]
Perkasie	Fall 2012	Converting 1,000 150W HPS fixtures to 55W LED fixtures [132]
Tarentum	December 2012	Converted 430 Street lights to dimmable and programmable LED fixtures[133]
Pittsburgh	September 2011	Converting 40,000 street light Inventory over 5-10 years[134]
West Nottingham	May 2011	Converting lights through Relume Technologies[135]
Altoona	2009	Received a $200,000 grant to convert 179 lights to LED. [136]
Abbington	2009	Received a $500,000 grant for LED conversion[137]
Allentown	Unknown	Converted walkway lighting outside city hall [138]
Horsham	Unknown	Replacing lamps on an as-needed basis with LED[139]

[129] Denver Express Newsletter. *"Denver Borough Street light System Purchase and LED Conversion."* Spring 2014. Accessed: 1/12/15. Available at: http://www.denverboro.net/ArchiveCenter/ViewFile/Item/36
[130] Bristol Township Press Release. "New LED Street lights Brighten Bristol Township. (March 2014) Accessed: 1/12/15. Available at: http://www.bristoltwp.com/uploads/PRESS20RELEASE%20LED%20STREETpercent20RELEASEpercent20LEDpercent20STREETLIGHTS203%2027%2014percent203percent2027percent2014.pdf
[131] Lehigh Valley News. *"Bethlehem Replaces 4,000 Street lights with LED Bulbs."* (October 2013) Accessed: 1/12/15. Available at: http://www.wfmz.com/news/news-regional-lehighvalley/Bethlehem-replaces-4-000-street-lights-with-LED-bulbs/22321802
[132] Borough of Perkasie Fall Newsletter. (Fall 2012) Accessed: 1/12/15. Available at: http://www.perkasieborough.org/newsletter/2012_Edition_2_website.pdf
[133] GE Lighting Press Release. *"Pennsylvania Town Finds $40,000 Savings and Cash Flow Positive Financing in GE LED Street Lighting Solution."* (December 2012) Accessed: 1/12/15. Available at: http://pressroom.gelighting.com/news/pennsylvania-town-finds-40-000-savings-and-cash-flow-positive-financing-in-ge-led-street-lighting-solution#.U-0V4vldVUU
[134] Remaking Cities Institute. *LED Street Light Research Project*. (September 2011) Accessed: 1/12/15. Available at: http://www.cmu.edu/rci/documents/led-updated-web-report.pdf
[135] CBS News Detroit. "Relume Technologies Upgrades PA Town's Street Lights to LEDs" (May 2011) Accessed: 1/12/15. Available at: http://detroit.cbslocal.com/2011/05/11/relume-technologies-upgrades-pa-towns-street-lights-to-leds/
[136] Power Online Press Release. *"Obama Administration Delivers More Than $36M to Pennsylvania Communities for Energy Efficiency Projects."* (September 2009) Accessed: 1/12/15. Available at: http://www.poweronline.com/doc/obama-administration-delivers-more-than-36m-0001
[137] Power Online Press Release. *"Obama Administration Delivers More Than $36M to Pennsylvania Communities for Energy Efficiency Projects."* (September 2009) Accessed: 1/12/15. Available at: http://www.poweronline.com/doc/obama-administration-delivers-more-than-36m-0001
[138] Atlantic Energy Concepts Press Release (Date Unknown) Accessed: 1/12/15. Available at: http://www.atlanticenergyconcepts.com/case-studies/Allentown-City-Hall.aspx
[139] Horsham Township Website. Accessed: 1/12/15. Available at: http://www.horsham.org/pView.aspx?id=10625&catid=611

K. Rhode Island

Rhode Island Street Light Analysis	
Number of Street Lights:	91,363
Percent Region's Total Street Lights:	2 percent
Annual Street light Energy Usage:	56.2 GWh
Annual Potential Energy Savings:	28.1 GWh
Annual Potential Energy-Cost Savings:	$2.5 Million
Annual Potential Maintenance Cost-Savings:	$4.6 Million
LED Conversion Installed Costs:	$25.7 Million
Annual Potential Lighting Controls Energy Savings:	2.5 GWh
Annual Potential Lighting Controls Cost Savings:	$227,563
Lighting Controls Installed Cost:	$2.7 Million



1. Tariff Status

Rhode Island is home to only three utilities, and one of those utilities—Narragansett Electric (a subsidiary of National Grid)—is responsible for 98.5 percent of the state's street light opportunities. Narragansett Electric Co. does not offer a utility-owned tariff for LEDs, but does offer a customer-owned tariff that lists an LED rate.

2. Legislative Background

The state has not legislatively enabled energy savings performance contracts, but the Rhode Island Office of Energy Resources does support performance contracting.

3. Municipal Street light Investment Act

The Rhode Island state legislature recently passed a law requiring that utilities sell their street lights to Rhode Island municipalities requesting sale.[140] Known at the Municipal Street light Investment Act, this legislation **delegated power to Rhode Island Public Utility Commission to decide on reasonable procedures for sale of utility-owned street lights and required that Narragansett Electric publish an LED tariff that includes dimmable lighting controls**. This pending tariff could set an example for new LED tariffs which incorporate advanced controls for LED street lights. Such advanced controls help mitigate greenhouse gas emissions and limit expenses for municipalities.

[140] R.I. GEN. LAWS § 39-30-1 (Known as "The Municipal Street light Investment Act")

3. Notable Conversion Projects

A simple search found LED conversion projects under discussion, pending, or completed in Pascoagville, Burilloville, and Harrisville. (Table A23)

Table A23: Notable Conversion Projects (Rhode Island)

Rhode Island LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Pascoag/Harrisville	July 2014	Currently implementing a "very aggressive" street-lighting retrofit program[141]
Burilloville	November 2013	Converted 56 of 1,147 street lights to LED[142]

[141] Kirkwood, Michael R. Pascoag Utility District Letter RE: Proposed Plan for Allocation and Distribution of Regional greenhouse Gas Initiative Auction Proceeds. (July 2014) Accessed: 1/12/15. Available at: http://www.energy.ri.gov/documents/rggi/201420Plan%20Itemspercent20Planpercent20Items/PUD20-%20RGGI%20Allocation%20letter%202014percent20-percent20RGGIpercent20Allocationpercent20letterpercent202014_3.pdf

[142] Alban Inspections Website. "*Rhode Island Community Converting to Energy Efficient Street Lamps.*" (November 2013) Accessed: 1/12/15. Available at: http://www.albaninspect.com/news/home-inspection/rhode-island-community-converting-to-energy-efficient-street-lamps/

L. Vermont

Vermont Street Light Analysis	
Number of Street Lights:	31,036
Percent Region's Total Street Lights:	1%
Annual Street light Energy Usage:	19 GWh
Annual Potential Energy Savings:	9.5 GWh
Annual Potential Energy-Cost Savings:	$1 Million
Annual Potential Maintenance Cost-Savings:	$1.6 Million
LED Conversion Installed Costs:	$8.7 Million
Annual Potential Lighting Controls Energy Savings:	859 MWh
Annual Potential Lighting Controls Cost Savings:	$85,894
Lighting Controls Installed Cost:	$931,108

1. Tariff Status

Vermont is unique in the region due to a 2011 law requiring all investor-owned utilities offer a utility-owned LED street light tariff.[143] Further, a partnership between Efficiency Vermont (EVT), the state's largest electric utilities, and several municipalities aims to convert more than 18,000[144] of Vermont's investor owned street lights. EVT estimates that as of January 2015, 11,800 Vermont street lights have been converted to LED.[145] (Table A24 and Table A25)

2. Legislative Background

Vermont has not legislatively enabled energy performance contracting outside the context of a "district,"[146] but appears to have municipalities who have engaged in city-wide energy performance contracting.[147] A 2009 bill requiring the sale of street lights to interested municipalities did not pass the legislature; [148] however there is evidence of a Central Vermont Public Service (CVPS) Memorandum of Understanding (MOU) that sets clear guidelines for municipal street light purchases.[149]

[143] Vermont Energy Act of 2011. Accessed: 1/12/15. Available at: http://www.leg.state.vt.us/docs/2012/acts/act047.pdf
[144] DeMarco, Peter. The Boston Globe. *"Future Seems Bright for LED Lights."* (December 2013) Accessed: 1/12/15. Available at: http://www.bostonglobe.com/metro/regionals/north/2013/12/22/who-taught-you-drive-shedding-some-new-light-street-signs/BRbQaLcTByChA4Uj10edEO/story.html
[145] NEEP staff Communications with Efficiency Vermont on 1/5/15. Estimates do not include conversions within the Burlington Electric Department's geographic territory.
[146] 16 V.S.A. §3448f.
[147] Efficiency Vermont. *"Preliminary Review of Energy Savings Measures for the Town of Brattleboro and Brattleboro Public School Facilities."* (July 2004). Accessed: 1/12/15. Available at: http://www.sustainablecitiesinstitute.org/Documents/SCI/Case_Study/Case20Study%20-%20Performance%20Contracting%20Brattleboropercent20Studypercent20-percent20Performancepercent20Contractingpercent20Brattleboro.pdf
[148] Vermont House Bill 273. *"An Act Relating to Municipal Acquisition of Street Lights."* Accessed: 1/12/15. Available at: http://legiscan.com/VT/text/H0273/id/483388/Vermont-2009-H0273-Introduced.pdf
[149] Vermont Public Service Board. Docket No. 7085. Petition of Town of [Woodstock et. al.] Requesting an Investigation into Terms and Conditions offered by Central Vermont Public Service. Accessed: 1/12/15. Available at: http://www.state.vt.us/psb/orders/2008/files/7085finalorderonmou.pdf

3. Notable Conversion Projects

A simple search revealed several municipalities with current or pending LED conversion projects including Colchester, Waterbury, Montpelier, Burlington, Hartford, Thetford, Bradford, Sharon, Cabot, Bennington, and Northfield. (Table A26)

Table A24: Green Mountain Power HPS/LED Rate Comparison

Green Mountain Power (Vermont)[150] Note: Includes Luminaire, Distribution, Generation, and Transmission Charges							
HPS Rate				**LED Rate**			
Nominal Wattage	Lumens	Annual Charge Per Light		LEDs	Lumens	Input Watts	Annual Charge Per Light
70	5,200	$173.16		20	2,530	37	$127.20
100	8,500	$191.04		20	3,162	50	$130.92
150	14,400	$219.12		40	5,050	67	$158.88
200	19,800	$253.92		40	6,312	92	$166.08
250	24,700	$279.72					

Table A25: Central Vermont Public Service HPS/LED Rate Comparison

Central Vermont Public Service (Legacy Customers- now GMP) (Vermont)[151] Note: Includes Luminaire, Distribution, Generation, and Transmission Charges							
HPS Rate				**LED Rate**			
Nominal Wattage	Approximate Initial Lumens	Annual Charge Per Light		LEDs	Approximate Initial Lumens	Input Watts	Annual Charge Per Light
70	5,800	$198.20		20	2,000	39	$147.46
150	16,000	$254.40		30	3,100	55	$166.44
250	30,000	$375.59		40	3,500	70	$184.69
400	50,000	$517.57		50	4,300	95	$221.56
				60	5,100	113	$237.98
				80	8,100	140	$287.26

[150] Green Mountain Power Outdoor Lighting Rate 18. Accessed: 9/13/14. Available at: http://www.greenmountainpower.com/upload/photos/308Outdoor_Lighting_new_10-1-14.pdf
[151] Green Mountain Power Rate Schedule for former Central Vermont Public Service Customers. Accessed: 9/13/14. Available at: http://www.greenmountainpower.com/upload/photos/307RATE_6_Municipal_Street_and_Highway_Lighting_10-1-14.pdf

TableA26: Notable Conversion Projects (Vermont)

Vermont LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Northfield	August 2014	Converting all lights to LED[152]
Burlington	July 2014	LED mentioned within Street Lighting Policy [153]
Bennington	October 2013	Converted more than 500 street lights[154]
Thetford	Summer 2013	Converted Street lights[155]
Bradford	Summer 2013	Converted Street lights
Sharon	Summer 2013	Considering Conversion
Cabot	February 2012	Converted all street lights to LED[156]
Hartford/Queechee/White River	2011	All Fixtures Converted[157]
Waterbury	2011	Converted several Streets to LED[158]
Colchester	Unknown	Phased LED conversion of 780 street lights[159]
Middlebury	Unknown	Converted Street lights to LEDs[160]
Johnson	Unknown	Converted Street lights to LEDs[161]

[152] Northfield Celebrates National Night Out. (August 2014) Accessed: 8/23/14. Available at: http://www.northfield-vt.gov/text/Current_Notices/National_Night_Out_2014.pdf
[153] Report of the Street lighting Committee to the Burlington Electric Commission. (July 2014) Accessed: 1/12/15. Available at: http://www.burlingtonvt.gov/sites/default/files/Agendas/Item204%20-%20Newly%20Adopted%20Lighting%20Policypercent204percent20-percent20Newlypercent20Adoptedpercent20Lightingpercent20Policy.pdf
[154] Robinson, Susan. Vermont Guide. "*Bennington Racks Up Accolades*" (October 2013) Accessed: 1/12/15. Available at: http://vermontnews-guide.com/bennington-racks-up-accolades/
[155] Letter from Sharon Energy Committee to Business Owners/Residents. (May 2013) Accessed: 1/12/15. Available at: http://www.sharonvt.net/government/documents/doc_download/215-street light-study-details.html (Also mentioning Bradford and Sharon as having finished conversions)
[156] Bernadino, Alyssa. The Cabot Chronicle. "*A Bright Idea.*" (February 2012) Accessed: 8/23/14. Available at: http://www.cabotchronicle.org/index.php?option=com_content&view=article&id=2093Aapercent3Aa-bright-idea&Itemid=7
[157] Rancis, Eric. Vermont Standard. "*Quechee in Line for LED Lighting.*" (December 2011) Accessed: 1/12/15. Available at: http://www.thevermontstandard.com/2011/12/quechee-in-line-for-led-lighting/
[158] Sutkoski, Matt. Burlington Free Press. "*Light Future: Vermont Towns Turning to LED Lights.*" (February 2011) Accessed: 1/12/15. Available at: http://archive.burlingtonfreepress.com/article/20110220/LIVING09/102200304/Light-Future-Vermont-towns-turning-LED-lights
[159] Town of Colchester Public Works Department Website. Accessed: 1/12/15. Available at: http://colchestervt.gov/PublicWorks/Highway/Street lights.shtml and http://colchestervt.gov/Manager/AroundTown/23FinalLightsParksBallotItems110131.pdf
[160] Middlebury Energy Committee Website. (Date Unknown) Accessed: 1/12/15. Available at: http://www.middleburyenergy.org/efficiency_first.php
[161] Burgess, Nathan. "*Big Construction Projects Get Started.*" (June 2011) Accessed: 1/12/15. Available at: http://www.stowetoday.com/stowe_reporter/news/article_de264076-a323-11e0-a697-001cc4c002e0.html

APPENDIX B: Methodologies Detailed

Each state's opportunity analysis contains information on approximate number of street lights, energy savings opportunities, tariffs, legislation, street light purchases, and ongoing efforts. Methodologies used to reach conclusions are discussed in detail below. In general, the approximate number of streetlights was determined through use of data from New York, Massachusetts, Rhode Island, and Vermont. Analysis of this data found that the number of streetlights correlates strongly with population of a given municipality or state, but is also affected also by population density. Cities with populations over 500,000 were outliers within a regression analysis measuring population against street light quantities, so they were extracted from the state by state analysis and considered independently. States with low population density (Vermont, New Hampshire, and Maine) were also separated out from the rest of the region and considered separately.[162] Average wattages and percentage savings were calculated according to the average for the entire inventory, as described below.

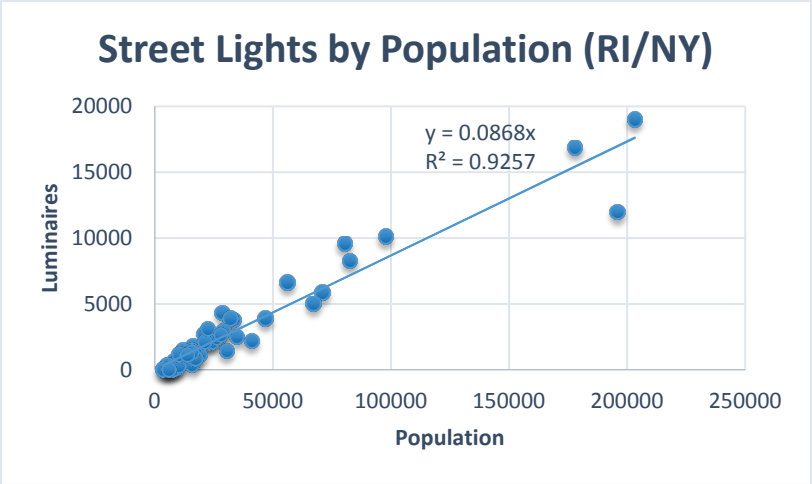
Approximate Number of Street Lights

Street light inventories were obtained for: (1) Nine municipalities in New York;[163] (2) all National Grid-served municipalities in the state of Rhode Island;[164] and (3) 21 municipalities in Massachusetts.[165] Also, previous street light counts from Massachusetts, New York, and Rhode Island were utilized in calculation assumptions, including to check for a tolerable margin of error in other states.

Population as Street Light Quantity Indicator
Supplementing these inventories with data obtained from the 2010 census, regression analysis identified a strong correlation between number of street lights and population. (Table A27) As a general rule of thumb, there are approximately 8.7 street lights for every 100 persons in a municipal population.

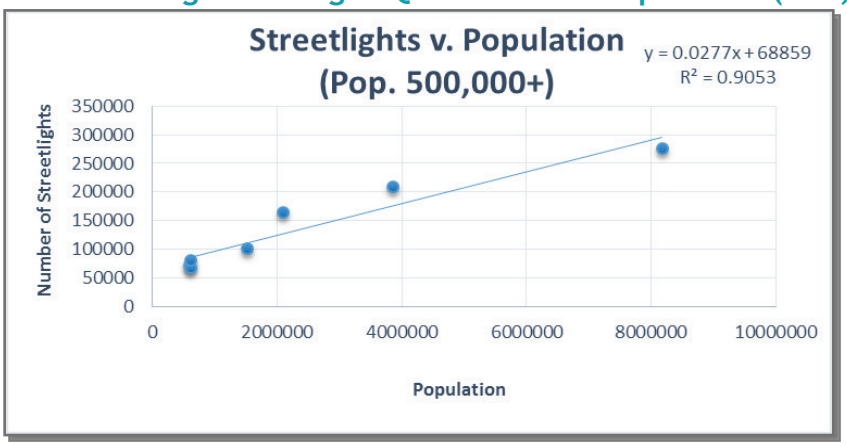
[162] This strategy is consistent with a 2014 MSSLC survey which found, "[G]reater variability in towns with populations of less than a few thousand, suggesting that other variables begin to markedly influence the number of luminaires below some threshold." While this threshold likely affects many municipalities, it does not likely affect the majority of street lighting counts as weighted by population.
[163] New York municipalities included Rochester, Huntington, Yonkers, Albany, Mt. Vernon, Union, Vestal, Oneonta, and New York City.
[164] Rhode Island municipalities included Barrington, Bristol, Burrillville, Central Falls, Charlestown, Coventry, Cranston, Cumberland, East Greenwich, East Providence, Exeter, Foster, Glocester, Hopkinton, Jamestown, Johnston, Lincoln, Lincoln, Little Compton, Middletown, Narragansett, Newport, North Kingstown, North Providence, North Smithfield, Pawtucket, Portsmouth, Providence, Richmond, Scituate, Smithfield, South Kingstown, Tiverton, Warren, Warwick, West Greenwich, West Warwick, Westerly, and Woonsocket.
[165] Massachusetts municipalities included Arlington, Chelsea, Natick, Woburn, Somerville, Sharon, Winchester, Swampscott, Winthrop, Gloucester, Hamilton, Melrose, Wenham, Beverly, Northampton, Salem, Lowell, Chicopee, Westfield, Malden, and Brockton.

Table A27: Existing Street light Quantities vs. Population



Cities having populations greater than 500,000 within each state were then identified and an approximate number of street lights determined according to a publicly accessible inventory approximations, often found on a city's department of public works' website.[166] These approximate inventories were then used to run an analysis of street light inventories in cities with populations greater than 500,000. A strong correlation was found and extrapolated out for cities having populations of greater than 500,000, but without a publicly listed street light inventory.[167] (Table A28) Estimated inventories for cities having a population greater than 500,000 were then combined with estimated inventories for each state according to population residing in jurisdictions of 500,000 people or less to arrive at statewide street light totals.

Table A28: Existing Street light Quantities vs. Population (500,000+)

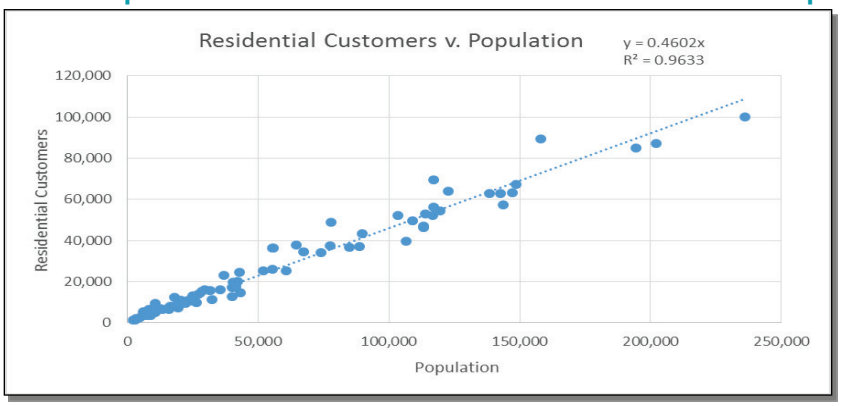


[166] These cities included New York, Los Angeles, Philadelphia, Washington D.C., Boston, and Baltimore.
[167] New York City, the largest city in the country, was identified as an outlier with street lighting characteristics unique to that jurisdiction, and therefore excluded from this analysis.

Street Light Opportunities per Utility

The number of residential customers a utility serves can be used to calculate its approximate number of street lights served. To reach this conclusion, a combination of EIA data containing residential customers per utility and census data containing populations for each municipality were analyzed. EIA data on almost all municipal utilities in the United States was sorted to determine which municipal utilities shared an approximate boundary with only their namesake municipality.[168] A regression analysis comparing residential customers per municipal utility against population for each municipality proved a strong correlation. (Table A29) Therefore, since number of residential customers strongly correlates with population, and population correlates strongly with number of street lights, one can assume that a state's percentage of residential customers by utility accurately represents each utility's percentage share of a state's total street lights.

Table A29: Expanded Data Set- Residential Customers v. Population



Savings Opportunities

Savings Opportunities were identified by using the dataset outlined above to determine an approximate average street light input wattage, which was then extrapolated out across estimated street light inventories. Conservative estimates were utilized in determining luminaire type, wattage, and energy savings.

Since our data set shows that the vast majority of existing lamps are high pressure sodium (94 percent in Rhode Island communities, 89 percent in New York communities, and 72 percent in Massachusetts communities), this report conservatively assumes all existing luminaries to be high pressure sodium. Of the three major existing legacy technologies—High Pressure Sodium, Metal Halide, and Mercury Vapor—High Pressure Sodium is, in many cases the most efficient of the three, and therefore will provide the most conservative energy savings assumptions when compared with a LED luminaire.

Approximate nominal wattage was calculated according to a simple average of all

[168] Municipal Utilities often reach beyond the geographic area of a single municipality and incorporate customers in surrounding jurisdictions. The vast majority of utilities who offer such services make note of it on their website.

luminaries within the available data set, and came to 140 Watts. This number was then assigned a conservative input wattage of 170 Watts. To determine annual energy usage per luminaire, the input wattage was multiplied by an approximate annual hourly run-time of 4100 hours, then divided by 1,000 to find annual kWh per luminaire. The resulting estimate was then multiplied by the number of luminaries in each state to determine current street lighting energy usage estimates per state.

Energy savings opportunities per state were conservatively estimated at 50percent of total input wattage[169] and maintenance savings were estimated at $50/luminaire annually.[170]

Advanced controls were assumed to only be available for roughly 30percent of street lights due to aesthetic and practice barriers. Savings were conservatively estimated at 30percent of after-conversion consumption.

Tariff Status

Tariff status was analyzed according to currently published tariffs, either as identified on a utility's website, or as listed according to a state public utility commission. In states where utility restructuring has occurred, standard offers were approximated according to those utilities offering LED tariffs, and extrapolated on a statewide basis to determine energy cost-savings resulting from a conversion.

Legislation, Completed or Pending Conversions, and Ongoing Efforts

This paper lists relevant legislation, completed or pending street light LED conversion projects, and ongoing efforts within each state. This information was extracted from a multitude of sources, including simple web searches, interview of relevant industry actors, newspaper articles, and docket searches. The listing of completed or pending conversions in each state recognizes that not all LED street light conversions are documented in the public record.

Individual Utility-Owned LED Tariffs

Individual utility tariffs values were gathered, unless otherwise noted, to include only: (1) Lights being served from overhead wires; (2) Lights mounted on existing poles with existing brackets/arms; and (4) cobra head or cutoff HPS lights depending upon each utility's offerings. Whenever possible, rates in the utility tariff charts cover only luminaire charges, not distribution, transmission, energy, or other charges. Those that include distribution or transmission charges do so for both HPS and LED rates. This data should be used to compare across lighting types, not across utilities, as tariff components vary from utility to utility and are not displayed uniformly here.

[169] *Supra*, at note 11. (Citing a 63 percent overall energy savings for Los Angeles' LED Street light Project)
[170] US Department of Energy. *Gateway Demonstrations: Demonstration Assessment of LED Post Top Lighting in New York City*. Page 3.1. (September 2012) (Citing maintenance cost-savings between $46 and $111) Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_gateway_central-park.pdf

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 9

Responding Witness: John P. Malloy

Q-9. Please refer to KU's response to LFUCG 1-28. On page 24 of Attachment 1, there is a line item for Maintenance Savings under Annual Cost/Savings. Please confirm that the negative numbers shown in the row for "Maintenance Savings" reflect KU's understanding that operations and maintenance costs will be reduced for LED lights as compared to other KU light offerings.

A-9. Based on the assumptions used to create the various scenarios presented in Attachment 1 of response to LFUCG 1-28, the negative numbers represent estimated maintenance expense and capital savings.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 10

Responding Witness: John P. Malloy

Q-10. Please refer to KU's response to LFUCG 1-28. On page 25 of Attachment 1, it states that one benefit of LED lights is "Maintenance Cost Savings." Please confirm that KU agrees that one benefit of LED lights is that LED lights provide reduced operations and maintenance costs as compared to equivalent high pressure sodium lights.

A-10. Based on the assumptions used to create the various scenarios presented in Attachment 1 of response to LFUCG 1-28, estimated maintenance expense and capital savings are a benefit of LED lights.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 11

Responding Witness: John P. Malloy

Q-11. Please refer to KU's response to LFUCG 1-28. On page 31 of Attachment 1, it provides a recommendation that KU develop a tool to estimate the cost to switch to LED lighting.

a. State whether KU has developed a tool to estimate the cost to switch to LED lighting.

b. If not, please state whether KU is committed to developing such a tool and when it anticipates that it will accomplish that objective.

A-11. a. The Company has not developed a tool to estimate the costs to switch to LED lighting.

b. At this time, the Company has not committed to developing a tool.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 12

Responding Witness: John P. Malloy

Q-12. Please refer to KU's response to LFUCG 1-28. There are several references in Attachment 1 to "Business Partners." Please define "Business Partners."

A-12. Business Partners are the people or companies with whom the Company maintains a business relationship.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 13

Responding Witness: John P. Malloy

Q-13. Please refer to KU's response to LFUCG 1-28. Please provide all underlying analysis, data, calculations, and supporting documentation for the information contained in Attachments 1 and 2 that is not otherwise provided to items above.

A-13. See the response to Question No. 4.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 14

Responding Witness: John K. Wolfe

Q-14. Please refer to KU's response to LFUCG 1-32. Please state whether KU has plans to update its construction standards, as included in Attachment 1, to reflect changes to KU's light offerings.

A-14. Yes, KU will update the construction standards to include a standards drawing for LED lights.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 15

Responding Witness: John K. Wolfe

Q-15. Please refer to KU's response to LFUCG 1-32(b) and KLC 1-50. Please identify how KU calculates the average amount of time a light is repaired. For example, is this based on the time after the light has failed? Is this based on the amount of time after a work order is generated?

A-15. KU calculates "time to repair" by taking the difference between the time the call is entered into the work management system from the time the repair is made.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 16

Responding Witness: John K. Wolfe

Q-16. Please refer to KU's response to LFUCG 1-46. Please provide copies of the communications with the lighting manufacturers referenced and all other communication regarding all possible LED lighting fixtures.

A-16. KU does not have copies of these communications which were strictly informal discussions to determine pertinent fixture and life cycle information.

See response to Question No. 52 to view preliminary brands and models that are being considered.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 17

Responding Witness: Robert M. Conroy

Q-17. Please refer to KU's response to LFUCG 1-49.

a. Please state whether KU considers its proposal for lighting rates to be based on cost of service in this rate case.

b. If KU has never performed a cost-of-service study to determine rates for lighting, please describe KU's methodology in calculating lighting rates when the rates were originally proposed.

A-17. a. No. However, the Company is proposing to move lighting rates in the direction of cost of service.

b. Leased lighting has been offered by the Company as early as the 1950s. No current Company employee was employed at the lights' inception. Over the many years since, lighting has received nominal adjustments. The Company determined that this lighting review be performed in order to determine the appropriate allocations.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 18

Responding Witness: William S. Seelye / John K. Wolfe

Q-18. Please refer to KU's response to LFUCG 1-50(c).

a. KU's response identifies what KU describes as the "majority" of the cost differential between KU and LG&E. What is all of the cost differential?

b. Please explain why KU lights require 10-, 12-, or 15-foot brackets and LG&E lights do not require those brackets.

A-18.

a. The remainder of the difference is minor variations and inclusions of the cost of wire, clamps, bolts, washers, one-wire racks, and connectors.

b. KU uses 10', 12', and 15' brackets based on the distance the pole is set back from the road. The light pattern, required on the roadway, requires longer bracket arms when the pole is (by necessity or existing location) set further from the road. LG&E did not include any brackets of this length in their equation.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 19

Responding Witness: John K. Wolfe

Q-19. Please refer to KU's response to LFUCG 1-50(o). KU states that, "Operation and maintenance expenses include the cost of replacing the LED fixture and photocells, including associated labor expenses." Does this mean that when an LED fixture fails and is replaced, neither the purchase nor installation labor of the fixture is capitalized? If they are capitalized, what costs are treated as expenses and allocated as operation and maintenance expenses?

A-19. Should an LED lamp fail and only the lamp is replaced, the labor and the materials are considered operation and maintenance expenses. When the photocell and starter/controller for that light are replaced along with the fixture, then all labor and all materials are capitalized.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 20

Responding Witness: John K. Wolfe

Q-20. Please provide copies of the contract with Davis H. Elliott Company.

A-20. See attached. The information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.

The entire attachments are Confidential and provided separately under seal.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 21

Responding Witness: John K. Wolfe

Q-21. Please refer to KU's response to LFUCG 1-57.

a. Please provide the four bid submissions referenced in the response.

b. The response specifically mentions work performed in Lexington and Louisville.

i. Please confirm that Wilhod and Reed Utilities do not perform work outside of Lexington or Louisville.

ii. Please state what entity performs services related to lighting outside of Lexington or Louisville.

A-21.

a. See attached. The information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.

b.

i. Wilhod and Reed do perform work outside of the Lexington and Louisville territory under the provisions of the contract.

ii. Company personnel perform most of the lighting services outside of the Lexington and Louisville limits; Wilhod and Reed perform some work in the counties surrounding Fayette County. Davis H. Elliott performs work both in Lexington and outside of Lexington. Additionally, Shane Floyd, Fishel, CR Cable, and Lane Construction also perform lighting work outside of Lexington.

The entire attachments are Confidential and provided separately under seal.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 22

Responding Witness: John K. Wolfe

Q-22. Please explain whether KU attempts to use the lowest-cost approved contractor for lighting services on a particular project.

A-22. KU does not evaluate every project or install individually for lowest cost. Through use of the negotiated contract award process, KU ensures that the lowest possible pricing can be achieved while maintaining high service quality. KU uses the two contractors interchangeably for work depending on the work types, current workloads, capabilities, availability, and customer need dates.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 23

Responding Witness: Daniel K. Arbough / Valerie L. Scott

Q-23. Please refer to KU's response to LFUCG 1-66.

a. Does KU receive revenue (insurance, FEMA, or private reimbursement) for equipment damage caused by vehicle collisions, severe weather, or any other catastrophic event?

b. If so, are the repair expenses and other maintenance costs factored into the survivor curve?

c. Where are these revenues posted?

d. Are corrections to cost posted based on revenue received or reimbursed?

A-23.

a. KU does not receive revenue from insurance for street lighting equipment damage. KU may receive reimbursement of damage to street lighting equipment resulting from negligent acts of a third party, if the responsible third party can be identified. These recoveries could be from the third party's insurance coverage and/or their private reimbursement.

b. See the response to part a.

c. KU does not record revenue, as discuss in the response to part a. KU posts the third party reimbursement as a credit to FERC Account 107 Construction Work in Progress.

d. See the response to part c.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 24

Responding Witness: Valerie L. Scott

Q-24. Please refer to KU's response to LFUCG 1-68.

a. Please state whether KU has ever recorded plant costs by lighting type or rate code.

b. Does KU record plant costs differently for LS and RLS classifications, as compared to other classifications?

A-24. a. To the best of my knowledge, KU has never recorded plant costs by rate code.

b. KU does not record plant costs by rate classifications.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 25

Responding Witness: John P. Malloy / John K. Wolfe

Q-25. Please refer to KU's response to LFUCG 1-71.

a. Provide a list of any and all municipalities in which PPL Corporation or its subsidiaries has converted street lights to LED technology.

b. Provide any internal reviews, communications, assessments, and presentations regarding the roll out or operations of these LED lights.

A-25. See the response to Question No. 4.

a. KU is aware that PPL Corporation has LED offerings under their lighting tariffs, but KU does not have specific information or data on those conversions. KU has not converted any municipalities to LED technology.

b. See the response to part a. KU has not commenced upon a conversion or rollout of LED lights for municipalities.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 26

Responding Witness: William S. Seelye

Q-26. Please refer to KU's response to LFUCG 1-72(c).

a. Confirm that the service life for this property group is 26 years as stated in the response.
b. Please reconcile why the service life for this property group is 26 years, but William Seelye calculates the Carrying Charge based on a rate of 4.00% or 25 years, as shown in response to LFUCG 1-50

A-26.

a. The average service life for street lighting equipment is 25 years, not 26 years. The response to LFUCG 1-72(c) was incorrect.

b. See the response to part a. The 4% depreciation rate corresponds to a 25-year service life and is correct.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 27

Responding Witness: William S. Seelye

Q-27. Please refer to KU's response to LFUCG 1-73.

a. Confirm that the service life for the LS offerings is 26 years as stated in the response.
b. Please reconcile why the service life for this property group is 26 years, but William Seelye calculates the Carrying Charge based on a rate of 4.00% or 25 years, as shown in response to LFUCG 1-50.

A-27.

a. The average service life for street lighting equipment is 25 years, not 26 years. The response to LFUCG 1-73 was incorrect.

b. See the response to part a. The 4% depreciation rate corresponds to a 25-year service life and is correct.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 28

Responding Witness: John K. Wolfe

Q-28. Please refer to KU's response to LFUCG 1-73.

a. On what does KU base its statement that the average service life of an LED fixture is 13 years?
b. Please provide all documentation that supports KU's position stated in subparagraph (a).

A-28.

a. The average life of 13 years is based on manufacturers' specifications.

b. KU does not have written documentation from the vendor(s). Certain Company personnel have become educated on LED lighting by attending lighting seminars, by reaching out to other electric utilities that have implemented LED lighting and by discussing the service life issue with numerous manufacturing representatives. Through these interactions a 50,000 hour life cycle was determined which equates to approximately 13 years.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 29

Responding Witness: John P. Malloy / John K. Wolfe

Q-29. Please refer to KU's response to LFUCG 1-75. State whether PPL Corporation or its subsidiaries have partnered with any municipalities or entities other than LFUCG to acquire experience in new technologies, including LED lights. If so, please identify the municipalities and the nature of the project

A-29. See the response to Question No. 4. KU is aware that PPL Corporation has LED offerings under their lighting tariffs, but KU does not have specific information on any partnerships. LFUCG is the only entity that KU or LG&E have partnered with on LED lights.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 30

Responding Witness: Counsel / John P. Malloy / John K. Wolfe

Q-30. Please refer to KU's response to LFUCG 1-75.

a. Please provide a detailed breakdown of the actual $45,910.80 costs, separated by project.
b. Provide copies of all invoices and other documentation to support the expenses identified in subparagraph (a) above.
c. Please explain whether and how KU has accounted for the project cost of $45,910.80 for the purposes of ratemaking.

A-30.

a. – b. Objection. The requested information is irrelevant to the subject matter of this proceeding, namely setting new base rates for KU beginning July 1, 2017. All such cited expenses, to the extent any were chargeable to or incurred by KU, were below the line and were not included in test years used for setting rates. In addition, the forecasted test year in this proceeding includes no such expenses, which are below the line to the extent any are chargeable to or incurred by KU.

c. Project costs were below the line and not included in ratemaking. See responses to parts (a) and (b).

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 31

Responding Witness: John P. Malloy

Q-31. State whether there are any LED lights serving customers in KU's system that are currently billed under an LS or RLS rate code or billed based on a special contract. If so, please identify what the rate code or terms of the contract are.

A-31. KU is not currently billing any customer for LED lights, and does not currently offer LED lights under any LS or RLS rate code.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 32

Responding Witness: John K. Wolfe

Q-32. Please refer to KU's response to LFUCG 1-79. Please provide a rate comparison based on the lighting accounts held by LFUCG.

A-32. The requested rate comparison would require original work the Company has not already performed.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 33

Responding Witness: John K. Wolfe

Q-33. Please refer to KU's response to LFUCG 1-80. Each of the LED-equivalent lights listed by KU is a high pressure sodium offering. The Energy Policy Act of 2005 – Section 135H.R. 6-39 states that "Mercury vapor lamp ballasts . . . shall not be manufactured or imported after January 1, 2008." It appears as though LED technology would be a logical replacement for RLS light offerings. Please confirm that no LED technologies were considered for replacement of mercury vapor light offerings and explain why.

A-33. LED technology would be a possible replacement for RLS light offerings should the customer opt for LED instead of high pressure sodium offerings. High pressure sodium lighting would be considered the default replacement for mercury vapor lights due to the comparatively higher cost of LED lighting.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 34

Responding Witness: John K. Wolfe

Q-34. Please refer to KU's response to LFUCG 1-81. Please provide greater detail on how KU determined the varieties of LED lights to include in its proposed tariff, and particularly the wattage/lumens options. In your response, specify the metrics used to "develop alternative LED options that will provide the same effective lighting as HID options" and the range of LED options considered. Specify the time period during which this work was done. Provide any documents, spreadsheets, or presentation materials received by KU or prepared by or on behalf of KU in reaching those decisions.

A-34. See the responses to Question No. 4, LFUCG 1-46 and LFUCG 1-80. The Company decided to offer the LED choices that were acceptable (not equivalent) options that most closely provide the same effective visual photopic illumination as the current HPS offerings. The range of options was limited to promote efficiencies in procurement and warehousing as well as to limit the number of new rate codes.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 35

Responding Witness: William S. Seelye

Q-35. Please refer to KU's response to LFUCG 1-107.

a. Please confirm that KU agrees that transmission and distribution costs are generally shared by more than one customer.
b. Please confirm that KU agrees that customers have independent demand profiles.

A-35. a. Mr. Seelye does not agree with the general statement. Some transmission and distribution costs are joint and some are related to individual customers. For example, individual transformers, service lines, meters, and often distribution lines will be installed to serve individual customers.

Furthermore, the appropriateness of the proposed 100% ratchet for classes with unbundled demands rates is not mitigated by whether or not distribution and transmission facilities are shared by customers. KU installed transmission and distribution capacity to meet the highest demands of each customer on its system. Some of those facilities are jointly used and some are specific to individual customers. However, each class, and each customer, contributed toward the need for those required facilities, jointly used or not, based on the demands they impose on the distribution and transmission system. Each customer within a class shares responsibility for the revenue requirement associated with the transmission and distribution capacity, jointly used or not, installed to serve the customer's peak load requirements. The use of a 100% ratchet demand charge that is determined specifically on transmission and distribution costs is the only way to ensure each customer pays for the transmission and distribution capacity installed to serve the customer's load.

b. While customers often have similar load patterns, no two load shapes are likely to be the same.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 36

Responding Witness: John P. Malloy

Q-36. Please refer to KU's response to LFUCG 1-101.

a. The item requested that KU provide each contract for current and future unmetered service. Please provide these contracts or state that none exist.
b. If no contracts for unmetered service exist, please provide a detailed description of each customer that has unmetered service, including each customer's facilities, and the amount of estimated energy usage.

A-36.

a. After a limited review of contract files, the Company was unable to locate the contracts associated with these 54 customers. The original contracts were filed in the KU/LG&E business offices serving each account at the time it was activated. Some years ago the majority of these business offices were consolidated with larger business office locations or closed altogether. Existing contracts were forwarded to various business offices or to corporate locations in Lexington and Louisville. The location of specific, historic contracts is not certain at this time. Some contracts might be located if an extensive search were undertaken. However, it would require an undetermined amount of time to conduct such a search.

b. See attached. Certain information is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection. In regards to zero use unmetered accounts, many of these are sirens that are not used often. Instead of placing a meter and attempting to read it each month, it was decided to simply charge the customer the basic service charge. This benefits the customer and Company.

CONFIDENTIAL INFORMATION REDACTED

Customer	Average Monthly KWh	Customer Description	Customer Contract Account	Facility Address	Facility City, State, Zip Code
1	1,300				
2	100				
3	250				
4	100				
5	250				
6	250				
7	152				
8	152				
9	30				
10	-				
11	167				
12	-				
13	-				
14	40				
15	1,200				
16	50				
17	50				
18	50				
19	50				
20	1,287				
21	-				
22	-				
23	400				
24	1				
25	32				
26	24				
27	25				
28	23				
29	1,107				
30	1,665				
31	65				
32	1				
33	11,320				
34	86				
35	-				
36	452				
37	-				
38	-				
39	-				
40	-				
41	-				
42	-				
43	100				
44	120				
45	70				
46	100				
47	25				
48	125				
49	900				
50	5				
51	284				
52	390				
53	62				
54	1				

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 37

Responding Witness: John K. Wolfe

Q-37. Please provide a detailed description on how KU has increased its projected revenue for cable attachments based on the KentuckyWired project for which KU entered into a license agreement with the Commonwealth of Kentucky Finance and Administration cabinet. Include within your response the actual and projected connections and revenue associated with this project during the base period, test year, and any future periods that have been forecasted by KU.

A-37. KU has not increased its projected revenue for cable attachments based on the KentuckyWired project.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 38

Responding Witness: Christopher M. Garrett

Q-38. Please identify every rate code and special contract for which KU collects revenue that is subject to LFUCG's franchise fee.

A-38.

Kentucky Utilities Company Case No. 2016-00370 Rate Codes and Special Contacts Subject to Franchise Fees
Rate Codes:
All Electric School
Electric Vehicle Charging Service
General Service
Lighting Service
Power Service
Residential Service
Residential Time-of-Day Energy Service
Restricted Lighting Service
Retail Transmission Service
Time-of-Day Primary Service
Time-of-Day Secondary Service
Traffic Energy Service
Special Contracts:
None

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 39

Responding Witness: John K. Wolfe

Q-39. Please refer to KU's response to KLC 1-55(a). Please explain what the "# of poles" is inclusive of. Please include in your response whether the "# of poles" includes every KU pole with electrical transmission or distribution lines, as well as every KU pole with lighting.

A-39. The total "# of poles" is inclusive of all poles that KU has primary or secondary voltage level facilities including street lighting, service, and guying poles. Transmission line poles are only included if there are primary or secondary conductors underbuilt on the pole route.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 40

Responding Witness: John K. Wolfe

Q-40. Please explain how KU marks its poles within Fayette County to identify them as being owned and maintained by KU.

A-40. For wood poles, the poles have a stamped birthmark into the wood showing the class, size, and year of the pole's manufacture as well as by pole number and mapping location. For metal poles the poles are identified by pole numbers and by mapping.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 41

Responding Witness: William S. Seelye

Q-41. Is a cost-of-service study using the Base/Intermediate/Peak methodology described in the NARUC Electric Utility Cost Allocation Manual?

A-41. While the Base-Intermediate-Peak (BIP) methodology is described in the NARUC Electric Utility Cost Allocation Manual, the Company uses a modified version of the BIP methodology.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 42

Responding Witness: John K. Wolfe

Q-42. Please refer to KU's response to PSC 2-89.

a. Please explain why KU is willing to replace failed mercury vapor bulbs but will remove the entire fixture if the fixture is broken.
b. Please identify the replacement fixtures KU uses for each mercury vapor fixture.
c. Please state whether KU will begin to replace broken mercury vapor fixtures with LED technology.

A-42

a. KU does not maintain an inventory of the mercury vapor fixtures.

b. The replacement fixtures are based on lumen output as below:

	Mercury Vapor	HPS
	Lumens	Lumens
Cobra Head	7000	5800
Cobra Head	10000	9500
Cobra Head	20000	22000
Open Bottom	7000	5800

c. No, KU will not replace mercury vapor fixtures with LED as the default replacement due to the higher cost of LED lights over high pressure sodium. KU will replace with LED lights should the customer request LED lights.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 43

Responding Witness: Robert M. Conroy

Q-43. Please confirm that KU agrees that stranded asset losses would be reduced or eliminated if KU stopped installing non-LED lighting technology and began to only install LED at lower or same costs but with reduced or lower O & M. Please also state whether KU will consider this approach.

A-43. The Company is unaware of what is meant by reducing or eliminating stranded asset losses if KU stopped installing non-LED lighting technology and began to only install LED technology. The rates for the proposed LED lights are developed to reflect the cost of providing service for that fixture and KU is unable to artificially reduce the cost to install or maintain such fixtures.

Regarding KU's willingness to stop installing non-LED lighting technology, it is KU's goal to serve its customers. One way of achieving that goal is adding LED lighting offerings. If customers ask KU to install only LED lights going forward, KU will install only LED lights in response to customer orders. But it seems likely that customers will ask KU to install at least some non-LED lights in the future; therefore, KU does not believe it is appropriate at this time to cease offering all non-LED lights.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 44

Responding Witness: William S. Seelye / John K. Wolfe

Q-44. In tab "KU Rate Summary" of the spreadsheet "Att_DU_PSC_1-54_KULights.xlsx", cells F30:F96 in a table by rate code are labelled as Total Lights. Cells AF30:AF96 are similarly labelled as Total Lights but contain different values. Please explain the origins and differences of these two sets of values for Total Lights.

A-44. It is assumed that the spreadsheet reference was meant to be "Att_KU_PSC_1-54_KULights.xlsx". The cells F30:F96 indicate the number of lighting fixtures by bill code for the forecasted test period ending 6/30/2018. The cells AF30:AF96 indicate the number of existing lighting fixtures by bill code for the period ending 8/31/2016.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 45

Responding Witness: William S. Seelye / John K. Wolfe

Q-45. In tab "KU Rate Summary" of the spreadsheet "Att_DU_PSC_1-54_KULights.xlsx", cells C21:CC21 contain annual operations and maintenance cost allocations for by rate code. Some entries in these cells are formulae referencing other cells in this spreadsheet but some entries contain specific numerical values or formulae that contain specific numerical values. For each of these cells C21:CC21, identify the origin and basis for any numerical values included in the contents of the cell.

A-45. See the response to PSC 3-43.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 46

Responding Witness: William S. Seelye / John K. Wolfe

Q-46. In tab "KU Rate Summary" of the spreadsheet "Att_DU_PSC_1-54_KULights.xlsx", cells BU4 and BU14 contain notes identifying certain spreadsheets as sources for adjacent information. Provide copies of the referenced spreadsheets in electronic format with all formulas intact.

A-46. It is assumed that the spreadsheet reference was meant to be "Att_KU_PSC_1-54_KULights.xlsx". See attachments being provided in Excel format. The information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.

The attachment is Confidential and provided under seal in a separate file in Excel format.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 47

Responding Witness: William S. Seelye / John K. Wolfe

Q-47. In tab "LED Rates" of the spreadsheet "Att_DU_PSC_1-54_KULights.xlsx", cells BU4, CH16 and CH18 contain notes identifying certain spreadsheets as sources for adjacent information. Provide copies of the referenced spreadsheets in electronic format with all formulas intact.

A-47. See the response to Question No. 46.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 48

Responding Witness: William S. Seelye / John K. Wolfe

Q-48. In the spreadsheet "Att_DU_PSC_1-54_KULights.xlsx", light wattage is used extensively in various calculations. Specify for each lighting rate code whether these are nominal lamp wattage or fixture input wattage and provide both values.

A-48. It is assumed that the spreadsheet reference was meant to be "Att_KU_PSC_1-54_KULights.xlsx". See the filing requirements tariff offerings. The wattage rating for each lighting fixture is listed in the rate schedules for Rate LS and Rate RLS and represents the total power requirement (which includes both the light and any ballast load).

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 49

Responding Witness: John K. Wolfe

Q-49. In tab "LED Rates" of the spreadsheet "Att_DU_PSC_1-54_KULights.xlsx", each LED light proposed for inclusion in the tariff is compared with a non-LED light listed below the LED light. Explain how the non-LED lights were chosen for this comparison.

A-49. Assuming the spreadsheet reference was meant to be "Att_KU_PSC_1-54_KULights.xlsx" the comparison offering was based on lumen output, temperature, color rendering, distribution of light, and the visual photopic illumination of the light.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 50

Responding Witness: John K. Wolfe

Q-50. Explain how KU will decide or assist a customer to decide what LED light to use if a customer wishes to replace an existing non-LED street light with an LED light.

A-50. For most offerings, KU would recommend the customer use an LED light with similar visual photopic illumination to the existing light. See also the listed alternative replacements shown in the answer to LFUCG 1-78.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 51

Responding Witness: John K. Wolfe

Q-51. Explain how KU will in the future decide or assist a customer to decide what light to use if a customer wishes to have KU install a new light where one has not been installed.

A-51. KU will only serve to advise the customer on their choice of light and does not recommend a specific light. KU will explain the lumen, wattage differences, color temperature, and light distribution pattern of the light options in addition to reviewing with the customer the pricing and desired lighting characteristics.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 52

Responding Witness: John K. Wolfe

Q-52. Identify the brand and model KU proposes to use for each LED light rate code and provide product literature or specifications including at least nominal lamp wattage, fixture input wattage, CRI, color temperature, L70 life, initial warranty duration, and costs that would be covered by a warranty claim. Provide similar data for each non-LED street light luminaire currently provided by KU.

A-52. The brand and product numbers for LEDs purchased have not been finalized and the Company is expected to approve multiple manufacturers for each tariffed item offered. See attachments 1 – 3 of preliminary brands and models that are being considered. The information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.

LED standard warranties from at least one vendor under consideration are 5 years, with an option for an additional 5 year extended warranty at additional cost. The warranty would cover the cost of the fixture. Warranty provisions, CRI and color temperature are still under review and vary by manufacturer. Total fixture wattage for both non-LED and LED lights are provided in the appropriate tariff. Input wattage, CRI, L70 life will vary by manufacturer and cannot be determined until vendors and products have been finalized. See attachments 4 – 7 for data sheets of existing HID lighting options for which an LED alternative is being offered.

The entire attachments are Confidential and provided separately under seal.

GE
Lighting Solutions

Decorative Post Top Lighting

Town and Country™ (T10C & T10R)

imagination at work

Product Features

GE offers a variety of decorative Post Top and Pendant Mount Lighting solutions that range from the nostalgic looks of yesterday to the sleek, modern designs of today, providing style and elegance to downtown areas, commercial developments, parks and residential communities.

Applications

- Residential areas and walkways
- Shopping centers and malls

Housing

- Die-cast aluminum housing

Finish

- Powder coat paint finish

Ratings

- UL/cUL 1598 Listed Suitable for Wet Locations
- UL listed to Canadian National Standards and Codes when polycarbonate refractor is used and "U" option is chosen

Unique Features

- Hinged canopy
- Stainless steel catch to avoid hinge breakage
- Acrylic or polycarbonate refractors
- Integral ballast
- Mogul base socket – E39 standard (T10C vertical; T10R horizontal – 15°)
- Plug-in ignitor
- No-tool PE receptacle
- Optional pendant mount (Contact factory)

Ordering Number Logic

Town and Country™ (T10C & T10R)

____ - __ - _ - _ - _ - _ - _ - _ - ___ - __ - _

PROD. ID	WATTAGE	LIGHT SOURCE	VOLTAGE	BALLAST TYPE	PE FUNCTION	REFRACTOR	IES DISTRIBUTION TYPE	COLOR	OPTIONS
T10C = Town and Country Luminaire with vertical socket **T10R** = Town and Country Luminaire with horizontal -15° socket **NOTE:** UL Listed and CSA certified when Polycarbonate refractor is used. See "U" option.	**05** = 50 **07** = 70 **10** = 100 **15** = 150 (55V)	**S** = HPS Standard: Lamp not included.	**60Hz** **0** = Multivolt HPS Auto-Reg **1** = 120 **2** = 208 **3** = 240 **4** = 277 **5** = 480 **7** = 120X240 **8** = 240V Ballast 120V PE Receptacle. Not reconnectable **C** = 120x240 277 **D** = 347 **F** = 120X347 **NOTE:** Dual voltage connected for lower voltage	See Ballast and Photometric Selection Table **A** = Autoreg **G** = Mag-Reg with Grounded Socket Shell **H** = HPF Reactor or Lag **M** = Mag-Reg **N** = NPF Reactor or Lag	**1** = None **2** = PE Receptacle **NOTE:** Receptacles connected same voltage as unit except as noted. Order PE Control separately.	**A** = Acrylic **L** = Polycarbonate	See Ballast and Photometric Selection Table **SS4** = Short Semi-cutoff Type IV **SS5** = Short Semi-cutoff Type V **MS2** = Medium Semi-cutoff Type II **MS3** = Medium Semi-cutoff Type III **MS5** = Medium Semi-cutoff Type V	**BL** = Black (Standard) **DB** = Dark Bronze **GR** = Gray	**F** = Fusing (Not available with dual voltage) **J** = Line Surge Protector, Expulsion Type (Not available for UL Listed units) **L** = Latch Canopy **T** = Terminal Board **U** = UL/cUL Listed and CSA Certified (Available with polycarbonate refractor only) **NOTE:** Terminal Board (T option) Required for UL Listing

ALL METAL HALIDE VERSIONS AND THEIR ASSOCIATED OPTIONS ARE NO LONGER AVAILABLE EFFECTIVE JANUARY 1, 2017

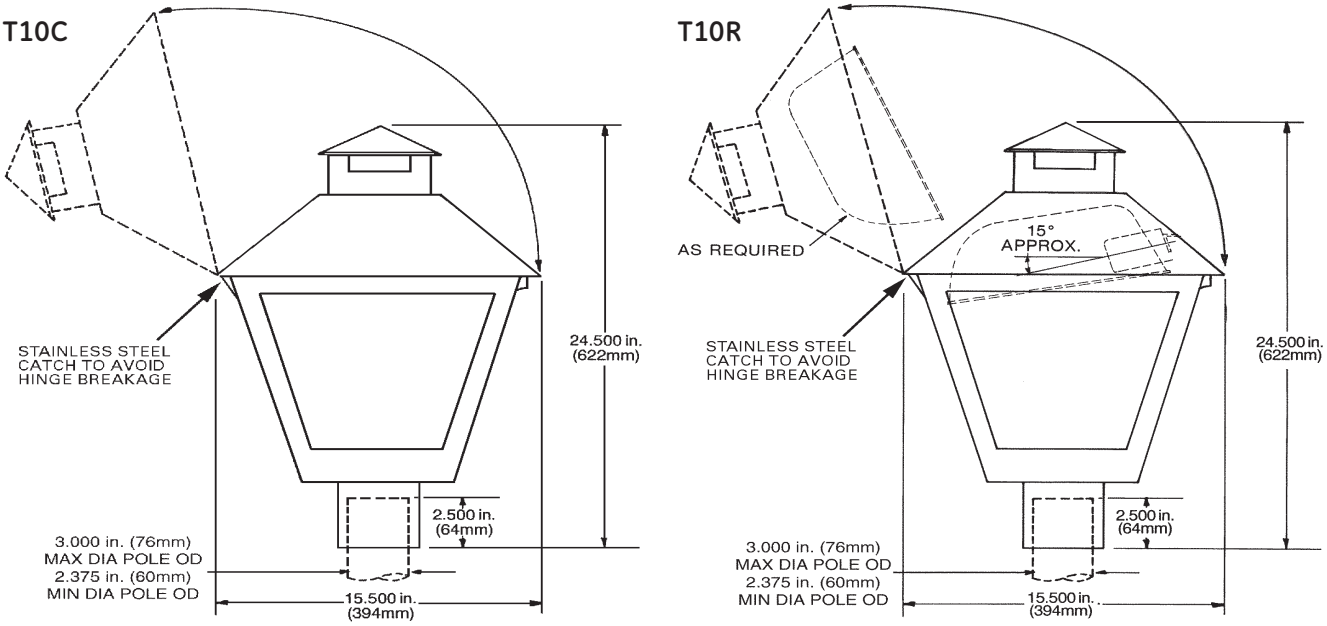
Ballast and Photometric Selection Table

All light sources are clear unless otherwise indicated.

		Ballast Type/Voltage 60Hz									Photometric Curve Number 35- T10C			T10R		
Wattage	Light Source	Multi-volt	120	208	240	277	480	347, 120X240	120X347	PE R 240/120	IES Distribution Type MS5	SS4	SS5	MS2	M	SS4
50	HPS	N/A	**H, N**	N/A	N/A	N/A	N/A	N/A	**H**	N/A	177505	N/A	N/A	177502	177503	N/A
70, 100, 150 (55V)	HPS	**A,H**	**A,G,H,M,N**	**A,G,H,M,N**	**A,G,H,M,N**	**A,G,H,M,N**	**A,G,M**	N/A	**H**	N/A	177505	N/A	N/A	177502	177503	N/A

NOTE: N/A = Not available.
**Medium Base Socket

Product Dimensions



DATA

- Approximate Net Weight: 10-16 lbs (5-7 kgs)
- Suggested Mounting Height: 10-18 ft. (3-5 M)
- Effective Projected Area: 1.6 sq ft. max (0.15 sq M max)

GE
Lighting Solutions

Roadway Lighting

201SA Unit Pack (SAM)

imagination at work

Product Features

GE Roadway Lighting systems have been recognized for the highest quality and reliability in Outdoor, Utility, DOT and infrastructure lighting applications.

Applications

- For outdoor work yards, roadside commercial establishments, suburban developments, rural areas Housing

Housing

- Die-cast aluminum hood

Finish

- Polyester powder gray paint finish

Rating

- Ⓤ/ᶜⓊ Listed for wet location available as an option

Mounting

- Slipfitter is designed for 1-1/4 in. pipe
- Mounting Hardware Kit
  — (1) 5/8 x 10 Throughbolt and Nut (15.9mm x 254mm)
  — (2) 3/8 x 3 Lag Screws (9.5mm x 76mm)

Reflectors

- Skygard™ reflector provides IESNA Full Cutoff

Unique Features

- Complete unit pack in one package standard: includes hood, optical, lamp, PE control, prewired cable and mounting hardware
- Mogul base socket - E39 standard
- Terminal board and plug-in ignitor are standard

Ordering Number Logic

201SA Unit Pack (SAM)

S A M _ _ _ - _ _ - S _ - _ _ - N _ - _ _ - _ _ - _ _ - _ _ _ _ - _

PROD. ID	WATTAGE	LIGHT SOURCE	VOLTAGE	BALLAST TYPE SELECTION	PE FUNCTION	CABLE	MOUNTING BRACKET	LENS TYPE	LAMP TYPE
SAM = 201SA Type unit pack	**07** = 70 **10** = 100 **15** = 150 (55V)	**S** = HPS	**1** = 120 **3** = 240* *240 available for 100W HPS only	**N** = NPF Reactor or Lag	**2**=PE Receptacle **5**=PE Receptacle with PE Control	**1** = None **2** = 3-ft #14 **4** = 5-ft #14 **5** = 8-ft #14 **6** = 8-ft #10	**L** = Long 24-in. (610mm) **N** = None	**V3AL** = Open Type 3 Acrylic Latch Type **V5AL** = Open Type 5 Acrylic Latch Type **V5SL** = Open Type 5 Skygard aluminum reflector Latch Type, meets Full Cutoff * requirements * = Previously IESNA Full Cutoff Optics	**C** = Clear **E** = Clear ECO Lamp **N** = No Lamp **P** = Encapsulated Ignitor **S** = Standby Dual Arc Tube Lamp **Y** = Clear ECO NC Lamp

Photometric Selection Table

201SA OPTICAL (V3AL, V5AL)

Wattage	Light Source	IES Type	Photometric Curve Number
70, 100, 150 (55V)	HPS	Symmetric	35-176919
70, 100, 150 (55V)	HPS	Asymmetric	35-178983

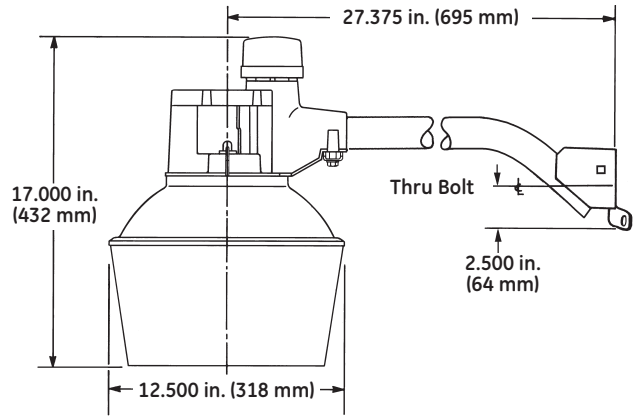
Photometric Selection Table

SKYGARD™ OPEN FULL CUTOFF REFLECTOR (V5SL)

Wattage	Light Source	IES Type	Photometric Curve Number
70	HPS	Symmetric	35-452513
100	HPS	Symmetric	35-452512
100	HPS	Symmetric	35-452511

Product Dimensions

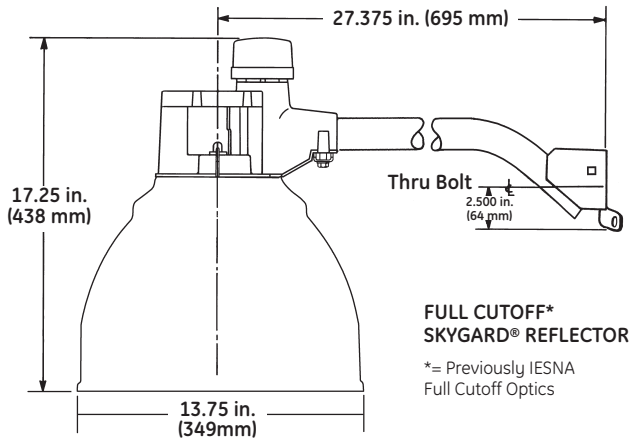
MOUNTING BRACKET



DATA

- Approximate Net Weight
  Long 24 in. (610 mm) Mounting Bracket: 16 lbs (7.3 kgs)
- Effective Projected Area: 1.37 sq. ft. max. (0.1 sq. M max.)
- Suggested Mounting Height: 12-25 ft. (4-8 M)

SKYGUARD OPTICAL



DATA

- Approximate Net Weight
  Long 24 in. (610 mm) Mounting Bracket: 17 lbs (7.7 kgs)
- Effective Projected Area: 1.4 sq. ft. max. (0.13 sq. M max.)
- Suggested Mounting Height: 12-25 ft. (4-8 M)

GE
Lighting

Roadway Lighting

M-250R2 (M2RR)

imagination at work

Product Features

From HID to LED, GE continues to push Roadway Lighting to new heights. Recognized for the highest quality and reliability in street, highway, parkway, and commercial applications, GE offers a wide selection of styles to meet the lighting needs of municipalities, utilities, DOT customers and more.

Applications

- For lower wattage roadway applications including residential streets, parking lots and other long, narrow areas

Housing

- Die-cast aluminum housing
- External stainless steel bail latch

Finish

- Polyester powder gray paint finish

Rating

- Listed for wet location available as an option

Mounting

- Universal two-bolt slipfitter
- Metal pest guard standard (not required for 2 in. pipe mounting)

Unique Features

- Adjustable mogul base socket (street side) – E39 standard
- No-tool PE receptacle
- Plug-in ignitor
- Plastic pest guard standard (not required for 2 in. pipe)

Ordering Number Logic

M-250R2 (M2RR)

M2RR ____ __ _ _ _ _ _ _ _

PROD. ID	WATTAGE	LIGHT SOURCE	VOLTAGE	BALLAST TYPE SELECTION	PE FUNCTION	LENS TYPE (PRISMATIC) REFRACTOR	IES DISTRIBUTION TYPE	OPTIONS
M2RR = M-250R2	**05** = 50 **07** = 70 **10** = 100 **15** = 150 (55V) **17** = 175 **20** = 200 **21** = 100/150 (55V) **25** = 250 **NOTE:** Dual wattage connected for lower wattage	**S** = HPS Standard: Lamp not included.	**60Hz** **0** = 120/208/240/277 Multivolt **1** = 120 **2** = 208 **3** = 240 **4** = 277 **5** = 480 **7** = 120X240 **8** = 240V Ballast 120V PE Receptacle not reconnectable **D** = 347 **F** = 120X347 **T** = 220 **50Hz** **6** = 220 **R** = 230 **Y** = 240 **NOTE:** Dual voltage connected for lower voltage	See Ballast Selection Table **A** = Autoreg **G** = Mag-Reg with Grounded Socket Shell **H** = HPF Reactor or Lag **M** = Mag-Reg **N** = NPF Reactor or Lag **P** = CWI with Grounded Socket Shell	**1** = None **2** = PE Receptacle **NOTE:** Receptacle connected same voltage as unit except as noted. Order PE Control separately.	See Photometric Selection Table **A** = Acrylic **G** = Glass **L** = Polycarbonate **NOTE:** 150 watt Maximum with Acrylic or Polycarbonate Refractors.	See Photometric Selection Table **M** = Medium **L** = Long **S** = Semi-cutoff **N** = Non-cutoff **2** = Type II **3** = Type III	**C** = Charcoal filter **F** = Fusing (Not available with multivolt or dual voltage) **J** = Line Surge Protector, Expulsion Type (UL not available) **N** = Meets proposed ANSI C136.31 requirements for Bridge and Underpass Vibration **U** = UL/cUL listed with glass only (60Hz only)

ALL METAL HALIDE VERSIONS AND THEIR ASSOCIATED OPTIONS ARE NO LONGER AVAILABLE EFFECTIVE JANUARY 1, 2017

Ballast Selection Table

		Ballast Type/Voltage 60Hz											Ballast Type/Voltage 50Hz		
Wattage	Light Source	Multivolt	120	208	240	277	480	120X240	120X347	347 PER	240/120 220	230	220	230	240
50	HPS	H,N	H,N	H,N	H,N	H,N	H,N	H,N	H,N	H,N	N/A	N/A	N/A	N/A	N/A
70,100,150 (55V)	HPS	A,H,N	A,G,H,M,N,P	A,G,H,M,N	A,G,H,M,N,P	A,G,H,M,N	G,M	G,H,M,N,P	G*,H,M*,N	G,H,M,N	H,M,N	N/A	H,M,N	H	N/A
100/150 (55V)	HPS	N/A	H,N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200, 250	HPS	A,P	A,H,N,P	A,H,N,P	A,H,N,P	A,P	A,P**	A,P	A**,P	A,H,N	H	H	A,H,N	H	H

NOTE: N/A = Not available. *Not available in 120 X 347. **Not available in 200 watt or 310 watt. • = Medium base socket

Photometric Selection Table

All light sources are clear unless otherwise indicated.

			IES Distribution Type Photometric Curve Number 35 (Socket Postition)					
Wattage	Light Source	Lens Type (Prismatic Refractor)	LN3	MN2	MN2	MN3	MS2	MS3
50,70,100,150 (55 V)	HPS	Acrylic	N/A	N/A	177246(1A)	177247(2A)	177244(2B)	177245(2.5B)
50,70,100,150 (55 V)	HPS	Glass	N/A	N/A	177250(1A)	177251(2A)	177248(1.5B)	177249(2.5B)
50,70,100,150 (55 V)	HPS	Polycarb.	177258(1A)	177259(2A)	N/A	177256(2B)	177311	N/A
200, 250	HPS	Glass	N/A	N/A	N/A	N/A	177261(2DH)	177260(1DH)

NOTE: N/A = Not Available

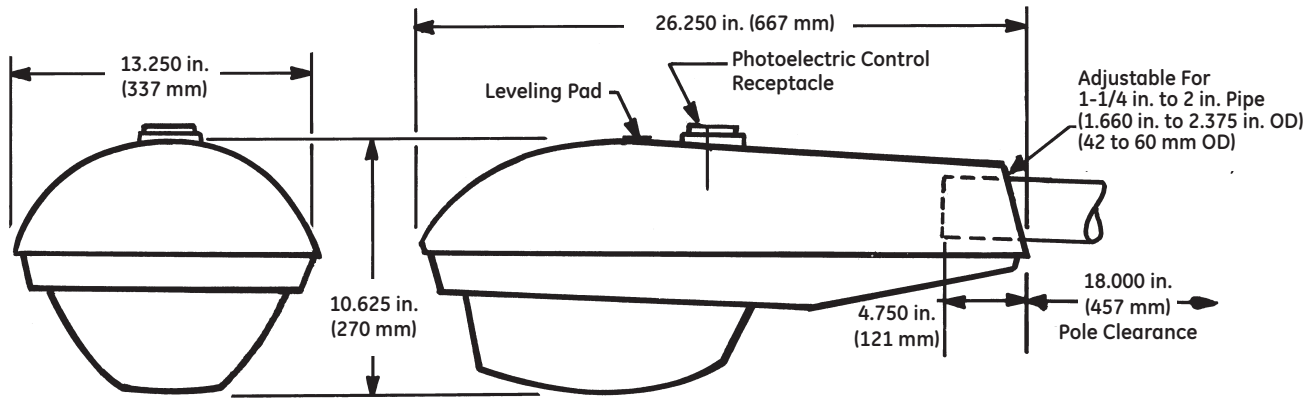
M2AC – Suggested Catalog Ordering Numbers

Catalog Number	Wattage	Light Source	Voltage (60 Hz)	Ballast Type	Refractor Type	Photometric Distribution
M2RR10S1N2AMS2	100	HPS	120	NPF Reactor	Acrylic	MS2
M2RR15S1N2AMS3	150	HPS	120	NPF Reactor	Acrylic	MS3
M2RR25S0A2GMS3	250	HPS	Multivolt	Auto-Regulator	Glass	MS3

All GE suggested catalog ordering numbers come with PE receptacle. PE control must be ordered separately. Order and install SCCL-PECTL if no PE is desired.

Multivolt ballasts can be for either 120, 208, 240, or 277 volt incoming power supply.

Product Dimensions



DATA

- Approximate Net Weight: 20-30 lbs (9-14 kgs)
- Effective Projected Area: 0.7 sq. ft. max. (0.07 sq. M max.)
- Suggested Mounting Height: 20-40 ft. (6-12 M)

www.gelighting.com

OLP2934 (Rev 01/17/17)

GE
Lighting

Roadway Lighting

M-400 (MSRL & MSRA)

imagination at work

Product Features

From HID to LED, GE continues to push Roadway Lighting to new heights. Recognized for the highest quality and reliability in street, highway, parkway, and commercial applications, GE offers a wide selection of styles to meet the lighting needs of municipalities, utilities, DOT customers and more.

Applications

- For street, highway, parking lot and area lighting

Housing

- Die-cast aluminum housing.
- External paddle type stainless steel bail latch

Finish

- Polyester powder gray paint finish

Ratings

- UL/cUL listed for wet location available

Mounting

- Universal two or four-bolt slipfitter
- Metal pest guard standard (not required for 2 in. pipe mounting)

Reflectors

- Standardized reflector

Unique Features

- Adjustable mogul base socket (house side) – E39 standard
- Plug-in ignitor standard
- “Dead back” tunnel type terminal board
- No-tool PE receptacle

Ordering Number Logic

M-400 (MSRL & MSRA)

____ __ _ _ _ _ 2 _ _ _

PROD. ID	WATTAGE	LIGHT SOURCE	VOLTAGE	BALLAST TYPE SELECTION	PE FUNCTION	IGNITOR MOUNTING	LENS TYPE	IES DISTRIBUTION TYPE	OPTIONS
MSRL = M-400 with 2-bolt slipfitter **MSRA** = M-400 with 4-bolt slipfitter	**07** = 70 **10** = 100 **15** = 150 (55V) **17** = 175 **20** = 200 **24** = 250/400 **25** = 250 **31** = 310 **32** = 320 **35** = 350 **40** = 400 **84** = 85 (4000K) **83** = 85 (3000K) **NOTE:** Dual wattage connected for lower wattage	**S** = HPS **Q** = QL **Induction Standard:** Lamp not included.	**60Hz** **0** = 120/208/240/277 Multivolt **1** = 120 **2** = 208 **3** = 240 **4** = 277 **5** = 480 **7** = 120X240 **8** = 240V Ballast 120V PE Receptacle not reconnectable **D** = 347 **G** = 200-277 **T** = 220 **W** = 230 **50Hz** **6** = 220 **R** = 230 **Y** = 240 **NOTE:** Dual voltage connected for lower voltage	See Ballast Selection Table **A** = Autoreg **E** = Induction Ballast **G** = Mag-Reg with Grounded Socket Shell **H** = HPF Reactor or Lag **M** = Mag-Reg **N** = NPF Reactor or Lag **P** = CWI with Grounded Socket Shell	**1** = None **2** = PE Receptacle **NOTE:** Receptacle connected same voltage as unit except as noted. Order PE Control separately.	**2** = Plug-in base and Ignitor	**R** = Prismatic Glass Refractor **P** = Lexan *250 Watt HPS Maximum Prismatic Refractor	See Photometric Selection Table **S** = Short **M** = Medium **S** = Semi-cutoff **C** = Cutoff **2** = Type II **3** = Type III	**C** = Charcoal filter **F** = Fusing (Not available with multivolt or dual voltage) **J** = Line Surge Protector, Expulsion Type (UL not available) **U** = UL/cUL listed with glass only (60Hz only)

ALL METAL HALIDE VERSIONS AND THEIR ASSOCIATED OPTIONS ARE NO LONGER AVAILABLE EFFECTIVE JANUARY 1, 2017

Ballast Selection Table

Wattage	Light Source	Ballast Type/Voltage 60Hz												Ballast Type/Voltage 50Hz		
		Multivolt	120	208	240	277	480	120X240	347** 120X347	240/120 PE R	220	230	200-277	220	230	240
150 (55V)	HPS	H,N,A	G,H,M,N	G,M	G,M	G,M	G,M	G,H,M,N	G*,H,M*,N	G,M	N/A	N/A	N/A	N/A	N/A	N/A
200	HPS	A,G,M,P	A,G,H,M,N,P	A,G,H,M,N,P	A,G,H,M,N,P	A,G,M,P	A,G,M	A,G,M,P	A,G,M,P	A,G,H,M,N	N/A	H	N/A	N/A	N/A	N/A
250	HPS	A,G,M,P	A,G,H,M,N,P	A,G,H,M,N,P	A,G,H,M,N,P	A,G,M,P	A,G,M,P	A,G,M,P	A,G,M,P	A,G,H,M,N	A,H	H	N/A	A,H,M,N	H	M
250/400	HPS	A	A	A	A	A	A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
310	HPS	A,G,M	A,G,M	A,G,H,M,N	A,G,H,M,N	A,G,M	A,G,M	A,G,M	A,G,M	A,G,H,M,N	N/A	H	N/A	N/A	N/A	N/A
400	HPS	A,G,M	A,G,M	A,G,H,M,N	A,G,H,M,N	A,G,M	A,G,M	A,G,M	A,G,M	A,G,H,M,N	A,H,N	H	N/A	A,H,M,N	N/A	A,H,M

NOTE: N/A = Not available. *Not available in 120 X 347. **Not available in 200 watt or 310 watt. C/F = Contact Manufacturer

Photometric Selection Table

GLASS PRISMATIC REFRACTOR
All light sources are clear unless otherwise indicated.

Wattage	Light Source	IES Distribution Type Photometric Curve Number 35-						Polycarbonate
		Semi-Cutoff			Cutoff			
		MS2	MS3	MC2	MC3	SC2	SC3	
150 (55V)	HPS	450395	450394	N/A	450393	N/A	N/A	450957(MC3)
200-400	HPS	451012	451013	451014	451015	N/A	451016	450958(MS3)

NOTE: N/A = Not Available C/F = Contact Manufacturer

MSRL – Suggested Catalog Ordering Numbers

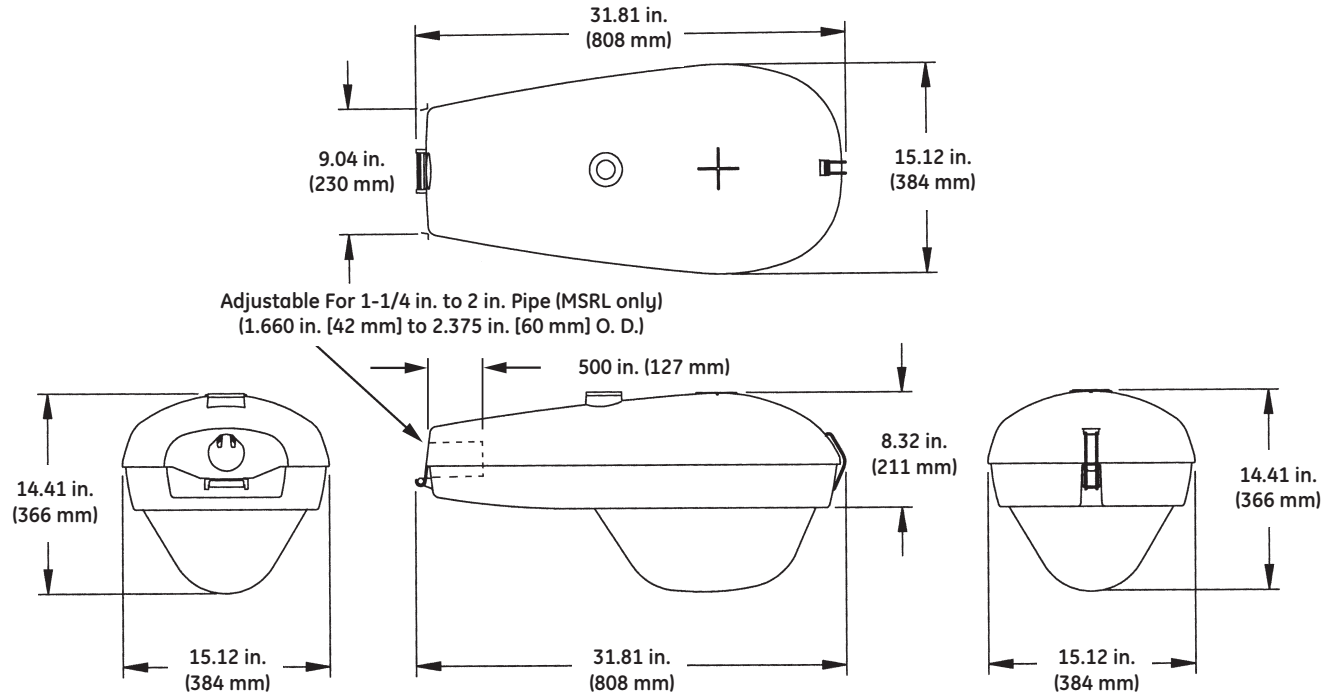
Catalog Number	Wattage	Light Source	Voltage (60 Hz)	Ballast Type	Refractor Type	Photometric Distribution
MSRL25S0A22RMS3	250	HPS	Multivolt	Auto-Regulator	Glass	MS3
MSRL40S0A22RMS3	400	HPS	Multivolt	Auto-Regulator	Glass	MS3

All GE suggested catalog ordering numbers come with PE receptacle. PE control must be ordered separately. Order and install SCCL-PECTL if no PE is desired.

Multivolt ballasts can be for either 120, 208, 240, or 277 volt incoming power supply.

Product Dimensions

TOP VIEW



SIDE VIEWS

DATA

- Approximate Net Weight: 33-39 lbs (15-18 kgs)
- Effective Projected Area: 1.4 sq. ft. max. (0.13 sq. M max.)
- Suggested Mounting Height: 30-50 ft. (9-15 M)

www.gelighting.com

OLP2925 (Rev 01/17/17)

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 53

Responding Witness: John K. Wolfe

Q-53. What are the specifications of the photocell receptacles and photocells KU will use when installing street light luminaires in the immediate future? Specify in your response how many pins will be included.

A-53. A 7-pin PEC receptacle is standard or will be specified on all LED fixtures. A long life photocell will be used with LED fixtures. Vendor and product specifications for PEC's have not be finalized.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 54

Responding Witness: John K. Wolfe

Q-54. KU currently plans to deploy "smart grid" technologies that will require wireless communications. Will that deployment enable wireless communications with street lights if street lights are appropriately equipped? If so, please describe the time frame in which this will occur within KU's system?

A-54. Street lights have not been evaluated as part of the proposed "smart grid" deployment.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 55

Responding Witness: John K. Wolfe

Q-55. For each lighting technology offered by KU, including HPS, metal halide, MV, and LED and any variants of each for which there is a material difference, identify each of the operations and maintenance activities that KU anticipates performing on such street lights, whether the activity is performed on a scheduled (periodic) basis or as-needed, the anticipated frequency of the activity with respect to an individual light, the cost elements associated with that activity, and whether or in what circumstances each such cost element is covered by warranty.

A-55. All lights will have the same operations and maintenance activities performed including replacing failed fixtures, bulbs, photocells, starters, and repairs to damaged service conductors. All operations and maintenance activities are performed upon failure of operability of the light as needed. The anticipated lifespans of each light can vary by wattage but in general are as follows: HPS, metal halide, and MV lights have an expected lifespan of 6 years; LED lights have an expected lifespan of 13 years. At the end of lifespan for HPS, the expected cost elements are the photocell, starter and bulb; for metal halide and MV, the expected cost elements are the photocell and bulb; none of these are tracked for warranty coverage. For LED the entire fixture will be replaced; all vendors under consideration for the LED fixture have a standard 5-year warranty coverage.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 56

Responding Witness: John K. Wolfe

Q-56. Provide any documents, spreadsheets, or presentation materials received by KU or prepared by or on behalf of KU since January 1, 2014, that provide estimates of the annual operations and maintenance costs for any lighting offering by KU, including HPS, metal halide, MV, and LED and any variants of each for which there is a material difference.

A-56. KU does not track the O&M expenses for each specific lighting offering. KU's operating and maintenance costs per month by year for the period, January 1, 2014 to December 31, 2016, are attached.

Kentucky Utilities O&M per month for street light repairs

Year	Sum of Jan	Sum of Feb	Sum of Mar	Sum of Apr	Sum of May	Sum of Jun
2014	$ 47,313	$ 41,696	$ 51,333	$ 61,440	$ 58,039	$ 59,582
2015	$ 51,307	$ 45,334	$ 46,849	$ 53,102	$ 52,164	$ 53,812
2016	$ 85,300	$ 77,601	$ 76,770	$ 68,750	$ 51,759	$ 60,000
Total	**$ 183,920**	**$ 164,631**	**$ 174,952**	**$ 183,292**	**$ 161,962**	**$ 173,394**

Year	Sum of Jul	Sum of Aug	Sum of Sep	Sum of Oct	Sum of Nov	Sum of Dec	TOTAL
2014	$ 57,359	$ 57,431	$ 66,294	$ 61,822	$ 57,136	$ 64,170	**$ 683,617**
2015	$ 47,184	$ 57,948	$ 60,385	$ 75,662	$ 73,552	$ 80,421	**$ 697,720**
2016	$ 45,470	$ 56,248	$ 66,184	$ 55,723	$ 46,329	$ 61,021	**$ 751,153**
Total	**$ 150,013**	**$ 171,627**	**$ 192,862**	**$ 193,208**	**$ 177,016**	**$ 205,612**	**$ 2,132,490**

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 57

Responding Witness: John K. Wolfe

Q-57. Provide any documents, spreadsheets, or presentation materials received by KU or prepared by or on behalf of KU since January 1, 2014, that provide data about or forecasts of the expected life, failure rates, or similar statistics concerning light fixture technologies for light offerings by KU.

A-57. KU does not document such information; the manufacturer's life projection and readily available industry technical information can be used to perform a forecast.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 58

Responding Witness: John K. Wolfe

Q-58. Explain KU's basis for establishing the expected life of each lighting technology, including HPS, metal halide, MV, and LED and any variants of each for which there is a material difference in expected life. Include within your response all documentation to support your response. If KU does not have any documents to support its response and relies only on oral communication, please identify who made statements on behalf of what companies, to whom at KU those statements were made, when the statements were made, and a detailed description of the substance of those communications.

A-58. See the response to KLC 2–22.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 59

Responding Witness: William S. Seelye

Q-59. Some lights that are being placed in restricted lighting service will be replaced earlier than normal because replacement parts are not available for those lights. Explain how KU has reflected this fact in its projected street lighting costs and in allocating costs to various street light types to establish the Company's tariff proposal in this case.

A-59. The Company has not explicitly reflected the fact that some lights that are being placed in restricted lighting service will be replaced earlier than normal in the development of the rates. The effect of any such early replacement of lights would be reflected in the determination of depreciation rates for lighting equipment in depreciation studies.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 60

Responding Witness: William S. Seelye / John K. Wolfe

Q-60. Tab "Installed Cost" of the spreadsheet "Att_DU_PSC_1-54_KULights.xlsx", contains a table of the installed costs projected by KU for each street light technology for which KU proposes a rate in this case, except for LED lights. Each entry of this table reflects a detailed analysis provided in a tab for that lighting type. Provide similar detailed analyses of installed cost for the LED lights proposed for tariff in this case.

A-60. See the response to KLC 1-27.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 61

Responding Witness: John K. Wolfe

Q-61. When a street light fixture for a non-LED light fails and is replaced, are the purchase or installation labor expenses of the fixture capitalized? If they are capitalized, what costs are treated as expenses and allocated as operation and maintenance expenses?

A-61. Should a non-LED fixture fail, all labor and materials associated with replacement are capitalized.

KENTUCKY UTILITIES COMPANY

CASE NO. 2016-00370

Response to Second Request for Information of Lexington-Fayette Urban County Government
Dated February 7, 2017

Question No. 62

Responding Witness: John K. Wolfe

Q-62. When a street light lamp for a non-LED light fails and is replaced, are the purchase or installation labor expenses of the lamp capitalized? If they are capitalized, what costs are treated as expenses and allocated as operation and maintenance expenses?

A-62. KU expenses labor and material replacement costs whenever a non-LED lamp fails and only the lamp is replaced. KU capitalizes labor and material costs whenever the photocell and, if applicable, starter for a light are replaced along with the lamp.