COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

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

LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT'S RESPONSES TO THE KENTUCKY UTILITIES COMPANY'S DATA REQUEST

Lexington-Fayette Urban County Government, by counsel, hereby submits the following responses to Kentucky Utilities Company's Data Request.

Respectfully submitted

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CERTIFICATE OF SERVICE

In accordance with 807 KAR 5:001, Section 8, I certify that the March 31, 2017, electronic filing of this Response is a true and accurate copy of the same document being filed in paper medium; that the electronic filing will be transmitted to the Commission on March 31, 2017; that there are currently no parties that the Commission has excused from participation by electronic means in this proceeding; and that an original paper medium of the Response will be delivered to the Commission within two business days.

M. Todd Osterloh

Counsel for LFUCG

1. Provide a copy of all notes, data, and workpapers prepared by, or on behalf of, Mr. Jester in connection with this proceeding. If any Excel spreadsheets or other computer generated documents were prepared by or on behalf of Mr. Jester, please provide an electronic version of those documents with all formulas intact.

The only notes, data or workpapers prepared by, or on behalf of, Mr. Jester in connection with this proceeding is the Excel spreadsheet KPSC 2016-00370 Jester Levelization Ratio Workpaper, provided in response to question 4.

WITNESS – Douglas Jester

2. Provide a copy of all direct and rebuttal testimony submitted by Mr. Jester in any state regulatory proceeding that deals with lighting rates.

RESPONSE - Mr. Jester's testimony from Michigan Public Service Commission Case U-17767 is attached.

WITNESS – Douglas Jester

S T A T E   O F   M I C H I G A N

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

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In the matter of the Application of **DTE ELECTRIC COMPANY** for authority to increase its rates, amend its rate schedules and rules governing the distribution and supply of electric energy, and for miscellaneous accounting authority. _______________________________________/	))))))	 Case No. U-17767 (Paperless/e-file)

Direct Testimony

And Exhibits

of
Douglas B. Jester

On behalf of

Municipal Street Lighting Coalition

May 22, 2015

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Q. State your name, business name and address.

A. My name is Douglas B. Jester. I am a principal of 5 Lakes Energy LLC, a Michigan limited liability corporation, located at Suite 805, 120 N Washington Square, Lansing, Michigan 48933.

Q. On whose behalf are you appearing in this case?

A. I am appearing here as an expert witness on behalf of the Municipal Street Lighting Coalition.

Q. Summarize your experience in the field of electric utility regulation.

A. I have worked for more than 20 years in regulating the electricity industry and in related fields. My work experience is summarized in my resume, attached as Exhibit MSLC-1.

Q. Have you testified before this Commission or as an expert in any other proceeding?

A. Yes. I have testified in:

- Case U-17473 (Consumers Energy Plant Retirement Securitization)
- Case U-17096-R (Indiana Michigan 2013 PSCR Reconciliation)
- Case U-17301 (Consumers Energy Renewable Energy Plan 2013 Biennial Review);
- Case U-17302 (DTE Energy Renewable Energy Plan 2013 Biennial Review);
- Case U-17317 (Consumers Energy 2014 PSCR Plan);
- Case U-17319 (DTE Electric 2014 PSCR Plan);

- Case U-17689 (DTE Electric Cost of Service and Rate Design);
- Case U-17688 (Consumers Energy Cost of Service and Rate Design);
- U-17684 (Wisconsin Electric 2015 PSCR);
- U-17762 (DTE Electric Energy Optimization Plan);
- U-17752 (Consumers Energy Community Solar); and
- U-17735 (Consumers Energy General Rates).

In the past, I have also testified as an expert witness on behalf of the State of Michigan before the Federal Energy Regulatory Commission in cases relating to the relicensing of hydro-electric generation. I also have been listed as a witness on behalf of the State of Michigan, prepared case files and submissions, and been deposed in cases before the United States District Court for the Western District of Michigan and the Ingham County Circuit Court of the State of Michigan, concerning electricity generation matters in which the cases were settled before trial.

Q. Are you sponsoring any exhibits?

A. MSLC-1 Resume of Douglas B Jester

MSLC-2 DTE Response to MSLCDE-1.16

MSLC-3 NYSERDA Street-Lighting-in-NYS

MLSC-4	DOE_LED Street Lighting Assessment and Strategies for the Northeast and Mid-Atlantic
MSLC-5	DTE Response to MSLCDE-2.30
MSLC-6	DTE Response to MSLCDE-2.32
MSLC-7	DTE Response to MSLCDE-2.34
MSLC-8	DTE Supplemental Response to MSLCDE-2.31
MSLC-9	DTE Supplemental Response to MSLCDE-2.33
MSLC-10	DTE Supplemental Response to MSLCDE-2.35
MSLC-11	DTE Rate Schedule E1 Current Tariff
MSLC-12	DTE Response to MSLCDE-1.22b
MSLC-13	Print of MSLDCE-1 Conversion Project Model Spreadsheet
MSLC-14	Siminovitch Essay
MSLC-15	DTE Response to MSLCDE-1.14
MSLC-16	Print of MSLCDE-1 Lighting Model
MSLC-17	DTE Response to MSLCDE-1.19
MSLC-18	DTE Response to MSLCDE-2.28

MSLC-19 MSLC Recommended Fixture Rates

MSLC-20 DTE Supplemental Response to MSLCDE-2.45

MSLC-21 Master Agreement for Street Lighting

MSLC-22 DTE Supplemental Response to MSLCDE-1.2

MSLC-23 DTE Supplemental Response to MSLCDE-1.22 c and d

MSLC-24 Print of MSLCDE-1 Q22c and d – Jester Modified

MSLC-25 DTE Answers to Management Plan Discovery Questions

Q. What is the purpose of your testimony?

A. On behalf of the Municipal Street Lighting Coalition, I have examined DTE's proposals in this case as they specifically affect the street lighting class and tariff. My testimony specifically addresses DTE's Community Lighting Program, the use of Contributions in Aid of Construction (CIAC) in relation to street lighting, and Rate Schedule E1.

The Coalition desires a Community Lighting Program that is: (1) responsive to their needs and efficiently executed; (2) revenue requirements for the street lighting class that are accurate and fair; and (3) a rate design within the street lighting class that is accurate and fair and also enables them to pursue lighting technologies that will improve public safety and will increase energy efficiency to reduce both their costs and their contributions to carbon emissions and other forms of pollution.

I am separately providing testimony in this case on behalf of the Michigan Environmental Council, Natural Resources Defense Council, and Sierra Club. The Municipal Street Lighting Coalition neither supports nor opposes the Company's proposals in this case concerning power supply, transmission, and general distribution and the associated costs, nor the allocation of energy costs to the street lighting class, which are the topics on which I am testifying for the other parties.

Q. What is the Municipal Street Lighting Coalition?

A. The Municipal Street Lighting Coalition is a voluntary group of municipal governments within the DTE service territory who have shared concerns about the Company's Community Lighting Program and a shared desire to migrate as quickly as possible to more energy efficient street lighting technologies. While additional municipalities are continuing to join the Coalition, the members as of my preparation of this testimony are:

City of Ann Arbor

Brownstown Township

City of Dearborn

City of Eastpointe

City of Harper Woods

City of Huntington Woods

City of Lincoln Park

City of Milan

City of Roseville

City of Royal Oak

City of Saint Clair Shores

City of Saline

City of Southgate

City of Ypsilanti.

Q. Why is the Municipal Street Lighting Coalition intervening in this case?

A. This is a period of significant change in street lighting and related technologies, presenting new opportunities to municipalities and new challenges to DTE's Community Lighting Program. As a result, street lighting requires a close examination in this case.

The Company has 157,596 street lights in its E1 Rate Schedule (Option 1).[1] Of these, 70,434 (44.7%) are high pressure sodium; 63,583 (40.3%) are mercury vapor; 21,314 (13.5%) are LED; and 2,265 (1.4%) are metal halide.[2] As discussed by DTE Witness Holmes, mercury vapor light technology is now obsolete, due in part to provisions of the federal Energy Policy

[1] The sum of lamps by type and wattage from Exhibit A-14, Schedule F3 is 157,596 while the sum of subtotals from the two pages summarizing present and proposed revenue from Option 1 of the E1 Rate Schedule is 152,200. For purposes of this testimony I am using the total of the individual entries.
[2] See pages 35-36 of DTE's Exhibit A-14, Schedule F3.

Act of 2005.[3] Additionally, some metal halide technology is now obsolete, due in part to provisions of the federal Energy Independence and Security Act of 2007.[4] As a result, the Company must now replace both failed mercury vapor and metal halide lamps with a substitute technology. The Company's high pressure sodium lights are not technically obsolete, despite the fact that they are less energy efficient than LED lights. DTE considers high pressure sodium lights to be the most cost-effective street lighting technology at the present time.

The Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007, directed the Secretary of Energy to carry out a Next Generation Lighting Initiative to support research, development, demonstration, and application activities related to advanced solid-state lighting technologies. These activities are described at http://energy.gov/eere/ssl/solid-state-lighting. Federal support of these technologies is due to the fact that they are significantly more energy efficient than other lighting technologies. Additionally, they provide full-spectrum light and increased optical control which can enhance public safety in street lighting applications. As a result of both federal support and continuing private-sector investment, solid state lighting continues to improve rapidly and is the emerging market-leading street-lighting technology. Light-emitting diodes, or LED lights, are the most common form of new solid-state lighting technologies that are being widely used for street lighting applications.

One of the Department of Energy's Next Generation Lighting Initiative activities is the Municipal Solid-State Street Lighting Consortium, described at

[3] See K.A. Holmes testimony page KAH-11, lines 23-25 and DTE's response to Discovery Question MSLCDE-1.16 (MSLC-2).
[4] Ibid.

http://energy.gov/eere/ssl/doe-municipal-solid-state-street-lighting-consortium. Several Michigan municipalities, including members of the Municipal Street Lighting Coalition, are primary members of the Consortium.

As a result of both the inherent advantages of LED technology and of the strategic support of the Department of Energy, LED street lights are the emerging standard for municipalities including, as examples, comprehensive deployment in the City of Los Angeles, New York City, and the City of Detroit. Consequently, the members of the Municipal Street Lighting Coalition have a specific interest in access to LED street lighting for use in their municipalities and the terms of that access. Recent reports describing the case for LED street lighting were prepared by the New York State Energy Research and Development Authority, which is offered as Exhibit MSLC-3, and the Northeast Energy Efficiency Partnerships, which is offered as Exhibit MSLC-4.

Because of the specific interest of various municipalities in LED street lighting, DTE previously established an Experimental Emerging Lighting provision in the E-1 tariff. In that provision, a municipality wanting to use LED lighting must make a significant financial payment to DTE. This payment is called a Contribution in Aid of Construction ("CIAC").

Thus, due to the replacement of obsolete mercury vapor and metal halide lights and municipality interest in LED lights, the mix of lighting technologies in DTE's ownership is and will continue to change rapidly over the next few years.

In this case, DTE proposes to incorporate LED technology into the standard formulation of the street lighting tariff. In doing so, the Company proposes to continue its practice of requiring CIAC for converting existing street lights to LED technology and also proposes changes in the rate design within the street lighting rate schedule that will diminish the financial advantages for municipalities to convert from mercury vapor and metal halide lights to LED rather than high pressure sodium lights. These changes in rate design also undermine financial returns on the investments in LED lights that municipalities they have already made through CIAC.

Since the vast majority of existing mercury vapor and metal halide lights will likely be converted to either high pressure sodium or LED before DTE's next following general rate case, the Municipal Street Lighting Coalition requests that the Commission pay particular attention to Municipal Street lighting in this case. Specifically, the Municipal Street Lighting Coalition asks the Commission to ensure that:

1) DTE has a sound business plan for Community Lighting that will timely meet municipal customer needs and preferences during this period of transition;

2) Total revenue from street lighting customers accurately and fairly reflects the cost of service during this period of transition;

3) Rate design within the street lighting rate schedule is accurate and fair; and

4) Municipal street lighting customers have appropriate and fair access to LED lighting and other technologies that are more energy efficient which will reduce street lighting costs and pollution.

The Commission should take note that since most hours in which streetlights consume power are at low-load times, the marginal fuel for street lighting is usually coal. Consequently, street lighting energy efficiency may be particularly cost-effective in achieving compliance with EPA's proposed Clean Power Plan.

The Commission should also be aware that LED lighting technologies are capable of supporting wireless data communications and can be rapidly and remotely controlled as to color, intensity, flashing, and other changes that can send the public safety alert signals or guide municipal operations. Consequently, LED streetlights are an emerging critical element of "smart cities" implementation that could provide additional value and open up additional business opportunities for DTE if the Company chose to work with its municipal customers.

Q. Please summarize your recommendations on behalf of the Municipal Street Lighting Coalition?

A. As I will discuss later, there are multiple interconnected issues with respect to DTE's current Community Lighting Program and its Municipal Street Lighting proposals in this case. These issues would be better resolved through a more collaborative process than a fully-contested rate case. I therefore recommend that the Commission deny DTE's requests to change the E-1 Rate Schedule and direct DTE to file a new request pursuant to the Commission's guidance on these issues, after consultation with the Municipal Street Lighting Coalition and other municipal street lighting customers facilitated by the Commission's Staff.

In the alternative, if the Commission wishes to resolve these issues in this case I recommend that the Commission:

1) Direct DTE to reform its use of Contribution in Aid of Construction within the Municipal Street Lighting Rate Schedule, as detailed later in my testimony;

2) With respect to Rate Schedule E1 – Municipal Street Lighting,

a) Accept DTE's proposals to restructure its Municipal Street Lighting charges by separating lamp charges into service, fixture, and energy charges and its proposal to provide for LED lighting within the standard Municipal Street Lighting tariff;

b) Direct DTE to include per-fixture energy charges and per-fixture total charges in the E1 Rate Schedule tariff sheets alongside the fixture charges for each streetlight type;

c) Direct DTE to include within the restructured Municipal Street Lighting rate schedule a provision for the use of dimmers or other automated controls, with appropriate incremental fixture charges and reduced energy charges;

d) Approve energy charges for municipal street lighting customers consistent with the Commission's decisions concerning required revenue and cost allocation for power supply in the overall case;

e) Deny DTE's proposed schedule of fixture charges and use instead the lamp charges in current rate schedules less the appropriate energy charge for each lamp type, effectively leaving lamp charges unchanged;

f) Deny DTE's proposal to combine its Municipal Street Lighting and Outdoor Protective Lighting tariffs, or in the alternative direct DTE to appropriately disaggregate lighting technologies and customer service charges to reflect differences in the cost of service;

g) Direct Commission Staff to audit DTE's Community Lighting Program to establish a clear evidentiary basis for setting fixture charges in future;

3) Allow DTE to close the Experimental Emerging Lighting provision of tariff E1 to any additional lights, but direct DTE to grandfather for a period until 31 December 2025 existing lighting agreements and limit increases in lamp charges inflation unless the equipment needs to be replaced or the customer voluntarily switches to the standard tariff,;

4) Direct DTE to offer each municipality that made a Contribution in Aid of Construction for lighting technology conversions the option to receive a rebate of any difference between the Contribution in Aid of Construction and the amount they would have paid under the proposed CIAC reform, conditional on the related lights being transferred to the new lighting tariff; and

5) Direct DTE to develop and provide to the Commission a business plan for its Community Lighting Program, after consultation with the Municipal Street Lighting Coalition and other municipal street lighting customers facilitated by the Commission's Staff;

Q. Please explain why you recommend that the Commission direct DTE to reform its use of Contribution in Aid of Construction within the Municipal Street Lighting Rate Schedule?

A. As I shall detail momentarily, DTE's use of Contribution in Aid of Construction (CIAC) in its Community Lighting Program inappropriately discourages municipalities from adopting LED lighting technology, and is therefore unreasonable , arguably violates the terms of the tariff provision, and unjustly allocates costs to municipal customers who adopt LED lighting.

Q. Please explain why you say that DTE's use of CIAC discourages municipalities from adopting LED technology?

A. In its response to discovery question MSLCDE-2.30 (MSLC-5), DTE acknowledges that it does not propose to require CIAC when it replaces failed mercury vapor lighting with high pressure sodium lighting. In its response to discovery question MSLCDE-2.32 (MSLC-6), DTE acknowledges that it does not require CIAC when it replaces failed metal halide lighting with high pressure sodium lighting. In its response to discovery question MSLCDE-2.34, (MSLC-7), DTE states that it would only replace failed mercury vapor or metal halide lighting with high pressure sodium lighting. However, any replacement of functioning mercury vapor or metal halide lighting must be performed on a planned basis, which, as I show below, triggers a requirement for CIAC.

Since DTE proposes fixture charges for each type of lighting that it represents reflect any differences in life-cycle cost of service, there can be no economic reason that DTE replaces failed mercury vapor or metal halide lighting with high pressure sodium rather than LED. Operationally, it should be straightforward for DTE to accept an LED vs high pressure sodium decision by the municipality for the replacement of failed mercury vapor and metal halide lights either on a standing basis from each municipality or when the municipality reports that a light has failed.

Both federal and state public policy currently encourage energy efficiency, and federal policy specifically encourages the adoption of LED lighting.

I therefore conclude that DTE's requirement that failed mercury vapor or metal halide lighting be replaced with high pressure sodium, with no option for a municipality to convert to LED for replacement of failed lights, inappropriately discourages municipalities from adopting LED lighting technology. Therefore it is my opinion that the Commission should direct DTE to allow municipal lighting customers to replace failed mercury vapor or metal halide lights with either high pressure sodium or LED on an equal basis and without any CIAC.

Q. Please explain why you say that DTE's use of CIAC is unjust and unreasonable.

A. Due to DTE's practice of requiring a community that prefers to replace obsolete mercury vapor or metal halide lighting with LED to do so on a planned basis, a number of municipalities who are members of the Municipal Street Lighting Coalition have undertaken such projects. We therefore undertook thorough discovery to determine DTE's practices in this regard more precisely.

In its supplemental response to discovery question MSLCDE-2.31(MSLC-8), DTE acknowledges that it does not intend to replace functioning mercury vapor lighting with high pressure sodium in bulk of its own volition, and would require CIAC if a municipality made such a request. In its supplemental response to discovery question MSLCDE-2.33 (MSLC-9), DTE similarly acknowledges that it does not intend to replace functioning metal halide lights with high pressure sodium in bulk of its own volition, and would require CIAC if a municipality made such a request. In its supplemental response to discovery question MSLCDE-2.35 (MSLC-10), DTE acknowledges that it does not intend to replace functioning mercury vapor or metal halide lighting with LED in bulk of its own volition, and would require CIAC if a customer made such a request. It is therefore clear that since DTE will not reactively replace failed mercury vapor or metal halide lights with LED, a municipality wishing to adopt LED lighting must pay CIAC in order to do so.

Suppose that a municipality requests DTE to replace the still-functioning mercury vapor and metal halide lights within its borders with high pressure sodium lighting on a planned, bulk basis. DTE has already acknowledged in Exhibits MSLC-6 and MSLC-7 that if the municipality waits until these lights fail, DTE will replace them with high pressure sodium lights without charging the municipality CIAC. Therefore, DTE does not incur any additional replacement cost by replacing these lights on a planned, bulk basis that it would not incur by replacing the lights reactively as they fail. Indeed, DTE would experience a lower cost as it acknowledges in each of MSLC-8, MSLC-9, and MSLC-10 where DTE says "Currently, the Contribution in Aid of Construction is then reduced by the labor component associated with efficiencies gained as a result of group conversions." It is therefore clear that ultimately there are no increased costs as a result of a planned bulk replacement of of mercury vapor or metal halide lights with high pressure sodium lights.

I do acknowledge that there is an economic cost to incurring costs earlier. One might therefore argue that the planned, bulk replacement of mercury vapor or metal halide lights before they fail and must be replaced constitutes an increased cost to DTE warranting some contribution from the customer who requests this accelerated expenditure. However, I don't believe it reasonable to allow DTE to recover "time value of money" for such advance expenditures because DTE would also be receiving the revenues appropriate for the new lights once the new lights were in place. In other words, DTE's costs for the new lights are offset by the appropriate revenues and they therefore shouldn't be permitted to receive compensation for the "time value of money" for the expenditure of the installation sooner than would have been anticipated. My opinion is supported by the fact that DTE represents that its charges for each type of street lighting in its rate schedule reflect its cost of service for that type of street lighting. It is therefore clear that CIAC is not warranted because of the acceleration of costs for planned, bulk replacement of mercury vapor or metal halide lights with high pressure sodium lights.

When DTE replaces mercury vapor or metal halide lights on a planned, bulk basis before they fail, there is but one economically logical reason to charge CIAC. In such a circumstance, DTE loses the revenue it would have received for the continued use of the mercury vapor or metal halide lights until they failed. If DTE's rates for mercury vapor and metal halide lights are correctly set, a portion of the rates, hence the forgone revenue, would have been for energy, management, and maintenance costs that will be avoided as a result of the conversion to high pressure sodium and will be appropriately recovered for the high pressure sodium lights through the rates for the high pressure sodium lights. However, a portion of the forgone revenue for the prematurely retired mercury vapor or metal halide lights will have been warranted for recovery of DTE's investment in the prematurely retired equipment. The present value of the remaining revenue that DTE might reasonably have expected for depreciation and return on investment during the remaining life of the prematurely retired mercury vapor or metal halide lights is the net book value of the equipment less salvage value. DTE is entitled to recovery of this net book value less salvage value and it is not appropriate to impose the recovery of that cost on other customers. Thus, the economically logical CIAC from a customer that requests the proactive planned replacement of mercury vapor or metal halide lights with high pressure sodium is just the remaining book value of the equipment that is prematurely replaced.

Now suppose that a municipality requests DTE to replace the still-functioning mercury vapor and metal halide lights within its borders with LED lighting on a planned, bulk basis. In this case, the logic is identical to the case I just discussed where the municipality requested to replace the still-functioning mercury vapor and metal halide lights with high pressure sodium. DTE will make a larger investment to replace the obsolete lights with LED than with high pressure sodium, but that larger investment will be recovered through the charges for LED lights established in the rate schedule, assuming DTE has correctly modeled the cost of service of the various lighting technologies. Nonetheless, as DTE acknowledges in Exhibit MSLC-10, it would require a customer to pay CIAC under these circumstances.

When CIAC is charged to a customer to recover a portion of the costs of an unusually expensive line extension, this is economically justified because such customers are allocated and charged for power delivery at the same rate as other customers. CIAC is warranted so that DTE recovers its costs for distribution without undue cross-subsidization by other customers who did not require unusually expensive line extension. However, since DTE distinguishes lighting types in its rate structure, CIAC for more expensive lighting types is not warranted to avoid cross-subsidization. Any difference in the life-cycle cost of service for LED lighting as compared to high pressure sodium lighting should be adequately reflected in the technology-specific charges in the Municipal Street Lighting Rate Schedule and therefore does not warrant CIAC. Thus, in my opinion, it would be just and reasonable for DTE to receive CIAC from a customer that requests the proactive planned replacement of mercury vapor or metal halide lights with LED lights for only the remaining book value, minus salvage value, of the equipment that is prematurely replaced.

Even though the economic logic is that CIAC for replacing still-functioning lights with a different lighting technology should be limited to the remaining book value, minus salvage value, of the still-functioning equipment that is prematurely replaced, DTE's current practice is to charge CIAC for the entire cost of the conversion but for an allowance for labor efficiency, as is explained in Exhibits MSLC-8, MSLC-9, and MSLC-10.

The preceding discussion does point to one additional just and reasonable use of CIAC in the Community Lighting Program. There is no evidence, nor any reason to believe, that the cost of service for the luminaire, lamp, and energy supply for a street light of given technology and wattage varies systematically amongst customers. DTE's proposed Municipal Street Lighting Rate Schedule purports to accurately represent the cost of service for each type of lighting technology and wattage. Thus, CIAC is never warranted based on the choice of lighting technology or wattage. However, when new street lights are installed there can be considerable variation in costs of wiring and fixtures due to details of location and lighting application. Such variation in costs is exactly analogous to the case of high-cost line extensions for power delivery and is therefore a reasonable use of CIAC. Additionally, DTE also incurs costs in excess of the basis of the Rate Schedule when it relocates or removes lighting, which are therefore appropriate grounds for CIAC.

I therefore recommend that the Commission amend the Municipal Street Lighting Rate Schedule to provide that CIAC be used only for (1) the recovery of remaining book value minus salvage value of still-functioning lights when a municipality requests conversion to a different lighting technology or the removal of still-functioning lights, (2) the unusually expensive installation or replacement of light posts or distribution wiring, and (3) to recover the costs of relocating or removing lights at the customer's request.

Q. Do you acknowledge that DTE's use of Contribution in Aid of Construction in the Community Lighting Program is consistent with its current tariff?

A. Not entirely.

There are two provisions for Contribution in Aid of Construction in DTE's current Rate Schedule E1, which I sponsor as Exhibit MSLC-11. The second of these is on page D-50.0 in the second paragraph, titled "Option I: Company Owned Street Lighting System" and provides for CIAC for new installations, which is the application of CIAC in the current tariff that I testified above is economically appropriate. To my knowledge, this CIAC provision is currently being correctly applied by DTE.

The first provision for Contribution in Aid of Construction in DTE's current Rate Schedule E1 is on page D-49.0 of Exhibit MSLC-11 in the paragraph titled "Experimental Emerging Lighting Technology Provision". This paragraph reads, in full:

“Available on an optional basis to customers desiring Municipal Street Lighting Service using emerging lighting technologies not otherwise offered through the standard tariff. The Company will own, operate, and maintain the emerging lighting technology equipment and the Customer will provide a contribution in aid of construction equal to the amount by which the investment exceeds three times the estimated annual revenue. Emerging lighting technologies and Customer participation must be approved by the Company and the energy and maintenance benefits for each project will be calculated based on predicted energy and luminaire life. The Company and the Customer will mutually agree on all prices, terms, and conditions for the service under this provision, evidenced by signed agreement.”

This provision of the tariff has been the basis for CIAC for the installation or conversion of most of the 21,314 LED street lights that DTE currently owns. Despite the explicit language of this provision that CIAC will be in the “amount by which the investment exceeds three times the estimated annual revenue”, it is DTE’s practice to interpret this phrase as though CIAC should be in the amount by which the investment exceeds three times the estimated INCREMENTAL annual revenue (see Exhibits MSLC-8, MSLC-9, and MSLC-10).

In the discovery questions to which DTE’s responses are included in Exhibits MSLC-8, MSLC-9, and MSLC-10, we requested that DTE “Provide any proposals for Contribution in Aid of Construction to convert…that have been presented to a municipality by the Company since 1 January 2012, whether or not the proposals were accepted.” DTE objected to providing these proposals for reasons shown in Exhibits MSLC-8, MSLC-9, and MSLC-10. Through informal discussions, DTE agreed that I could go to a DTE office and review a sample of lighting Purchase Agreements of my choosing out of those accepted since 1 January

2013. Based on that review, it is apparent that because the incremental revenue associated with the replacement of mercury vapor or metal halide lights with LED lights is negative (i.e,, the annual revenue from a mercury vapor light or metal halide light exceeds the annual revenue from an appropriate LED replacement), DTE simply requires CIAC in the amount of cost of the conversion project. Since CIAC charges to convert mercury vapor or metal halide lights to either high pressure sodium lights or LED are not consistent with economic logic nor with the letter of the current tariff, I recommend below that the Commission take certain steps to equitably resolve this problem.

Q. Are your concerns about Contribution in Aid of Construction resolved by DTE's proposed changes to the E1 Rate Schedule tariff sheets, as presented in Exhibit A-15 of its Application and pre-filed testimony?

A. No.

Q. Are you concerned about any other issues concerning DTE's use of Contributions in Aid of Construction in the Community Lighting Program?

A. Yes.

In partial, supplemental response to discovery question MSLCDE-1.22.b, the initial response to which I am sponsoring as Exhibit MSLC-12, DTE provided a spreadsheet titled "MSLCDE-1 Conversion Project Model" which I understand to be the current version of the calculations used by DTE to determine costs and CIAC for lighting conversion to LED. I am sponsoring a printed version of that spreadsheet as Exhibit MSLC-13 and will provide the working spreadsheet as a work paper unchanged from the way it was provided to me by DTE.

In this Conversion Project Model, as can be seen in the block of rows below the table of fixture numbers, DTE calculates the "Cost to Convert", from which it deducts "DTE labor contribution" and "2015 EO Rebate" to obtain the net CIAC charge to the customer labeled as "CTC – EO Rebate – DTE Contribution". This calculation is consistent with DTE's narrative description of this calculation in the second paragraph of its answers to discovery questions in Exhibits MSLC-8, MSLC-9, and MSLC-10.

However, in the third paragraph of DTE's answer in each of these Exhibits, the last sentence says "The contribution in aid of construction does not include the labor expense." In fact, the formula in the spreadsheet that calculates the cell labeled "Cost to Convert" calculates the sum over all luminaire types of the product of the number of luminaires and the "Total Cost per Fixture", and the formula for each cell in the column labeled "Total Cost per Fixture" clearly sums the cells in the same row that are labeled "Cost of LED per LUM", "long Life Photocell", and "Labor". I therefore assume that this statement by DTE was meant to convey that the CIAC required of the customer is net of the cell below the table that is labeled as "DTE labor contribution". In the sample of lighting Purchase Agreements that I reviewed, those that were for conversions showed a value for "DTE labor contribution" but the value in that cell did not correspond with a likely calculation of the entire labor cost that is embedded in the "Cost to Convert" cell. It therefore appears that a better characterization of this calculation is not that "The contribution in aid of construction does not include the labor expense" but rather that as DTE says in the second paragraph of its answer in each of Exhibits MSLC-8, MSLC-9, and MSLC-10 "The Contribution in Aid of Construction is currently being reduced by the labor component as a result of efficiencies gained as a result of group conversions." It follows that the amount labeled as "DTE labor contribution" is in fact not a donation by the Company but a recognition that its labor costs per luminaire converted as represented in the project cost calculation do not accurately represent costs of a bulk conversion.

According to the calculation methods displayed in the Conversion Project Model spreadsheet, the entirety of cost of a project to convert mercury vapor and/or high pressure sodium lights to LED lights will be recovered by DTE through CIAC, calculated as the table-based project cost estimate less the DTE labor contribution. Even if the DTE labor contribution was for all project labor, all of the cost of luminaires and photocells were included in CIAC payments. The EO rebate is subsequently paid by DTE's Energy Optimization Program to the customer. Since Contributions in Aid of Construction should be excluded from rate base and are usually recognized by DTE as offsets to capital expenditures, none of the costs of projects to convert municipal street lighting to LED should be in rate base. Further, these costs should not be recorded without offsets to asset accounts that are then used to determine capital costs in a cost of service study. Nonetheless, as I will show below, DTE proposes in this case to establish fixture charges for various streetlight types that include capital cost recovery for LED lights. Indeed, because LED lights have higher initial cost than other streetlight types, DTE proposes to assign greater capital costs per LED fixture than for other fixture types. It therefore appears that the accounting principles for Contributions in Aid of Construction are not being consistently applied in DTE's Community Lighting Program or that DTE is inappropriately considering the capital costs of LED luminaires in its rate design.

I therefore recommend that the Commission direct its Staff to audit DTE's accounting treatment of CIAC in this program to ensure that construction costs that are recovered through CIAC payments are not in rate base, that asset increments in the street lighting asset accounts due to conversion projects are appropriately offset by the associated CIAC payments, that the "DTE Labor contribution" is not recorded in rate base or street lighting asset accounts since it appears to be merely a means to correct project cost estimates, and hence that the required revenue calculated by DTE for the street lighting customer class does not include depreciation and cost of capital for LED conversion projects.

Q. Please summarize your recommendations with respect to Contributions in Aid of Construction in DTE's Community Lighting Program.

A. They are that the Commission:

1) Direct DTE to allow its municipal customers individually to determine whether failed, obsolete mercury vapor and metal halide lights and failed high pressure sodium lights should be replaced with high pressure sodium or LED lights;

2) For future conversions or installations, direct DTE to recover costs of luminaires and lamps entirely through fixture charges and limit Contribution in Aid of Construction for lighting conversions to the remaining book value minus salvage value of any assets that are prematurely replaced;

3) Direct Commission staff to audit Contributions in Aid of Construction for appropriate accounting treatment with respect to rate base, asset accounting, and allocations in cost of service analyses; and

4) Adopt a means as I will recommend below to equitably resolve the problems that the current tariff provisions are not just and reasonable with respect to CIAC and that DTE has apparently overcharged CIAC by considering project costs in excess of incremental revenue rather than total revenue from the involved lights.

Q. Let us now turn to DTE's proposals concerning Rate Schedule E1. You indicated earlier that you recommend that the Commission accept DTE's proposals to restructure its Municipal Street Lighting charges by separating lamp charges into service, fixture, and energy charges and its proposal to provide for LED lighting within the standard Municipal Street Lighting tariff. Why?

A. I agree that separating lamp charges into service, fixture, and energy charges is more transparent and potentially provides greater accountability for DTE's municipal lighting offerings.

I also agree that LED lighting is no longer experimental, and as the preferred lighting technology for many municipalities and the strategic street lighting technology of the US Department of Energy, LED lighting should be supported in the standard tariff.

I therefore recommend that the Commission accept both of these aspects of DTE's proposal.

Q. You also recommended earlier that the Commission direct DTE to include per-fixture energy charges and per-fixture total charges in the E1 Rate Schedule tariff sheets alongside the fixture charges for each streetlight type. Why?

A. Unfortunately, DTE's proposed revisions to the tariff sheet for Rate Schedule E1 negate much of the potential gain in transparency that results from separating lamp charges into service, fixture, and energy charges. DTE's proposed Rate Schedule E1 presents fixture charges in table form in relation to luminaire type and wattage but then presents the energy charge as a single rate per kWh. However, since lights are generally not metered, energy charges are actually calculated and billed per light based on engineering calculations performed by DTE. For some lighting types, the wattage consumption used for billing purposes is not just the wattage rating of the lamp, so the facts involved in these calculations may also be obscure to municipal staff. Therefore, I recommend that the calculated energy charges and total charge per light also be displayed in the tariff schedule, thereby restoring the transparency gain that could result from separating energy and fixture charges in the tariff.

Q. Why do you recommend that the Commission direct DTE to include within the restructured Municipal Street Lighting rate schedule a provision for the use of dimmers or other automated controls, with appropriate incremental fixture charges and reduced energy charges?

A. DTE is proposing in this case to eliminate two little-used street lighting options: dusk-to-midnight operation and de-energized lamps.[5] I do not oppose that proposal, but recommend instead that the Commission direct DTE to include a provision for the use of dimmers or other automated controls.

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[5] See pre-filed Direct Testimony of DTE Witness K. A. Holmes, page KAH-18, lines 4-20

One of the distinguishing features of LED lights compared to other street lighting technologies is that LED lights are highly controllable, as is shown in the following table from Exhibit MSLC-3:

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.

Further, such lighting controls can be cost-effective as is reported in Exhibit MSLC-4, page 9, Table 1. I also sponsor as Exhibit MSLC-14 an essay describing some of the potential values of LED lighting controls by Michael Siminovitch, Director of the California Lighting Technology Center, which I downloaded from the University of California-Davis web site at http://cltc.ucdavis.edu/sites/default/files/files/publication/20100700-researchmatters.pdf. During my own work on Smart Grid product development with the Office of the Chief Technology Officer at Verizon, I did significant work with the City of New York and ConEd on communication protocols for networked LED lights to enable them to participate in Smart Cities applications.

I therefore recommend that the Commission direct DTE to provide for emerging community interest in, and needs for, advanced controls of LED streetlights.

Q. You also recommend that the Commission approve energy charges for municipal street lighting customers consistent with the Commission's decisions concerning required revenue and cost allocation for power supply in the overall case?

A. Yes. In this case, the Municipal Street Lighting Coalition neither supports nor opposes DTE's proposals with respect to power supply rates. Rather, the Coalition is focused on those aspects of the case that are specific to municipal street lighting. We are therefore recommending that the Commission approve energy charges for municipal street lighting consistent with the Commission's decisions concerning required revenue and cost allocation for power supply in the overall case.

Q. You recommended that the Commission deny DTE's proposed schedule of fixture charges and use instead the lamp charges in current rate schedules less the appropriate energy charge for each lamp type, effectively leaving lamp charges unchanged. Why?

A. The Municipal Street Lighting Coalition actually prefers that the Commission deny DTE's requests to change the E-1 Rate and direct DTE to file a new request pursuant to the Commission's guidance on the issues I am addressing in testimony, after consultation with the Municipal Street Lighting Coalition and other municipal street lighting customers facilitated by the Commission's Staff. My recommendation that the Commission deny DTE's proposed schedule of fixture charges and use instead the lamp charges in current rate schedules less the appropriate energy charge for each lamp type is a second-best option.

The Coalition takes this position because the revenue requirements and rate design proposed for municipal street lighting are flawed in ways that are interconnected with the issues about management of the Community Lighting Program and the uses of Contribution in Aid of Construction to which I testified earlier.

Q. In what ways are DTE's proposed revenue requirements and rate design for municipal street lighting flawed?

A. Both the revenue requirement and rate design appear to fail to properly account for offsets that should be taken because of the Community Lighting Program's uses of Contributions in Aid of Construction. Both the revenue requirement and rate design fail to properly account for the effects of changing lighting technology mix on maintenance costs.

Q. Why do you say that the revenue requirement and rate design for municipal street lighting appear to fail to properly account for offsets that should be taken because of the Community Lighting Program's uses of Contributions in Aid of Construction?

A. DTE's principal witness with respect to the rates it proposes for municipal street lighting is K. A. Holmes. Current and proposed rates and revenues for municipal street lighting are summarized in DTE Exhibit A-14, Schedule F3, pages 35 – 38, sponsored by witness Holmes. Witness Holmes narrative from page KAH-9, line 1 through KAH-12, line 10 concerning DTE's development of its street lighting proposal in this case describes calculations provided in a spreadsheet titled "U-17767 MSLCDE-1 Lighting Model" that was supplied by DTE in response to discovery request MSLCDE-1.14. DTE's response to MSLCDE-1.14 is offered as Exhibit MSLC-15 and a printed version of "U-17767 MSLCDE-1 Lighting Model" is offered as Exhibit MSLC-16. I will hereafter refer to the spreadsheet MSLCDE-1 Lighting Model simply as the Lighting Model.

As I testified earlier, essentially all of the Company-owned LED lights have either been converted or installed under terms where the municipality customer has paid for the luminaire and installation through a Contribution in Aid of Construction. Nonetheless, the Lighting Model, in Column AK, shows capital recovery revenue under the previous rates and in Column AJ shows capital recovery revenue in the proposed rates for Luminaires and Lamps of LED fixtures. Indeed, this is clear evidence that the revenue requirements and/or consequent rate design have not been properly adjusted by offsets for Contribution in Aid of Construction. Further, the adjustment factors used in Column AI to calculate capital recovery revenue in Column AJ is clearly proportional to the combined luminaire and lamp cost shown in Column AH. But if the cost of LED luminaires is entirely recovered through Contribution in Aid of Construction, the prices of luminaires and lamps should not be a factor in the rate design.

Q. Why do you say that the revenue requirement and rate design fail to properly account for the effects of changing lighting technology mix on maintenance costs?

A. DTE's response to discovery question MSLCDE-1.19, which I offer as Exhibit MSLC-17, indicates that DTE did not forecast any effect on the costs of Maintenance of Street Lighting and Signal Systems, account 596 and that test period adjustments were due to inflation only.

I offer DTE's answer to discovery question MSLCDE-2.28 as Exhibit MSLC-18. Because of its particular relevance to this part of my testimony, I quote that answer in full below:

"DTE has discontinued the periodic re-lamping of Mercury Vapor luminaires. The lamps are replaced upon failure and the luminaires are converted upon failure. DTE currently performs periodic re-lamping for both High Pressure Sodium and Metal Halide on a 5-year interval but will move to a 8-year re-lamping interval for High Pressure Sodium in 2016 as a result of completing a fleet replacement of standard 24,000 hour High Pressure Sodium lamps with 40,000 hour rated lamps. Metal Halide relamping will continue on a 5 year interval. DTE's proposed tariff does not reflect any planned maintenance expense on LED lighting. Therefore, it does not anticipate visiting LED luminaires. DTE does not have the detailed data to provide an average cost per visit per fixture based upon how some maintenance visits are bundled together."

Mercury vapor lights are currently approximately 40.3% of DTE-owned street lights. According to DTE, there will be no further maintenance of the luminaires and lamps of these lights, since they are obsolete, so these will be converted on the next failure. Conversions upon failure will be to high pressure sodium, per DTE's practices that I discussed earlier. Planned, pro-active bulk conversions may be to either high pressure sodium or, more likely, to LED based on customer request and paid for by Contributions in Aid of Construction. According to established practice, these conversions will either be capitalized or covered by CIAC, so they should not appear as maintenance costs. After conversion, these lights will need luminaire and lamp maintenance on the frequencies of the light type to which they are converted.

High pressure sodium lights are currently approximately 44.7% of DTE-owned street lights. DTE represents that in 2016 it will complete a fleet replacement of 24,000 hour high pressure sodium lamps with 40,000 hour rated lamps. Assuming that DTE has rationally undertaken these lamp replacements in the course of normal replacement schedules, the majority of its fleet of high pressure sodium lights should already have been converted and DTE should already have experienced some modest reduction in high pressure sodium lamp replacement and should see a 40% reduction from historical frequency in 2016 and beyond.

The presence of LED lights in DTE's fleet has grown rapidly in the last few years to approximately 14.4%. LED lights do not have distinct lamps as part of the light assembly; instead, the light emitting diode is integrated with the entire luminaire assembly – which is a capital item. Thus, appropriately, DTE answers above that its "proposed tariff does not reflect any planned maintenance expense on LED lighting."

Thus, changes in DTE's streetlight fleet have occurred and will rapidly continue that will result in luminaire and lamp maintenance activity being reduced by somewhere between 40% and 100% over the next few years. According to the Lighting Model, luminaire and light maintenance constitute approximately 36.6% of historical municipal street lighting operations and maintenance as incorporated into DTE's proposed fixture charges. We should therefore expect that required revenue for maintenance in 2016 and beyond is reduced by at least 40%*36.6% = 14.6% and, given that maintenance events will be skipped for mercury vapor lights for the next few years – in favor of conversions – and will be non-existent for LED lights, we might more reasonably expect luminaire and lamp maintenance to apply to only high pressure sodium lights (44.7%) at only 60% of historical frequency, so that maintenance will be but 44.7%*60% = 26.82% of its historical level. Yet, DTE represents that its required revenue for luminaire and light maintenance should rise by inflation from 2013 to 2016 and that 2016 test year rates should then apply for some indefinite period thereafter.

Further, in the Lighting Model that was used to develop DTE's proposed fixture rates by technology and lamp wattage, Column X shows the luminaire and lamp O&M elements of the proposed fixture charges and Column Y shows the corresponding revenue. These are not zero for mercury vapor and LED lights, as might be expected from DTE's answer in MSLC-18. In fact, in Column W of the Lighting Model, DTE has applied a "Lum & Lamps O&M Adjustment Factor" to each fixture type. This adjustment has the clear effect of increasing the luminaire and lamp maintenance cost attributed to LED lights and decreasing the luminaire and lamp maintenance cost attributed to mercury vapor and high pressure sodium lights, relative to the average light. This was done, despite DTE's assertion in Exhibit MSLC-18 that its "proposed tariff does not reflect any planned maintenance expense on LED lighting." I conclude that DTE's proposed fixture charges in this case fail to properly account for the effect of changing lighting technology mix on maintenance costs.

Finally, the application of the "Lum & Lamps O&M Adjustment Factor" in the Lighting Model has the effect of assigning greater maintenance costs to LED luminaires than to all but the largest mercury vapor, metal halide, and high pressure sodium lights. This is inconsistent with the available studies on maintenance costs of LED versus other lighting technologies, including as examples those presented and referenced in Exhibits MSLC-3 and MSLC-4.

Q. Are other aspects of DTE's proposed fixture charges that you think inappropriate?

A. Yes. In principle, I would expect that the fixture differential between a light served by overhead and an underground distribution wiring would be independent of the lighting technology mounted on the post and that the fixture differential between lighting technologies amongst posts served by overhead distribution would be matched by the fixture differentials between lighting technologies amongst posts with underground distribution. That does not appear to be the case.

Q. So, what do you recommend that the Commission do in response to DTE's proposed Municipal Street Lighting Tariff?

A. First, I remind the Commission that the Municipal Street Lighting Coalition prefers that the Commission deny DTE's requests to change the E-1 Rate and direct DTE to file a new request pursuant to the Commission's guidance on the issues I am addressing in testimony, after consultation with the Municipal Street Lighting Coalition and other municipal street lighting customers facilitated by the Commission's Staff. If the Commission does not accept that recommendation, then in light of the issues I've just described, the Commission should order an E1 Rate Schedule that separates and adjusts the energy charge in line with its decisions about power supply costs in this case but retains the fixture charges that are implicit in current lamp charges. It is highly likely that the resulting fixture charges will be laden with some of the issues that I address in this testimony, but at least these problems will not be compounded.

To assist the Commission in that regard, I have appended the necessary columns to the Lighting Model, which I will make available as a work paper, and have displayed the resulting fixture charges in Exhibit MSLC-19, which I am sponsoring.

Q. You recommended earlier that the Commission deny DTE's proposal to combine its Municipal Street Lighting and Outdoor Protective Lighting tariffs, or in the alternative direct DTE to appropriately disaggregate lighting technologies and customer service charges to reflect differences in the cost of service. Why?

A. In its Lighting Model, DTE proposed certain adjustments in various fixture charges to support the combination of these two tariffs. In response to discovery question MSLCDE-2.45 which I am sponsoring as Exhibit MSLD-20, page 4, DTE provided a partial explanation of these adjustments under the heading "Column AY Adjustment Factor". This explanation reads:

"A comparison of the overhead served D-9 Outdoor Protective Lighting (OPL) products to overhead E-1 Municipal Streetlights Lighting (MSL) revealed that the 250 and 400 watt HPS D-9 OPL lighting equipment was on average 28.0% higher than that of the like E-1 MSL products. Conversely, a comparison of the OPL D-9 overhead 70 and 100 watt HPS lighting products were found to be on average 15.1% lower than the E-1 MSL 70 and 100 watt HPS products. This service cost discrepancy is due to the product mix between that of cobrahead, floodlights, and NEMA heads style luminaires; with cobraheads being 62% more costly than NEMA heads, and floodlights being 90% more costly than cobraheads. In order to maintain revenue neutrality, the adjustment factors in column AY were created to effectively reduce the revenue requirement of the overhead 70 watt fixture cost by $40,497 and reduce the revenue requirement of the overhead 100 watt fixture cost by $285,690 (-$326,188 combined) while increasing the revenue requirement of the overhead 250 watt fixture cost by $163,825 and increasing the revenue requirement of the overhead 400 watt fixture cost by $162,155 (+$335,980 combined). These adjustments support the consolidation in the D-9 and E-1 tariffs while simultaneously allowing the Company to offer the most desired high wattage floodlight luminaires at a proper COS competitive price while staying revenue neutral within the overhead HPS rate class."

It is apparent from this narrative that there are significant differences in the product mix used in municipal street lighting and outdoor protective lighting. DTE's proposed adjustments appear revenue neutral in total but will have the effect of either raising or lowering bills of some municipalities as a result. Furthermore, it is likely that there will be significant customer service cost differences per fixture between Outdoor Protective Lighting customers who typically have only a small number of lights and Municipal Street Lighting customers who typically have hundreds or thousands of lights. I therefore recommend that the Commission deny DTE's proposal as presented.

It is likely that there are benefits to DTE and its Outdoor Protective Lighting customers in the combination of the Outdoor Protective Lighting and Municipal Street Lighting tariffs. This can be accomplished by standardizing most aspects of the tariffs of these two distinct rate schedules or by combining these into one tariff but preserving appropriate distinctions between lighting products and customer service charges.

Q. Why do you recommend that the Commission direct its Staff to audit DTE's Community Lighting Program to establish a clear evidentiary basis for setting fixture charges in future?

A. I have identified several issues in my testimony, particularly with respect to the accounting treatment of Contributions in Aid of Construction and the consequences for revenue requirements and rate design, that can only be resolved through careful auditing of the transactions and accounts involved. General rate case discovery is not conducive to resolving these questions. I therefore recommend an audit by Commission Staff.

Q. Earlier, you recommended that the Commission allow DTE to close the Experimental Emerging Lighting provision of the E1 Rate Schedule to the additional of further lights. You also recommended that the Commission direct DTE to grandfather for a period until 31 December 2025 existing lighting agreements under that provision unless the equipment needs to be replaced or the customer voluntarily switches to the standard tariff. Finally you recommend that increases in lamp charges in the Experimental Emerging Lighting provision be limited to the rate of inflation. Please explain.

A. Most, if not all, of the municipalities who have converted or installed LED streetlights under the Experimental Emerging Lighting provision of tariff E1 have done so through a Purchase Agreement in the form shown on pages 5 through 7 of Exhibit MSLC-21, which was provided by DTE in partial response to discovery question MSLCDE-1.2, (MSLC-22). Paragraph 12.C of that Purchase Agreement reads:

"Upon the approval of any future MPSC Option I tariff for EELT street lighting equipment, the approved rate schedules will automatically apply for service continuation to the Customer under Option 1 Municipal Street Lighting Rate, as approved by the MPSC. The terms of this paragraph C replace in its entirety Section 7 of the Master Agreement with respect to any EELT equipment purchased under this Agreement."

It is therefore clear that if the Commission approves an Option I tariff for LED street lighting, these lights will contractually transfer to that new rate schedule. I therefore make this recommendation only in search of a just outcome.

Municipalities have made substantial Contribution in Aid of Construction to convert lights to LED, partly based on estimates of ongoing savings estimated by DTE. Nothing in DTE's standard presentation of these matters, suggests that the Rate Schedule for these lights will be subject to significantly greater increases than ordinary changes in rates (See the Conversion Model Spreadsheet, MSLC 13, and the Master Agreement, MSLC 21). In the present rate case, DTE proposes extraordinary increases in the charges for LED lights.

In a supplemental response to discovery questions MSLCDE-1.22c and MSLCDE-1.23, (MSLC-23), DTE provided the spreadsheet named "U-17767 MSLCDE-1 Q22c and d Supplemental". This spreadsheet contained calculations of DTE's proposed monthly total charge for each type of LED light and a calculation of the % increase or decrease in that charge for LED lights converted after May 2013. I modified this spreadsheet only to add the similar calculation for LED lights converted before May 2013. A print from that spreadsheet is offered as Exhibit MSLC-24. These calculations show that for LED lights converted under the Experimental Emerging Lighting provision after May 2013, the proposed rate increase is between 13% and 15% and for LED lights converted under the Experimental Emerging Lighting provision before May 2013, the proposed rate increase is between 14% and 67%.

As I explained earlier in this testimony, it is my opinion that DTE has incorrectly determined the rates it proposes in this case. However, if the Commission does not accept that argument then it should consider limiting the harm to those municipalities who made investments in LED lighting based in part on DTE's representations of the anticipated savings. Closing the Experimental Emerging Lighting provision to additional lights while grandfathering the existing lights in this tariff for a period of time and limiting the increases in rates in this tariff to general inflation seems a just outcome, particularly since the proposed rate schedule is based on allocating capital recovery costs for luminaires that these customers have already paid for through CIAC.

Q. You also recommended that the Commission direct DTE to offer each municipality that made a Contribution in Aid of Construction for lighting technology conversions the option to receive a rebate of any difference between the Contribution in Aid of Construction and the amount they would have paid under the proposed CIAC reform, conditional on the related lights being transferred to the new lighting tariff. Why?

A. As I argued earlier in my testimony, the current scheme of Contribution in Aid of Construction for street lighting is not consistent with economic logic and should be reformed. The reform that I suggest would mean that a conversion project would require CIAC only for DTE to recover the remaining book value, minus salvage value, of assets that are retired prematurely. I also observed that the CIAC payments required of municipalities for LED conversion projects appear to have violated the terms of the tariff in that DTE deducted only three times the INCREMENTAL revenue, which is nil, rather than three times the revenue from the affected lights.

I therefore recommend that this issue be resolved by a rebate of the difference between CIAC paid and the CIAC that would be paid under any reform directed by the Commission. On the other hand, if appropriate CIAC is returned to those municipalities, it would also be appropriate to withdraw the protection against extraordinary rate increases that I recommended above and place these lights into the standard LED tariff.

Q. Your final recommendation was that the Commission direct DTE to develop and provide to the Commission a business plan for its Community Lighting Program, after consultation with the Municipal Street Lighting Coalition and other municipal street lighting customers facilitated by the Commission's Staff. Why?

A. There are two basic reasons. First, as I observed early in this testimony, this is a period of change in street lighting technology. This transition will likely go much more smoothly for DTE and its municipal lighting customers if DTE, the municipalities, and the Commission have a shared understanding of how DTE will navigate this transition. A number of the issues about which I have testified, including the use of Contribution in Aid of Construction for technology conversion projects and the contrast between DTE's static view of its maintenance costs and the rapid change in its lighting fleet, arise because DTE lacks such a plan.

In response to several discovery questions, DTE clearly and definitively responded that it does not have a plan of this kind. Responses to questions MSLCDE-1.17, MSLCDE-1.18, and supplemental responses to MSLCDE-2.25, MSLCDE-2.26, MSLCDE-2.27, and MSLCDE-2.44 are included in Exhibit MSLC-25.

Second, there are a number of concerns held by the municipalities that are members of the Municipal Street Lighting Coalition that are not directly at issue in this case but that require resolution. These are best addressed through collaborative engagement between DTE and these customers, the resolution of which might well be rendered in a management plan of the kind recommended. The concerns that have been articulated to me in meetings, conversations, and correspondence with members of the Municipal Street Lighting Coalition include:

1) Whether DTE should be normally transitioning failed light fixtures to LED or high pressure sodium, given environmental, public safety, and other considerations in municipalities;

2) Billing inaccuracies;

3) Absence or inadequacy of closed-loop tracking of streetlight outage reports to resolution;

4) Slow response to some outage reports;

5) Seemingly high overhead or indirect costs in the Community Lighting Program;

6) Higher maintenance costs in the Community Lighting Program than are reported by municipalities who own lights and perform or contract for their own maintenance;

7) Differences in cost of capital between municipalities and DTE and the appropriate roles of each in financing street lighting projects;

8) Substandard street light repairs or installations; and

9) Development by DTE of cost tracking methods that can properly support bottom-up cost-of-service rate design by lighting type.

In addition, the Commission should take note of letters from some municipalities that it has received as public comment in this docket and the resolution of the City Council of Warren that I am providing as Exhibit MSLC-26.

I am therefore recommending that the Commission direct DTE to develop and provide to the Commission a business plan for its Community Lighting Program through a consultative process with its municipal customers facilitated by Commission staff.

Q. Does that complete your testimony?

A. Yes.

Douglas B. Jester

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Citizen of the United States

Professional experience

January 2011 - present 5 Lakes Energy LLC

Principal/Co-Owner

Together with Stanley "Skip" Pruss and Liesl Eichler Clark, working to accelerate the development of Michigan's clean energy economy. Engagements have included market analytics on industrial energy efficiency and smart grid cluster development for NextEnergy, solar market development for a large multinational corporation and a Michigan-based startup, economic analysis and advocacy for renewable electric generation supporters and for the wind industry, analysis of storage and demand response opportunities in Michigan using electric vehicles for an automobile original equipment manufacturer, examination of best practices in electric vehicle infrastructure development for the Pew Charitable Trusts, and marketing advisory services for an industrial energy management company and a clean energy finance company.

February 2010 - December 2010 Michigan Department of Energy, Labor and Economic Growth

Senior Energy Policy Advisor

Advisor to the Chief Energy Officer of the State of Michigan with primary focus on institutionalizing energy efficiency and renewable energy strategies and policies and developing clean energy businesses in Michigan. Provided several policy analyses concerning utility regulation, grid-integrated storage, performance contracting, feed-in tariffs, and low-income energy efficiency and assistance. Participated in Pluggable Electric Vehicle Task Force, Smart Grid Collaborative, Michigan Prosperity Initiative, and Green Partnership Team. Managed development of social-media-based community for energy practitioners. Organized conference on Biomass Waste to Energy.

August 2008 - February 2010 Rose International/Verizon

Business Development Consultant - Smart Grid

- Employed by Verizon Business' exclusive external staffing agency for the purpose of providing business and solution development consultation services to Verizon Business in the areas of Smart Grid services and transportation management services.

December 2007 - March 2010 Efficient Printers Inc

President/Co-Owner

- Co-founder and co-owner with Keith Carlson of a corporation formed for the purpose of acquiring J A Thomas Company, a sole proprietorship owned by Keith Carlson. Recognized as Sacramento County (California) 2008 Supplier of the Year and Washoe County (Nevada) Association for Retarded Citizens 2008 Employer of the Year. Business operations discontinued by asset sale to focus on associated printing software services of IT Services Corporation.

August 2007 - present IT Services Corporation

President/Owner

- Founder, co-owner, and President of a startup business intended to provide advanced IT consulting services and to acquire or develop managed services in selected niches, currently focused on developing e-commerce solutions for commercial printing with software-as-a-service currently in first customer use.

2004 – August 2007 Automated License Systems

Chief Technology Officer

- Member of four-person executive team and member of board of directors of a privately-held corporation specializing in automated systems for the sale of hunting and fishing licenses and in automated background check systems. Executive responsible for project management, network and data center operations, software and product development. Brought company through mezzanine financing and sold it to Active Networks.

2000 - 2004 WorldCom/MCI

Director, Government Application Solutions

- Executive responsible in various combinations for line of business sales, state and local government product marketing, project management, network and data center operations, software and product development, and contact center operations for specialized government process outsourcing business. Principal lines of business were vehicle emissions testing, firearm background checks, automated hunting and fishing license systems, automated appointment scheduling, and managed application hosting services. Also responsible for managing order entry, tracking, and service support systems for numerous large federal telecommunications contracts such as the US Post Office, Federal Aviation Administration, and Navy-Marine Corps Intranet.
- Increased annual line-of-business revenue from $64 million to $93 million, improved EBITDA from approximately 2% to 27%, and retained all customers, in context of corporate scandal and bankruptcy.
- Repeatedly evaluated in top 10% of company executive management on annual performance evaluations.

1999-2000 Compuware Corporation

Senior Project Manager

- Senior project manager, on customer site with five project managers and team of approximately 80, to migrate a major dental insurer from a mainframe environment to internet-enabled client-server environment.

1995 - 1999 City of East Lansing, Michigan

Mayor and Councilmember

- Elected chief executive of the City of East Lansing, a sophisticated city of 52,000 residents with a council-manager government employing about 350 staff and with an annual budget of about $47 million. Major accomplishments included incorporation of public asset depreciation into budgets with consequent improvements in public facilities and services, complete rewrite and modernization of city charter, greatly intensified cooperation between the City of East Lansing and the East Lansing Public Schools, significant increases in recreational facilities and services, major revisions to housing code, initiation of revision of the City Master Plan, facilitation of the merger of the Capital Area Transportation Authority and Michigan State University bus systems, initiation of a major downtown redevelopment project, City government efficiency improvements, and numerous other policy initiatives. Member of Michigan Municipal League policy committee on Transportation and Environment and principal writer of league policy on these subjects (still substantially unchanged as of 2009).

1995-1999 Michigan Department of Natural Resources

Chief Information Officer

- Executive responsibility for end-user computing, data center operations, wide area network, local area network, telephony, public safety radio, videoconferencing, application development and support, Y2K readiness for Departments of Natural Resources and Environmental Quality. Directed staff of about 110. Member of MERIT Affiliates Board and of the Great Lakes Commission's Great Lakes Information Network (GLIN) Board.

1990-1995 Michigan Department of Natural Resources

Senior Fisheries Manager

- Responsible for coordinating management of Michigan's Great Lakes fisheries worth about $4 billion per year including fish stocking and sport and commercial fishing regulation decisions, fishery monitoring and research programs, information systems development, market and economic analyses, litigation, legislative analysis and negotiation. University relations. Extensive involvement in regulation of steam electric and hydroelectric power plants. Considerable involvement with Great Lakes Fishery Commission, including:
    - Co-chair of Strategic Great Lakes Fishery Management Plan working group
    - Member of Lake Erie and Lake St. Clair Committees
    - Chair, Council of Lake Committees
    - Member, Sea Lamprey Control Advisory Committee
    - St Clair and Detroit River Areas of Concern Planning Committees

1989-1990 American Fisheries Society

Editor, North American Journal of Fisheries Management

- Full responsibility for publication of one of the premier academic journals in natural resource management.

1984 - 1989 Michigan Department of Natural Resources

Fisheries Administrator

- Assistant to Chief of Fisheries, responsible for strategic planning, budgets, personnel management, public relations, market and economic analysis, and information systems. Department of Natural Resources representative to Governor's Cabinet Council on Economic Development.

1983-present Michigan State University

Adjunct Instructor

- Irregular lecturer in various undergraduate and graduate fisheries and wildlife courses and informal graduate student research advisor in fisheries and wildlife, resource economics, and in parks and recreation marketing.

1977 – 1984 Michigan Department of Natural Resources

Fisheries Research Biologist

- Simulation modeling & policy analysis of Great Lakes ecosystems. Development of problem-oriented management records system and "epidemiological" approaches to managing inland fisheries.

Education

1991-1995 Michigan State University

PhD Candidate, Environmental Economics

Coursework completed, dissertation not pursued due to decision to pursue different career direction.

1980-1981 University of British Columbia

Non-degree Program, Institute of Animal Resource Ecology

1974-1977 Virginia Polytechnic Institute & State University

MS Fisheries and Wildlife Sciences

MS Statistics and Operations Research

1971-1974 New Mexico State University

BIS Mathematics, Biology, and Fine Arts

Citizenship and Community Involvement

Youth Soccer Coach, East Lansing Soccer League, 1987-89

Co-organizer, East Lansing Community Unity, 1992-1993

Bailey Community Association Board, 1993-1995

East Lansing Commission on the Environment, 1993-1995

Councilmember, City of East Lansing, 1995-1999

Mayor, City of East Lansing, 1995-1997

East Lansing Downtown Development Authority Board Member, 1995-1999

East Lansing Transportation Commission, 1999-2004

East Lansing Non-Profit Housing and Neighborhood Services Corporation Board Member, 2001-2004

Lansing Smart Zone Board of Directors, 2007-present

Council on Labor and Economic Growth, State of Michigan, by appointment of the Governor, May 2009 – May 2012

East Lansing Downtown Development Authority Board Member and Vice-Chair, 2010 – present.

East Lansing Brownfield Authority Board Member and Vice-Chair, 2010 – present.

East Lansing Downtown Management Board and Chair, 2010 – present.

Specific Energy-Related Accomplishments

Unrelated to Employment

- Member of Michigan Green Jobs Initiative, representing the Council for Labor and Economic Growth.
- Participated in Lansing Board of Water and Light Integrated Resource Planning, leading to their recent completion of a combined cycle natural gas power plant that also provides district heating to downtown Lansing.
- In graduate school, participated in development of database and algorithms for optimal routing of major transmission lines for Virginia Electric Power Company (now part of Dominion Resources).

For 5 Lakes Energy

- Coordinator of multi-stakeholder Michigan campaign to support the Clean Power Plan and chair of Midwest regional stakeholder technical committee.
- Policy development lead for multi-stakeholder campaign to increase Michigan's energy efficiency and renewable energy standards.
- In conjunction with Jeremiah Johnson, University of Michigan, conceived and developed the SCRAPS model for planning implementation of the 111d rule of the Clean Power Plan.
- Expert witness in multiple power supply cost recovery rate cases, renewable energy plan cases, and other matters before the Michigan Public Service Commission.
- Representative to several MISO stakeholder committees representing Michigan utility customer interests.
- Lead participant on behalf of solar interests in Michigan Public Service Commission Solar Work Group.
- Participant in the Michigan Public Service Commission Smart Grid Collaborative, authoring recommendations on data access, application priorities, and electric vehicle integration to the grid.
- Participant in the Michigan Public Service Commission Energy Optimization Collaborative, a regular meeting and action collaborative of parties involved in the Energy Optimization programs required of utilities by Michigan law enacted in 2008.
- Under contract to NextEnergy, authored "Alternative Energy and Distributed Generation" chapter of Smart Grid Economic Development Opportunities report to Michigan Economic Development Corporation and assisted authors of chapters on "Demand Response" and "Automated Energy Management Systems".
- Developed presentation on "Whole System Perspective on Energy Optimization Strategy" for Michigan Energy Optimization Collaborative.
- Under contract to NextEnergy, assisted in development of industrial energy efficiency technology development strategy.
- Under contract to a multinational solar photovoltaics company, developed market strategy recommendations.
- For an automobile OEM, developed analyses of economic benefits of demand response in vehicle charging and vehicle-to-grid electricity storage solutions.
- Under contract to Pew Charitable Trusts, assisted in development of a report of best practices for electric vehicle charging infrastructure.
- Under contract to a national foundation, developed renewable energy business case for Michigan including estimates of rate impacts, employment and income effects, health effects, and greenhouse gas emissions effects.
- Assisted in Michigan market development for a solar panel manufacturer, clean energy finance company, and industrial energy management systems company.
- Under contract to Institute for Energy Innovation, organized legislative learning sessions covering a synopsis of Michigan's energy uses and supply, energy efficiency, and economic impacts of clean energy.

For Department of Energy Labor and Economic Growth

- Participant in the Michigan Public Service Commission Energy Optimization Collaborative, a regular meeting and action collaborative of parties involved in the Energy Optimization programs required of utilities by Michigan law enacted in 2008.
- Lead development of a social-media-based community for energy practitioners in Michigan at www.MichEEN.org.
- Drafted analysis and policy paper concerning customer and third-party access to utility meter data.
- Analyzed hourly electric utility load demonstrating relationship amongst time of day, daylight, and temperature on loads of residential, commercial, industrial, and public lighting customers. Analysis demonstrated the importance of heating for residential electrical loads and the effects of various energy efficiency measures on load-duration curves.
- Analyzed relationship of marginal locational prices to load, demonstrating that traditional assumptions of Integrated Resource Planning are invalid and that there are substantial current opportunities for cost-effective grid-integrated storage for the purpose of price arbitrage as opposed to traditionally considered load arbitrage.
- Developed analyses and recommendations concerning the use of feed-in tariffs in Michigan.
- Participated in Pluggable Electric Vehicle Task Force and initiated changes in State building code to accommodate installation of vehicle charging equipment.
- Organized December 2010 conference on Biomass Waste to Energy technologies and market opportunities.
- Participated in and provided support for teams working on developing Michigan businesses involved in renewable energy, storage, and smart grid supply chains.
- Developed analyses and recommendations concerning low-income energy assistance coordination with low-income energy efficiency programs and utility payment collection programs.
- Drafted State of Michigan response to a US Department of Energy request for information on offshore wind energy technology development opportunities.
- Assisted in development of draft performance contracting enabling legislation, since adopted by the State of Michigan.

For Verizon Business

- Analyzed several potential new lines of business for potential entry by Verizon's Global Services Systems Integration business unit and recommended entry to the "Smart Grid" market. This recommendation was adopted and became a major corporate initiative.
- Provided market analysis and participation in various conferences to aid in positioning Verizon in the "Smart Grid" market. Recommendations are proprietary to Verizon.
- Led a task force to identify potential converged solutions for the "Smart Grid" market by integrating Verizon's current products and selected partners. Established five key partnerships that are the basis for Verizon's current "Smart Grid" product offerings.
- Participated in the "Smart Grid" architecture team sponsored by the corporate Chief Technology Officer with sub-team lead responsibilities in the areas of Software and System Integration and Network and Systems Management. This team established a reference architecture for the company's "Smart Grid" offerings, identified necessary changes in networks and product offerings, and recommended public policy positions concerning spectrum allocation by the FCC, security standards being developed by the North American Reliability Council, and interoperability standards being developed by the National Institute of Standards and Technology.
- Developed product proposals and requirements in the areas of residential energy management, commercial building energy management, advanced metering infrastructure, power distribution monitoring and control, power outage detection and restoration, energy market integration and trading platforms, utility customer portals and notification services, utility contact center voice application enablement, and critical infrastructure physical security.

- Lead solution architecture and proposal development for six utilities with solutions encompassing customer portal, advanced metering, outage management, security assessment, distribution automation, and comprehensive “Smart Grid” implementation.
- Presented Verizon’s “Smart Grid” capabilities to seventeen utilities.
- Presented “Role of Telecommunications Carriers in Smart Grid Implementation” to 2009 Mid-America Regulatory Conference.
- Presented “Smart Grid: Transforming the Electricity Supply Chain” to the 2009 World Energy Engineering Conference.
- Participant in NASPInet work groups of the North American Energy Reliability Corporation (NERC), developing specifications for a wide-area situational awareness network to facilitate the sharing and analysis of synchrophasor data amongst utilities in order to increase transmission reliability.
- Provided technical advice to account team concerning successful proposal to provide network services and information systems support for the California ISO, which coordinates power dispatch and intercompany power sales transactions for the California market.

For Michigan Department of Natural Resources

- Determined permit requirements under Section 316 of the Clean Water Act for all steam electric plants currently operating in the State of Michigan.
- Case manager and key witness for the State of Michigan in FERC, State court, and Federal court cases concerning economics and environmental impacts of the Ludington Pumped Storage Plant, which was the world’s largest pumped storage plant. A lead negotiator for the State in the ultimate settlement of this issue. The settlement was valued at $127 million in 1995 and included considerations of environmental mitigation, changes in power system dispatch rules, and damages compensation.
- Managed FERC license application reviews for the State of Michigan for all hydroelectric projects in Michigan as these came up for reissuance in 1970s and 1980s.
- Testified on behalf of the State of Michigan in contested cases before the Federal Energy Regulatory Commission concerning benefit-cost analyses and regulatory issues for four different hydroelectric dams in Michigan.
- Reviewed (as regulator) the environmental impacts and benefit-cost analyses of all major steam electric and most hydroelectric plants in the State of Michigan.
- Executive responsibility for development, maintenance, and operations of the State of Michigan’s information system for mineral (includes oil and gas) rights leasing, unitization and apportionment, and royalty collection.
- In cooperative project with Ontario Ministry of Natural Resources, participated in development of a simulation model of oil field development logistics and environmental impact on Canada’s Arctic slope for Tesoro Oil.

MPSC Case No.:	U-17767
Respondent:	K.D. Johnston
Requestor:	MSLC-1
Question No.:	MSLCDE-1.16
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Question: Identify the specific government standards causing Mercury Vapor and Metal Halide technologies to become obsolete as discussed by Witness K. A. Holmes, Page KAH-11, lines 23-25. Specify when these technologies may no longer be acquired, installed, maintained, or left in place by DTE.

Answer: Under the Energy Policy Act, signed by President Bush in August 2005, manufacturers cannot make or import ballasts for mercury vapor lights after Jan. 1, 2008. Similarly, the Energy Independence and Security Act of 2007 imposed restrictions on the minimum efficiencies permissible for many metal halide fixtures manufactured on or after Jan. 1, 2009. The full text of the most recent act may be found at https://www.govtrack.us/congress/bills/110/hr6/text.

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
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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.

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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

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Project Manager

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Bristol, VT

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Project Manager

NYSERDA Report 14-42 NYSERDA Contract 35661 December 2014

Notice

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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

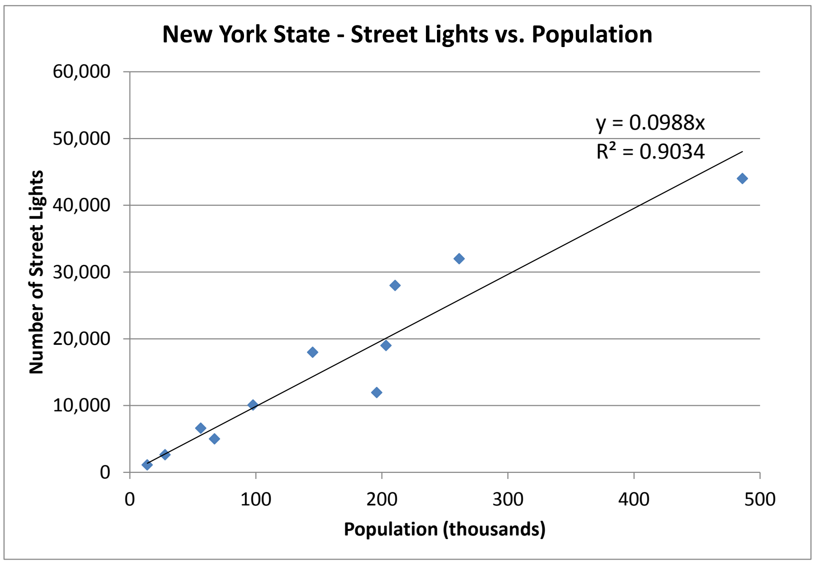
If New York State decides to implement a coordinated statewide LED street lighting program, the following steps would be critical to establishing a successful program:

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.

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[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

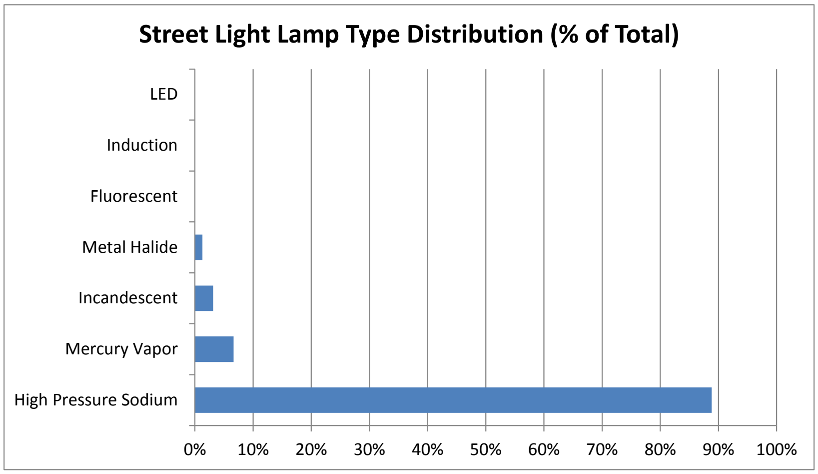
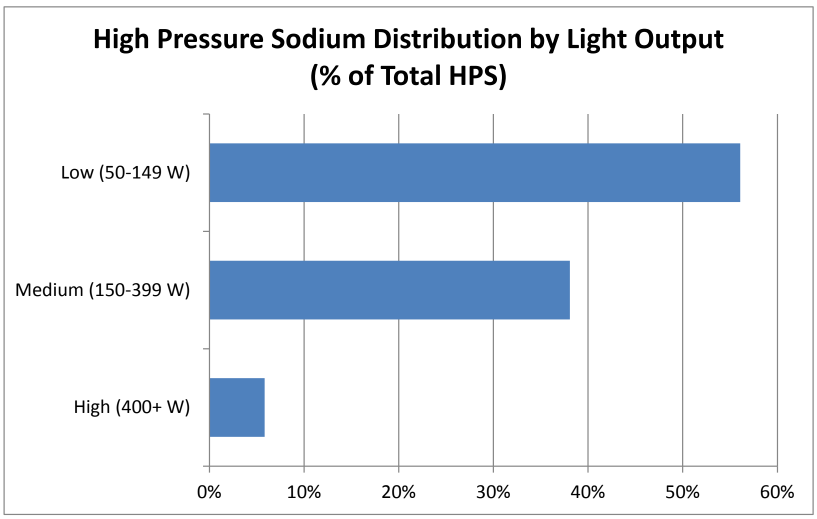


Figure 1-3. Existing New York State HPS Street Light Wattage Distribution



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.

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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 = ^{o}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.

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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

	Light Output					
	Low (<50W)		Medium (50W-100W)		High (>100W)	
LED 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

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]

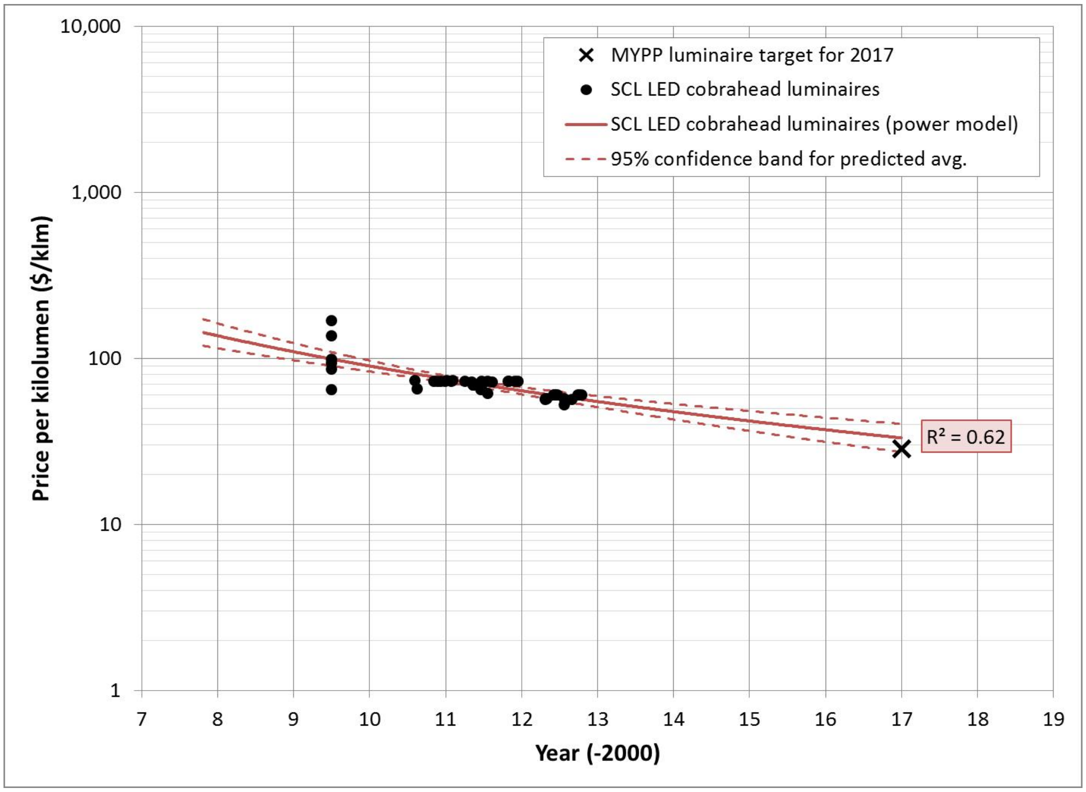
Seattle streetlight experience (for purchases of 2,000+ units)

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]

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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

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[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.

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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."

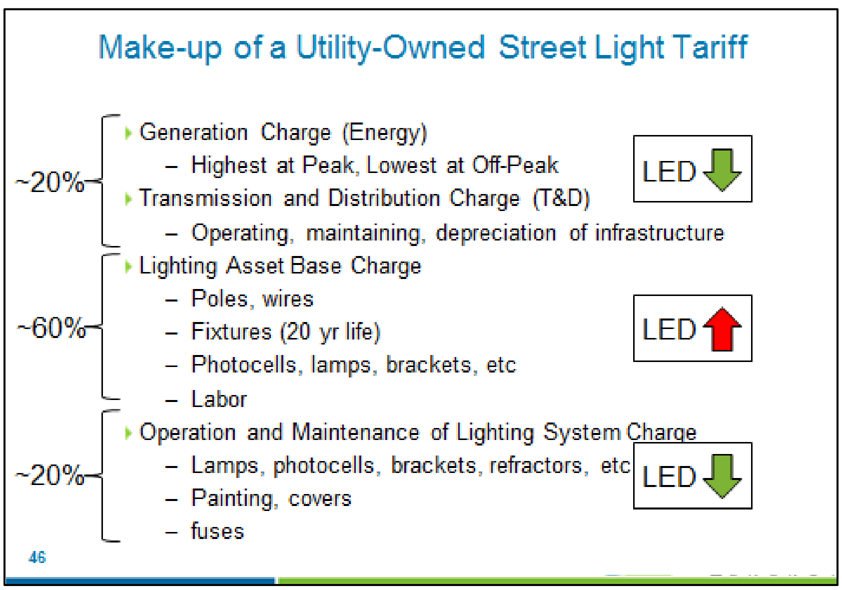
30 Massachusetts Restructuring Utility Industry Act, Chapter 164, Section 34a, 1997. Rhode Island Municipal Street Light Investment Act, 2013. Maine Energy Cost Reduction Act, 2013.

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

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 04
Source: NEEP
63 Pages

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

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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:

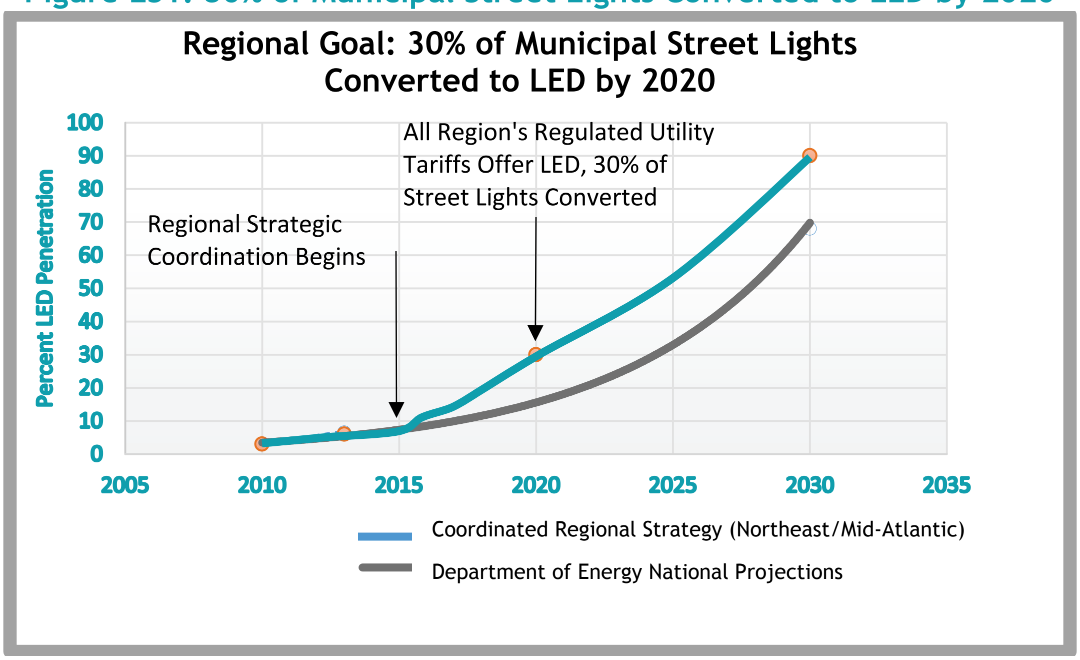
Barrier Type	Description
Technical	Many municipalities lack the resources and the technical expertise needed to design and implement successful LED street lighting upgrade projects.
Regulatory	Most utility tariffs in the region for utility-owned street lights do not offer LED technology and/or street 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



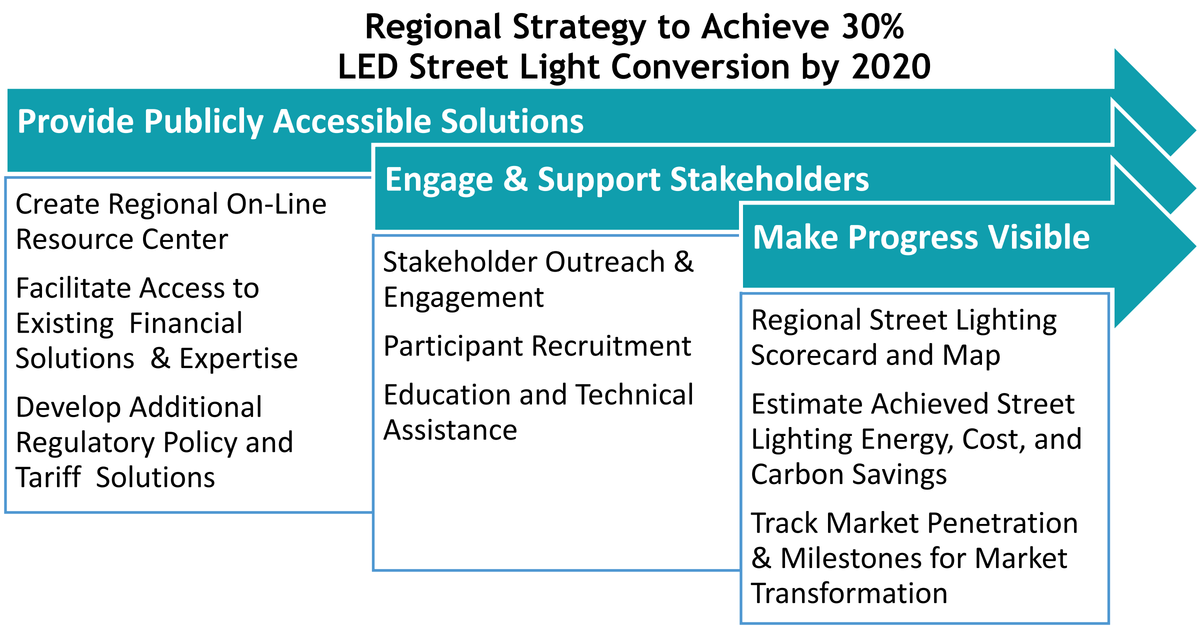
The core driver of this result is the adoption and implementation of street lighting tariffs that encourage LED conversions supported by complementary regulatory policies that address issues of stranded cost and other disincentives, as well as financial tools and strategies that reduce the cost of LED 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

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[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/

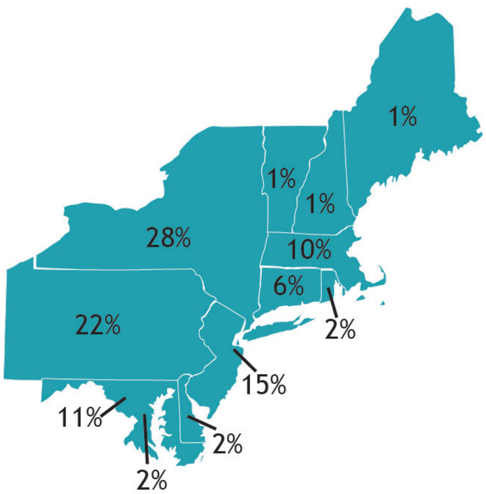
[8] US Department of Energy Building Technologies Office. *Solid State Lighting Technology Fact Sheet*. (August 2013) (Stating that "LEDs have the potential to best other technologies in terms of longevity,") Accessed: 1/12/15. Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/life-reliability_fact-sheet.pdf

[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.

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[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]

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[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

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.

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]

[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

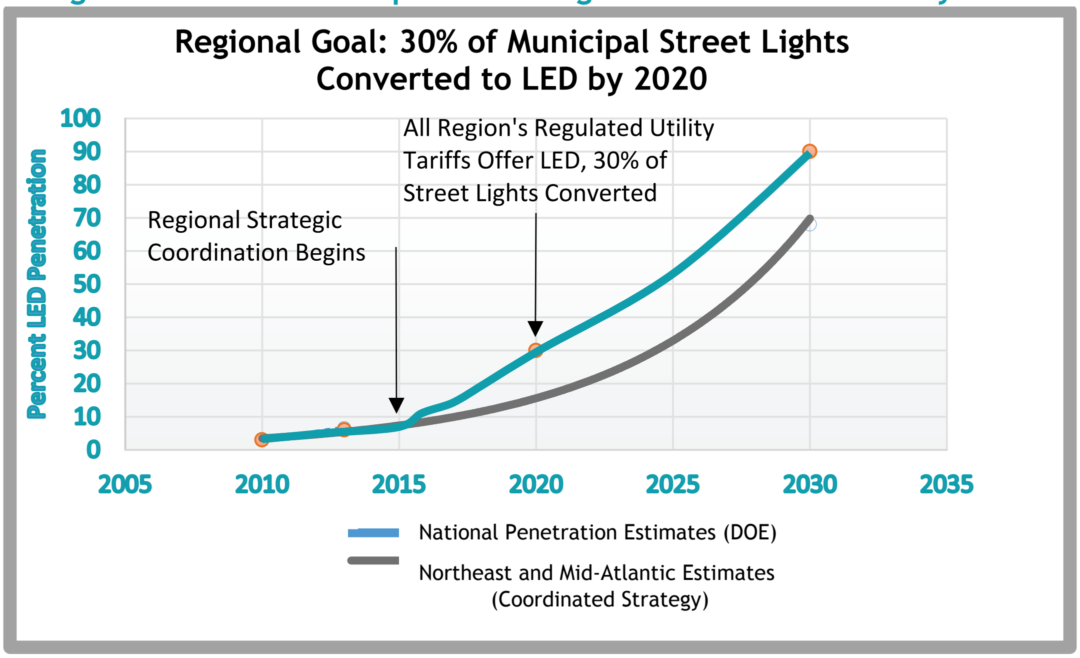
[35] The Department of Energy provides a trove of outreach materials through their MSSSLC and High Performance Street and Outdoor Lighting Accelerator. For example, the Department of Energy publishes a Model Specification for LED Roadway Luminaires V2.0 and Retrofit Financial Analysis Tool that can that 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

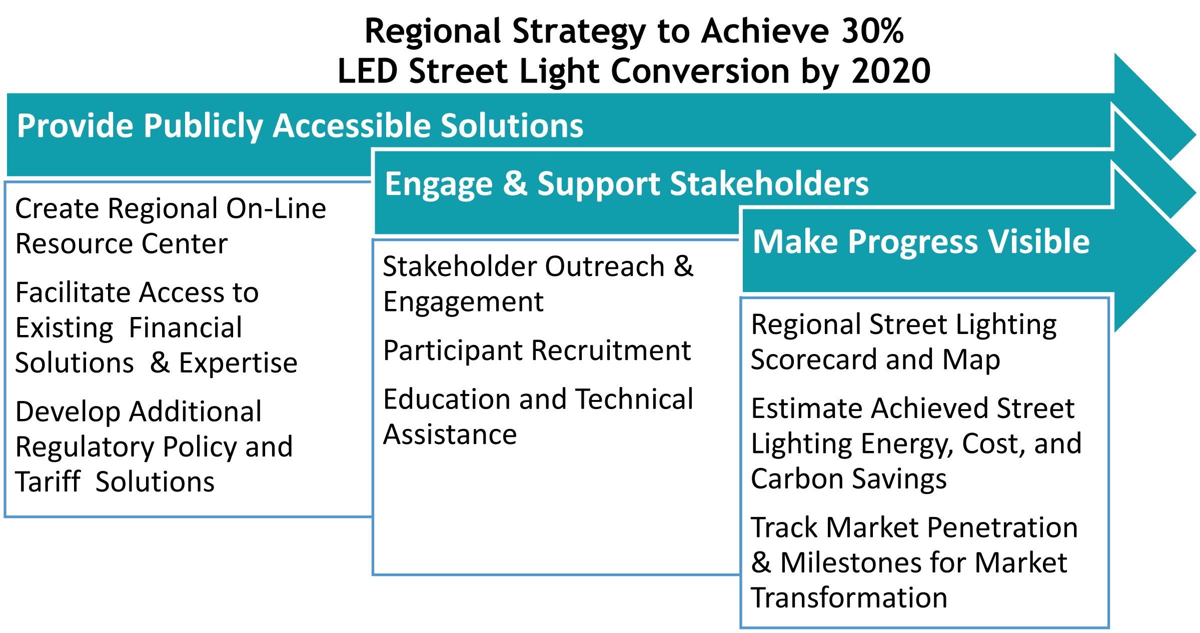
BARRIERS	SOLUTIONS
Technical Municipalities lack resources and technical expertise	Regional information sharing Forums, On-line Resource Center and Identified Expertise
Financial Stranded costs from legacy lighting and high up-front transactional costs for new LED street lights	Financial Tools and Resources
Regulatory Utilities lack incentives to retire legacy lighting or adjust street lighting tariffs to encourage LED street light conversions	Regulatory Policies and Model Tariffs

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)

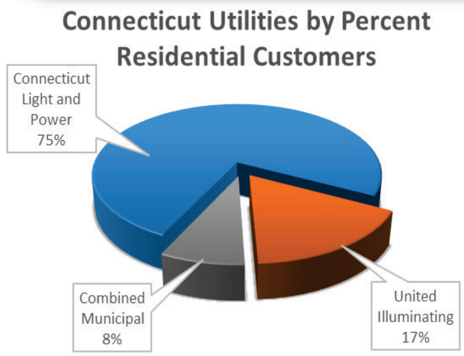
Table A2: Northeast and Mid-Atlantic MSSSLC Participants

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

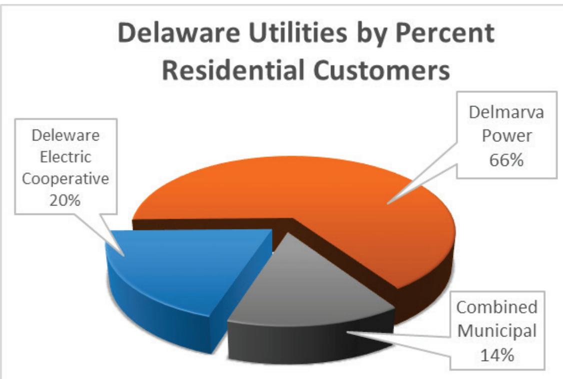
[56] MacMillan, Thomas. New Haven Independent. "2,000 Street lights on the Way." (December 2012) Accessed: 1/12/15. Available at: http://www.newhavenindependent.org/index.php/archives/entry/led_street lights_on_the_way/

[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

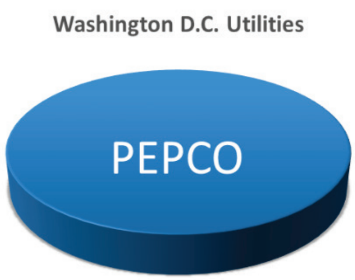
Table A5: Delmarva Power HPS/LED Rate Comparison

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

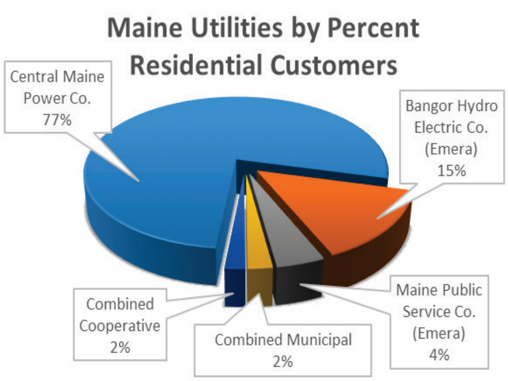
[63] Washington Metropolitan Transit Authority (WMATA). Press Release. Metro to Overhaul Parking Garage Lighting for Safety, Efficiency. (November 2013) Accessed: 8/23/14. Available at: http://www.wmata.com/about_metro/news/PressReleaseDetail.cfm?ReleaseID=5613

[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)

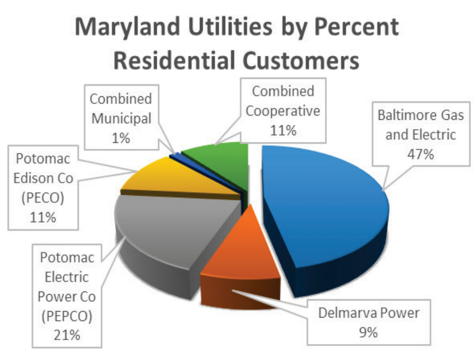
Maine LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Lewiston	March 2014	Request for quotation for purchase of 120 LED Street lights[69]
I-295	June 2012	Retrofitting 105 high mast light towers on I-295[70]
Brunswick Landing	May 2012	Energy performance contract 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-if5kAUtDpmdSonrCLxslw&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

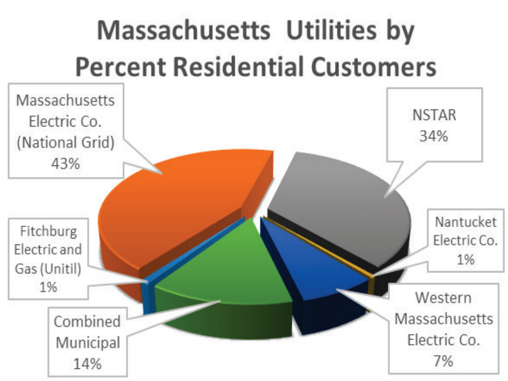
[85] Maryland Department of Transportation. "*State High Administration Begins Major US 50 Lighting Upgrades in Queen Anne's County*" Accessed: 1/12/15. Available at: http://www.marylandroads.com/pages/release.aspx?newsId=1483

[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

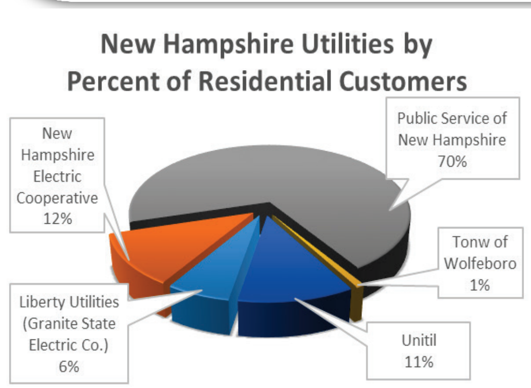
[97] Greenfield LED Street Lighting Project. Initiation to Bid. (October 2013) Accessed: 1/12/15. Available at: http://www.townofgreenfield.org/pages/greenfieldma_finance/purchasing/13-10IFBLEDStreetlightInstallation.pdf

[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.

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[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.

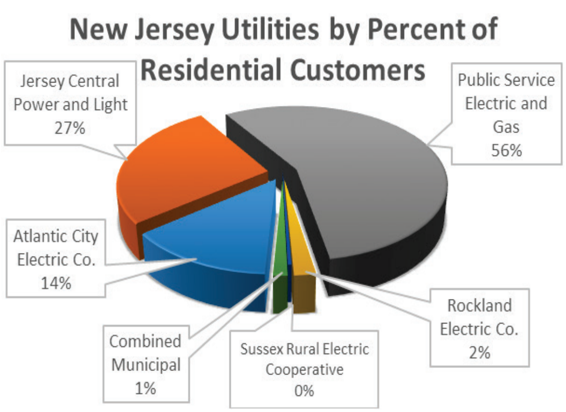
Table A14: Notable Conversion Projects (New Hampshire)

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

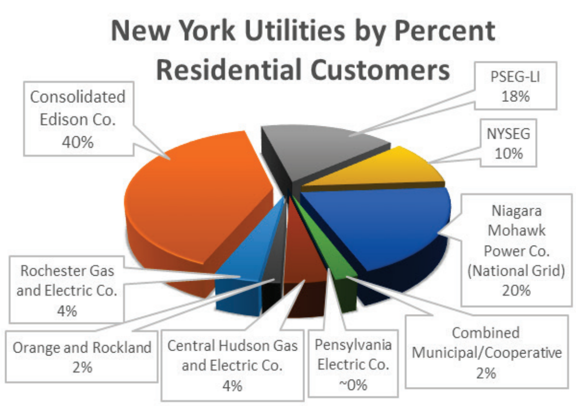
[114]US Department of Energy. Office of Weatherization and Intergovernmental Programs. EECBG/SEP Grantee TA Impact Statement. Accessed: 1/12/15. Available at: http://www1.eere.energy.gov/wip/solutioncenter/pdfs/eecbg_tap_impact_statement_trenton_nj_revised_0811.pdf

[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

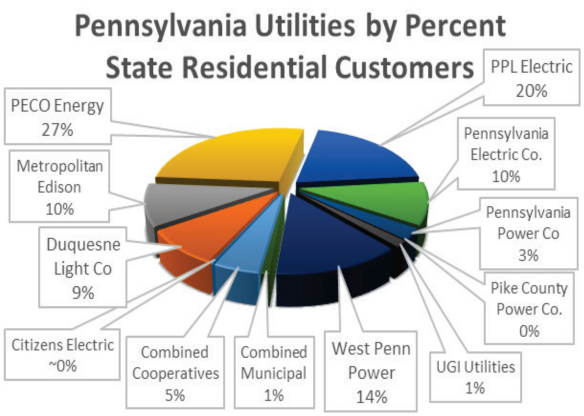
[123] Barton, Siobhan. Newsday. *"Islip Installs Thousands of Energy Efficient Street Lights."* (May 2014) Accessed: 1/12/15. Available at: http://www.newsday.com/long-island/towns/islip-installs-thousands-of-energy-efficient-street-lights-1.8023700

[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%20STREETpercent20RELEASEpercent20LEDpercent20STREET LIGHTS203%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

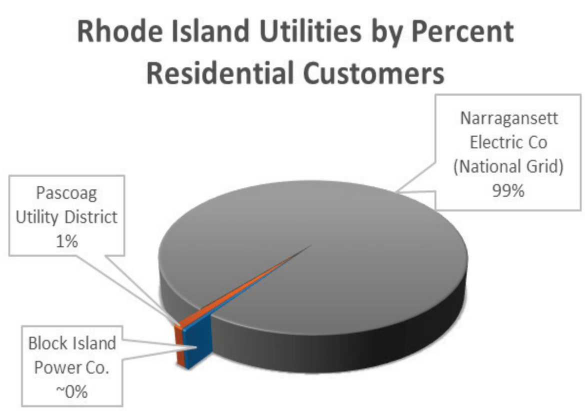
[137] Power Online Press Release. "*Obama Administration Delivers More Than $36M to Pennsylvania Communities for Energy Efficiency Projects.*" (September 2009) Accessed: 1/12/15. Available at: http://www.poweronline.com/doc/obama-administration-delivers-more-than-36m-0001

[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)

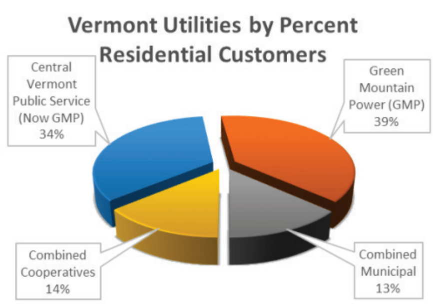
Rhode Island LED Street Light Projects and Prospective Projects		
Municipality	**Date**	**Details**
Pascoag/Harrisville	July 2014	Currently implementing a "very aggressive" street-lighting retrofit program[141]
Burilloville	November 2013	Converted 56 of 1,147 street lights to LED[142]

[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]

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[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]

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[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.

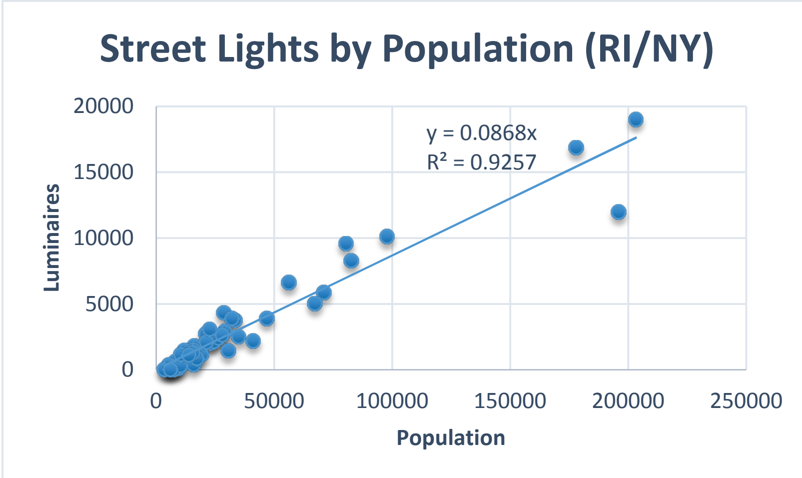
[162] This strategy is consistent with a 2014 MSSLC survey which found, "[G]reater variability in towns with populations of less than a few thousand, suggesting that other variables begin to markedly influence the number of luminaires below some threshold." While this threshold likely affects many municipalities, 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.

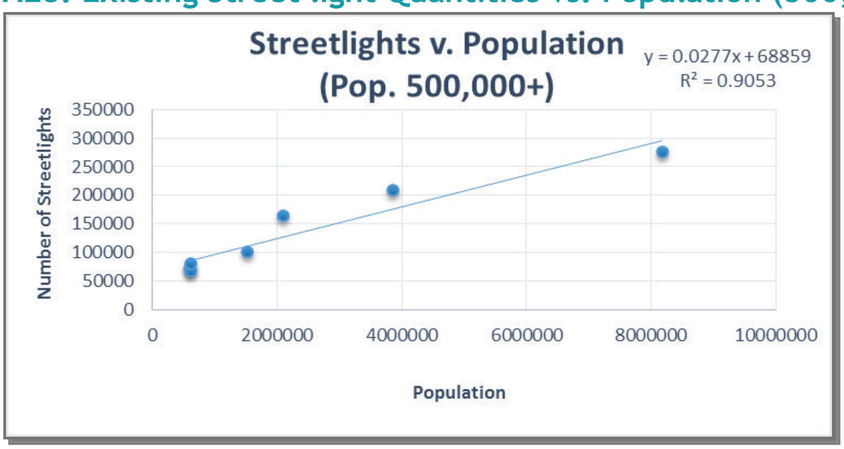
[165] Massachusetts municipalities included Arlington, Chelsea, Natick, Woburn, Somerville, Sharon, Winchester, Swampscott, Winthrop, Gloucester, Hamilton, Melrose, Wenham, Beverly, Northampton, Salem, Lowell, Chicopee, Westfield, Malden, and Brockton.

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+)

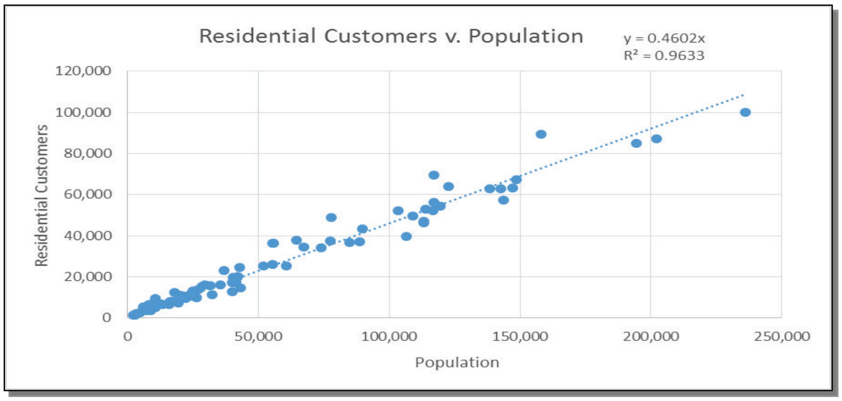


[166] These cities included New York, Los Angeles, Philadelphia, Washington D.C., Boston, and Baltimore.
[167] New York City, the largest city in the country, was identified as an outlier with street lighting characteristics unique to that jurisdiction, and therefore excluded from this analysis.

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.

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[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

MPSC Case No.: U-17767
Respondent: Legal/K. D. Johnston
Requestor: MSLC-2
Question No.: MSLC/DE-2.30
Page: 1 of 1

Question: Confirm that the Company does not propose to require Contribution in Aid of Construction for conversion of failed Mercury Vapor municipal lighting to High Pressure Sodium, in order to continue service after the pending phase-out of Mercury Vapor lighting.

Answer: DTE objects for the reason that the request is unclear and unduly vague and incapable of answer in its present form since the Company is unclear regarding the meaning of “pending phase-out of Mercury Vapor lighting”.

Subject to this objection and without waiving this objection, DTE would state as follows: DTE confirms that it does not currently propose to require customers to make a Contribution in Aid of Construction for conversion of Mercury Vapor municipal lighting to High Pressure Sodium at which time DTE can no longer maintain the Mercury Vapor lighting.

MPSC Case No.: U-17767
Respondent: Legal/K. D. Johnston
Requestor: MSLC-2
Question No.: MSLC/DE-2.32
Page: 1 of 1

Question: Confirm that the Company does not propose to require Contribution in Aid of Construction for conversion of failed Metal Halide municipal lighting to High Pressure Sodium, in order to continue service after the pending phase-out of Metal Halide lighting.

Answer: DTE objects for the reason that the request is unclear and unduly vague and incapable of answer in its present form since the Company is unclear regarding the meaning of "pending phase-out of Metal Halide lighting".

Subject to this objection and without waiving this objection, DTE would state as follows: DTE confirms that it does not currently propose to require customers to make a Contribution in Aid of Construction for conversion of Metal Halide municipal lighting to High Pressure Sodium at which time DTE can no longer maintain the Metal Halide lighting.

MPSC Case No.:	U-17767
Respondent:	Legal/K. D. Johnston
Requestor:	MSLC-2
Question No.:	MSLC/DE-2.34
Page:	1 of 1

Question: Provide a step-by-step description of how the Company proposes to calculate Contribution in Aid of Construction for a municipality that wishes to convert failed Mercury Vapor or Metal Halide lights to LED instead of to High Pressure Sodium. Provide any proposals for Contribution in Aid of Construction to convert failed Mercury Vapor or Metal Halide lights to LED instead of High Pressure Sodium that have been presented to a municipality by the Company since 1 January 2012, whether or not the proposals were accepted.

Answer: DTE objects for the reason that the information requested consists of private customer information, confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its Customers competitive harm. DTE also objects for the reason that the request is unclear and unduly vague and incapable of answer in its present form since the Company is unclear regarding the meaning of "failed Mercury Vapor or Metal Halide lights."

Subject to this objection and without waiving this objection, DTE states that it would replace Mercury Vapor or Metal Halide lighting with High Pressure Sodium lighting upon failure of the Mercury Vapor or Metal Halide lighting. Any replacement of Mercury Vapor or Metal Halide lighting to LED lighting must be performed on a planned basis driven by customer demand rather than on a reactive basis. See also the answer to MSLC/DE-2.39.

MPSC Case No.:	U-17767
Respondent:	Legal/K. D. Johnston
Requestor:	MSLC-2
Question No.:	MSLC/DE-2.31 Supplemental
Page:	1 of 2

Question: Will the Company seek Contribution in Aid of Construction to convert still-functioning Mercury Vapor municipal lighting to High Pressure Sodium in bulk, in order to continue service after the pending phase-out of Mercury Vapor lighting? If so, provide a step-by- step description of how the Company proposes to calculate Contribution in Aid of Construction for a municipality that wishes to convert still-functioning Mercury Vapor to High Pressure Sodium in bulk. Provide any proposals for Contribution in Aid of Construction to convert still-functioning Mercury Vapor to High Pressure Sodium that have been presented to a municipality by the Company since 1 January 2012, whether or not the proposals were accepted.

Answer: DTE objects for the reason that the information requested consists of private customer information, confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its Customers competitive harm. DTE objects for the reason that the request is unclear and unduly vague and incapable of answer in its present form since the Company is unclear regarding the meaning of “pending phase-out of Mercury Vapor lighting”.

Subject to this objection and without waiving this objection, DTE would state as follows: DTE does not intend to proactively replace Mercury Vapor lighting to High Pressure Sodium lighting in bulk, it currently plans to continue to reactively convert Mercury Vapor lighting with High Pressure Sodium lighting when DTE can no longer maintain existing Mercury Vapor lighting. DTE would require customers to provide Contribution in Aid of Construction if the customer requested DTE to convert functioning Mercury Vapor lighting. Contribution in Aid of Construction will be calculated in accordance with DTE’s MPSC approved tariff which is to calculate total conversion cost and reduce that total cost by 3 years of incremental revenue from the resultant High Pressure Sodium lighting. Currently, the Contribution in Aid of Construction is then reduced by the labor component associated with efficiencies gained as a result of group conversions. In addition, the Contribution in Aid of Construction may be offset by a contribution from DTE’s Energy Optimization program (LED only). See also response to MSLC/DE-2.39.

See file provided in response to MSLCDE-1.22b Supplemental named MSLCDE-1 Conversion Project Model.xlsx for the standard model used to determine total project costs and calculation of CIAC. Customer contracts are available for review onsite in the the Company's Lansing office. and include both the projected cost of continued lighting service, and the amount charged for Contribution in Aid of Construction (CIAC) on these conversion projects. The total constructed project cost is determined through Community Lighting's current spreadsheet model which contains current pricing for LED luminaires, photocells, and labor. The spreadsheet also contains a calculation for the current energy optimization credit. The contribution in aid of construction does not include the labor expense.

MPSC Case No.: U-17767
Respondent: Legal/K. D. Johnston
Requestor: MSLC-2
Question No.: MSLC/DE-2.33
Supplemental

Question: Will the Company seek Contribution in Aid of Construction to convert still-functioning Metal Halide municipal lighting to High Pressure Sodium in bulk, in order to continue service after the pending phase-out of Metal Halide lighting? If so, provide a step-by-step description of how the Company proposes to calculate Contribution in Aid of Construction for a municipality that wishes to convert still-functioning Metal Halide to High Pressure Sodium in bulk. Provide any proposals for Contribution in Aid of Construction to convert still-functioning Metal Halide to High Pressure Sodium that have been presented to a municipality by the Company since 1 January 2012, whether or not the proposals were accepted.

Answer: DTE objects for the reason that the information requested consists of private customer information, confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its Customers competitive harm. DTE objects for the reason that the request is unclear and unduly vague and incapable of answer in its present form since the Company is unclear regarding the meaning of "pending phase-out of Metal Halide lighting".

Subject to this objection and without waiving this objection, DTE would state as follows: DTE does not intend to proactively replace Metal Halide lighting to High Pressure Sodium in bulk; it will continue to reactively convert Metal Halide lighting with High Pressure Sodium lighting when DTE can no longer maintain existing Metal Halide lighting. DTE would require customers to provide Contribution in Aid of Construction if the customer requested to DTE to convert functioning Metal Halide lighting. Contribution in Aid of Construction will be calculated in accordance with DTE's MPSC approved tariff which is to calculate total conversion cost and reduce that total cost by three years of incremental revenue from the resultant High Pressure Sodium lighting. The Contribution in Aid of Construction is currently being reduced by the labor component as a result of efficiencies gained as a result of group conversions. In addition, the Contribution in Aid of Construction may be offset by a contribution from DTE's Energy Optimization program (LED only). See also the answer to MSLC/DE-2.39.

MPSC Case No.: U-17767
Respondent: Legal/K. D. Johnston
Requestor: MSLC-2
Question No.: MSLC/DE-2.33 Supplemental
Page: 2 of 2

See file provided in response to MSLCDE-1.22b Supplemental named MSLCDE-1 Conversion Project Model.xlsx for the standard model used to determine total project costs and calculation of CIAC. Customer contracts are available for review onsite in the the Company's Lansing office. and include both the projected cost of continued lighting service, and the amount charged for Contribution in Aid of Construction (CIAC) on these conversion projects. The total constructed project cost is determined through Community Lighting's current spreadsheet model which contains current pricing for LED luminaires, photocells, and labor. The spreadsheet also contains a calculation for the current energy optimization credit. The contribution in aid of construction does not include the labor expense.

MPSC Case No.: U-17767
Respondent: Legal/K. D. Johnston
Requestor: MSLC-2
Question No.: MSLC/DE-2.35
Supplemental
Page: 1 of 1

Question: Provide a step-by-step description of how the Company proposes to calculate Contribution in Aid of Construction for a municipality that wishes to convert still- functioning Mercury Vapor or Metal Halide lights to LED instead of to High Pressure Sodium. Provide any proposals for Contribution in Aid of Construction to convert still- functioning Mercury Vapor or Metal Halide lights to LED instead of High Pressure Sodium that have been presented to a municipality by the Company since 1 January 2012, whether or not the proposals were accepted.

Answer: DTE objects for the reason that the information requested consists of private customer information, confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its Customers competitive harm.

Subject to this objection and without waiving this objection, DTE would calculate Contribution in Aid of Construction will be calculated in accordance with DTE's MPSC approved tariff which is to calculate total conversion cost and reduce that total cost by three years of incremental revenue from the resultant High Pressure Sodium lighting. The Contribution in Aid of Construction is currently being reduced by the labor component as a result of efficiencies gained as a result of group conversions. In addition, the Contribution in Aid of Construction may be offset by a contribution from DTE's Energy Optimization program (LED only). See also the answer to MSLC/DE-2.39.

See file provided in response to MSLCDE-1.22b Supplemental named MSLCDE-1 Conversion Project Model.xlsx for the standard model used to determine total project costs and calculation of CIAC. Customer contracts are available for review onsite in the the Company's Lansing office. and include both the projected cost of continued lighting service, and the amount charged for Contribution in Aid of Construction (CIAC) on these conversion projects. The total constructed project cost is determined through Community Lighting's current spreadsheet model which contains current pricing for LED luminaires, photocells, and labor. The spreadsheet also contains a calculation for the current energy optimization credit. The contribution in aid of construction does not include the labor expense.

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 11
Source: DTE Current E1 Tariff
Page 1 of 6

RATE SCHEDULE NO. E1 **MUNICIPAL STREET LIGHTING RATE**

AVAILABILITY OF SERVICE: Available to governmental agencies desiring controlled nighttime service for street lighting, for public thoroughfares, public parking lots and other public areas. Mercury Vapor service listed hereunder is not available for new business, except for limited additions to existing systems, but will be continued for customers taking said service as of July 23, 1981.

HOURS OF SERVICE: For circuits controlled by photo-sensitive devices, the street lights are burning at all times when the general level of illumination is lower than about 3/4 of a footcandle.

KIND OF SERVICE: Multiple or series street lighting at the option of the Company from overhead lines or underground circuits.

The Company presently has three (3) street lighting rate options available to municipalities. They are: (I) A Company owned system, (II) A municipally owned and Company maintained system, (III) A municipally owned and maintained system.

OPTION I
The Company will clean, inspect, operate and maintain street lighting equipment and furnish lamp replacements.

EXPERIMENTAL EMERGING LIGHTING TECHNOLOGY PROVISION: Available on an optional basis to customers desiring Municipal Street Lighting Service using emerging lighting technologies not otherwise offered through the standard tariff. The Company will own, operate, and maintain the emerging lighting technology equipment and the Customer will provide a contribution in aid of construction equal to the amount by which the investment exceeds three times the estimated annual revenue. Emerging lighting technologies and Customer participation must be approved by the Company and the energy and maintenance benefits for each project will be calculated based on predicted energy and luminaire life. The Company and the Customer will mutually agree on all prices, terms, and conditions for the service under this provision, evidenced by signed agreement.

OPTION II
Where the street lighting system is owned by the municipality, but is maintained by the Company, the normal maintenance will consist of replacement of glassware and lamps. Major maintenance such as broken lamp posts, etc., must be paid for by the municipality. The street lighting system must be built to Company specifications.

This option has been closed to new customers effective January 14, 2009.

Existing Option II customers desiring a change to emerging lighting technology (including LEDs) will be required to convert either to Option I or Option III to accommodate this change in lighting source.

OPTION III
Where the municipality owns and maintains the system, the Company's function will be confined solely to the supply of electricity. Customers desiring service under Option III are free to determine the appropriate light source for their application including incumbent and emerging technologies (including LEDs). Customers must supply adequate documentation of the wattage of the light source that will be subject to the approval of the Company.

RATES: As shown on Sheet Nos. D-50.00, D-51.00 and D-52.00.

BILLING: Billing will be on a monthly basis using the annual rate divided by twelve and rounded to the nearest cent.

SURCHARGES AND CREDITS: As approved by the Commission. See Sections C8.5 and C9.8.

LATE PAYMENT CHARGE: See Section C4.8.

(Continued on Sheet No. D-50.00)

(Continued from Sheet No. D-49.00)

RATE SCHEDULE NO. E1 (Contd.) **MUNICIPAL STREET LIGHTING RATE**

CONTRACT TERM: Open order terminable on a thirty day written notice by either party. Any conversion, relocation and/or removal of existing street lighting facilities at the customer's request, including those removals necessitated by termination of service, must be paid for by the customer. The detailed provisions and schedule of charges, which may include the remaining value of the existing facilities, will be quoted upon request. The Company shall not withdraw service, and the municipality shall not substitute another source of service in whole or in part, without twelve months' written notice to the other party.

Option I: Company Owned Street Lighting System

Where new installations require an investment in excess of an investment allowance, Option I is available only to customers who make a contribution in aid of construction equal to the amount by which the investment exceeds three times the annual revenue at the prevailing rate at the time of installation. (Effective January 1, 1991, the investment amount will be limited to direct cost. Effective January 1, 1992, the investment amount will include full cost.)

As an alternative, where the required contribution exceeds $10,000, upon agreement of the customer and the Company, the customer will pay an additional annual charge of 12% times the contribution amount in lieu of the cash contribution.

DE-ENERGIZED LIGHTS: Customers may elect to have any or all luminaires served under this rate disconnected. The charge per luminaire per year, payable in equal monthly installments, shall be 60% of the regular yearly rates. A *$35.00* charge per luminaire will be made at the time of de-energization and at the time of re-energization.

DUSK TO MIDNIGHT SERVICE: For service to parking lots from dusk to approximately twelve o'clock midnight E.S.T., a discount of 1.060¢ per nominal lamp size wattage per month will be applied. One control per circuit will be provided.

EXPERIMENTAL PROGRAMMABLE PHOTOCELL SERVICE: Customers may elect to place luninaires on photocells that are programmable to turn off lights at pre-determined times during the night. A discount of 1.060¢ per nominal lamp size wattage per month will be applied.

RATES: All-night service.
(Overhead Street Lighting Service)

Nominal Lamp Size	Type of Service	Charge per Lamp per Year
100 Watt	Mercury Vapor	$*155.28*
175 Watt	Mercury Vapor	$201.12
250 Watt	Mercury Vapor	$226.44
400 Watt	Mercury Vapor	$301.56
1,000 Watt	Mercury Vapor	$537.84
70 Watt	High Pressure Sodium	$174.84
100 Watt	High Pressure Sodium	$183.96
150 Watt	High Pressure Sodium	$201.12
250 Watt	High Pressure Sodium	$234.60
360 or 400 Watt	High Pressure Sodium	$306.12
1,000 Watt	High Pressure Sodium	$566.64
70 Watt	Metal Halide	$252.84
100 Watt	Metal Halide	$266.04
150 or 175 Watt	Metal Halide	$314.76
250 Watt	Metal Halide	$353.16
320 or 400 Watt	Metal Halide	$459.60
1,000 Watt	Metal Halide	$760.32

- Multiple Lamps on a Single Pole
- For each additional luminaire added to the same pole, reduce rate per lamp per year on the added luminaire $12.24.
- The Energy Policy Act of 2005 states that no Mercury Vapor lamp ballasts may be manufactured or imported after January 1, 2008. As a result, effective January 1, 2008, new Mercury Vapor lamps will no longer be available. Customers with existing Mercury Vapor lamp ballasts will continue to receive service until those fixtures fail. At that time, customers will be given the option of switching to High Pressure Sodium, Metal Halide or retiring the fixture.

(Continued on Sheet No. D-51.00)

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 11
Source: DTE Current E1 Tariff
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(Continued from Sheet No. D-50.00)

RATE SCHEDULE NO. E1 (Contd.) **MUNICIPAL STREET LIGHTING RATE**

Option I: Company Owned Street Lighting System (Contd.)
Ornamental Underground Street Lighting Service
(Lamp Spacing up to 120 Feet of Street)

RATES: All-night service.

Nominal Lamp Size	Type of Service	Charge per Lamp per Year
100 Watt	Mercury Vapor	$352.56
175 Watt	Mercury Vapor	$405.36
250 Watt	Mercury Vapor	$446.88
400 Watt	Mercury Vapor	$532.08
1,000 Watt	Mercury Vapor	$747.24
70 Watt	High Pressure Sodium	$321.12
100 Watt	High Pressure Sodium	$330.12
150 Watt	High Pressure Sodium	$360.00
250 Watt	High Pressure Sodium	$420.60
360 Watt	High Pressure Sodium	$513.96
400 Watt	High Pressure Sodium	$513.12
1,000 Watt	High Pressure Sodium	$666.84
70 Watt	Metal Halide	$420.24
100 Watt	Metal Halide	$432.96
150 or 175 Watt	Metal Halide	$511.56
250 Watt	Metal Halide	$573.60
320 or 400 Watt	Metal Halide	$705.00
1,000 Watt	Metal Halide	$874.56

- For lamp spacing over 120 feet up to 325 feet on the same side of street, add to rate per lamp per year $24.48
- For Semi-Ornamental Systems which employ Ornamental Post Units served from overhead conductors, where such construction is practical, reduce rate per lamp per year $21.48

Multiple Lamps on a Single Pole

- For additional luminaire added to the same pole, reduce rate per lamp per year on the added luminaire
  - Ornamental $97.92
  - Ornamental-Lamp spacing over 120 feet $122.40
  - Semi-Ornamental $76.56

(Continued on Sheet No. D-52.00)

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 11
Source: DTE Current E1 Tariff
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(Continued from Sheet No. D-51.00)

RATE SCHEDULE NO. E1 (Contd.) **MUNICIPAL STREET LIGHTING RATE**

OPTION II: Street Equipment Owned by Municipality

RATES: All-night service.

Nominal Lamp Size	Type of Service	Charge per Lamp per Year
175 Watt	Mercury Vapor	$123.72
250 Watt	Mercury Vapor	$157.92
400 Watt	Mercury Vapor	$192.12
1,000 Watt	Mercury Vapor	$330.72
70 Watt	High Pressure Sodium	$101.40
100 Watt	High Pressure Sodium	$110.28
250 Watt	High Pressure Sodium	$163.92
360 or 400 Watt	High Pressure Sodium	$236.76
1,000 Watt	High Pressure Sodium	$424.44
70 Watt	Metal Halide	$116.88
100 Watt	Metal Halide	$125.04
175 Watt	Metal Halide	$162.96
250 Watt	Metal Halide	$177.72
400 Watt	Metal Halide	$257.76
1,000 Watt	Metal Halide	$434.52

- The Energy Policy Act of 2005 states that no Mercury Vapor lamp ballasts may be manufactured or imported after January 1, 2008. As a result, effective January 1, 2008, new Mercury Vapor lamps will no longer be available. Customers with existing Mercury Vapor lamp ballasts will continue to receive service until those fixtures fail. At that time, customers will be given the option of switching to High Pressure Sodium, Metal Halide or retiring the fixture.
- **DE-ENERGIZED LIGHTS:** Customers may elect to have any or all luminaires served under this rate disconnected. The charge per luminaire per year, payable in equal monthly installments, shall be 10% of the above yearly rates. A $35.00 charge per luminaire will be made at the time of de-energization and at the time of re-energization.
- **DUSK TO MIDNIGHT SERVICE:** For service to parking lots from dusk to approximately twelve o'clock midnight E.S.T., a discount of 1.060¢ per nominal watt per month will be applied. One control per circuit will be provided.

(Continued on Sheet No. D-53.00)

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 11
Source: DTE Current E1 Tariff
Page 5 of 6

(Continued from Sheet No. D-52.00)

RATE SCHEDULE NO. E1 (Contd.) **MUNICIPAL STREET LIGHTING RATE**

OPTION III: Municipally Owned and Maintained Street Lighting System (Unmetered)

RATES: Where the municipality owns, operates, cleans and renews the lamps, and the Company's service is confined solely to the supply of electricity from dusk to dawn, the monthly charge of said service shall be 3.60¢ per nominal connected watt per month of lamps so served. If it is necessary for the Company to install facilities to provide service for the lamps, the customer will reimburse the Company for these costs. Contract Rider No. 2 charges will also apply.

OPTION III: Municipally Owned and Maintained Street Lighting System (Controlled/Metered)

AVAILABILITY OF SERVICE: Available to governmental agencies desiring controlled nighttime service for primary or secondary voltage energy-only street lighting service where the Company has existing distribution lines available for supplying energy for such service. Luminaires served under any of the Company's other street lighting rates shall not be intermixed with luminaires serviced under this street lighting rate. This rate is not available for resale purposes. Service is governed by the Company's Standard Rules and Regulations.

HOURS OF SERVICE: For circuits controlled by automatic timing devices, one-half hour after sunset until one-half hour before sunrise. For circuits controlled by photo-sensitive devices, the streetlights burn whenever the general level of illumination is less than approximately 3/4 footcandle. For dusk to midnight service, luminaires shall be controlled to turn off at approximately twelve o'clock midnight.

KIND OF SERVICE:

Secondary Voltage Service: Alternating current, 60 hertz, single-phase 120/240 nominal volt service for a minimum of ten luminaires located within a clearly defined area. Except for control equipment, the customer will furnish, install, own and maintain all equipment comprising the street lighting system up to the point of attachment with the Company's distribution system. The Company will connect the customer's equipment to the Company's lines and supply the energy for operation. All of the customer's equipment will be subject to the Company's review.

Primary Voltage Service: Alternating current, 60 hertz, single-phase or three-phase, primary voltage service for actual demands of not less than 100 kW at each point of delivery. The particular nature of the voltage shall be determined by the Company. The customer will furnish, install, own and maintain all equipment comprising the street lighting system, including control equipment, up to the point of attachment with the Company's distribution system. The Company will supply the energy for operation of the customer's street lighting system.

(Continued on Sheet No. D-54.00)

(Continued from Sheet No. D-53.00)

RATE SCHEDULE NO. E1 (Contd.) **MUNICIPAL STREET LIGHTING RATE**

MONTHLY RATE:
Secondary Energy
Full Service Customers:

Power Supply Charge:
5.228¢ per kWh for all kWh

Delivery System Charge:
2.266¢ per kWh based on the capacity requirements in kilowatts of the equipment assuming 4,200 burning hours per year, adjusted by the ratio of the monthly kWh consumption to the total annual kWh consumption.

Retail Access Service Customers:

Delivery System Charge:
2.035¢ per kWh based on the capacity requirements in kilowatts of the equipment assuming 4,200 burning hours per year, adjusted by the ratio of the monthly kWh consumption and the total annual kWh consumption.

At the Company's option, service may be metered and the metered kWh will be the basis for billing. Capacity requirements of lighting equipment shall be determined by the Company from manufacturer specifications, but the Company maintains the right to test such capacity requirements from time to time. In the event that Company tests show capacity requirements other than those indicated in manufacturer specifications, the capacity requirements indicated by Company tests will be used. The customer shall not change the capacity requirements of its equipment without first notifying the Company in writing.

Option III: Municipally Owned and Maintained Street Lighting System (Controlled/Metered)

For dusk to midnight service, the monthly Power Supply Charge per kWh shall be 10.399¢ per kWh and the Delivery System Charge shall be 2.266¢ per kWh for secondary service.

PRIMARY ENERGY CHARGE: 7.551¢ per kWh as metered.

BILLING: Billing will be on a monthly basis.

SURCHARGES AND CREDITS: As approved by the Commission. Power Supply Charges are subject to Section C8.5. Delivery Charges are subject to Section C9.8.

LATE PAYMENT CHARGE: See Section C4.8.

MINIMUM CHARGE: The contract minimum.

CONTRACT TERM: Contracts will be taken for a minimum of two years, extending thereafter from year to year until terminated by mutual consent or upon 12 months' written notice by either party.

MPSC Case No.: U-17767
Respondent: Legal/K. D. Johnston
Requestor: MSLC-1
Question No.: MSLCDE-1.22b
Page: 1 of 1

Question: Provide any documents possessed by DTE that support your response. Provide a list of any and all municipalities in which DTE has converted municipal street lights to LED technology. For each such municipality, provide:

b. The amount charged to the municipality as a Contribution in Aid of Construction for the conversion and the calculations used to determine such a charge.

Answer: DTE objects for the reason that the information requested consists of confidential, proprietary, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its customers competitive harm.

Subject to this objection and without waiving this objection, DTE would answer as follows: In general, the amount charged to the municipality as a Contribution in Aid of Construction for the LED conversion is equal to the total constructed project cost less the labor efficiency contribution from DTE to install the lights. The labor efficiency contribution from DTE was used as part of the emerging technology provision to improve the affordability of the LED adoption. Any energy efficiency rebates are handled later in a separate transaction.

Current Invoiced Rate							Future Invoiced Rate												
Current Watt	Type	Quantity OH	Annual Rate OH lum	Quantity UG	Annual Rate UG per lum	Current Invoice Totals	New Watt	Type	Quantity OH	Annual Rate OH per lum	Quantity UG	Annual Rate UG per lum	Future Invoiced Total	Cost of LED per LUM	Long Life Photocell	Labor	Total Cost Per Fixture	New Watt	EO Rebate
100	MV	0	$166.45	0	$378.71	$0.00	65	LED	0	$156.10	0	$307.86	$0.00	$192	$10	$56	$258	65	$18.00
175	MV	0	$215.38	0	$435.14	$0.00	65	LED	0	$156.10	0	$307.86	$0.00	$192	$10	$56	$258	65	$41.00
250	MV	0	$242.07	0	$479.30	$0.00	135	LED	0	$179.90	0	$329.56	$0.00	$387	$10	$56	$453	135	$46.00
400	MV	0	$322.12	0	$570.04	$0.00	135	LED	0	$179.90	0	$329.56	$0.00	$387	$10	$56	$453	135	$94.00
1000	MV	0	$573.26	0	$798.19	$0.00	280	LED	0	$226.92	0	$373.27	$0.00	$558	$10	$56	$624	280	$234.00
70	HPS	0	$143.69	0	$350.54	$0.00	65	LED	0	$156.10	0	$307.86	$0.00	$192	$10	$56	$258	65	$9.00
100	HPS	0	$150.57	0	$352.01	$0.00	65	LED	0	$156.10	0	$307.86	$0.00	$192	$10	$56	$258	65	$21.00
150	HPS	0	$179.93	0	$363.30	$0.00	135	LED	0	$179.90	0	$329.56	$0.00	$387	$10	$56	$453	135	$16.00
250	HPS	0	$222.17	0	$396.06	$0.00	135	LED	0	$179.90	0	$329.56	$0.00	$387	$10	$56	$453	135	$47.00
400	HPS	0	$320.56	0	$443.66	$0.00	280	LED	0	$226.92	0	$373.27	$0.00	$558	$10	$56	$624	280	$54.00
1000	HPS	0	$440.43	0	$800.63	$0.00	280	LED	0	$226.92	0	$373.27	$0.00	$558	$10	$56	$624	280	$241.00
400	MV	0	$322.12	0	$570.04	$0.00	280	LED	0	$226.92	0	$373.27	$0.00	$558	$10	$56	$624	280	$51.00
400	HPS	0	$320.56	0	$443.66	$0.00	135	LED	0	$179.90	0	$329.56	$0.00	$387	$10	$56	$453	135	$97.00

Total Current Lums	0
Total Proposed Invoice with New Rates	$0.00

Total Future Lums	0
Total Future Invoice with New Rates	$0.00
Annual Savings	$0.00
Cost to Convert	$0.00
DTE labor contribution	$0.00
2015 EO Rebate	$0.00
CTC - EO Rebate - DTE Contri	$0.00
Project Payback (yrs)	#DIV/0!

		Payback (yrs) including EO rebate
CIAC with Labor Contribution	**$0**	#DIV/0!
CIAC without Labor Contribution	**$0**	#DIV/0!

FOR INTERNAL DTE ENERGY USE ONLY

* Surcharges and longspan charges are fixed costs and will be the same for both rates
** This calculator is for the DTE incentive program. DTE is contributing labor costs
*** Cobrahead lighting fixtures only
**** Agreements signed by **June 30, 2015**. Construction MUST be completed by Nov 30th.

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 13
Source: Jester
Page 1 of 1

Taking the Long View on LED Street Lighting

BY MICHAEL SIMINOVITCH

Concerns about energy efficiency, coupled with a growing awareness of climate change, have renewed our national interest in reducing energy use and the associated carbon footprint. Following this we have seen an unprecedented investment directed at municipal and state entities to explore "efficiency opportunities." The understanding is that this investment will achieve deep and sustained energy savings in infrastructure for our public spaces. One target is relighting municipal roadway applications, focusing on the ubiquitous streetlight.

More specifically, the retrofit includes replacing traditional high-pressure sodium (HPS) cobra heads with LED fixtures. The rationale behind this effort is the potential for energy savings from the inherent increase in LED light source efficacy compared to traditional HPS light sources. The retrofits typically advanced are almost exclusively static LED lighting systems.

Unfortunately, there is growing concern that this narrow approach to transforming our nation's street lighting inventory will result in the loss or trapping of significant energy savings and eliminate the potential for enhanced safety and amenity for the public.

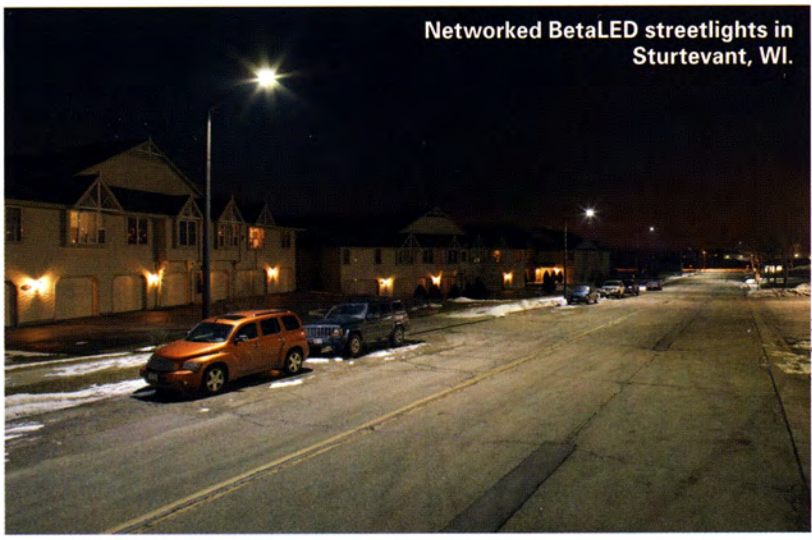
This doesn't have to happen. One of the inherent features with these new electronic LED lighting systems is the option for a high level of dynamic control capability. The system can be dynamically tuned, dimmed, brightened, or even flashed to obtain any light level that might be desired, thereby achieving a significantly enhanced level of utility and energy savings well above the static approaches that are being put forward. Dynamic controlled street lighting is perhaps one of the largest opportunities that exists in the U.S for energy savings and increased safety and amenity for outdoor lighting, and this potential is being trapped by current policy and recommendations.

CAPABILITIES

What is the potential for dynamic control capabilities to aid lighting America's streets and roadways? The concept involves the simple addition of sensors and electronics that would allow each streetlight to be controlled to three basic levels. The first level would be a standard design to achieve the appropriate illumination desired for the roadway from the streetlight. This level would depend upon prevailing local municipal recommendations.

The second level would be at reduced power corresponding to approximately 30 to 50 percent of normal illuminance. The reduced power level would occur automatically with the integration of simple sensors, during periods of no traffic or pedestrian activity, with a corresponding automatic increase to full output during periods of occupancy. The dynamic and automatic increase to full brightness actually could increase security through heightened awareness. This dynamic control function would greatly reduce the amount of light pollution and dramatically increase energy savings while maintaining safety and security. Reducing the amount of wasted light during long periods of typical vacancy is one of the single largest opportunities for energy savings in this country, and the technology exists today for it to be easily integrated into the ongoing LED transformation. Unfortunately, the real savings opportunities associated with this transformation are being lost in the rush to achieve poorly defined goals.

At the third level, the streetlight could be easily "signaled" to switch to a higher level of light output corresponding to an emergency situation. The higher light level or even flashing would provide a point of focus and attention for police and fire departments during a response event, greatly assisting emergency personal. For example, an emergency call from a homeowner to a police or fire station could prompt an RF signal to be dispatched to the streetlight or lights adjacent to the home, which would switch those lights to a much higher light level or a flashing signal that would provide key focus for responding emergency vehicles. The increased



Networked BetaLED streetlights in Sturtevant, WI.

Copyright 2010 BetaLED

Bi-level LED parking structure, University of California, Davis.

Photo: Kathreen Fontecha, CLTC

light levels or flashing streetlights would enhance response times and be a valuable addition to the safety infrastructure of any municipality.

This option can be easily integrated via sensors and RF signals, again a relatively simple addition with a marginal cost increase to the LED streetlight fixtures currently being installed. Emergency responders and police within a municipal setting undoubtedly would appreciate the increased safety and amenity, but unfortunately they are not being informed by energy advocates or federal entities advocating the LED transformation.

LOST IN THE RUSH

Significant public investment is being focused on relighting America's streets, and, unfortunately, large energy savings and enhanced safety and amenity are being lost in the rush by federal and environmental groups to transform the marketplace to LED. A broader, longer-term vision needs to be developed quickly that truly takes advantage of electronic LED light sources through the addition of low-cost, dynamic control capabilities. The additional best practice capability will allow us to fully realize the promise associated with this next-generation lighting technology, providing real energy savings and user amenity for all.

A national specification needs to be developed at once, and all public investment should be linked to installing LED fixtures that are fully functional to achieve both energy savings and increased user amenity.

Michael Siminovitch, Ph.D., is the director of the California Lighting Technology Center and a professor in the UC Davis Design Program. He is a graduate of Carleton University, received master's degrees in Industrial Design and Architecture from the University of Illinois, and earned his doctoral degree in Architecture and Human Factors Engineering from the University of Michigan. His work entails research and development in new residential and commercial lighting technologies.

MPSC Case No.: U-17767
Respondent: K. A. Holmes
Requestor: MSLC-1
Question No.: MSLCDE-1.14
Page: 1 of 1

Question: Please provide workpapers, analyses, and supporting detail that illustrate how each Municipal Street Lighting rate was calculated by light fixture in Exhibits A-14, Schedule F3, Witness K. A. Holmes, Pages 35, 36, 37, and 38 (of 39). Please ensure the workpapers illustrate DTE's total cost and how they are allocated to each line item in these Exhibits to total the proposed revenue requirement. If the rate design or revenue requirement includes assumptions on certain number of units (ex. Number of customers, number of lights, annual kw, etc.), please provide those assumptions.

Answer: Please see attached file "U-17767 MSLCDE-1 Lighting Model.xlsx" and "U-17767 MSLCDE-1 Q 14 Exhibits.xlsx", which includes three tabs (the tab labeled 'OPL' includes Exhibit A-14, Schedule F3 Pages 31 and 32 of 39, the tab labeled 'SL' includes Exhibit A-14, Schedule F3 Pages 35 through 39 of 39, and a tab named WP-KAH-4 which was also provided at the prehearing conference). The file "U-17767 MSLCDE-1 Lighting Model.xlsx" is referred to in the responses to MSCLDCE-1.5 and MSLDCE-1.12.

The fixture charges derived for each lamp in this model (in column BH) were carried forward to the respective sections of Exhibit A-14, Schedule F3 pages 35 and 36 as what I will refer to and is labeled as the "base fixture charge". For Exhibit A-14, Schedule F3 page 37, the base fixture charge was determined by splitting the present annual charge into an energy component and fixture charge component. The service listed on Exhibit A-14 Schedule F3, Page 38 is an energy only service so there is no fixture charge.

After determining what the total revenue and remaining revenue deficiency would be using these base fixture charges, an equal adjustment factor was applied to each fixture charge so that the full distribution revenue requirement would be recovered (as stated on Page KAH-12, Lines 8-10 of Witness Holmes' testimony). The proposed energy rate allows for full recovery of the power supply revenue requirement. The detail of the lighting group's total revenue requirement for power supply and distribution and how the present and proposed revenue recover the amounts is shown on WP-KAH-4. The assumptions regarding number of lamps, number of customers, and annual kilowatthours are provided in the Billing Determinant columns of Exhibit A-14.

U-17767 MSLCDE-1 Lighting Model

WP-KAH5

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 16
Source: MSLCDE-1
Lighting Model
Page 1 of 6

Exl

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue

E1 Street Lighting - Option I

Process to determine the correct fixture rate
Based on COS revenue requirements

Step 1 - split revenue into Proposed Fixture Rate and Energy Charge | Step 2 - separate SL O&M Rate component from all other non energy | Step 3 - spilt and show SL O&M Lum & Lamp dependent COS components | Step 4 - Adjust Fixture rate based on SL O&M COS characteristics (HPS, LED, MV, MH) | Step 5 - Adjust to calculate / model revenue neutral cond. | Step 6 - Results of Steps 1 to 5 compared to fixture baseline | Step 7 Capital Treatment - apply technology specific capital cost adjustment | Step 8 - Adjust Fixture rate based on Capital - Tecl (HPS, LED, MV, MH)

Line No.	(a) Description: Overhead	(b) Billing Determinants: Quantity	Units	(c) Present: Rate ($/lamp/yr)	(d) Present: Revenue ($000)		(e) Proposed: Rate ($/lamp/mth)	(f) Proposed: Energy (c/kWh)	(g) Proposed: Revenue ($000)	(g / e) Rate	(g / f) (A) Energy	(g) Rev	(O) All other less (A) and (B) - fixture rate	(O) All other less (A) and (B) - rev	(B) SL O&M - fixture rate	(B) SL O&M - rev	(C) SL O&M Not Lum & Lamp - fixture rate	(C) SL O&M Not Lum & Lamp - rev	(D) Lum & Lamps - fixture rate	(D) SL O&M Lum & Lamps - rev	Lum & Lamps O&M adjustment factor	(E) Lum & Lamps - fixture rate	(E) SL O&M Lum & Lamps - rev	(F) O + C + E Rate - fixture rate	(F) O + C + E Rate - rev	(H) (F / G) Rate Rev Adjusted	New Rev Rate Rev + Energy	Proposed Starting Base Rate - fixture rate	Step (1- 6) Results New Rate - fixture rate	Technology specific Lamp & Lum cost: Lamp cost (1)	Lum cost (2)	All Luminaire (3) (1 + 2)	Lum & Lamp Capital adjustment factor	(I) New Capital Rev after Adjustment	(J) Old Capital Rate - rev
	Hg Vapor																																		
1	100 W	318	Lamps	155.28	49.33		9.69	0.05375	45.90	36.94	8.96	45.90	8.61	32.807	1.08	4.131	0.69	2.620	0.40	1.511	0.885	0.35	1.337	9.64	36.764	49.34	58.30	9.69	12.94	2.88	67.80	70.68	0.646	6.44	9.97
2	175 W	41,282	Lamps	201.12	8,302.69		9.69	0.054	6,710.79	4800.30	1910.49	6710.79	8.61	4263.409	1.08	536.893	0.69	340.541	0.40	196.352	0.885	0.35	173.771	9.64	4777.722	6411.92	8322.41	9.69	12.94	2.88	67.80	70.68	0.646	837.41	1295.47
3	250 W	1,317	Lamps	226.44	298.15		9.69	0.054	239.30	153.10	86.20	239.30	8.61	135.978	1.08	17.124	0.69	10.861	0.40	6.262	0.885	0.35	5.542	9.64	152.382	204.50	290.70	9.69	12.94	3.680	84.040	87.72	0.802	33.15	41.32
4	400 W	7,845	Lamps	301.56	2,365.78		9.69	0.054	1,718.05	912.23	805.82	1718.05	8.61	810.202	1.08	102.029	0.69	64.715	0.40	37.314	0.885	0.35	33.023	9.64	907.940	1218.50	2024.32	9.69	12.94	4.15	115.29	119.44	1.092	268.92	246.19
5	1,000 W	94	Lamps	537.84	50.45		9.69	0.054	33.67	10.91	22.76	33.67	8.61	9.687	1.08	1.220	0.69	0.774	0.40	0.446	3.010	1.19	1.343	10.49	11.803	15.84	38.60	9.69	14.07	18.23	381.03	399.26	3.651	11.69	3.20
6																																			
7	Na Vapor																																		
8	70 W	1,329	Lamps	174.84	232.37		9.69	0.054	183.05	154.54	28.50	183.05	8.61	137.257	1.08	17.285	0.69	10.963	0.40	6.321	0.885	0.35	5.594	9.64	153.815	206.43	234.93	9.69	12.94	8.25	81.52	89.77	0.821	34.24	41.71
9	100 W	17,638	Lamps	183.96	3,244.76		9.69	0.054	2,600.49	2050.99	549.50	2600.49	8.61	1821.598	1.08	229.395	0.69	145.501	0.40	83.894	0.885	0.35	74.246	9.64	2041.345	2739.58	3289.08	9.69	12.94	8.25	81.52	89.77	0.821	454.43	553.51
10	150 W	0	Lamps	201.12	0.00		9.69	0.054	0.00	0.00	0.00	0.00									0.885							9.69		8.25	81.52	89.77	0.821		
11	250 W	9,477	Lamps	234.60	2,223.21		9.69	0.054	1,733.05	1101.94	631.11	1733.05	8.61	978.693	1.08	123.247	0.69	78.173	0.40	45.074	0.885	0.35	39.890	9.64	1096.756	1471.90	2103.00	9.69	12.94	7.69	100.27	107.96	0.987	293.62	297.38
12	360 W	35	Lamps	306.12	10.56		9.69	0.054	7.24	4.01	3.23	7.24	8.61	3.564	1.08	0.449	0.69	0.285	0.40	0.164	0.885	0.35	0.145	9.64	3.994	5.36	8.59	9.69	12.94	8.64	118.55	127.19	1.163	1.26	1.08
13	400 W	2,194	Lamps	306.12	671.63		9.69	0.054	485.43	255.12	230.31	485.43	8.61	226.586	1.08	28.534	0.69	18.099	0.40	10.435	0.885	0.35	9.235	9.64	253.920	340.77	571.09	9.69	12.94	8.64	118.55	127.19	1.163	80.09	68.85
14	1,000 W	61	Lamps	566.64	34.60		9.69	0.054	22.26	7.10	15.16	22.26	8.61	6.305	1.08	0.794	0.69	0.504	0.40	0.290	3.010	1.19	0.874	10.49	7.683	10.31	25.47	9.69	14.07	28.63	468.18	496.81	4.544	9.47	2.08
15																																			
16	Metal Halide																																		
17	70 W	2	Lamps	252.84	0.45		9.69	0.054	0.24	0.21	0.03	0.24	8.61	0.183	1.08	0.023	0.69	0.015	0.40	0.008	0.885	0.35	0.007	9.64	0.205	0.27	0.31	9.69	12.94	7.10	67.80	74.90	0.685	0.04	0.06
18	100 W	0	Lamps	266.04	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69		7.10	67.80	74.90	0.685		
19	150 or 175 W	40	Lamps	314.76	12.53		9.69	0.054	6.10	4.63	1.47	6.10	8.61	4.112	1.08	0.518	0.69	0.328	0.40	0.189	0.885	0.35	0.168	9.64	4.608	6.18	7.65	9.69	12.94	7.10	67.80	74.90	0.685	0.86	1.25
20	250 W	16	Lamps	353.16	5.62		9.69	0.054	2.81	1.85	0.96	2.81	8.61	1.645	1.08	0.207	0.69	0.131	0.40	0.076	0.885	0.35	0.067	9.64	1.843	2.47	3.43	9.69	12.94	7.10	84.04	91.14	0.834	0.42	0.50
21	320 or 400 W	28	Lamps	459.60	13.01		9.69	0.054	6.26	3.29	2.97	6.26	8.61	2.924	1.08	0.368	0.69	0.234	0.40	0.135	0.885	0.35	0.119	9.64	3.277	4.40	7.37	9.69	12.94	7.65	115.29	122.94	1.124	1.00	0.89
22	1,000 W	9	Lamps	760.32	6.73		9.69	0.054	3.18	1.03	2.15	3.18	8.61	0.914	1.08	0.115	0.69	0.073	0.40	0.042	3.010	1.19	0.127	10.49	1.114	1.49	3.65	9.69	14.07	16.34	294.20	310.54	2.840	0.86	0.30
23																																			
56																																			
57	< May 2013 Old Emerging Technology Rates																																		
58	30 - 39 Watt LED	0	Lamps	87.78	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																				138.06		0.00	0.00
59	40 - 49 Watt LED	0	Lamps	92.06	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																				151.18		0.00	0.00
60	50 - 59 Watt LED	3	Lamps	96.21	0.29	8	9.69	0.054	0.39	0.35	0.04	0.39	8.61	0.310	1.08	0.039	0.69	0.025	0.40	0.014	1.69	0.67	0.024	9.96	0.359	0.48	0.52	9.69	13.37			165.54	1.514	0.15	0.10
61	60 - 69 Watt LED	0	Lamps	100.48	0.00	4,545	9.69	0.054	0.00	0.00	0.00	0.00																9.69				181.26		0.00	0.00
62	70 - 79 Watt LED	0	Lamps	104.76	0.00	4	9.69	0.054	0.00	0.00	0.00	0.00																9.69				196.98		0.00	0.00
63	80 - 89 Watt LED	0	Lamps	108.91	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				214.07		0.00	0.00
64	90 - 99 Watt LED	1,250	Lamps	113.18	141.48	5,242	9.69	0.054	172.16	145.35	26.81	172.16	8.61	129.093	1.08	16.257	0.69	10.311	0.40	5.945	1.69	0.67	10.048	9.96	149.452	200.57	227.38	9.69	13.37			232.64	2.128	86.22	40.52
65	100 - 109 Watt LED	67	Lamps	117.33	7.86	315	9.69	0.054	9.38	7.79	1.59	9.38	8.61	6.919	1.08	0.871	0.69	0.553	0.40	0.319	1.69	0.67	0.539	9.96	8.011	10.75	12.34	9.69	13.37			252.82	2.312	5.02	2.17
66	110 - 119 Watt LED	0	Lamps	121.61	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00									1.69							9.69				274.75		0.00	0.00
67	120 - 129 Watt LED	13	Lamps	125.76	1.63	119	9.69	0.054	1.88	1.51	0.37	1.88	8.61	1.343	1.08	0.169	0.69	0.107	0.40	0.062	1.69	0.67	0.104	9.96	1.554	2.09	2.45	9.69	13.37			298.59	2.731	1.15	0.42
68	130 - 139 Watt LED	0	Lamps	130.04	0.00	1,087	9.69	0.054	0.00	0.00	0.00	0.00																9.69				324.74		0.00	0.00
69	140 - 149 Watt LED	0	Lamps	134.19	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				336.77		0.00	0.00
70	150 - 159 Watt LED	407	Lamps	138.34	56.30	1,605	9.69	0.054	61.57	47.33	14.24	61.57	8.61	42.033	1.08	5.293	0.69	3.357	0.40	1.936	1.69	0.67	3.272	9.96	48.662	65.31	79.55	9.69	13.37			349.25	3.194	42.14	13.19
71	160 - 169 Watt LED	107	Lamps	142.61	15.26	426	9.69	0.054	16.43	12.44	3.99	16.43	8.61	11.050	1.08	1.392	0.69	0.883	0.40	0.509	1.69	0.67	0.860	9.96	12.793	17.17	21.15	9.69	13.37			362.19	3.312	11.49	3.47
72	170 - 179 Watt LED	12	Lamps	146.76	1.76	48	9.69	0.054	1.87	1.40	0.47	1.87	8.61	1.239	1.08	0.156	0.69	0.099	0.40	0.057	1.69	0.67	0.096	9.96	1.435	1.93	2.40	9.69	13.37			375.61	3.435	1.34	0.39
73	180 - 189 Watt LED	0	Lamps	151.04	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				389.53		0.00	0.00
74	190 - 199 Watt LED	0	Lamps	155.19	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				403.96		0.00	0.00
75	200 - 209 Watt LED	1	Lamps	159.46	0.16	8	9.69	0.054	0.16	0.12	0.05	0.16	8.61	0.103	1.08	0.013	0.69	0.008	0.40	0.005	1.69	0.67	0.008	9.96	0.120	0.16	0.21	9.69	13.37			418.93	3.831	0.12	0.03
76	210 - 219 Watt LED	0	Lamps	163.74	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				434.45		0.00	0.00
77	220 - 229 Watt LED	0	Lamps	167.89	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				450.55		0.00	0.00
78	230 - 239 Watt LED	0	Lamps	172.17	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				467.24		0.00	0.00
79	240 - 249 Watt LED	0	Lamps	176.19	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				484.56		0.00	0.00
80	250 - 259 Watt LED	0	Lamps	180.47	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				502.51		0.00	0.00
81	260 - 269 Watt LED	0	Lamps	184.62	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				521.13		0.00	0.00
82	270 - 279 Watt LED	0	Lamps	188.89	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				540.44		0.00	0.00
83	280 - 289 Watt LED	0	Lamps	193.17	0.00	4	9.69	0.054	0.00	0.00	0.00	0.00																9.69				560.51		0.00	0.00
84	290 - 299 Watt LED	0	Lamps	197.32	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				581.28		0.00	0.00
85	300 - 309 Watt LED	0	Lamps	201.59	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				602.82		0.00	0.00
86	310 - 319 Watt LED	0	Lamps	205.74	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				625.15		0.00	0.00
87	320 - 329 Watt LED	0	Lamps	210.02	0.00	0	9.69	0.054	0.00	0.00	0.00	0.00																9.69				648.32		0.00	0.00
88																																			
89	>May 2013 New Emerging Technology Rates																																		
90	30 - 39 Watt LED	0	Lamps	129.58	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				138.06		0.00	0.00
91	40 - 49 Watt LED	0	Lamps	132.32	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				151.18		0.00	0.00
92	50 - 59 Watt LED	5	Lamps	135.06	0.67		9.69	0.054	0.64	0.58	0.06	0.64	8.61	0.513	1.08	0.065	0.69	0.041	0.40	0.024	1.69	0.67	0.040	9.96	0.594	0.80	0.86	9.69	13.37			165.54	1.514	0.24	0.16
93	60 - 69 Watt LED	4,545	Lamps	137.80	626.28		9.69	0.054	595.17	528.48	66.69	595.17	8.61	469.370	1.08	59.108	0.69	37.491	0.40	21.617	1.69	0.67	36.532	9.96	543.393	729.26	795.95	9.69	13.37			181.26	1.658	244.25	147.34
94	70 - 79 Watt LED	4	Lamps	140.54	0.56		9.69	0.054	0.53	0.46	0.07	0.53	8.61	0.411	1.08	0.052	0.69	0.033	0.40	0.019	1.69	0.67	0.032	9.96	0.476	0.64	0.71	9.69	13.37			196.98	1.802	0.23	0.13
95	80 - 89 Watt LED	0	Lamps	143.28	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				214.07		0.00	0.00
96	90 - 99 Watt LED	3,992	Lamps	146.01	582.86		9.69	0.054	549.79	464.18	85.61	549.79	8.61	412.266	1.08	51.917	0.69	32.930	0.40	18.987	1.69	0.67	32.088	9.96	477.284	640.54	726.15	9.69	13.37			232.64	2.128	275.35	129.41
97	100 - 109 Watt LED	248	Lamps	148.75	36.84		9.69	0.054	34.67	28.80	5.87	34.67	8.61	25.579	1.08	3.221	0.69	2.043	0.40	1.178	1.69	0.67	1.991	9.96	29.613	39.74	45.61	9.69	13.37			252.82	2.312	18.57	8.03
98	110 - 119 Watt LED	0	Lamps	151.49	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				274.75		0.00	0.00
99	120 - 129 Watt LED	106	Lamps	154.23	16.43		9.69	0.054	15.39	12.38	3.01	15.39	8.61	10.998	1.08	1.385	0.69	0.879	0.40	0.507	1.69	0.67	0.856	9.96	12.733	17.09	20.09	9.69	13.37			298.59	2.731	9.43	3.45
100	130 - 139 Watt LED	1,087	Lamps	156.97	170.69		9.69	0.054	159.59	126.45	33.14	159.59	8.61	112.303	1.08	14.142	0.69	8.970	0.40	5.172	1.69	0.67	8.741	9.96	130.014	174.49	207.63	9.69	13.37			324.74	2.970	104.70	35.25
101	140 - 149 Watt LED	0	Lamps	159.71	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				336.77		0.00	0.00
102	150 - 159 Watt LED	1,198	Lamps	162.45	194.65		9.69	0.054	181.26	139.33	41.93	181.26	8.61	123.748	1.08	15.584	0.69	9.884	0.40	5.699	1.69	0.67	9.632	9.96	143.264	192.27	234.20	9.69	13.37			349.25	3.194	124.08	38.85
103	160 - 169 Watt LED	319	Lamps	165.18	52.73		9.69	0.054	49.01	37.12	11.89	49.01	8.61	32.966	1.08	4.151	0.69	2.633	0.40	1.518	1.69	0.67	2.566	9.96	38.165	51.22	63.11	9.69	13.37			362.19	3.312	34.28	10.35
104	170 - 179 Watt LED	36	Lamps	167.92	6.01		9.69	0.054	5.58	4.16	1.41	5.58	8.61	3.697	1.08	0.466	0.69	0.295	0.40	0.170	1.69	0.67	0.288	9.96	4.280	5.74	7.16	9.69	13.37			375.61	3.435	3.99	1.16
105	180 - 189 Watt LED	0	Lamps	170.66	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				389.53		0.00	0.00
106	190 - 199 Watt LED	0	Lamps	173.40	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				403.96		0.00	0.00
107	200 - 209 Watt LED	7	Lamps	176.14	1.23		9.69	0.054	1.13	0.81	0.32	1.13	8.61	0.719	1.08	0.091	0.69	0.057	0.40	0.033	1.69	0.67	0.056	9.96	0.833	1.12	1.44	9.69	13.37			418.93	3.831	0.87	0.23
108	210 - 219 Watt LED	0	Lamps	178.88	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				434.45		0.00	0.00
109	220 - 229 Watt LED	0	Lamps	181.61	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				450.55		0.00	0.00
110	230 - 239 Watt LED	0	Lamps	184.35	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				467.24		0.00	0.00
111	240 - 249 Watt LED	0	Lamps	187.09	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				484.56		0.00	0.00
112	250 - 259 Watt LED	0	Lamps	189.83	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				502.51		0.00	0.00
113	260 - 269 Watt LED	0	Lamps	192.57	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				521.13		0.00	0.00
114	270 - 279 Watt LED	0	Lamps	195.31	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				540.44		0.00	0.00
115	280 - 289 Watt LED	4	Lamps	198.04	0.79		9.69	0.054	0.72	0.46	0.26	0.72	8.61	0.411	1.08	0.052	0.69	0.033	0.40	0.019	1.69	0.67	0.032	9.96	0.476	0.64	0.90	9.69	13.37			560.51	5.126	0.66	0.13
116	290 - 299 Watt LED	0	Lamps	200.78	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				581.28		0.00	0.00
117	300 - 309 Watt LED	0	Lamps	203.52	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				602.82		0.00	0.00
118	310 - 319 Watt LED	0	Lamps	206.26	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				625.15		0.00	0.00
119	320 - 329 Watt LED	0	Lamps	209.00	0.00		9.69	0.054	0.00	0.00	0.00	0.00																9.69				648.32		0.00	0.00
120																																			
121	Service Charge	516	Cust				8.00		49.56																										
122																																			
123										11057.69	4597.43	15655.12		9820.94		1236.75		784.45		452.30			452.30		11058.68	14841.25	19438.68	2.33						2998.55	
124										70.63%	29.37%			62.73%		7.90%		5.01%		2.89%			2.89%		70.64%	76.35%								34.39%	
125	Multiple Lamp Discount	764	Lamps	-12.24	-9.35		-12.24		-9.35	Rate	Energy			All other less		SL O&M		SL O&M		SL O&M			SL O&M		Rate									SL Capital	
126	Subtotal		Lamps		19,436.36				15,655.12	-3781.23	23.65%			(A) and (B)		(B)		Not Lum & Lamp		Lum & Lamps			Lum & Lamps											Lum & Lamps	
127																		(C)		(D)			(E)	(G) ->	0.74513135	<- adjusted Rate to be Rev neutral								(Cap)	
128	Nuclear Decomm.	88,592	MWh	0.172%	33		0.0003774		33	Total Lums / Lamps =>		95,095		9820.94		1236.75		784.45		452.30			453.29		1	Correction to get back to Revenue neutral					Technology Balancing Key must match cell AJ149 ->			2998.16	2998.55
129																									-0.2548687	from starting template provided									
130	Sub-Total				19,470				15,738	Total LED Lums / Lamps =>		13,412	14.10%																						
131																																			
132																									-3990.00										
133	Energy Optimization	516	Meters	0.9%	175.23		28.29		175.23																-3781.23										
134	REPS	516	Meters	0.2%	39.29		6.34		39.29																										
135	Rate Realignment	88,592	MWh	0.720%	141.73		0.00		141.73																										
136	**Total E1 - Option 1**	**88,592**	**MWh**		19,826				16,094	-3731.68																									
137	Increase/Decrease ($)								(3,732.00)																										
					19492.48				19220.97																										

Rev
8719.24 58.8% of non energy COS that is Capital related
2998.55 34.4% of non energy COS that is Luminaire Technology Capital dependent

44.86% % of total E1 COS that is Capital related
15.43% % total E1 COS that is Luminaire Technology Capital dependent

Exl

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue
E1 Street Lighting - Option I

Process to determine the correct fixture rate
Based on COS revenue requirements

Step 1 - split revenue into Proposed Fixture Rate and Energy Charge | Step 2 - separate SL O&M Rate component from all other non energy | Step 3 - spilt and show SL O&M Lum & Lamp dependent COS components | Step 4 - Adjust Fixture rate based on SL O&M COS characteristics (HPS, LED, MV, MH) | Step 5 - Adjust to calculate / model revenue neutral cond. | Step 6 - Results of Steps 1 to 5 compared to fixture baseline | Step 7 Capital Treatment - apply technology specific capital cost adjustment | Step 8 - Adjust Fixture rate based on Capital - Tecl (HPS, LED, MV, MH)

Line No.	(a) Description: Co. Owned Ornamental	(b) Billing Determinants: Quantity	Units	(c) Present: Rate ($/lamp/yr)	(d) Present: Revenue ($000)	(e) Proposed: Rate ($/lamp/mth)	(f) Proposed: Energy (c/watt)	(g) Proposed: Revenue ($000)	(g / e) Rate	(g / f) (A) Energy	(g) Rev	(O) All other less (A) and (B) - fixture rate	(O) All other less (A) and (B) - rev	(B) SL O&M - fixture rate	(B) SL O&M - rev	(C) SL O&M Not Lum & Lamp - fixture rate	(C) SL O&M Not Lum & Lamp - rev	(D) Lum & Lamps - fixture rate	(D) SL O&M Lum & Lamps - rev	Lum & Lamps O&M adjustment factor	(E) Lum & Lamps - fixture rate	(E) SL O&M Lum & Lamps - rev	(F) O + C + E Rate - fixture rate	(F) O + C + E Rate - rev	(H) (F / G) Rate Rev Adjusted	New Rev Rate Rev + Energy	Proposed Starting Base Rate - fixture rate	Step (1- 6) Results New Rate - fixture rate	Technology specific Lamp & Lum cost: Lamp cost (1)	Lum cost (2)	All Luminaire (3) (1 + 2)	Lum & Lamp Capital adjustment factor	(I) New Capital Rev after Adjustment	(J) Old Capital Rate - rev
	Hg Vapor																																	
1	100 W	17	Lamps	352.56	6.02	23.53	0.054	5.30	4.82	0.48	5.30	21.33	4.369	2.20	0.451	1.40	0.286	0.80	0.165	0.899	0.72	0.148	23.45	4.803	5.80	6.28	23.53	28.33	2.88	67.80	70.68	0.572	0.67	1.17
2	175 W	7,623	Lamps	405.36	3089.99	23.53	0.054	2505.15	2152.38	352.77	2505.15	21.33	1951.179	2.20	201.200	1.40	127.617	0.80	73.583	0.899	0.72	66.151	23.45	2144.947	2591.75	2944.53	23.53	28.33	2.88	67.80	70.68	0.572	299.32	523.64
3	250 W	213	Lamps	446.88	94.96	23.53	0.054	73.91	60.00	13.91	73.91	21.33	54.394	2.20	5.609	1.40	3.558	0.80	2.051	0.899	0.72	1.844	23.45	59.795	72.25	86.16	23.53	28.33	3.680	84.040	87.72	0.709	10.36	14.60
4	400 W	4,778	Lamps	532.08	2542.45	23.53	0.054	1840.02	1349.21	490.81	1840.02	21.33	1223.088	2.20	126.121	1.40	79.996	0.80	46.125	0.899	0.72	41.466	23.45	1344.551	1624.63	2115.44	23.53	28.33	4.15	115.29	119.44	0.966	317.07	328.24
5	1,000 W	96	Lamps	747.24	72.06	23.53	0.054	50.63	27.23	23.40	50.63	21.33	24.685	2.20	2.545	1.40	1.615	0.80	0.931	3.010	2.42	2.802	25.15	29.101	35.16	58.57	23.53	30.39	18.23	381.03	399.26	3.229	22.94	7.10
6																																		
7	Na Vapor																																	
8	70 W	89	Lamps	321.12	28.50	23.53	0.054	26.96	25.06	1.90	26.96	21.33	22.719	2.20	2.343	1.40	1.486	0.80	0.857	0.899	0.72	0.770	23.45	24.975	30.18	32.08	23.53	28.33	8.25	81.52	89.77	0.726	4.43	6.10
9	100 W	22,453	Lamps	330.12	7412.19	23.53	0.054	7039.33	6339.84	699.49	7039.33	21.33	5747.203	2.20	592.635	1.40	375.897	0.80	216.738	0.899	0.72	194.847	23.45	6317.947	7634.01	8333.50	23.53	28.33	8.25	81.52	89.77	0.726	1119.77	1542.39
10	150 W	796	Lamps	360.00	286.65	23.53	0.054	258.62	224.83	33.79	258.62	21.33	203.812	2.20	21.017	1.40	13.330	0.80	7.686	0.899	0.72	6.910	23.45	224.052	270.72	304.52	23.53	28.33	8.25	81.52	89.77	0.726	39.71	54.70
11	250 W	12,223	Lamps	420.60	5140.86	23.53	0.054	4265.18	3451.20	813.99	4265.18	21.33	3128.587	2.20	322.611	1.40	204.626	0.80	117.985	0.899	0.72	106.068	23.45	3439.282	4155.70	4969.69	23.53	28.33	7.69	100.27	107.96	0.873	733.08	839.62
12	360 W	0	Lamps	513.96	0.00	23.53	0.054	0.00	0.00	0.00	0.00																23.53		8.64	118.55	127.19			
13	400 W	4,128	Lamps	513.12	2118.18	23.53	0.054	1598.93	1165.59	433.33	1598.93	21.33	1056.634	2.20	108.957	1.40	69.109	0.80	39.848	0.899	0.72	35.823	23.45	1161.566	1403.53	1836.86	23.53	28.33	8.64	118.55	127.19	1.029	291.69	283.57
14	1,000 W	11	Lamps	666.84	7.40	23.53	0.054	5.89	3.13	2.76	5.89	21.33	2.840	2.20	0.293	1.40	0.186	0.80	0.107	3.010	2.42	0.322	25.15	3.348	4.05	6.80	23.53	30.39	28.63	468.18	496.81	4.018	3.28	0.82
15																																		

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue

Process to determine the correct fixture rate

Based on COS revenue requirements

E1 Street Lighting - Option I

Row	(a)	(b)		(c)	(d)		(e)	(f)	(g)
16	Metal Halide								
17	70 W	166	Lamps	420.24	69.94		23.53	0.054	49.92
18	100 W	58	Lamps	432.96	25.13		23.53	0.054	17.83
19	150 or 175 W	721	Lamps	511.56	368.91		23.53	0.054	230.16
20	250 W	242	Lamps	573.60	139.03		23.53	0.054	82.99
21	320 or 400 W	983	Lamps	705.00	693.12		23.53	0.054	366.38
22	1,000 W	0	Lamps	874.56	0.00		23.53	0.054	0.00
23									
56									
57	< May 2013 Old Rates								
58	30 - 39 Watt LED	0	Lamps	261.71	0.00	0	23.53	0.054	0.00
59	40 - 49 Watt LED	27	Lamps	266.61	7.20	105	23.53	0.054	7.90
60	50 - 59 Watt LED	19	Lamps	271.52	5.16	74	23.53	0.054	5.60
61	60 - 69 Watt LED	0	Lamps	276.42	0.00	2,571	23.53	0.054	0.00
62	70 - 79 Watt LED	32	Lamps	281.33	9.00	124	23.53	0.054	9.58
63	80 - 89 Watt LED	9	Lamps	286.23	2.58	132	23.53	0.054	2.71
64	90 - 99 Watt LED	38	Lamps	291.13	11.06	143	23.53	0.054	11.54
65	100 - 109 Watt LED	304	Lamps	296.16	90.03	1,350	23.53	0.054	93.04
66	110 - 119 Watt LED	2	Lamps	300.94	0.60	35	23.53	0.054	0.62
67	120 - 129 Watt LED	1	Lamps	305.85	0.31	31	23.53	0.054	0.31
68	130 - 139 Watt LED	0	Lamps	310.75	0.00	1,163	23.53	0.054	0.00
69	140 - 149 Watt LED	3	Lamps	315.66	0.95	12	23.53	0.054	0.95
70	150 - 159 Watt LED	75	Lamps	320.56	24.04	314	23.53	0.054	23.80
71	160 - 169 Watt LED	37	Lamps	325.47	12.04	143	23.53	0.054	11.83
72	170 - 179 Watt LED	0	Lamps	330.37	0.00	16	23.53	0.054	0.00
73	180 - 189 Watt LED	0	Lamps	335.28	0.00	0	23.53	0.054	0.00
74	190 - 199 Watt LED	0	Lamps	340.18	0.00	0	23.53	0.054	0.00
75	200 - 209 Watt LED	193	Lamps	345.09	66.60	748	23.53	0.054	63.43
76	210 - 219 Watt LED	0	Lamps	350.12	0.00	0	23.53	0.054	0.00
77	220 - 229 Watt LED	0	Lamps	354.89	0.00	0	23.53	0.054	0.00
78	230 - 239 Watt LED	0	Lamps	359.93	0.00	0	23.53	0.054	0.00
79	240 - 249 Watt LED	0	Lamps	364.70	0.00	0	23.53	0.054	0.00
80	250 - 259 Watt LED	0	Lamps	369.73	0.00	0	23.53	0.054	0.00
81	260 - 269 Watt LED	0	Lamps	374.51	0.00	0	23.53	0.054	0.00
82	270 - 279 Watt LED	0	Lamps	379.42	0.00	0	23.53	0.054	0.00
83	280 - 289 Watt LED	0	Lamps	384.32	0.00	27	23.53	0.054	0.00
84	290 - 299 Watt LED	0	Lamps	389.23	0.00	0	23.53	0.054	0.00
85	300 - 309 Watt LED	236	Lamps	394.26	93.05	915	23.53	0.054	82.89
86	310 - 319 Watt LED	0	Lamps	399.04	0.00	0	23.53	0.054	0.00
87	320 - 329 Watt LED	0	Lamps	404.07	0.00	0	23.53	0.054	0.00
88									
89	>May 2013 New Rates								
90	30 - 39 Watt LED	0	Lamps	284.58	0.00		23.53	0.054	0.00
91	40 - 49 Watt LED	78	Lamps	287.32	22.33		23.53	0.054	22.73
92	50 - 59 Watt LED	55	Lamps	290.06	15.86		23.53	0.054	16.12
93	60 - 69 Watt LED	2,571	Lamps	292.80	752.86		23.53	0.054	763.74
94	70 - 79 Watt LED	92	Lamps	295.54	27.22		23.53	0.054	27.57
95	80 - 89 Watt LED	123	Lamps	298.28	36.65		23.53	0.054	37.05
96	90 - 99 Watt LED	105	Lamps	301.01	31.75		23.53	0.054	32.05
97	100 - 109 Watt LED	1,046	Lamps	303.75	317.61		23.53	0.054	320.02
98	110 - 119 Watt LED	33	Lamps	306.49	10.08		23.53	0.054	10.14
99	120 - 129 Watt LED	30	Lamps	309.23	9.28		23.53	0.054	9.33
100	130 - 139 Watt LED	1,163	Lamps	311.97	362.96		23.53	0.054	363.97
101	140 - 149 Watt LED	9	Lamps	314.71	2.72		23.53	0.054	2.72
102	150 - 159 Watt LED	239	Lamps	317.45	75.91		23.53	0.054	75.89
103	160 - 169 Watt LED	106	Lamps	320.18	34.10		23.53	0.054	34.04
104	170 - 179 Watt LED	16	Lamps	322.92	5.01		23.53	0.054	4.99
105	180 - 189 Watt LED	0	Lamps	325.66	0.00		23.53	0.054	0.00
106	190 - 199 Watt LED	0	Lamps	328.40	0.00		23.53	0.054	0.00
107	200 - 209 Watt LED	555	Lamps	331.14	183.94		23.53	0.054	182.56
108	210 - 219 Watt LED	0	Lamps	333.88	0.00		23.53	0.054	0.00
109	220 - 229 Watt LED	0	Lamps	336.61	0.00		23.53	0.054	0.00
110	230 - 239 Watt LED	0	Lamps	339.35	0.00		23.53	0.054	0.00
111	240 - 249 Watt LED	0	Lamps	342.09	0.00		23.53	0.054	0.00
112	250 - 259 Watt LED	0	Lamps	344.83	0.00		23.53	0.054	0.00
113	260 - 269 Watt LED	0	Lamps	347.57	0.00		23.53	0.054	0.00
114	270 - 279 Watt LED	0	Lamps	350.31	0.00		23.53	0.054	0.00
115	280 - 289 Watt LED	27	Lamps	353.04	9.58		23.53	0.054	9.41
116	290 - 299 Watt LED	0	Lamps	355.78	0.00		23.53	0.054	0.00
117	300 - 309 Watt LED	679	Lamps	358.52	243.53		23.53	0.054	238.56
118	310 - 319 Watt LED	0	Lamps	361.26	0.00		23.53	0.054	0.00
119	320 - 329 Watt LED	0	Lamps	364.00	0.00		23.53	0.054	0.00
120									
121	Service Charge	308	Cust				8.00		29.57
122									
123									
124									
125	Long Span Charge	43,870		24.48	1,073.94		24.48		1,073.94
126	Multiple Lamp Discount	1,644		-97.92	-160.98		-97.92		-160.98
127	Multiple Lamp Discount - Long S	1,972		-122.40	-241.37		-122.40		-241.37
128	Semi-Ornamental Discount	709		-21.48	-15.23		-21.48		-15.23
129	Multiple Lamp Discount - Semi-C	9		-76.56	-0.69		-76.56		-0.69
130	Subtotal				24559.39				20882.30
131									
132	Nuclear Decomm.	63,608	MWh	0.172%	42		0.000664		42
133									
134	Sub-Total				24,602				20,925
135									
136									
137	Energy Optimization	308	Meters	0.9%	221.41		59.91		221.41
138	REPS	308	Meters	0.2%	49.65		13.43		49.65
139	Rate Realignment	63,608	MWh	0.72%	179.08		0.00		179.08
140	**Total E1 - Option 1**	**63,608**	**MWh**		25,052				21,375
141	Increase/Decrease ($)								(3,677)
		62,502			25207.67				24070.52

Row	Step 1 - split revenue into Proposed Fixture Rate and Energy Charge (g / e)	(g / f)	(g)	Step 2 - separate SL O&M Rate component from all other non energy				Step 3 - split and show SL O&M Lum & Lamp dependent COS components				Step 4 - Adjust Fixture rate based on SL O&M COS characteristics (HPS, LED, MV, MH)
17	46.99	2.93	49.92	21.33	42.597	2.20	4.393	1.40	2.786	0.80	1.606	0.899
18	16.39	1.44	17.83	21.33	14.854	2.20	1.532	1.40	0.972	0.80	0.560	0.90
19	203.62	26.54	230.16	21.33	184.589	2.20	19.034	1.40	12.073	0.80	6.961	0.899
20	68.44	14.55	82.99	21.33	62.039	2.20	6.397	1.40	4.058	0.80	2.340	0.899
21	277.60	88.78	366.38	21.33	251.652	2.20	25.950	1.40	16.459	0.80	9.490	3.010
22	0.00	0.00	0.00									
58	0.00	0.00	0.00									
59	7.62	0.27	7.90	21.33	6.911	2.20	0.713	1.40	0.452	0.80	0.261	1.70
60	5.36	0.24	5.60	21.33	4.863	2.20	0.501	1.40	0.318	0.80	0.183	1.70
61	0.00	0.00	0.00									
62	9.04	0.54	9.58	21.33	8.191	2.20	0.845	1.40	0.536	0.80	0.309	1.70
63	2.54	0.17	2.71	21.33	2.304	2.20	0.238	1.40	0.151	0.80	0.087	1.70
64	10.73	0.81	11.54	21.33	9.727	2.20	1.003	1.40	0.636	0.80	0.367	1.70
65	85.84	7.21	93.04	21.33	77.814	2.20	8.024	1.40	5.089	0.80	2.934	1.70
66	0.56	0.05	0.62	21.33	0.512	2.20	0.053	1.40	0.033	0.80	0.019	1.70
67	0.28	0.03	0.31	21.33	0.256	2.20	0.026	1.40	0.017	0.80	0.010	1.70
68	0.00	0.00	0.00									
69	0.85	0.10	0.95	21.33	0.768	2.20	0.079	1.40	0.050	0.80	0.029	1.70
70	21.18	2.62	23.80	21.33	19.197	2.20	1.980	1.40	1.256	0.80	0.724	1.70
71	10.45	1.38	11.83	21.33	9.471	2.20	0.977	1.40	0.619	0.80	0.357	1.70
72	0.00	0.00	0.00									
73	0.00	0.00	0.00									
74	0.00	0.00	0.00									
75	54.50	8.93	63.43	21.33	49.401	2.20	5.094	1.40	3.231	0.80	1.863	1.70
76	0.00	0.00	0.00									
77	0.00	0.00	0.00									
78	0.00	0.00	0.00									
79	0.00	0.00	0.00									
80	0.00	0.00	0.00									
81	0.00	0.00	0.00									
82	0.00	0.00	0.00									
83	0.00	0.00	0.00									
84	0.00	0.00	0.00									
85	66.64	16.25	82.89	21.33	60.408	2.20	6.229	1.40	3.951	0.80	2.278	1.70
86	0.00	0.00	0.00									
87	0.00	0.00	0.00									
90	0.00	0.00	0.00									
91	21.94	0.79	22.73	21.33	19.891	2.20	2.051	1.40	1.301	0.80	0.750	1.70
92	15.44	0.68	16.12	21.33	13.998	2.20	1.443	1.40	0.916	0.80	0.528	1.70
93	726.01	37.73	763.74	21.33	658.148	2.20	67.866	1.40	43.046	0.80	24.820	1.70
94	26.01	1.56	27.57	21.33	23.575	2.20	2.431	1.40	1.542	0.80	0.889	1.70
95	34.69	2.36	37.05	21.33	31.447	2.20	3.243	1.40	2.057	0.80	1.186	1.70
96	29.79	2.26	32.05	21.33	27.003	2.20	2.784	1.40	1.766	0.80	1.018	1.70
97	295.24	24.78	320.02	21.33	267.640	2.20	27.598	1.40	17.505	0.80	10.093	1.70
98	9.29	0.85	10.14	21.33	8.422	2.20	0.868	1.40	0.551	0.80	0.318	1.70
99	8.48	0.85	9.33	21.33	7.685	2.20	0.793	1.40	0.503	0.80	0.290	1.70
100	328.51	35.46	363.97	21.33	297.804	2.20	30.709	1.40	19.478	0.80	11.231	1.70
101	2.44	0.28	2.72	21.33	2.210	2.20	0.228	1.40	0.145	0.80	0.083	1.70
102	67.52	8.37	75.89	21.33	61.210	2.20	6.312	1.40	4.003	0.80	2.308	1.70
103	30.07	3.97	34.04	21.33	27.258	2.20	2.811	1.40	1.783	0.80	1.028	1.70
104	4.38	0.61	4.99	21.33	3.971	2.20	0.409	1.40	0.260	0.80	0.150	1.70
105	0.00	0.00	0.00									
106	0.00	0.00	0.00									
107	156.85	25.71	182.56	21.33	142.186	2.20	14.662	1.40	9.300	0.80	5.362	1.70
108	0.00	0.00	0.00									
109	0.00	0.00	0.00									
110	0.00	0.00	0.00									
111	0.00	0.00	0.00									
112	0.00	0.00	0.00									
113	0.00	0.00	0.00									
114	0.00	0.00	0.00									
115	7.67	1.75	9.41	21.33	6.949	2.20	0.717	1.40	0.454	0.80	0.262	1.70
116	0.00	0.00	0.00									
117	191.79	46.77	238.56	21.33	173.865	2.20	17.928	1.40	11.372	0.80	6.557	1.70
118	0.00	0.00	0.00									
119	0.00	0.00	0.00									

Row	Step 4 (cont.)				Step 5 - Adjust to calculate / model revenue neutral cond.		Step 6 - Results of Steps 1 to 5 compared to fixture baseline		Step 7 Capital Treatment - apply technology specific capital cost adjustment			Step 8 - Adjust Fixture rate based on Capital - Tec (HPS, LED, MV, MH)		
17	0.72	1.444	23.45	46.828	56.58	59.51	23.53	28.33	7.10	67.80	74.90	0.606	6.92	11.43
18	0.72	0.504	23.45	16.330	19.73	21.17	23.53	28.33	7.10	67.80	74.90	0.606	2.41	3.99
19	0.72	6.258	23.45	202.920	245.19	271.73	23.53	28.33	7.10	67.80	74.90	0.606	30.01	49.54
20	0.72	2.103	23.45	68.200	82.41	96.96	23.53	28.33	7.10	84.04	91.14	0.737	12.27	16.65
21	2.42	28.566	25.15	296.677	358.48	447.26	23.53	30.39	7.65	115.29	122.94	0.994	72.01	72.43
22									16.34	294.20	310.54	2.511		
58							23.53				138.06			
59	1.37	0.443	24.09	7.806	9.43	9.71	23.53	29.11			151.18	1.223	2.33	1.91
60	1.37	0.312	24.09	5.493	6.64	6.87	23.53	29.11			165.54	1.339	1.80	1.34
61							23.53				181.26			
62	1.37	0.525	24.09	9.252	11.18	11.72	23.53	29.11			196.98	1.593	3.60	2.26
63	1.37	0.148	24.09	2.602	3.14	3.32	23.53	29.11			214.07	1.731	1.10	0.64
64	1.37	0.624	24.09	10.986	13.27	14.09	23.53	29.11			232.64	1.881	5.05	2.68
65	1.37	4.989	24.09	87.892	106.20	113.41	23.53	29.11			252.82	2.045	43.87	21.46
66	1.37	0.033	24.09	0.578	0.70	0.75	23.53	29.11			274.75	2.222	0.31	0.14
67	1.37	0.016	24.09	0.289	0.35	0.38	23.53	29.11			298.59	2.415	0.17	0.07
68							23.53				324.74			
69	1.37	0.049	24.09	0.867	1.05	1.15	23.53	29.11			336.77	2.724	0.58	0.21
70	1.37	1.231	24.09	21.684	26.20	28.82	23.53	29.11			349.25	2.825	14.95	5.29
71	1.37	0.607	24.09	10.697	12.93	14.30	23.53	29.11			362.19	2.929	7.65	2.61
72							23.53				375.61			
73							23.53				389.53			
74							23.53				403.96			
75	1.37	3.167	24.09	55.800	67.42	76.35	23.53	29.11			418.93	3.388	46.15	13.62
76							23.53				434.45			
77							23.53				450.55			
78							23.53				467.24			
79							23.53				484.56			
80							23.53				502.51			
81							23.53				521.13			
82							23.53				540.44			
83							23.53				560.51			
84							23.53				581.28			
85	1.37	3.873	24.09	68.232	82.44	98.69	23.53	29.11			602.82	4.875	81.21	16.66
86							23.53				625.15			
87							23.53				648.32			
90							23.53				138.06			
91	1.37	1.275	24.09	22.468	27.15	27.94	23.53	29.11			151.18	1.223	6.71	5.48
92	1.37	0.897	24.09	15.811	19.10	19.78	23.53	29.11			165.54	1.339	5.17	3.86
93	1.37	42.194	24.09	743.388	898.24	935.97	23.53	29.11			181.26	1.466	266.04	181.48
94	1.37	1.511	24.09	26.628	32.18	33.73	23.53	29.11			196.98	1.593	10.36	6.50
95	1.37	2.016	24.09	35.520	42.92	45.28	23.53	29.11			214.07	1.731	15.01	8.67
96	1.37	1.731	24.09	30.500	36.85	39.12	23.53	29.11			232.64	1.881	14.01	7.45
97	1.37	17.158	24.09	302.303	365.27	390.06	23.53	29.11			252.82	2.045	150.90	73.80
98	1.37	0.540	24.09	9.513	11.49	12.35	23.53	29.11			274.75	2.222	5.16	2.32
99	1.37	0.493	24.09	8.681	10.49	11.34	23.53	29.11			298.59	2.415	5.12	2.12
100	1.37	19.092	24.09	336.375	406.44	441.90	23.53	29.11			324.74	2.626	215.67	82.12
101	1.37	0.142	24.09	2.496	3.02	3.30	23.53	29.11			336.77	2.724	1.66	0.61
102	1.37	3.924	24.09	69.137	83.54	91.91	23.53	29.11			349.25	2.825	47.67	16.88
103	1.37	1.748	24.09	30.789	37.20	41.17	23.53	29.11			362.19	2.929	22.02	7.52
104	1.37	0.255	24.09	4.485	5.42	6.03	23.53	29.11			375.61	3.038	3.33	1.09
105							23.53				389.53			
106							23.53				403.96			
107	1.37	9.116	24.09	160.601	194.06	219.76	23.53	29.11			418.93	3.388	132.83	39.21
108							23.53				434.45			
109							23.53				450.55			
110							23.53				467.24			
111							23.53				484.56			
112							23.53				502.51			
113							23.53				521.13			
114							23.53				540.44			
115	1.37	0.445	24.09	7.849	9.48	11.23	23.53	29.11			560.51	4.533	8.69	1.92
116							23.53				581.28			
117	1.37	11.147	24.09	196.383	237.29	284.06	23.53	29.11			602.82	4.875	233.73	47.94
118							23.53				625.15			
119							23.53				648.32			

17648.03	3234.27	20882.30	15998.33	1649.70	1046.38	603.33	603.33	17670.43	21351.28	24585.55	26.15	4313.84
84.51% Rate	15.49% Energy	0.00	76.61% All other less (A) and (B)	7.90% SL O&M (B)	5.01% SL O&M Non Lum & Lamp (C)	2.89% SL O&M Lum & Lamps (D)	2.89% SL O&M Lum & Lamps (E)	84.62% Rate	86.84%			34.39% SL Capital Lum & Lamps (F)
-3677.10	13.17%											

Total Lums / Lamps => 62,502 | 15998.33 | 1649.70 | 1046.38 | 603.33 | 625.73

Total LED Lums / Lamps => 7,904 | 12.65%

0.82760517 <- adjusted Rate to be Rev neutral
1 Correction to get back to Revenue neutral
-0.1723948 from starting template provided
-3600.00
-3677.10

Technology Balancing Key must match cell AJ302 -> 4318.76 | 4313.84

Rev
12543.88 58.8% of non energy COS that is Capital related
4313.84 34.4% of non energy COS that is Luminaire Technology Capital dependent

51.02% of total E1 COS that is Capital related
17.55% total E1 COS that is Luminaire Technology Capital dependent

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue

Workpaper
Case No: U-17767
ıibit Supported: A-14 Schedule F3
Workpaper WP-KAH-5
Witness: K.A. Holmes

E1 Street Lighting - Option I

Process to deterı
Based on COS ı
Step 1 - split revenology dependent COS characteristics
Rate and Energ

Step 9 - Results of Steps 7 to 8 compared to fixture baseline

Step 10 - Adjust fixture rate based on current and future Lamp and Luminaire obsolescence (HPS, LED, MV, MH)

Step 11 - Results of Step 10 compared to fixture baseline

Step 12 - Adjust HPS Rate to bring into alignment the combining of D9 with E1 - OH Luminaire COS (HPS)

Step 13 - Results of Step 12 compared to fixture baseline

To Exhibit A-14
E1 design

Line No.	(a) Description: Overhead	(b) Billing Determinants: Quantity	Units	(c) Present: Rate ($/lamp/yr)	(d) Present: Revenue ($000)		(e) Proposed: Rate ($/lamp/mth)	(f) Proposed: Energy (c/kWh)	(g) Proposed: Revenue ($000)	(g / e) Rate
	Hg Vapor									
1	100 W	318	Lamps	155.28	49.33		9.69	0.05375	45.90	36.94
2	175 W	41,282	Lamps	201.12	8,302.69		9.69	0.054	6,710.79	4800.30
3	250 W	1,317	Lamps	226.44	298.15		9.69	0.054	239.30	153.10
4	400 W	7,845	Lamps	301.56	2,365.78		9.69	0.054	1,718.05	912.23
5	1,000 W	94	Lamps	537.84	50.45		9.69	0.054	33.67	10.91
6										
7	Na Vapor									
8	70 W	1,329	Lamps	174.84	232.37		9.69	0.054	183.05	154.54
9	100 W	17,638	Lamps	183.96	3,244.76		9.69	0.054	2,600.49	2050.99
10	150 W	0	Lamps	201.12	0.00		9.69	0.054	0.00	0.00
11	250 W	9,477	Lamps	234.60	2,223.21		9.69	0.054	1,733.05	1101.94
12	360 W	35	Lamps	306.12	10.56		9.69	0.054	7.24	4.01
13	400 W	2,194	Lamps	306.12	671.63		9.69	0.054	485.43	255.12
14	1,000 W	61	Lamps	566.64	34.60		9.69	0.054	22.26	7.10
15										
16	Metal Halide									
17	70 W	2	Lamps	252.84	0.45		9.69	0.054	0.24	0.21
18	100 W	0	Lamps	266.04	0.00		9.69	0.054	0.00	0.00
19	150 or 175 W	40	Lamps	314.76	12.53		9.69	0.054	6.10	4.63
20	250 W	16	Lamps	353.16	5.62		9.69	0.054	2.81	1.85
21	320 or 400 W	28	Lamps	459.60	13.01		9.69	0.054	6.26	3.29
22	1,000 W	9	Lamps	760.32	6.73		9.69	0.054	3.18	1.03
23										
56										
57	< May 2013 Old Emerging Technology Rates									
58	30 - 39 Watt LED	0	Lamps	87.78	0.00	0	9.69	0.054	0.00	0.00
59	40 - 49 Watt LED	0	Lamps	92.06	0.00	0	9.69	0.054	0.00	0.00
60	50 - 59 Watt LED	3	Lamps	96.21	0.29	8	9.69	0.054	0.39	0.35
61	60 - 69 Watt LED	0	Lamps	100.48	0.00	4,545	9.69	0.054	0.00	0.00
62	70 - 79 Watt LED	0	Lamps	104.76	0.00	4	9.69	0.054	0.00	0.00
63	80 - 89 Watt LED	0	Lamps	108.91	0.00	0	9.69	0.054	0.00	0.00
64	90 - 99 Watt LED	1,250	Lamps	113.18	141.48	5,242	9.69	0.054	172.16	145.35
65	100 - 109 Watt LED	67	Lamps	117.33	7.86	315	9.69	0.054	9.38	7.79
66	110 - 119 Watt LED	0	Lamps	121.61	0.00	0	9.69	0.054	0.00	0.00
67	120 - 129 Watt LED	13	Lamps	125.76	1.63	119	9.69	0.054	1.88	1.51
68	130 - 139 Watt LED	0	Lamps	130.04	0.00	1,087	9.69	0.054	0.00	0.00
69	140 - 149 Watt LED	0	Lamps	134.19	0.00	0	9.69	0.054	0.00	0.00
70	150 - 159 Watt LED	407	Lamps	138.34	56.30	1,605	9.69	0.054	61.57	47.33
71	160 - 169 Watt LED	107	Lamps	142.61	15.26	426	9.69	0.054	16.43	12.44
72	170 - 179 Watt LED	12	Lamps	146.76	1.76	48	9.69	0.054	1.87	1.40
73	180 - 189 Watt LED	0	Lamps	151.04	0.00	0	9.69	0.054	0.00	0.00
74	190 - 199 Watt LED	0	Lamps	155.19	0.00	0	9.69	0.054	0.00	0.00
75	200 - 209 Watt LED	1	Lamps	159.46	0.16	8	9.69	0.054	0.16	0.12
76	210 - 219 Watt LED	0	Lamps	163.74	0.00	0	9.69	0.054	0.00	0.00
77	220 - 229 Watt LED	0	Lamps	167.89	0.00	0	9.69	0.054	0.00	0.00
78	230 - 239 Watt LED	0	Lamps	172.17	0.00	0	9.69	0.054	0.00	0.00
79	240 - 249 Watt LED	0	Lamps	176.19	0.00	0	9.69	0.054	0.00	0.00
80	250 - 259 Watt LED	0	Lamps	180.47	0.00	0	9.69	0.054	0.00	0.00
81	260 - 269 Watt LED	0	Lamps	184.62	0.00	0	9.69	0.054	0.00	0.00
82	270 - 279 Watt LED	0	Lamps	188.89	0.00	0	9.69	0.054	0.00	0.00
83	280 - 289 Watt LED	0	Lamps	193.17	0.00	4	9.69	0.054	0.00	0.00
84	290 - 299 Watt LED	0	Lamps	197.32	0.00	0	9.69	0.054	0.00	0.00
85	300 - 309 Watt LED	0	Lamps	201.59	0.00	0	9.69	0.054	0.00	0.00
86	310 - 319 Watt LED	0	Lamps	205.74	0.00	0	9.69	0.054	0.00	0.00
87	320 - 329 Watt LED	0	Lamps	210.02	0.00	0	9.69	0.054	0.00	0.00
88										
89	>May 2013 New Emerging Technology Rates									
90	30 - 39 Watt LED	0	Lamps	129.58	0.00		9.69	0.054	0.00	0.00
91	40 - 49 Watt LED	0	Lamps	132.32	0.00		9.69	0.054	0.00	0.00
92	50 - 59 Watt LED	5	Lamps	135.06	0.67		9.69	0.054	0.64	0.58
93	60 - 69 Watt LED	4,545	Lamps	137.80	626.28		9.69	0.054	595.17	528.48
94	70 - 79 Watt LED	4	Lamps	140.54	0.56		9.69	0.054	0.53	0.46
95	80 - 89 Watt LED	0	Lamps	143.28	0.00		9.69	0.054	0.00	0.00
96	90 - 99 Watt LED	3,992	Lamps	146.01	582.86		9.69	0.054	549.79	464.18
97	100 - 109 Watt LED	248	Lamps	148.75	36.84		9.69	0.054	34.67	28.80
98	110 - 119 Watt LED	0	Lamps	151.49	0.00		9.69	0.054	0.00	0.00
99	120 - 129 Watt LED	106	Lamps	154.23	16.43		9.69	0.054	15.39	12.38
100	130 - 139 Watt LED	1,087	Lamps	156.97	170.69		9.69	0.054	159.59	126.45
101	140 - 149 Watt LED	0	Lamps	159.71	0.00		9.69	0.054	0.00	0.00
102	150 - 159 Watt LED	1,198	Lamps	162.45	194.65		9.69	0.054	181.26	139.33
103	160 - 169 Watt LED	319	Lamps	165.18	52.73		9.69	0.054	49.01	37.12
104	170 - 179 Watt LED	36	Lamps	167.92	6.01		9.69	0.054	5.58	4.16
105	180 - 189 Watt LED	0	Lamps	170.66	0.00		9.69	0.054	0.00	0.00
106	190 - 199 Watt LED	0	Lamps	173.40	0.00		9.69	0.054	0.00	0.00
107	200 - 209 Watt LED	7	Lamps	176.14	1.23		9.69	0.054	1.13	0.81
108	210 - 219 Watt LED	0	Lamps	178.88	0.00		9.69	0.054	0.00	0.00
109	220 - 229 Watt LED	0	Lamps	181.61	0.00		9.69	0.054	0.00	0.00
110	230 - 239 Watt LED	0	Lamps	184.35	0.00		9.69	0.054	0.00	0.00
111	240 - 249 Watt LED	0	Lamps	187.09	0.00		9.69	0.054	0.00	0.00
112	250 - 259 Watt LED	0	Lamps	189.83	0.00		9.69	0.054	0.00	0.00
113	260 - 269 Watt LED	0	Lamps	192.57	0.00		9.69	0.054	0.00	0.00
114	270 - 279 Watt LED	0	Lamps	195.31	0.00		9.69	0.054	0.00	0.00
115	280 - 289 Watt LED	4	Lamps	198.04	0.79		9.69	0.054	0.72	0.46
116	290 - 299 Watt LED	0	Lamps	200.78	0.00		9.69	0.054	0.00	0.00
117	300 - 309 Watt LED	0	Lamps	203.52	0.00		9.69	0.054	0.00	0.00
118	310 - 319 Watt LED	0	Lamps	206.26	0.00		9.69	0.054	0.00	0.00
119	320 - 329 Watt LED	0	Lamps	209.00	0.00		9.69	0.054	0.00	0.00
120										
121	Service Charge	516	Cust				8.00		49.56	
122										
123										11057.69
124										70.63%
125	Multiple Lamp Discount	764	Lamps	-12.24	-9.35		-12.24		-9.35	Rate
126	Subtotal		Lamps		19,436.36				15,655.12	-3781.23
127										
128	Nuclear Decomm.	88,592	MWh	0.172%	33		0.0003774		33	Total Lums / Lam
129										
130	Sub-Total				19,470				15,738	Total LED Lums /
131										
132										
133	Energy Optimization	516	Meters	0.9%	175.23		28.29		175.23	
134	REPS	516	Meters	0.2%	39.29		6.34		39.29	
135	Rate Realignment	88,592	MWh	0.720%	141.73		0.00		141.73	
136	**Total E1 - Option 1**	**88,592**	**MWh**		19,826				16,094	-3731.68
137	Increase/Decrease ($)								(3,732.00)	
					19492.48				19220.97	

Line No.	(K) Old Capital Rate - fixture rate	(L) Capital Rate Adjustment - rev	New Rev Rate Rev + Energy	Proposed Starting Base Rate - fixture rate	Step (7 - 9) Results New Rate - fixture rate	Lum & Lamp Obsolescence adjustment factor	(M) Obsolescence Rev after Adjustment	(Q) Obsolescence Old Rate - rev	(Q) Obsolescence Old - fixture rate	#2 Obsolescence Adjustment - rev	New Rev rate + energy
1	2.62	45.81	54.78	9.69	12.02	0.345	3.44	9.97	2.62	42.81	51.77
2	2.62	5953.85	7864.35	9.69	12.02	1.305	1690.59	1295.47	2.62	6807.04	8717.53
3	2.62	196.33	282.53	9.69	12.43	1.540	63.63	41.32	2.62	226.81	313.01
4	2.62	1241.23	2047.05	9.69	13.18	2.870	706.56	246.19	2.62	1678.87	2484.69
5	2.84	24.33	47.09	9.69	21.61	5.500	17.60	3.20	2.84	30.24	53.00
8	2.62	198.96	227.46	9.69	12.48	0.821	34.24	41.71	2.62	198.96	227.46
9	2.62	2640.50	3190.00	9.69	12.48	0.279	154.23	553.51	2.62	2340.30	2889.80
10				9.69		0.279					
11	2.62	1468.14	2099.24	9.69	12.91	0.335	99.66	297.38	2.62	1274.17	1905.28
12	2.62	5.54	8.76	9.69	13.37	0.395	0.43	1.08	2.62	4.70	7.93
13	2.62	352.01	582.32	9.69	13.37	0.395	27.18	68.85	2.62	299.10	529.42
14	2.84	17.69	32.86	9.69	24.15	1.542	3.21	2.08	2.84	11.44	26.60
17	2.62	0.26	0.29	9.69	12.12	3.950	0.22	0.06	2.62	0.44	0.47
18				9.69		0.000					
19	2.62	5.79	7.26	9.69	12.12	5.410	6.76	1.25	2.62	11.70	13.16
20	2.62	2.39	3.35	9.69	12.51	5.950	2.97	0.50	2.62	4.95	5.90
21	2.62	4.51	7.48	9.69	13.27	8.075	7.18	0.89	2.62	10.68	13.66
22	2.84	2.05	4.20	9.69	19.31	12.330	3.72	0.30	2.84	4.92	7.07
58				9.69			0.00	0.00			
59				9.69			0.00	0.00			
60	2.70	0.53	0.57	9.69	14.76	0.278	0.03	0.10	2.70	0.41	0.45
61				9.69			0.00	0.00			
62				9.69			0.00	0.00			
63				9.69			0.00	0.00			
64	2.70	246.27	273.08	9.69	16.42	0.390	15.82	40.52	2.70	175.87	202.68
65	2.70	13.60	15.19	9.69	16.92	0.424	0.92	2.17	2.70	9.50	11.09
66				9.69			0.00	0.00			
67	2.70	2.82	3.18	9.69	18.05	0.501	0.21	0.42	2.70	1.88	2.24
68				9.69			0.00	0.00			
69				9.69			0.00	0.00			
70	2.70	94.26	108.50	9.69	19.30	0.586	7.73	13.19	2.70	59.85	74.09
71	2.70	25.19	29.18	9.69	19.62	0.608	2.11	3.47	2.70	15.81	19.79
72	2.70	2.87	3.35	9.69	19.95	0.630	0.25	0.39	2.70	1.78	2.26
73				9.69			0.00	0.00			
74				9.69			0.00	0.00			
75	2.70	0.25	0.30	9.69	21.02	0.703	0.02	0.03	2.70	0.15	0.20
76				9.69			0.00	0.00			
77				9.69			0.00	0.00			
78				9.69			0.00	0.00			
79				9.69			0.00	0.00			
80				9.69			0.00	0.00			
81				9.69			0.00	0.00			
82				9.69			0.00	0.00			
83				9.69			0.00	0.00			
84				9.69			0.00	0.00			
85				9.69			0.00	0.00			
86				9.69			0.00	0.00			
87				9.69			0.00	0.00			
90				9.69			0.00	0.00			
91				9.69			0.00	0.00			
92	2.70	0.88	0.94	9.69	14.76	0.278	0.04	0.16	2.70	0.68	0.74
93	2.70	826.17	892.86	9.69	15.15	0.304	44.82	147.34	2.70	626.74	693.43
94	2.70	0.74	0.81	9.69	15.54	0.331	0.04	0.13	2.70	0.55	0.62
95				9.69			0.00	0.00			
96	2.70	786.47	872.08	9.69	16.42	0.390	50.53	129.41	2.70	561.65	647.26
97	2.70	50.28	56.15	9.69	16.92	0.424	3.41	8.03	2.70	35.12	40.99
98				9.69			0.00	0.00			
99	2.70	23.06	26.07	9.69	18.05	0.501	1.73	3.45	2.70	15.37	18.37
100	2.70	243.93	277.07	9.69	18.69	0.545	19.21	35.25	2.70	158.44	191.58
101				9.69			0.00	0.00			
102	2.70	277.50	319.43	9.69	19.30	0.586	22.77	38.85	2.70	176.19	218.12
103	2.70	75.15	87.04	9.69	19.62	0.608	6.29	10.35	2.70	47.16	59.05
104	2.70	8.57	9.98	9.69	19.95	0.630	0.73	1.16	2.70	5.32	6.73
105				9.69			0.00	0.00			
106				9.69			0.00	0.00			
107	2.70	1.76	2.08	9.69	21.02	0.703	0.16	0.23	2.70	1.05	1.37
108				9.69			0.00	0.00			
109				9.69			0.00	0.00			
110				9.69			0.00	0.00			
111				9.69			0.00	0.00			
112				9.69			0.00	0.00			
113				9.69			0.00	0.00			
114				9.69			0.00	0.00			
115	2.70	1.17	1.43	9.69	24.52	0.941	0.12	0.13	2.70	0.63	0.89
116				9.69			0.00	0.00			
117				9.69			0.00	0.00			
118				9.69			0.00	0.00			
119				9.69			0.00	0.00			
121						94.10%					
123		14840.87	19438.30	1.94			2998.55			14841.27	19438.70
124		14841.25	19438.68							0.00	19438.68
125		-0.39	-0.39							14841.27	0.021689548
127					Technology Balancing Key must match cell AQ149 ->		(Obs)				
128							2998.57	2998.55			

Line No.	Proposed Starting Base Rate - fixture rate	Step (9 - 10) Results New Rate - fixture rate	Lum & Lamp HPS Balance adjustment factor	(M) HPS Balance Rev after Adjustment	(Q) HPS Balance Old Rate - rev	(Q) HPS Balance Old - fixture rate	#2 HPS Balance Adjustment - rev	New Rev rate + energy	Proposed Starting Base Rate - fixture rate	Step (12 - 13) Results New Rate - fixture rate	To Exhibit A-14 E1 design
1	9.69	11.23	0.345	3.44	9.97	2.62	42.81	51.77	9.69	11.23	11.24
2	9.69	13.74	1.305	1690.59	1295.47	2.62	6807.04	8717.53	9.69	13.74	13.75
3	9.69	14.36	1.540	63.63	41.32	2.62	226.81	313.01	9.69	14.36	14.36
4	9.69	17.83	2.870	706.56	246.19	2.62	1678.87	2484.69	9.69	17.83	17.84
5	9.69	26.87	5.500	17.60	3.20	2.84	30.24	53.00	9.69	26.87	26.88
8	9.69	12.48	-0.150	-6.26	41.71	2.62	158.46	186.97	9.69	9.94	9.94
9	9.69	11.06	-0.238	-131.46	553.51	2.62	2054.61	2604.11	9.69	9.71	9.71
10	9.69		0.279						9.69		11.18
11	9.69	11.20	0.886	263.48	297.38	2.62	1437.99	2069.10	9.69	12.65	12.65
12	9.69	11.36	0.395	0.43	1.08	2.62	4.70	7.93	9.69	11.36	11.37
13	9.69	11.36	2.750	189.34	68.85	2.62	461.26	691.57	9.69	17.52	17.53
14	9.69	15.62	1.542	3.21	2.08	2.84	11.44	26.60	9.69	15.62	15.62
17	9.69	20.66	3.950	0.22	0.06	2.62	0.44	0.47	9.69	20.66	20.67
18	9.69		0.000						9.69		22.58
19	9.69	24.48	5.410	6.76	1.25	2.62	11.70	13.16	9.69	24.48	24.49
20	9.69	25.89	5.950	2.97	0.50	2.62	4.95	5.90	9.69	25.89	25.90
21	9.69	31.44	8.075	7.18	0.89	2.62	10.68	13.66	9.69	31.44	31.46
22	9.69	46.29	12.330	3.72	0.30	2.84	4.92	7.07	9.69	46.29	46.31
58	9.69			0.00	0.00				9.69		11.29
59	9.69			0.00	0.00				9.69		11.36
60	9.69	11.42	0.278	0.03	0.10	2.70	0.41	0.45	9.69	11.42	11.43
61	9.69			0.00	0.00				9.69		11.50
62	9.69			0.00	0.00				9.69		11.57
63	9.69			0.00	0.00				9.69		11.66
64	9.69	11.72	0.390	15.82	40.52	2.70	175.87	202.68	9.69	11.72	11.73
65	9.69	11.82	0.424	0.92	2.17	2.70	9.50	11.09	9.69	11.82	11.82
66	9.69			0.00	0.00				9.69		11.92
67	9.69	12.02	0.501	0.21	0.42	2.70	1.88	2.24	9.69	12.02	12.03
68	9.69			0.00	0.00				9.69		12.15
69	9.69			0.00	0.00				9.69		12.21
70	9.69	12.25	0.586	7.73	13.19	2.70	59.85	74.09	9.69	12.25	12.26
71	9.69	12.31	0.608	2.11	3.47	2.70	15.81	19.79	9.69	12.31	12.32
72	9.69	12.37	0.630	0.25	0.39	2.70	1.78	2.26	9.69	12.37	12.38
73	9.69			0.00	0.00				9.69		12.44
74	9.69			0.00	0.00				9.69		12.50
75	9.69	12.57	0.703	0.02	0.03	2.70	0.15	0.20	9.69	12.57	12.57
76	9.69			0.00	0.00				9.69		12.65
77	9.69			0.00	0.00				9.69		12.73
78	9.69			0.00	0.00				9.69		12.81
79	9.69			0.00	0.00				9.69		12.89
80	9.69			0.00	0.00				9.69		12.97
81	9.69			0.00	0.00				9.69		13.05
82	9.69			0.00	0.00				9.69		13.14
83	9.69			0.00	0.00				9.69		13.22
84	9.69			0.00	0.00				9.69		13.30
85	9.69			0.00	0.00				9.69		13.38
86	9.69			0.00	0.00				9.69		13.47
87	9.69			0.00	0.00				9.69		13.55
90	9.69			0.00	0.00				9.69		11.29
91	9.69			0.00	0.00				9.69		11.36
92	9.69	11.42	0.278	0.04	0.16	2.70	0.68	0.74	9.69	11.42	11.43
93	9.69	11.49	0.304	44.82	147.34	2.70	626.74	693.43	9.69	11.49	11.50
94	9.69	11.56	0.331	0.04	0.13	2.70	0.55	0.62	9.69	11.56	11.57
95	9.69			0.00	0.00				9.69		11.66
96	9.69	11.72	0.390	50.53	129.41	2.70	561.65	647.26	9.69	11.72	11.73
97	9.69	11.82	0.424	3.41	8.03	2.70	35.12	40.99	9.69	11.82	11.82
98	9.69			0.00	0.00				9.69		11.92
99	9.69	12.02	0.501	1.73	3.45	2.70	15.37	18.37	9.69	12.02	12.03
100	9.69	12.14	0.545	19.21	35.25	2.70	158.44	191.58	9.69	12.14	12.15
101	9.69			0.00	0.00				9.69		12.21
102	9.69	12.25	0.586	22.77	38.85	2.70	176.19	218.12	9.69	12.25	12.26
103	9.69	12.31	0.608	6.29	10.35	2.70	47.16	59.05	9.69	12.31	12.32
104	9.69	12.37	0.630	0.73	1.16	2.70	5.32	6.73	9.69	12.37	12.38
105	9.69			0.00	0.00				9.69		12.44
106	9.69			0.00	0.00				9.69		12.50
107	9.69	12.57	0.703	0.16	0.23	2.70	1.05	1.37	9.69	12.57	12.57
108	9.69			0.00	0.00				9.69		12.65
109	9.69			0.00	0.00				9.69		12.73
110	9.69			0.00	0.00				9.69		12.81
111	9.69			0.00	0.00				9.69		12.89
112	9.69			0.00	0.00				9.69		12.97
113	9.69			0.00	0.00				9.69		13.05
114	9.69			0.00	0.00				9.69		13.14
115	9.69	13.21	0.941	0.12	0.13	2.70	0.63	0.89	9.69	13.21	13.22
116	9.69			0.00	0.00				9.69		13.30
117	9.69			0.00	0.00				9.69		13.38
118	9.69			0.00	0.00				9.69		13.47
119	9.69			0.00	0.00				9.69		13.55
121			94.10%								
123	19438.70			2998.55			14841.07	19438.50	19438.50		
124							0.00	0.00			
125							14841.07	19438.49746			
127	Technology Balancing Key must match cell AZ149 ->			(Obs)							
128				2998.36	2998.55						
134										36.6%	

Workpaper
Case No: U-17767
ıibit Supported: A-14 Schedule F3
Workpaper WP-KAH-5
Witness: K.A. Holmes

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue
E1 Street Lighting - Option I

Process to deterı
Based on COS ı
Step 1 - split revenology dependent COS characteristics
Rate and Energ

Step 9 - Results of Steps 7 to 8 compared to fixture baseline

Step 10 - Adjust fixture rate based on current and future Lamp and Luminaire obsolescence (HPS, LED, MV, MH)

Step 11 - Results of Step 10 compared to fixture baseline

To Exhibit A-14
E1 design

Line No.	(a) Description: Co. Owned Ornamental	(b) Billing Determinants: Quantity	Units	(c) Present: Rate ($/lamp/yr)	(d) Present: Revenue ($000)	(e) Proposed: Rate ($/lamp/mth)	(f) Proposed: Energy (c/watt)	(g) Proposed: Revenue ($000)	(g / e) Rate
	Hg Vapor								
1	100 W	17	Lamps	352.56	6.02	23.53	0.054	5.30	4.82
2	175 W	7,623	Lamps	405.36	3089.99	23.53	0.054	2505.15	2152.38
3	250 W	213	Lamps	446.88	94.96	23.53	0.054	73.91	60.00
4	400 W	4,778	Lamps	532.08	2542.45	23.53	0.054	1840.02	1349.21
5	1,000 W	96	Lamps	747.24	72.06	23.53	0.054	50.63	27.23
6									
7	Na Vapor								
8	70 W	89	Lamps	321.12	28.50	23.53	0.054	26.96	25.06
9	100 W	22,453	Lamps	330.12	7412.19	23.53	0.054	7039.33	6339.84
10	150 W	796	Lamps	360.00	286.65	23.53	0.054	258.62	224.83
11	250 W	12,223	Lamps	420.60	5140.86	23.53	0.054	4265.18	3451.20
12	360 W	0	Lamps	513.96	0.00	23.53	0.054	0.00	0.00
13	400 W	4,128	Lamps	513.12	2118.18	23.53	0.054	1598.93	1165.59
14	1,000 W	11	Lamps	666.84	7.40	23.53	0.054	5.89	3.13
15									

Line No.	(K) Old Capital Rate - fixture rate	(L) Capital Rate Adjustment - rev	New Rev Rate Rev + Energy	Proposed Starting Base Rate - fixture rate	Step (7 - 9) Results New Rate - fixture rate	Lum & Lamp Obsolescence adjustment factor	(M) Obsolescence Rev after Adjustment	(Q) Obsolescence Old Rate - rev	(Q) Obsolescence Old - fixture rate	#2 Obsolescence Adjustment - rev	New Rev rate + energy	Proposed Starting Base Rate - fixture rate	Step (10 - 11) Results New Rate - fixture rate	To Exhibit A-14 E1 design
1	5.72	5.30	5.78	23.53	25.88	1.029	1.21	1.17	5.72	5.84	6.32	23.53	28.50	28.50
2	5.72	2367.43	2720.21	23.53	25.88	1.575	824.73	523.64	5.72	2892.85	3245.62	23.53	31.62	31.62
3	5.72	68.01	81.92	23.53	26.67	1.930	28.17	14.60	5.72	85.83	99.74	23.53	33.66	33.65
4	5.72	1613.45	2104.26	23.53	28.14	2.690	882.97	328.24	5.72	2179.36	2670.17	23.53	38.01	38.00
5	6.14	51.00	74.40	23.53	44.07	3.410	24.23	7.10	6.14	52.28	75.69	23.53	45.18	45.17
8	5.72	28.51	30.41	23.53	26.76	0.726	4.43	6.10	5.72	28.51	30.41	23.53	26.76	26.76
9	5.72	7211.40	7910.89	23.53	26.76	0.608	938.37	1542.39	5.72	7029.99	7729.49	23.53	26.09	26.09
10	5.72	255.74	289.53	23.53	26.76	0.608	33.28	54.70	5.72	249.30	283.10	23.53	26.09	26.09
11	5.72	4049.16	4863.15	23.53	27.61	0.732	614.32	839.62	5.72	3930.40	4744.39	23.53	26.80	26.79
12				23.53								23.53		26.26
13	5.72	1411.65	1844.98	23.53	28.50	0.862	244.43	283.57	5.72	1364.39	1797.73	23.53	27.54	27.54
14	6.14	6.51	9.27	23.53	48.91	3.367	2.75	0.82	6.14	5.98	8.73	23.53	44.92	44.91

U-17767 MSLCDE-1 Lighting Model

WP-KAH5

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 16
Source: MSLCDE-1
Lighting Model
Page 4 of 6

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue

Workpaper
Case No: U-17767
Process to determi Exhibit Supported: A-14 Schedule F3
Workpaper WP-KAH-5
Witness: K.A. Holmes

E1 Street Lighting - Option I

Based on COS
Step 1 - split revenue Rate and Energy — Technology dependent COS characteristics
Step 9 - Results of Steps 7 to 8 compared to fixture baseline
Step 10 - Adjust fixture rate based on current and future Lamp and Luminaire obsolescence (HPS, LED, MV, MH)
Step 11 - Results of Step 10 compared to fixture baseline
Step 12 - Adjust HPS Rate to bring into alignment the combining of D9 with E1 - OH Luminaire COS (HPS)
Step 13 - Results of Step 12 compared to fixture baseline
To Exhibit A-14 E1 design

	(a)	(b)		(c)	(d)		(e)	(f)	(g)	(g / e)														To Exhibit A-14 E1 design
16	Metal Halide																							
17	70 W	166	Lamps	420.24	69.94		23.53	0.054	49.92	46.99	5.72	52.08	55.01	23.53	26.08	2.220	25.38	11.43	5.72	70.53	73.46	23.53	35.32	35.31
18	100 W	58	Lamps	432.96	25.13		23.53	0.054	17.83	16.39	5.72	18.16	19.60	23.53	26.08	2.310	9.21	3.99	5.72	24.95	26.39	23.53	35.83	35.83
19	150 or 175 W	721	Lamps	511.56	368.91		23.53	0.054	230.16	203.62	5.72	225.66	252.19	23.53	26.08	3.335	165.21	49.54	5.72	360.86	387.40	23.53	41.70	41.70
20	250 W	242	Lamps	573.60	139.03		23.53	0.054	82.99	68.44	5.72	78.03	92.58	23.53	26.83	3.950	65.77	16.65	5.72	131.52	146.08	23.53	45.22	45.22
21	320 or 400 W	983	Lamps	705.00	693.12		23.53	0.054	366.38	277.60	6.14	358.06	446.84	23.53	30.35	4.880	353.44	72.43	6.14	639.49	728.27	23.53	54.20	54.20
22	1,000 W	0	Lamps	874.56	0.00		23.53	0.054	0.00	0.00				23.53		0.000						23.53		69.05
23																								
56																								
57	< May 2013 Old Rates																							
58	30 - 39 Watt LED	0	Lamps	261.71	0.00	0	23.53	0.054	0.00	0.00												23.53		23.69
59	40 - 49 Watt LED	27	Lamps	266.61	7.20	105	23.53	0.054	7.90	7.62	5.88	9.86	10.13	23.53	30.42	0.087	0.17	1.91	5.88	7.69	7.97	23.53	23.74	23.74
60	50 - 59 Watt LED	19	Lamps	271.52	5.16	74	23.53	0.054	5.60	5.36	5.88	7.09	7.33	23.53	31.10	0.095	0.13	1.34	5.88	5.42	5.66	23.53	23.79	23.79
61	60 - 69 Watt LED	0	Lamps	276.42	0.00	2,571	23.53	0.054	0.00	0.00				23.53								23.53		23.84
62	70 - 79 Watt LED	32	Lamps	281.33	9.00	124	23.53	0.054	9.58	9.04	5.88	12.52	13.06	23.53	32.60	0.113	0.26	2.26	5.88	9.18	9.72	23.53	23.90	23.89
63	80 - 89 Watt LED	9	Lamps	286.23	2.58	132	23.53	0.054	2.71	2.54	5.88	3.61	3.78	23.53	33.41	0.123	0.08	0.64	5.88	2.59	2.76	23.53	23.95	23.95
64	90 - 99 Watt LED	38	Lamps	291.13	11.06	143	23.53	0.054	11.54	10.73	5.88	15.64	16.45	23.53	34.30	0.134	0.36	2.68	5.88	10.95	11.77	23.53	24.02	24.01
65	100 - 109 Watt LED	304	Lamps	296.16	90.03	1,350	23.53	0.054	93.04	85.84	5.88	128.61	135.82	23.53	35.26	0.145	3.11	21.46	5.88	87.86	95.06	23.53	24.08	24.08
66	110 - 119 Watt LED	2	Lamps	300.94	0.60	35	23.53	0.054	0.62	0.56	5.88	0.87	0.92	23.53	36.30	0.158	0.02	0.14	5.88	0.58	0.63	23.53	24.16	24.16
67	120 - 129 Watt LED	1	Lamps	305.85	0.31	31	23.53	0.054	0.31	0.28	5.88	0.45	0.48	23.53	37.43	0.171	0.01	0.07	5.88	0.29	0.32	23.53	24.24	24.24
68	130 - 139 Watt LED	0	Lamps	310.75	0.00	1,163	23.53	0.054	0.00	0.00				23.53								23.53		24.32
69	140 - 149 Watt LED	3	Lamps	315.66	0.95	12	23.53	0.054	0.95	0.85	5.88	1.41	1.51	23.53	39.25	0.193	0.04	0.21	5.88	0.88	0.98	23.53	24.37	24.36
70	150 - 159 Watt LED	75	Lamps	320.56	24.04	314	23.53	0.054	23.80	21.18	5.88	35.86	38.48	23.53	39.84	0.201	1.06	5.29	5.88	21.97	24.59	23.53	24.41	24.41
71	160 - 169 Watt LED	37	Lamps	325.47	12.04	143	23.53	0.054	11.83	10.45	5.88	17.96	19.34	23.53	40.46	0.208	0.54	2.61	5.88	10.86	12.24	23.53	24.45	24.45
72	170 - 179 Watt LED	0	Lamps	330.37	0.00	16	23.53	0.054	0.00	0.00				23.53								23.53		24.50
73	180 - 189 Watt LED	0	Lamps	335.28	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		24.54
74	190 - 199 Watt LED	0	Lamps	340.18	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		24.59
75	200 - 209 Watt LED	193	Lamps	345.09	66.60	748	23.53	0.054	63.43	54.50	5.88	99.95	108.88	23.53	43.16	0.241	3.28	13.62	5.88	57.08	66.01	23.53	24.64	24.64
76	210 - 219 Watt LED	0	Lamps	350.12	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		24.70
77	220 - 229 Watt LED	0	Lamps	354.89	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		24.76
78	230 - 239 Watt LED	0	Lamps	359.93	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		24.82
79	240 - 249 Watt LED	0	Lamps	364.70	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		24.88
80	250 - 259 Watt LED	0	Lamps	369.73	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		24.94
81	260 - 269 Watt LED	0	Lamps	374.51	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		25.00
82	270 - 279 Watt LED	0	Lamps	379.42	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		25.06
83	280 - 289 Watt LED	0	Lamps	384.32	0.00	27	23.53	0.054	0.00	0.00				23.53								23.53		25.12
84	290 - 299 Watt LED	0	Lamps	389.23	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		25.18
85	300 - 309 Watt LED	236	Lamps	394.26	93.05	915	23.53	0.054	82.89	66.64	5.88	146.99	163.24	23.53	51.90	0.346	5.77	16.66	5.88	71.55	87.80	23.53	25.27	25.26
86	310 - 319 Watt LED	0	Lamps	399.04	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		25.32
87	320 - 329 Watt LED	0	Lamps	404.07	0.00	0	23.53	0.054	0.00	0.00				23.53								23.53		25.38
88																								
89	>May 2013 New Rates																							
90	30 - 39 Watt LED	0	Lamps	284.58	0.00		23.53	0.054	0.00	0.00				23.53								23.53		23.69
91	40 - 49 Watt LED	78	Lamps	287.32	22.33		23.53	0.054	22.73	21.94	5.88	28.37	29.16	23.53	30.42	0.087	0.48	5.48	5.88	22.14	22.93	23.53	23.74	23.74
92	50 - 59 Watt LED	55	Lamps	290.06	15.86		23.53	0.054	16.12	15.44	5.88	20.41	21.09	23.53	31.10	0.095	0.37	3.86	5.88	15.61	16.29	23.53	23.79	23.79
93	60 - 69 Watt LED	2,571	Lamps	292.80	752.86		23.53	0.054	763.74	726.01	5.88	982.79	1020.52	23.53	31.85	0.104	18.89	181.48	5.88	735.65	773.38	23.53	23.84	23.84
94	70 - 79 Watt LED	92	Lamps	295.54	27.22		23.53	0.054	27.57	26.01	5.88	36.03	37.59	23.53	32.60	0.113	0.74	6.50	5.88	26.41	27.97	23.53	23.90	23.89
95	80 - 89 Watt LED	123	Lamps	298.28	36.65		23.53	0.054	37.05	34.69	5.88	49.26	51.62	23.53	33.41	0.123	1.07	8.67	5.88	35.31	37.67	23.53	23.95	23.95
96	90 - 99 Watt LED	105	Lamps	301.01	31.75		23.53	0.054	32.05	29.79	5.88	43.42	45.68	23.53	34.30	0.134	0.99	7.45	5.88	30.40	32.66	23.53	24.02	24.01
97	100 - 109 Watt LED	1,046	Lamps	303.75	317.61		23.53	0.054	320.02	295.24	5.88	442.37	467.16	23.53	35.26	0.145	10.71	73.80	5.88	302.19	326.97	23.53	24.08	24.08
98	110 - 119 Watt LED	33	Lamps	306.49	10.08		23.53	0.054	10.14	9.29	5.88	14.33	15.19	23.53	36.30	0.158	0.37	2.32	5.88	9.54	10.39	23.53	24.16	24.16
99	120 - 129 Watt LED	30	Lamps	309.23	9.28		23.53	0.054	9.33	8.48	5.88	13.49	14.33	23.53	37.43	0.171	0.36	2.12	5.88	8.73	9.58	23.53	24.24	24.24
100	130 - 139 Watt LED	1,163	Lamps	311.97	362.96		23.53	0.054	363.97	328.51	5.88	539.99	575.45	23.53	38.68	0.186	15.31	82.12	5.88	339.64	375.10	23.53	24.33	24.32
101	140 - 149 Watt LED	9	Lamps	314.71	2.72		23.53	0.054	2.72	2.44	5.88	4.07	4.35	23.53	39.25	0.193	0.12	0.61	5.88	2.52	2.81	23.53	24.37	24.36
102	150 - 159 Watt LED	239	Lamps	317.45	75.91		23.53	0.054	75.89	67.52	5.88	114.33	122.70	23.53	39.84	0.201	3.38	16.88	5.88	70.05	78.41	23.53	24.41	24.41
103	160 - 169 Watt LED	106	Lamps	320.18	34.10		23.53	0.054	34.04	30.07	5.88	51.70	55.67	23.53	40.46	0.208	1.56	7.52	5.88	31.25	35.22	23.53	24.45	24.45
104	170 - 179 Watt LED	16	Lamps	322.92	5.01		23.53	0.054	4.99	4.38	5.88	7.65	8.26	23.53	41.10	0.216	0.24	1.09	5.88	4.56	5.17	23.53	24.50	24.50
105	180 - 189 Watt LED	0	Lamps	325.66	0.00		23.53	0.054	0.00	0.00				23.53								23.53		24.54
106	190 - 199 Watt LED	0	Lamps	328.40	0.00		23.53	0.054	0.00	0.00				23.53								23.53		24.59
107	200 - 209 Watt LED	555	Lamps	331.14	183.94		23.53	0.054	182.56	156.85	5.88	287.68	313.39	23.53	43.16	0.241	9.43	39.21	5.88	164.28	189.99	23.53	24.64	24.64
108	210 - 219 Watt LED	0	Lamps	333.88	0.00		23.53	0.054	0.00	0.00				23.53								23.53		24.70
109	220 - 229 Watt LED	0	Lamps	336.61	0.00		23.53	0.054	0.00	0.00				23.53								23.53		24.76
110	230 - 239 Watt LED	0	Lamps	339.35	0.00		23.53	0.054	0.00	0.00				23.53								23.53		24.82
111	240 - 249 Watt LED	0	Lamps	342.09	0.00		23.53	0.054	0.00	0.00				23.53								23.53		24.88
112	250 - 259 Watt LED	0	Lamps	344.83	0.00		23.53	0.054	0.00	0.00				23.53								23.53		24.94
113	260 - 269 Watt LED	0	Lamps	347.57	0.00		23.53	0.054	0.00	0.00				23.53								23.53		25.00
114	270 - 279 Watt LED	0	Lamps	350.31	0.00		23.53	0.054	0.00	0.00				23.53								23.53		25.06
115	280 - 289 Watt LED	27	Lamps	353.04	9.58		23.53	0.054	9.41	7.67	5.88	16.25	18.00	23.53	49.89	0.322	0.62	1.92	5.88	8.18	9.93	23.53	25.12	25.12
116	290 - 299 Watt LED	0	Lamps	355.78	0.00		23.53	0.054	0.00	0.00				23.53								23.53		25.18
117	300 - 309 Watt LED	679	Lamps	358.52	243.53		23.53	0.054	238.56	191.79	5.88	423.08	469.85	23.53	51.90	0.346	16.59	47.94	5.88	205.94	252.71	23.53	25.27	25.26
118	310 - 319 Watt LED	0	Lamps	361.26	0.00		23.53	0.054	0.00	0.00				23.53								23.53		25.32
119	320 - 329 Watt LED	0	Lamps	364.00	0.00		23.53	0.054	0.00	0.00				23.53								23.53		25.38
120																								
121	Service Charge	308	Cust				8.00		29.57															
122																								
123										17648.03		21356.20	24590.47	31.07			4313.84			21351.39	24585.66	26.27		
124										84.51%		21351.28	24585.55							21351.28	24585.55			
125	Long Span Charge	43,870		24.48	1,073.94		24.48		1,073.94	Rate		4.92	4.92							0.11	0.11			
126	Multiple Lamp Discount	1,644		-97.92	-160.98		-97.92		-160.98	-3677.10														
127	Multiple Lamp Discount - Long S	1,972		-122.40	-241.37		-122.40		-241.37															
128	Semi-Ornamental Discount	709		-21.48	-15.23		-21.48		-15.23	Total Lums / Lam						Technology Balancing Key must match cell AR302 ->	4313.95	4313.84						
129	Multiple Lamp Discount - Semi-C	9		-76.56	-0.69		-76.56		-0.69															
130	Subtotal				24559.39				20882.30	Total LED Lums /														
131																								
132	Nuclear Decomm.	63,608	MWh	0.172%	42		0.000664		42															
133																								
134	Sub-Total				24,602				20,925															
135																								
136																								
137	Energy Optimization	308	Meters	0.9%	221.41		59.91		221.41															
138	REPS	308	Meters	0.2%	49.65		13.43		49.65															
139	Rate Realignment	63,608	MWh	0.72%	179.08		0.00		179.08															
140	**Total E1 - Option 1**	**63,608**	**MWh**		25,052				21,375															
141	Increase/Decrease ($)								(3,677)															
		62,502			25207.67				24070.52															

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue

Workpaper
Case No: U-17767
Exhibit Supported: A-14 Schedule F3
Workpaper WP-KAH-5
Witness: K.A. Holmes

Process to deter
Based on COS
Step 1 - split reve
Rate and Energ

Step 14 - show New Rate and Energy effective rate to Existing bundled Rates (less any revenue requirement adjustments)

E1 Street Lighting - Option I

	(a)	(b)		(c)	(d)		(e)	(f)	(g)	(g / e)					
	Description	Billing Determinants		Present			Proposed				(column BF)				
Line No.	**Overhead**	Quantity	Units	Rate ($/lamp/yr)	Revenue ($000)		Rate ($/lamp/mth)	Energy (c/kWh)	Revenue ($000)	Rate	new effective un-bundled < cust SC chr	current bundled rate	Quantity	Variance	Variance %
	Hg Vapor														
1	100 W	318	Lamps	155.28	49.33		9.69	0.05375	45.90	36.94	162.98	155.28	318	7.70	5.0%
2	175 W	41,282	Lamps	201.12	8,302.69		9.69	0.054	6,710.79	4800.30	211.17	201.12	41,282	10.05	5.0%
3	250 W	1,317	Lamps	226.44	298.15		9.69	0.054	239.30	153.10	237.73	226.44	1,317	11.29	5.0%
4	400 W	7,845	Lamps	301.56	2,365.78		9.69	0.054	1,718.05	912.23	316.72	301.56	7,845	15.16	5.0%
5	1,000 W	94	Lamps	537.84	50.45		9.69	0.054	33.67	10.91	565.11	537.84	94	27.27	5.1%
6															
7	Na Vapor														
8	70 W	1,329	Lamps	174.84	232.37		9.69	0.054	183.05	154.54	140.68	174.84	1,329	-34.16	-19.5%
9	100 W	17,638	Lamps	183.96	3,244.76		9.69	0.054	2,600.49	2050.99	147.64	183.96	17,638	-36.32	-19.7%
10	150 W	0	Lamps	201.12	0.00		9.69	0.054	0.00	0.00					
11	250 W	9,477	Lamps	234.60	2,223.21		9.69	0.054	1,733.05	1101.94	218.34	234.60	9,477	-16.26	-6.9%
12	360 W	35	Lamps	306.12	10.56		9.69	0.054	7.24	4.01	229.79	306.12	35	-76.33	-24.9%
13	400 W	2,194	Lamps	306.12	671.63		9.69	0.054	485.43	255.12	315.21	306.12	2,194	9.09	3.0%
14	1,000 W	61	Lamps	566.64	34.60		9.69	0.054	22.26	7.10	435.71	566.64	61	-130.93	-23.1%
15															
16	Metal Halide														
17	70 W	2	Lamps	252.84	0.45		9.69	0.054	0.24	0.21	265.50	252.84	2	12.66	5.0%
18	100 W	0	Lamps	266.04	0.00		9.69	0.054	0.00	0.00					
19	150 or 175 W	40	Lamps	314.76	12.53		9.69	0.054	6.10	4.63	330.51	314.76	40	15.75	5.0%
20	250 W	16	Lamps	353.16	5.62		9.69	0.054	2.81	1.85	370.70	353.16	16	17.54	5.0%
21	320 or 400 W	28	Lamps	459.60	13.01		9.69	0.054	6.26	3.29	482.31	459.60	28	22.71	4.9%
22	1,000 W	9	Lamps	760.32	6.73		9.69	0.054	3.18	1.03	798.61	760.32	9	38.29	5.0%
23															
56															
57	< May 2013 Old Emerging Technology Rates														
58	30 - 39 Watt LED	0	Lamps	87.78	0.00	*0*	9.69	0.054	0.00	0.00			0		
59	40 - 49 Watt LED	0	Lamps	92.06	0.00	*0*	9.69	0.054	0.00	0.00			0		
60	50 - 59 Watt LED	3	Lamps	96.21	0.29	*8*	9.69	0.054	0.39	0.35	149.46	96.21	3	53.25	55.3%
61	60 - 69 Watt LED	0	Lamps	100.48	0.00	*4,545*	9.69	0.054	0.00	0.00			0		
62	70 - 79 Watt LED	0	Lamps	104.76	0.00	*4*	9.69	0.054	0.00	0.00			0		
63	80 - 89 Watt LED	0	Lamps	108.91	0.00	*0*	9.69	0.054	0.00	0.00			0		
64	90 - 99 Watt LED	1,250	Lamps	113.18	141.48	*5,242*	9.69	0.054	172.16	145.35	162.14	113.18	1,250	48.96	43.3%
65	100 - 109 Watt LED	67	Lamps	117.33	7.86	*315*	9.69	0.054	9.38	7.79	165.50	117.33	67	48.17	41.1%
66	110 - 119 Watt LED	0	Lamps	121.61	0.00	*0*	9.69	0.054	0.00	0.00			0		
67	120 - 129 Watt LED	13	Lamps	125.76	1.63	*119*	9.69	0.054	1.88	1.51	172.50	125.76	13	46.74	37.2%
68	130 - 139 Watt LED	0	Lamps	130.04	0.00	*1,087*	9.69	0.054	0.00	0.00			0		
69	140 - 149 Watt LED	0	Lamps	134.19	0.00	*0*	9.69	0.054	0.00	0.00			0		
70	150 - 159 Watt LED	407	Lamps	138.34	56.30	*1,605*	9.69	0.054	61.57	47.33	182.03	138.34	407	43.69	31.6%
71	160 - 169 Watt LED	107	Lamps	142.61	15.26	*426*	9.69	0.054	16.43	12.44	184.99	142.61	107	42.38	29.7%
72	170 - 179 Watt LED	12	Lamps	146.76	1.76	*48*	9.69	0.054	1.87	1.40	187.98	146.76	12	41.22	28.1%
73	180 - 189 Watt LED	0	Lamps	151.04	0.00	*0*	9.69	0.054	0.00	0.00			0		
74	190 - 199 Watt LED	0	Lamps	155.19	0.00	*0*	9.69	0.054	0.00	0.00			0		
75	200 - 209 Watt LED	1	Lamps	159.46	0.16	*8*	9.69	0.054	0.16	0.12	197.11	159.46	1	37.65	23.6%
76	210 - 219 Watt LED	0	Lamps	163.74	0.00	*0*	9.69	0.054	0.00	0.00			0		
77	220 - 229 Watt LED	0	Lamps	167.89	0.00	*0*	9.69	0.054	0.00	0.00			0		
78	230 - 239 Watt LED	0	Lamps	172.17	0.00	*0*	9.69	0.054	0.00	0.00			0		
79	240 - 249 Watt LED	0	Lamps	176.19	0.00	*0*	9.69	0.054	0.00	0.00			0		
80	250 - 259 Watt LED	0	Lamps	180.47	0.00	*0*	9.69	0.054	0.00	0.00			0		
81	260 - 269 Watt LED	0	Lamps	184.62	0.00	*0*	9.69	0.054	0.00	0.00			0		
82	270 - 279 Watt LED	0	Lamps	188.89	0.00	*0*	9.69	0.054	0.00	0.00			0		
83	280 - 289 Watt LED	0	Lamps	193.17	0.00	*4*	9.69	0.054	0.00	0.00			0		
84	290 - 299 Watt LED	0	Lamps	197.32	0.00	*0*	9.69	0.054	0.00	0.00			0		
85	300 - 309 Watt LED	0	Lamps	201.59	0.00	*0*	9.69	0.054	0.00	0.00			0		
86	310 - 319 Watt LED	0	Lamps	205.74	0.00	*0*	9.69	0.054	0.00	0.00			0		
87	320 - 329 Watt LED	0	Lamps	210.02	0.00	*0*	9.69	0.054	0.00	0.00			0		
88															
89	>May 2013 New Emerging Technology Rates														
90	30 - 39 Watt LED	0	Lamps	129.58	0.00		9.69	0.054	0.00	0.00			0		
91	40 - 49 Watt LED	0	Lamps	132.32	0.00		9.69	0.054	0.00	0.00			0		
92	50 - 59 Watt LED	5	Lamps	135.06	0.67		9.69	0.054	0.64	0.58	149.46	135.06	5	14.40	10.7%
93	60 - 69 Watt LED	4,545	Lamps	137.80	626.28		9.69	0.054	595.17	528.48	152.57	137.80	4,545	14.77	10.7%
94	70 - 79 Watt LED	4	Lamps	140.54	0.56		9.69	0.054	0.53	0.46	155.69	140.54	4	15.15	10.8%
95	80 - 89 Watt LED	0	Lamps	143.28	0.00		9.69	0.054	0.00	0.00			0		
96	90 - 99 Watt LED	3,992	Lamps	146.01	582.86		9.69	0.054	549.79	464.18	162.14	146.01	3,992	16.13	11.0%
97	100 - 109 Watt LED	248	Lamps	148.75	36.84		9.69	0.054	34.67	28.80	165.50	148.75	248	16.75	11.3%
98	110 - 119 Watt LED	0	Lamps	151.49	0.00		9.69	0.054	0.00	0.00			0		
99	120 - 129 Watt LED	106	Lamps	154.23	16.43		9.69	0.054	15.39	12.38	172.50	154.23	106	18.27	11.8%
100	130 - 139 Watt LED	1,087	Lamps	156.97	170.69		9.69	0.054	159.59	126.45	176.18	156.97	1,087	19.21	12.2%
101	140 - 149 Watt LED	0	Lamps	159.71	0.00		9.69	0.054	0.00	0.00			0		
102	150 - 159 Watt LED	1,198	Lamps	162.45	194.65		9.69	0.054	181.26	139.33	182.03	162.45	1,198	19.58	12.1%
103	160 - 169 Watt LED	319	Lamps	165.18	52.73		9.69	0.054	49.01	37.12	184.99	165.18	319	19.81	12.0%
104	170 - 179 Watt LED	36	Lamps	167.92	6.01		9.69	0.054	5.58	4.16	187.98	167.92	36	20.06	11.9%
105	180 - 189 Watt LED	0	Lamps	170.66	0.00		9.69	0.054	0.00	0.00			0		
106	190 - 199 Watt LED	0	Lamps	173.40	0.00		9.69	0.054	0.00	0.00			0		
107	200 - 209 Watt LED	7	Lamps	176.14	1.23		9.69	0.054	1.13	0.81	197.11	176.14	7	20.97	11.9%
108	210 - 219 Watt LED	0	Lamps	178.88	0.00		9.69	0.054	0.00	0.00			0		
109	220 - 229 Watt LED	0	Lamps	181.61	0.00		9.69	0.054	0.00	0.00			0		
110	230 - 239 Watt LED	0	Lamps	184.35	0.00		9.69	0.054	0.00	0.00			0		
111	240 - 249 Watt LED	0	Lamps	187.09	0.00		9.69	0.054	0.00	0.00			0		
112	250 - 259 Watt LED	0	Lamps	189.83	0.00		9.69	0.054	0.00	0.00			0		
113	260 - 269 Watt LED	0	Lamps	192.57	0.00		9.69	0.054	0.00	0.00			0		
114	270 - 279 Watt LED	0	Lamps	195.31	0.00		9.69	0.054	0.00	0.00			0		
115	280 - 289 Watt LED	4	Lamps	198.04	0.79		9.69	0.054	0.72	0.46	222.88	198.04	4	24.84	12.5%
116	290 - 299 Watt LED	0	Lamps	200.78	0.00		9.69	0.054	0.00	0.00			0		
117	300 - 309 Watt LED	0	Lamps	203.52	0.00		9.69	0.054	0.00	0.00			0		
118	310 - 319 Watt LED	0	Lamps	206.26	0.00		9.69	0.054	0.00	0.00			0		
119	320 - 329 Watt LED	0	Lamps	209.00	0.00		9.69	0.054	0.00	0.00			0		
120															
121	Service Charge	516	Cust				8.00		49.56						
122															
123										11057.69					
124										70.63%					
125	Multiple Lamp Discount	764	Lamps	-12.24	-9.35		-12.24		-9.35	Rate					
126	Subtotal		Lamps		19,436.36				15,655.12	-3781.23					
127															
128	Nuclear Decomm.	88,592	MWh	0.172%	33		0.0003774		33	Total Lums / Lam					
129															
130	Sub-Total				19,470				15,738	Total LED Lums /					
131															
132															
133	Energy Optimization	516	Meters	0.9%	175.23		28.29		175.23						
134	REPS	516	Meters	0.2%	39.29		6.34		39.29						
135	Rate Realignment	88,592	MWh	0.720%	141.73		0.00		141.73						
136	**Total E1 - Option 1**	**88,592**	**MWh**		**19,826**				**16,094**	-3731.68					
137	Increase/Decrease ($)								(3,732.00)						
					19492.48				19220.97						

Workpaper
Case No: U-17767
Exhibit Supported: A-14 Schedule F3
Workpaper WP-KAH-5
Witness: K.A. Holmes

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue
E1 Street Lighting - Option I

Process to deter
Based on COS
Step 1 - split reve
Rate and Energ

Step 14 - show New Rate and Energy effective rate to Existing bundled Rates (less any revenue requirement adjustments)

	(a)	(b)		(c)	(d)	(e)	(f)	(g)	(g / e)					
	Description	Billing Determinants		Present		Proposed				(column BF)				
Line No.	**Co. Owned Ornamental**	Quantity	Units	Rate ($/lamp/yr)	Revenue ($000)	Rate ($/lamp/mth)	Energy (c/watt)	Revenue ($000)	Rate	new effective un-bundled < cust SC chr	current bundled rate	Quantity	Variance	Variance %
	Hg Vapor													
1	100 W	17	Lamps	352.56	6.02	23.53	0.054	5.30	4.82	370.21	352.56	17	17.65	5.0%
2	175 W	7,623	Lamps	405.36	3089.99	23.53	0.054	2505.15	2152.38	425.78	405.36	7,623	20.42	5.0%
3	250 W	213	Lamps	446.88	94.96	23.53	0.054	73.91	60.00	469.35	446.88	213	22.47	5.0%
4	400 W	4,778	Lamps	532.08	2542.45	23.53	0.054	1840.02	1349.21	558.81	532.08	4,778	26.73	5.0%
5	1,000 W	96	Lamps	747.24	72.06	23.53	0.054	50.63	27.23	784.84	747.24	96	37.60	5.0%
6												0		
7	Na Vapor											0		
8	70 W	89	Lamps	321.12	28.50	23.53	0.054	26.96	25.06	342.62	321.12	89	21.50	6.7%
9	100 W	22,453	Lamps	330.12	7412.19	23.53	0.054	7039.33	6339.84	344.25	330.12	22,453	14.13	4.3%
10	150 W	796	Lamps	360.00	286.65	23.53	0.054	258.62	224.83	355.54	360.00	796	-4.46	-0.01
11	250 W	12,223	Lamps	420.60	5140.86	23.53	0.054	4265.18	3451.20	388.16	420.60	12,223	-32.44	-7.7%
12	360 W	0	Lamps	513.96	0.00	23.53	0.054	0.00	0.00			0		
13	400 W	4,128	Lamps	513.12	2118.18	23.53	0.054	1598.93	1165.59	435.49	513.12	4,128	-77.63	-15.1%
14	1,000 W	11	Lamps	666.84	7.40	23.53	0.054	5.89	3.13	787.32	666.84	11	120.48	18.1%
15												0		

WP-KAH5

U-17767 MSLCDE-1 Lighting Model

Michigan Public Service Commission
DTE Electric Company
Present and Proposed Revenue

Workpaper
Case No: U-17767
Exhibit Supported: A-14 Schedule F3
Workpaper WP-KAH-5
Witness: K.A. Holmes

Process to deterı

Based on COS ı

E1 Street Lighting - Option I

Step 1 - split reve
Rate and Energ

Step 14 - show New Rate and Energy effective rate to Existing bundled Rates (less any revenue requirement adjustments)

	(a)	(b)		(c)	(d)		(e)	(f)	(g)	(g / e)					
16	Metal Halide												0		
17	70 W	166	Lamps	420.24	69.94		23.53	0.054	49.92	46.99	441.41	420.24	166	21.17	5.0%
18	100 W	58	Lamps	432.96	25.13		23.53	0.054	17.83	16.39	454.82	432.96	58	21.86	5.0%
19	150 or 175 W	721	Lamps	511.56	368.91		23.53	0.054	230.16	203.62	537.20	511.56	721	25.64	5.0%
20	250 W	242	Lamps	573.60	139.03		23.53	0.054	82.99	68.44	602.70	573.60	242	29.10	5.1%
21	320 or 400 W	983	Lamps	705.00	693.12		23.53	0.054	366.38	277.60	740.76	705.00	983	35.76	5.1%
22	1,000 W	0	Lamps	874.56	0.00		23.53	0.054	0.00	0.00			0		
23													0		
56													0		
57	< May 2013 Old Rates												0		
58	30 - 39 Watt LED	0	Lamps	261.71	0.00	0	23.53	0.054	0.00	0.00			0		
59	40 - 49 Watt LED	27	Lamps	266.61	7.20	105	23.53	0.054	7.90	7.62	295.05	26661.0%	27	28.44	10.7%
60	50 - 59 Watt LED	19	Lamps	271.52	5.16	74	23.53	0.054	5.60	5.36	297.89	271.52	19	26.37	9.7%
61	60 - 69 Watt LED	0	Lamps	276.42	0.00	2,571	23.53	0.054	0.00	0.00			0		
62	70 - 79 Watt LED	32	Lamps	281.33	9.00	124	23.53	0.054	9.58	9.04	303.67	28133.0%	32	22.34	7.9%
63	80 - 89 Watt LED	9	Lamps	286.23	2.58	132	23.53	0.054	2.71	2.54	306.62	28623.0%	9	20.39	7.1%
64	90 - 99 Watt LED	38	Lamps	291.13	11.06	143	23.53	0.054	11.54	10.73	309.64	291.13	38	18.51	6.4%
65	100 - 109 Watt LED	304	Lamps	296.16	90.03	1,350	23.53	0.054	93.04	85.84	312.71	296.16	304	16.55	5.6%
66	110 - 119 Watt LED	2	Lamps	300.94	0.60	35	23.53	0.054	0.62	0.56	315.86	30094.0%	2	14.92	5.0%
67	120 - 129 Watt LED	1	Lamps	305.85	0.31	31	23.53	0.054	0.31	0.28	319.08	305.85	1	13.23	4.3%
68	130 - 139 Watt LED	0	Lamps	310.75	0.00	1,163	23.53	0.054	0.00	0.00			0		
69	140 - 149 Watt LED	3	Lamps	315.66	0.95	12	23.53	0.054	0.95	0.85	325.14	31566.0%	3	9.48	3.0%
70	150 - 159 Watt LED	75	Lamps	320.56	24.04	314	23.53	0.054	23.80	21.18	327.91	320.56	75	7.35	2.3%
71	160 - 169 Watt LED	37	Lamps	325.47	12.04	143	23.53	0.054	11.83	10.45	330.69	325.47	37	5.22	1.6%
72	170 - 179 Watt LED	0	Lamps	330.37	0.00	16	23.53	0.054	0.00	0.00			0		
73	180 - 189 Watt LED	0	Lamps	335.28	0.00	0	23.53	0.054	0.00	0.00			0		
74	190 - 199 Watt LED	0	Lamps	340.18	0.00	0	23.53	0.054	0.00	0.00			0		
75	200 - 209 Watt LED	193	Lamps	345.09	66.60	748	23.53	0.054	63.43	54.50	342.02	345.09	193	-3.07	-0.9%
76	210 - 219 Watt LED	0	Lamps	350.12	0.00	0	23.53	0.054	0.00	0.00			0		
77	220 - 229 Watt LED	0	Lamps	354.89	0.00	0	23.53	0.054	0.00	0.00			0		
78	230 - 239 Watt LED	0	Lamps	359.93	0.00	0	23.53	0.054	0.00	0.00			0		
79	240 - 249 Watt LED	0	Lamps	364.70	0.00	0	23.53	0.054	0.00	0.00			0		
80	250 - 259 Watt LED	0	Lamps	369.73	0.00	0	23.53	0.054	0.00	0.00			0		
81	260 - 269 Watt LED	0	Lamps	374.51	0.00	0	23.53	0.054	0.00	0.00			0		
82	270 - 279 Watt LED	0	Lamps	379.42	0.00	0	23.53	0.054	0.00	0.00			0		
83	280 - 289 Watt LED	0	Lamps	384.32	0.00	27	23.53	0.054	0.00	0.00			0		
84	290 - 299 Watt LED	0	Lamps	389.23	0.00	0	23.53	0.054	0.00	0.00			0		
85	300 - 309 Watt LED	236	Lamps	394.26	93.05	915	23.53	0.054	82.89	66.64	372.04	39426.0%	236	-22.22	-5.6%
86	310 - 319 Watt LED	0	Lamps	399.04	0.00	0	23.53	0.054	0.00	0.00			0		
87	320 - 329 Watt LED	0	Lamps	404.07	0.00	0	23.53	0.054	0.00	0.00			0		
88													0		
89	>May 2013 New Rates												0		
90	30 - 39 Watt LED	0	Lamps	284.58	0.00		23.53	0.054	0.00	0.00			0		
91	40 - 49 Watt LED	78	Lamps	287.32	22.33		23.53	0.054	22.73	21.94	295.05	28732.3%	78	7.72	2.7%
92	50 - 59 Watt LED	55	Lamps	290.06	15.86		23.53	0.054	16.12	15.44	297.89	290.06	55	7.82	2.7%
93	60 - 69 Watt LED	2,571	Lamps	292.80	752.86		23.53	0.054	763.74	726.01	300.78	292.80	2,571	7.98	2.7%
94	70 - 79 Watt LED	92	Lamps	295.54	27.22		23.53	0.054	27.57	26.01	303.67	295.54	92	8.14	2.8%
95	80 - 89 Watt LED	123	Lamps	298.28	36.65		23.53	0.054	37.05	34.69	306.62	29827.6%	123	8.35	2.8%
96	90 - 99 Watt LED	105	Lamps	301.01	31.75		23.53	0.054	32.05	29.79	309.64	301.01	105	8.62	2.9%
97	100 - 109 Watt LED	1,046	Lamps	303.75	317.61		23.53	0.054	320.02	295.24	312.71	303.75	1,046	8.96	2.9%
98	110 - 119 Watt LED	33	Lamps	306.49	10.08		23.53	0.054	10.14	9.29	315.86	30649.2%	33	9.37	3.1%
99	120 - 129 Watt LED	30	Lamps	309.23	9.28		23.53	0.054	9.33	8.48	319.08	309.23	30	9.85	3.2%
100	130 - 139 Watt LED	1,163	Lamps	311.97	362.96		23.53	0.054	363.97	328.51	322.40	311.97	1,163	10.43	3.3%
101	140 - 149 Watt LED	9	Lamps	314.71	2.72		23.53	0.054	2.72	2.44	325.14	31470.7%	9	10.44	3.3%
102	150 - 159 Watt LED	239	Lamps	317.45	75.91		23.53	0.054	75.89	67.52	327.91	317.45	239	10.46	3.3%
103	160 - 169 Watt LED	106	Lamps	320.18	34.10		23.53	0.054	34.04	30.07	330.69	320.18	106	10.50	3.3%
104	170 - 179 Watt LED	16	Lamps	322.92	5.01		23.53	0.054	4.99	4.38	333.49	322.92	16	10.57	3.3%
105	180 - 189 Watt LED	0	Lamps	325.66	0.00		23.53	0.054	0.00	0.00			0		
106	190 - 199 Watt LED	0	Lamps	328.40	0.00		23.53	0.054	0.00	0.00			0		
107	200 - 209 Watt LED	555	Lamps	331.14	183.94		23.53	0.054	182.56	156.85	342.02	331.14	555	10.88	3.3%
108	210 - 219 Watt LED	0	Lamps	333.88	0.00		23.53	0.054	0.00	0.00			0		
109	220 - 229 Watt LED	0	Lamps	336.61	0.00		23.53	0.054	0.00	0.00			0		
110	230 - 239 Watt LED	0	Lamps	339.35	0.00		23.53	0.054	0.00	0.00			0		
111	240 - 249 Watt LED	0	Lamps	342.09	0.00		23.53	0.054	0.00	0.00			0		
112	250 - 259 Watt LED	0	Lamps	344.83	0.00		23.53	0.054	0.00	0.00			0		
113	260 - 269 Watt LED	0	Lamps	347.57	0.00		23.53	0.054	0.00	0.00			0		
114	270 - 279 Watt LED	0	Lamps	350.31	0.00		23.53	0.054	0.00	0.00			0		
115	280 - 289 Watt LED	27	Lamps	353.04	9.58		23.53	0.054	9.41	7.67	365.82	353.04	27	12.77	3.6%
116	290 - 299 Watt LED	0	Lamps	355.78	0.00		23.53	0.054	0.00	0.00			0		
117	300 - 309 Watt LED	679	Lamps	358.52	243.53		23.53	0.054	238.56	191.79	372.04	35852.1%	679	13.52	3.8%
118	310 - 319 Watt LED	0	Lamps	361.26	0.00		23.53	0.054	0.00	0.00			0		
119	320 - 329 Watt LED	0	Lamps	364.00	0.00		23.53	0.054	0.00	0.00			0		
120															
121	Service Charge	308	Cust				8.00		29.57						
122															
123										17648.03					
124										84.51%					
125	Long Span Charge	43,870		24.48	1,073.94		24.48		1,073.94	Rate					
126	Multiple Lamp Discount	1,644		-97.92	-160.98		-97.92		-160.98	-3677.10					
127	Multiple Lamp Discount - Long S	1,972		-122.40	-241.37		-122.40		-241.37						
128	Semi-Ornamental Discount	709		-21.48	-15.23		-21.48		-15.23	Total Lums / Lam					
129	Multiple Lamp Discount - Semi-C	9		-76.56	-0.69		-76.56		-0.69						
130	Subtotal				24559.39				20882.30	Total LED Lums /					
131															
132	Nuclear Decomm.	63,608	MWh	0.172%	42		0.000664		42						
133															
134	Sub-Total				24,602				20,925						
135															
136															
137	Energy Optimization	308	Meters	0.9%	221.41		59.91		221.41						
138	REPS	308	Meters	0.2%	49.65		13.43		49.65						
139	Rate Realignment	63,608	MWh	0.72%	179.08		0.00		179.08						
140	**Total E1 - Option 1**	**63,608**	**MWh**		25,052				21,375						
141	Increase/Decrease ($)								(3,677)						
		62,502			25207.67				24070.52						

Attorney Client Priviledged Work Product
Prepared in Anticipation of Litigation

MPSC Case No.: U-17767
Respondent: R. M. Tomina
Requestor: MSLC-1
Question No.: MSLCDE-1.19
Page: 1 of 1

Question: Please provide DTE's forecast of the effects of conversion of its existing Mercury Vapor and Metal Halide street lights, pursuant to DTE's plans, on the costs of Maintenance of Street Lighting and Signal Systems, account 596.

Answer: No impact was reflected in Account 596, as the test period adjustments were due to inflation only. However, the impact of conversions on O&M is minimal.

MPSC Case No.: U-17767
Respondent: K. D. Johnston
Requestor: MSLC-2
Question No.: MSLC/DE-2.28
Page: 1 of 1

Question: For each outdoor lighting technology (High Pressure Sodium, Mercury Vapor, Metal Halide, LED) and lamp wattage, how often does the Company anticipate visiting each fixture and for what purpose (such as lamp replacement, photo control replacement, etc.)? What is the basis for this anticipation and what is the Company's recent experience? For each maintenance visit, what is the average cost per visit per fixture and what is the basis for your estimate?

Answer: DTE has discontinued the periodic re-lamping of Mercury Vapor luminaires. The lamps are replaced upon failure and the luminaires are converted upon failure. DTE currently performs periodic re-lamping for both High Pressure Sodium and Metal Halide on a 5-year interval but will move to a 8-year re-lamping interval for High Pressure Sodium in 2016 as a result of completing a fleet replacement of standard 24,000 hour High Pressure Sodium lamps with 40,000 hour rated lamps. Metal Halide re-lamping will continue on a 5 year interval. DTE's proposed tariff does not reflect any planned maintenance expense on LED lighting. Therefore, it does not anticipate visiting LED luminaires. DTE does not have the detailed data to provide an average cost per visit per fixture based upon how some maintenance visits are bundled together.

MSLC Proposed Fixture Charges

Overhead	Current Revenue	Energy Revenue	Fixture Revenue	Net Fixture Charge	Proposed Fixture Charge
Hg Vapor					
100 W	$ 49.33	$ 8.96	$ 40.36	$ 10.59	$ 10.59
175 W	$ 8,302.69	$ 1,910.49	$ 6,392.20	$ 12.90	$ 12.90
250 W	$ 298.15	$ 86.20	$ 211.95	$ 13.41	$ 13.41
400 W	$ 2,365.78	$ 805.82	$ 1,559.95	$ 16.57	$ 16.57
1,000 W	$ 50.45	$ 22.76	$ 27.68	$ 24.60	$ 24.60
Na Vapor					
70 W	$ 232.37	$ 28.50	$ 203.87	$ 12.78	$ 12.78
100 W	$ 3,244.76	$ 549.50	$ 2,695.26	$ 12.73	$ 12.73
150 W	$ -	$ -	$ -		$ 13.36
250 W	$ 2,223.21	$ 631.11	$ 1,592.11	$ 14.00	$ 14.00
360 W	$ 10.56	$ 3.23	$ 7.34	$ 17.72	$ 17.72
400 W	$ 671.63	$ 230.31	$ 441.32	$ 16.76	$ 16.76
1,000 W	$ 34.60	$ 15.16	$ 19.43	$ 26.53	$ 26.53
Metal Halide					
70 W	$ 0.45	$ 0.03	$ 0.42	$ 19.60	$ 19.60
100 W	$ -	$ -	$ -		$ 21.38
150 or 175 W	$ 12.53	$ 1.47	$ 11.07	$ 23.16	$ 23.16
250 W	$ 5.62	$ 0.96	$ 4.67	$ 24.43	$ 24.43
320 or 400 W	$ 13.01	$ 2.97	$ 10.04	$ 29.55	$ 29.55
1,000 W	$ 6.73	$ 2.15	$ 4.58	$ 43.10	$ 43.10

MSLC Proposed Fixture Charges

Overhead < May 2013 Old Emerging Technology Rates	Current Revenue	Energy Revenue	Fixture Revenue	Net Fixture Charge	Proposed Fixture Charge
30 - 39 Watt LED	$ -	$ -	$ -		$ 6.65
40 - 49 Watt LED	$ -	$ -	$ -		$ 6.82
50 - 59 Watt LED	$ 0.29	$ 0.04	$ 0.25	$ 6.98	$ 6.98
60 - 69 Watt LED	$ -	$ -	$ -		$ 7.15
70 - 79 Watt LED	$ -	$ -	$ -		$ 7.31
80 - 89 Watt LED	$ -	$ -	$ -		$ 7.48
90 - 99 Watt LED	$ 141.48	$ 26.81	$ 114.67	$ 7.64	$ 7.64
100 - 109 Watt LED	$ 7.86	$ 1.59	$ 6.27	$ 7.80	$ 7.80
110 - 119 Watt LED	$ -	$ -	$ -		$ 7.97
120 - 129 Watt LED	$ 1.63	$ 0.37	$ 1.27	$ 8.13	$ 8.13
130 - 139 Watt LED	$ -	$ -	$ -		$ 8.29
140 - 149 Watt LED	$ -	$ -	$ -		$ 8.45
150 - 159 Watt LED	$ 56.30	$ 14.24	$ 42.06	$ 8.61	$ 8.61
160 - 169 Watt LED	$ 15.26	$ 3.99	$ 11.27	$ 8.78	$ 8.78
170 - 179 Watt LED	$ 1.76	$ 0.47	$ 1.29	$ 8.94	$ 8.94
180 - 189 Watt LED	$ -	$ -	$ -		$ 9.10
190 - 199 Watt LED	$ -	$ -	$ -		$ 9.27
200 - 209 Watt LED	$ 0.16	$ 0.05	$ 0.11	$ 9.43	$ 9.43
210 - 219 Watt LED	$ -	$ -	$ -		$ 9.59
220 - 229 Watt LED	$ -	$ -	$ -		$ 9.76
230 - 239 Watt LED	$ -	$ -	$ -		$ 9.92
240 - 249 Watt LED	$ -	$ -	$ -		$ 10.08
250 - 259 Watt LED	$ -	$ -	$ -		$ 10.25
260 - 269 Watt LED	$ -	$ -	$ -		$ 10.41
270 - 279 Watt LED	$ -	$ -	$ -		$ 10.57
280 - 289 Watt LED	$ -	$ -	$ -		$ 10.74
290 - 299 Watt LED	$ -	$ -	$ -		$ 10.90
300 - 309 Watt LED	$ -	$ -	$ -		$ 11.06
310 - 319 Watt LED	$ -	$ -	$ -		$ 11.23
320 - 329 Watt LED	$ -	$ -	$ -		$ 11.39

	MSLC Proposed Fixture Charges				
Overhead	Current	Energy	Fixture	Net Fixture	Proposed
>May 2013 New Emerging Technology Rates	Revenue	Revenue	Revenue	Charge	Fixture Charge
30 - 39 Watt LED	$ -	$ -	$ -		$ 10.14
40 - 49 Watt LED	$ -	$ -	$ -		$ 10.18
50 - 59 Watt LED	$ 0.67	$ 0.06	$ 0.61	$ 10.22	$ 10.22
60 - 69 Watt LED	$ 626.28	$ 66.69	$ 559.59	$ 10.26	$ 10.26
70 - 79 Watt LED	$ 0.56	$ 0.07	$ 0.49	$ 10.30	$ 10.30
80 - 89 Watt LED	$ -	$ -	$ -		$ 10.34
90 - 99 Watt LED	$ 582.86	$ 85.61	$ 497.25	$ 10.38	$ 10.38
100 - 109 Watt LED	$ 36.84	$ 5.87	$ 30.97	$ 10.42	$ 10.42
110 - 119 Watt LED	$ -	$ -	$ -		$ 10.46
120 - 129 Watt LED	$ 16.43	$ 3.01	$ 13.42	$ 10.50	$ 10.50
130 - 139 Watt LED	$ 170.69	$ 33.14	$ 137.55	$ 10.54	$ 10.54
140 - 149 Watt LED	$ -	$ -	$ -		$ 10.58
150 - 159 Watt LED	$ 194.65	$ 41.93	$ 152.73	$ 10.62	$ 10.62
160 - 169 Watt LED	$ 52.73	$ 11.89	$ 40.84	$ 10.66	$ 10.66
170 - 179 Watt LED	$ 6.01	$ 1.41	$ 4.60	$ 10.70	$ 10.70
180 - 189 Watt LED	$ -	$ -	$ -		$ 10.74
190 - 199 Watt LED	$ -	$ -	$ -		$ 10.78
200 - 209 Watt LED	$ 1.23	$ 0.32	$ 0.90	$ 10.82	$ 10.82
210 - 219 Watt LED	$ -	$ -	$ -		$ 10.86
220 - 229 Watt LED	$ -	$ -	$ -		$ 10.90
230 - 239 Watt LED	$ -	$ -	$ -		$ 10.94
240 - 249 Watt LED	$ -	$ -	$ -		$ 10.98
250 - 259 Watt LED	$ -	$ -	$ -		$ 11.02
260 - 269 Watt LED	$ -	$ -	$ -		$ 11.06
270 - 279 Watt LED	$ -	$ -	$ -		$ 11.10
280 - 289 Watt LED	$ 0.79	$ 0.26	$ 0.53	$ 11.14	$ 11.14
290 - 299 Watt LED	$ -	$ -	$ -		$ 11.18
300 - 309 Watt LED	$ -	$ -	$ -		$ 11.22
310 - 319 Watt LED	$ -	$ -	$ -		$ 11.26
320 - 329 Watt LED	$ -	$ -	$ -		$ 11.30

	MSLC Proposed Fixture Charges				
Co. Owned Ornamental	Current Revenue	Energy Revenue	Fixture Revenue	Net Fixture Charge	Proposed Fixture Charge
Hg Vapor					
100 W	$ 6.02	$ 0.48	$ 5.54	$ 27.03	27.03
175 W	$ 3,089.99	$ 352.77	$ 2,737.21	$ 29.92	29.92
250 W	$ 94.96	$ 13.91	$ 81.05	$ 31.78	31.78
400 W	$ 2,542.45	$ 490.81	$ 2,051.64	$ 35.78	35.78
1,000 W	$ 72.06	$ 23.40	$ 48.66	$ 42.05	42.05
Na Vapor					
70 W	$ 28.50	$ 1.90	$ 26.60	$ 24.97	24.97
100 W	$ 7,412.19	$ 699.49	$ 6,712.70	$ 24.91	24.91
150 W	$ 286.65	$ 33.79	$ 252.86	$ 26.46	26.46
250 W	$ 5,140.86	$ 813.99	$ 4,326.88	$ 29.50	29.50
360 W	$ -	$ -	$ -		31.76
400 W	$ 2,118.18	$ 433.33	$ 1,684.84	$ 34.01	34.01
1,000 W	$ 7.40	$ 2.76	$ 4.64	$ 34.88	34.88
Metal Halide					
70 W	$ 69.94	$ 2.93	$ 67.01	$ 33.55	33.55
100 W	$ 25.13	$ 1.44	$ 23.68	$ 34.01	34.01
150 or 175 W	$ 368.91	$ 26.54	$ 342.37	$ 39.56	39.56
250 W	$ 139.03	$ 14.55	$ 124.47	$ 42.80	42.80
320 or 400 W	$ 693.12	$ 88.78	$ 604.34	$ 51.23	51.23
1,000 W	$ -	$ -	$ -		65.93

	MSLC Proposed Fixture Charges				
Co. Owned Ornamental	Current	Energy	Fixture	Net Fixture	Proposed
< May 2013 Old Rates	Revenue	Revenue	Revenue	Charge	Fixture Charge
30 - 39 Watt LED	$ -	$ -	$ -		21.15
40 - 49 Watt LED	$ 7.20	$ 0.27	$ 6.92	$ 21.37	21.37
50 - 59 Watt LED	$ 5.16	$ 0.24	$ 4.92	$ 21.59	21.59
60 - 69 Watt LED	$ -	$ -	$ -		21.81
70 - 79 Watt LED	$ 9.00	$ 0.54	$ 8.46	$ 22.03	22.03
80 - 89 Watt LED	$ 2.58	$ 0.17	$ 2.40	$ 22.25	22.25
90 - 99 Watt LED	$ 11.06	$ 0.81	$ 10.25	$ 22.47	22.47
100 - 109 Watt LED	$ 90.03	$ 7.21	$ 82.83	$ 22.70	22.70
110 - 119 Watt LED	$ 0.60	$ 0.05	$ 0.55	$ 22.91	22.91
120 - 129 Watt LED	$ 0.31	$ 0.03	$ 0.28	$ 23.14	23.14
130 - 139 Watt LED	$ -	$ -	$ -		23.36
140 - 149 Watt LED	$ 0.95	$ 0.10	$ 0.85	$ 23.58	23.58
150 - 159 Watt LED	$ 24.04	$ 2.62	$ 21.42	$ 23.80	23.80
160 - 169 Watt LED	$ 12.04	$ 1.38	$ 10.66	$ 24.02	24.02
170 - 179 Watt LED	$ -	$ -	$ -		24.24
180 - 189 Watt LED	$ -	$ -	$ -		24.46
190 - 199 Watt LED	$ -	$ -	$ -		24.68
200 - 209 Watt LED	$ 66.60	$ 8.93	$ 57.67	$ 24.90	24.90
210 - 219 Watt LED	$ -	$ -	$ -		25.12
220 - 229 Watt LED	$ -	$ -	$ -		25.34
230 - 239 Watt LED	$ -	$ -	$ -		25.56
240 - 249 Watt LED	$ -	$ -	$ -		25.78
250 - 259 Watt LED	$ -	$ -	$ -		26.00
260 - 269 Watt LED	$ -	$ -	$ -		26.22
270 - 279 Watt LED	$ -	$ -	$ -		26.44
280 - 289 Watt LED	$ -	$ -	$ -		26.66
290 - 299 Watt LED	$ -	$ -	$ -		26.88
300 - 309 Watt LED	$ 93.05	$ 16.25	$ 76.80	$ 27.12	27.10
310 - 319 Watt LED	$ -	$ -	$ -		27.32
320 - 329 Watt LED	$ -	$ -	$ -		27.54

	MSLC Proposed Fixture Charges				
Co. Owned Ornamental >May 2013 New Rates	Current Revenue	Energy Revenue	Fixture Revenue	Net Fixture Charge	Proposed Fixture Charge
30 - 39 Watt LED	$ -	$ -	$ -		$ 23.06
40 - 49 Watt LED	$ 22.33	$ 0.79	$ 21.54	$ 23.10	$ 23.10
50 - 59 Watt LED	$ 15.86	$ 0.68	$ 15.18	$ 23.14	$ 23.14
60 - 69 Watt LED	$ 752.86	$ 37.73	$ 715.13	$ 23.18	$ 23.18
70 - 79 Watt LED	$ 27.22	$ 1.56	$ 25.66	$ 23.22	$ 23.22
80 - 89 Watt LED	$ 36.65	$ 2.36	$ 34.29	$ 23.26	$ 23.26
90 - 99 Watt LED	$ 31.75	$ 2.26	$ 29.49	$ 23.30	$ 23.30
100 - 109 Watt LED	$ 317.61	$ 24.78	$ 292.82	$ 23.34	$ 23.34
110 - 119 Watt LED	$ 10.08	$ 0.85	$ 9.23	$ 23.38	$ 23.38
120 - 129 Watt LED	$ 9.28	$ 0.85	$ 8.44	$ 23.42	$ 23.42
130 - 139 Watt LED	$ 362.96	$ 35.46	$ 327.50	$ 23.46	$ 23.46
140 - 149 Watt LED	$ 2.72	$ 0.28	$ 2.43	$ 23.50	$ 23.50
150 - 159 Watt LED	$ 75.91	$ 8.37	$ 67.54	$ 23.54	$ 23.54
160 - 169 Watt LED	$ 34.10	$ 3.97	$ 30.13	$ 23.58	$ 23.58
170 - 179 Watt LED	$ 5.01	$ 0.61	$ 4.40	$ 23.62	$ 23.62
180 - 189 Watt LED	$ -	$ -	$ -		$ 23.66
190 - 199 Watt LED	$ -	$ -	$ -		$ 23.70
200 - 209 Watt LED	$ 183.94	$ 25.71	$ 158.24	$ 23.74	$ 23.74
210 - 219 Watt LED	$ -	$ -	$ -		$ 23.78
220 - 229 Watt LED	$ -	$ -	$ -		$ 23.82
230 - 239 Watt LED	$ -	$ -	$ -		$ 23.86
240 - 249 Watt LED	$ -	$ -	$ -		$ 23.90
250 - 259 Watt LED	$ -	$ -	$ -		$ 23.94
260 - 269 Watt LED	$ -	$ -	$ -		$ 23.98
270 - 279 Watt LED	$ -	$ -	$ -		$ 24.02
280 - 289 Watt LED	$ 9.58	$ 1.75	$ 7.84	$ 24.06	$ 24.06
290 - 299 Watt LED	$ -	$ -	$ -		$ 24.10
300 - 309 Watt LED	$ 243.53	$ 46.77	$ 196.76	$ 24.14	$ 24.14
310 - 319 Watt LED	$ -	$ -	$ -		$ 24.18
320 - 329 Watt LED	$ -	$ -	$ -		$ 24.22

MPSC Case No.:	U-17767
Respondent:	K. D. Johnston
Requestor:	MSLC-2
Question No.:	MSLC/DE-2.45
	Supplemental
Page:	1 of 4

Question: Refer to the Excel spreadsheet "U-17767 MSLCDE-1 Lighting Model" provided by the Company in response to the Municipal Lighting Coalition's First Discovery Request. Explain the origin, purpose, and meaning of the "adjustment factors" in each of columns W, AI, AQ, and AY. What is the origin, purpose, and meaning of the numbers in each of the following cells: R154, BF164, AG160, AG161. Also, please provide any alternative rate calculation scenarios for the Street Lighting rate design where DTE used different adjustment factors. If none were performed or are not being provided, please explain why not.

Answer: For all columns W, AI, AQ, and AY rows 31 to 149 and 186 to 304 were Cost of Service (COS) adjustment factors applied in developing the proposed fixture charges. Column W were COS adjustments to reflect the Company's streetlighting O&M revenue requirement characteristics of the lamp and luminaries. Column AI were COS adjustments to reflect the Company's streetlighting Capital revenue requirement characteristics of the lamp and luminaries. Column AQ were COS adjustments to reflect the Company's streetlighting current and future obsolescence of Mercury Vapor and Metal Halide revenue requirement characteristics of the lamp and luminaries. Lastly, column AY were COS adjustments to reflect the Company's overhead only streetlighting and outdoor protective lighting alignment revenue requirement characteristics of the lamp and luminaries. All of these adjustment factors were revenue neutral to the streetlighting class (overhead and ornamental) and were necessary to develop the proposed fixture charges commensurate with the type of luminaire and lamp equipment needed to provide the outdoor lighting services.

Cell R154 (7.9%) is the COS % of the revenue requirement attributed to the Streetlighting O&M component. Cell BF164 (36.6%) is the COS % of the revenue requirement attributed to overall Streetlighting O&M (7.90%) that is lamp and luminaire material or service dependent. Cell AG160 (58.5%) is the COS % of the non-energy revenue requirement attributed to the Streetlighting Capital component. Cell AG161 (34.4%) is the COS % of the revenue requirement attributed to overall non-energy Streetlighting revenue requirement (58.5%) that is lamp and luminaire material or service dependent. No other alternative rate design models, or adjustment factors were completed nor needed as the intent of this model was to calculate the proposed unbundled fixture charge exclusive of energy, service charge components and prior to any overall rate case revenue COS increases or decreases.

Column W Adjustment Factor

Column W adjustment factors were derived from a HID to LED weighted-average COS NPV model. This COS NPV model compared both the reactive outage and currently forecasted preventative maintenance requirements of the different light source technologies based on the Company's current service cost elements (both equipment and labor) along with Company approved forecasted time value escalation rates. This COS NPV model's weighting averages were based on 90% of the Company's combined E1 and D9 asset base. An adjustment factor of 1.69 was applied to the overhead LED technology light source assets, and an adjustment factor of 1.70 (rounding model variable) was applied to the underground serviced LED assets. To maintain overall revenue neutrality, a corresponding .885 factor for overhead service and a corresponding .899 factor for underground service was applied in order to create the correct COS fixture charge. For a very small population of the 1,000 watt HID asset base (271 or .017% of the Company's asset base) in which the COS is proportionally much greater than that of the 400 watt or less HID asset base, an adjustment factor of 3.010 was required and applied to these HID luminaires.

Column AI Adjustment Factor

For column AI, a succession adjustment factor from column W was used as a starting factor. As the High Pressure Sodium (HPS) lamp source achieved the highest cost benefit NPV and because using a single variable (lamp wattage) was necessary in order to apply this second adjustment factor, the 70 watt HPS lamp source was selected as the primary key for both the overhead and ornamental service luminaires. All other luminaire adjustment factors (AF) were based on the 70 watt HPS to properly adjust for the difference in luminaire cost (LC); specifically the following formulas were used in column AI.

For the overhead served luminaires this formula was used:

$$\left(\frac{AHz}{AH38}\right) * AI38$$

For the ornamental served luminaires this formula was used:

$$\left(\frac{AHz}{AH193}\right) * AI193$$

After completing this adjustment based on the luminaire cost, the new capital revenue after adjustment was found to be higher than old capital rate revenue, 7.78% and 23.97%, overhead and ornamental respectively. As this adjustment is required to be revenue neutral overall, cell AH38 was changed from 0.885 to 0.821 and cell AH193 was changed from 0.899 to 0.726 in order to create the correct COS fixture charge.

Column AQ Adjustment Factor

For column AQ a succession adjustment factor from column AI was used as a starting factor. Similar to the Column AI adjustment factor, the 70 watt HPS was selected as the primary key for both the overhead and ornamental service luminaires.

The adjustment factors in AQ were used to reflect revenue requirements for the different lighting technologies based upon future obsolescence of particular technologies, specifically Metal Halide (MH) and Mercury Vapor (MV). The revenue requirements for LED and HPS lighting technologies were adjusted downward (technology obsolescence adjustment) at the expense of MV and MH commensurate with the Company's future inability to maintain these lighting technologies and the additional processing expense related to the requirement to convert these lighting technologies to HPS and/or LED. The result of these adjustments was to not increase the overhead served LED effective rates by 47.9% and 96.1% when compared to the post-May 2013 and pre-May 2013 emerging technology billings. The technology obsolescence adjustment was similarly applied to the ornamental served LED rates, thereby avoiding effective rate increases of 53.8% and 61.8% when compared to the post-May 2013 and pre-May 2013 emerging technology billings, respectively. The adjustments ultimately resulted in limiting the rate increase to only 14.7% for the E1 LED asset base.

As briefly referenced above, the Company identified additional associated process cost involved with processing MV, and future MH, reactive technical failures. These technological obsolescence costs reflect the reactive field conversion of lighting technologies including the completion of additional equipment tracking by the service crews. In addition, additional expense is incurred to maintain proper system configuration within the Company's asset mapping system as well as the maintenance of the company's billing systems to ensure that customer billing accurately reflects the assets which reside in the field.

Column AY Adjustment Factor

A comparison of the overhead served D-9 Outdoor Protective Lighting (OPL) products to overhead E-1 Municipal Streetlights Lighting (MSL) revealed that the 250 and 400 watt HPS D-9 OPL lighting equipment was on average 28.0% higher than that of the like E-1 MSL products. Conversely, a comparison of the OPL D-9 overhead 70 and 100 watt HPS lighting products were found to be on average 15.1% lower than the E-1 MSL 70 and 100 watt HPS products. This service cost discrepancy is due to the product mix between that of cobrahead, floodlights, and NEMA heads style luminaires; with cobraheads being 62% more costly than NEMA heads, and floodlights being 90% more costly than cobraheads. In order to maintain revenue neutrality, the adjustment factors in column AY were created to effectively reduce the revenue requirement of the overhead 70 watt fixture cost by $40,497 and reduce the revenue requirement of the overhead 100 watt fixture cost by $285,690 (-$326,188 combined) while increasing the revenue requirement of the overhead 250 watt fixture cost by $163,825 and increasing the revenue requirement of the overhead 400 watt fixture cost by $162,155 (+$335,980 combined). These adjustments support the consolidation in the D-9 and E-1 tariffs while simultaneously allowing the Company to offer the most desired high wattage floodlight luminaires at a proper COS competitive price while staying revenue neutral within the overhead HPS rate class.

MASTER AGREEMENT FOR MUNICIPAL STREET LIGHTING

This Master Agreement For Municipal Street Lighting ("Master Agreement") is made between The Detroit Edison Company ("Company") and ____________________ ("Customer") as of ____________________.

RECITALS

A. Customer may, from time to time, request the Company to furnish, install, operate and/or maintain street lighting equipment for Customer.

B. Company may provide such services, subject to the terms of this Master Agreement.

Therefore, in consideration of the foregoing, Company and Customer hereby agree as follows:

AGREEMENT

1. Master Agreement. This Master Agreement sets forth the basic terms and conditions under which Company may furnish, install, operate and/or maintain street lighting equipment for Customer. Upon the Parties agreement as to the terms of a specific street lighting transaction, the parties shall execute and deliver a Purchase Agreement in the form of the attached Exhibit A (a "Purchase Agreement"). In the event of an inconsistency between this Agreement and any Purchase Agreement, the terms of the Purchase Agreement shall control.

2. Rules Governing Installation of Equipment and Electric Service. Installation of street light facilities and the extension of electric service to serve those facilities are subject to the provisions of the Company's Rate Book for Electric Service (the "Tariff"), Rule C 6.1, Extension of Service (or any other successor provision), as approved by the The Michigan Public Service Commission ("MPSC") from time to time.

3. Contribution in Aid of Construction. In connection with each Purchase Agreement and in accordance with the applicable Orders of the MPSC, Customer shall pay to Company a contribution in aid of construction ("CIAC") for the cost of installing Equipment ("as defined in the applicable Purchase Agreement") and recovery of costs associated with the removal of existing equipment, if any. The amount of the CIAC (the "CIAC Amount") shall be an amount equal to the total construction cost (including all labor, materials and overhead charges), less an amount equal to three years revenue expected from such new equipment. The CIAC Amount will be as set forth on the applicable Purchase Agreement. The CIAC Amount does not include charges for any additional cost or expense for unforeseen underground objects, or unusual conditions encountered in the construction and installation of Equipment. If Company encounters any such unforeseen or unusual conditions, which would increase the CIAC Amount, it will suspend the construction and installation of Equipment and give notice of such conditions to the Customer. The Customer will either pay additional costs or modify the work to be performed. If the work is modified, the CIAC Amount will be adjusted to account for such modification. Upon any such

suspension and/or subsequent modification of the work, the schedule for completion of the work shall also be appropriately modified.

4. Payment of CIAC Amount. Customer shall pay the CIAC Amount to Company as set forth in the applicable Purchase Agreement. Failure to pay the CIAC Amount when due shall relieve Company of its obligations to perform the work required herein until the CIAC Amount is paid.

5. Modifications. Subject to written permission of the respective municipality, after installation of the Equipment, any cost for additional modifications, relocations or removals will be the responsibility of the requesting party.

6. Maintenance, Replacement and Removal of Equipment. In accordance with the applicable Orders of the MPSC, under the Municipal Street Lighting Rate (as defined below), Company shall provide the necessary maintenance of the Equipment, including such replacement material and equipment as may be necessary. Customer may not remove any Equipment without the prior written consent of Company.

7. Street Lighting Service Rate.

a. Upon the installation of the Equipment, the Company will provide street lighting service to Customer under Option 1 of the Municipal Street Lighting Rate set forth in the Tariff, as approved by the MPSC from time to time, the terms of which are incorporated herein by reference.

b. The provision of street lighting service is also governed by rules for electric service established in MPSC Case Number U-6400. The Street Lighting Rate is subject to change from time to time by orders issued by the MPSC.

8. Contract Term. This Agreement shall commence upon execution and terminate on the later of (a) five (5) years from the date hereof or(b) the date on which the final Purchase Agreement entered into under this Master Agreement is terminated. Upon expiration of the initial term, this Agreement shall continue on a month-to-month basis until terminated by mutual written consent of the parties or by either party with twelve (12) months prior written notice to the other party.

9. Design Responsibility for Street Light Installation. The Company installs municipal street lighting installations following Illuminating Engineering Society of North America ("IESNA") recommended practices. If the Customer submits its own street lighting design for the street light installation or if the street lighting installation requested by Customer does not meet the IESNA recommended practices, Customer acknowledges the Company is not responsible for lighting design standards.

10. New Subdivisions. Company agrees to install street lights in new subdivisions when subdivision occupancy reaches a minimum of 80%. If Customer wishes to have installation occur prior to 80% occupancy, then Customer acknowledges it will be financially

responsible for all damages (knockdowns, etc.) and requests for modifications (movements due to modified curb cuts from original design, etc.).

11. Force Majeure. The obligation of Company to perform this Agreement shall be suspended or excused to the extent such performance is prevented or delayed because of acts beyond Company's reasonable control, including without limitation acts of God, fires, adverse weather conditions (including severe storms and blizzards), malicious mischief, strikes and other labor disturbances, compliance with any directives of any government authority, including but not limited to obtaining permits, and force majeure events affecting suppliers or subcontractors.

12. Subcontractors. Company may sub-contract in whole or in part its obligations under this Agreement to install the Equipment and any replacement Equipment.

13. Waiver; Limitation of Liability. To the maximum extent allowed by law, Customer hereby waives, releases and fully discharges Company from and against any and all claims, causes of action, rights, liabilities or damages whatsoever, including attorney's fees, arising out of the installation of the Equipment and/or any replacement Equipment, including claims for bodily injury or death and property damage, unless such matter is caused by or arises as a result of the sole negligence of Company and/or its subcontractors. Company shall not be liable under this Agreement for any special, incidental or consequential damages, including loss of business or profits, whether based upon breach of warranty, breach of contract, negligence, strict liability, tort or any other legal theory, and whether or not Company has been advised of the possibility of such damages. In no event will Company's liability to Customer for any and all claims related to or arising out of this Agreement exceed the CIAC Amount set forth in the Purchase Order to which the claim relates.

14. Notices. All notices required by the Agreement shall be in writing. Such notices shall be sent to Company at The Detroit Edison Company, Community Lighting Group, 8001 Haggerty Rd, Belleville, MI 48111 and to Customer at the address set forth on the applicable Purchase Agreement. Notice shall be deemed given hereunder upon personal delivery to the addresses set forth above or, if properly addressed, on the date sent by certified mail, return receipt requested, or the date such notice is placed in the custody of a nationally recognized overnight delivery service. A party may change its address for notices by giving notice of such change of address in the manner set forth herein.

15. Representations and Warranties. Company and Customer each represent and warrant that: (a) it has full corporate or public, as applicable, power and authority to execute and deliver this Agreement and to carry out the actions required of it by this Agreement; (b) the execution and delivery of this Agreement and the transactions contemplated hereby have been duly and validly authorized by all necessary corporate or public, as applicable, action required on the part of such party; and (c) this Agreement constitutes a legal, valid, and binding agreement of such party.

16. Miscellaneous.

a. This Agreement is the entire agreement of the parties concerning the subject matter hereof and supersedes all prior agreements and understandings. Any amendment or modification to this Agreement must be in writing and signed by both parties.

b. Customer may not assign its rights or obligations under this Agreement without the prior written consent of Company. This Agreement shall be binding upon and shall inure to the benefit of the parties' respective successors and permitted assigns. This Agreement is made solely for the benefit of Company, Customer and their respective successors and permitted assigns and no other party shall have any rights to enforce or rely upon this Agreement.

c. A waiver of any provision of this Agreement must be made in writing and signed by the party against whom the waiver is enforced. Failure of any party to strictly enforce the terms of this Agreement shall not be deemed a waiver of such party's rights hereunder.

d. The section headings contained in this Agreement are for convenience only and shall not affect the meaning or interpretation thereof.

e. This Agreement shall be construed in accordance with the laws of the State of Michigan, without regard to any conflicts of law principles. The parties agree that any action with respect to this Agreement shall be brought in the courts of the State of Michigan and each party hereby submits itself to the exclusive jurisdiction of such courts.

f. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original but all of which together will constitute one and the same instrument.

g. The invalidity of any provision of this Agreement shall not invalidate the remaining provisions of the Agreement.

****

Company and Customer have executed this Purchase Agreement as of the date first written above.

Company:	Customer:
The Detroit Edison Company	[Customer Name]
By: ______________________________	By: ______________________________
Name: ____________________________	Name: ____________________________
Title:_____________________________	Title:_____________________________

Exhibit A to Master Agreement

Purchase Agreement

This Purchase Agreement (this "Agreement") is dated as of [INSERT CURRENT DATE] between The Detroit Edison Company ("Company") and [INSERT CUSTOMER NAME] ("Customer").

This Agreement is a "Purchase Agreement" as referenced in the Master Agreement for Municipal Street Lighting dated [INSERT DATE OF MASTER AGREEMENT] (the "Master Agreement") between Company and Customer. All of the terms of the Master Agreement are incorporated herein by reference. In the event of an inconsistency between this Agreement and the Master Agreement, the terms of this Agreement shall control.

Customer requests the Company to furnish, install, operate and maintain street lighting equipment as set forth below:

1. DTE Work Order Number:	[#########]	
	If this is a conversion or replacement, indicate the Work Order Number for current installed equipment: [####### or N/A]	
2. Location where Equipment will be installed:	[Written Description of location], as more fully described on the map attached hereto as Attachment 1.	
3. Total number of lights to be installed:	[##]	
4. Description of Equipment to be installed (the "Equipment"):	[Description of Equipment]	
5. Estimated Total Annual Lamp Charges	$____________________	
6. Computation of Contribution in aid of Construction ("CIAC Amount")	Total estimated construction cost, including labor, materials, and overhead:	$__________
	Credit for 3 years of lamp charges:	$__________
	CIAC Amount (cost minus revenue)	**$__________**
7. Payment of CIAC Amount:	Due promptly upon execution of this Agreement	
8. Term of Agreement	5 years. Upon expiration of the initial term, this Agreement shall continue on a month-to-month basis until terminated by mutual written consent of the parties or by either party with twelve (12) months prior written notice to the other party.	
9. Does the requested Customer lighting design meet IESNA recommended practices?	(Check One) ☐ YES ☐ NO If "No", Customer must sign below and acknowledge that the lighting design does not meet IESNA recommended practices ____________________________	
10. Customer Address for Notices:	[Address] [Address] [Name]	

11. Special Order Material Terms:

All or a portion of the Equipment consists of special order material: (check one) ☐YES ☐NO

If "Yes" is checked, Customer and Company agree to the following additional terms.

A. Customer acknowledges that all or a portion of the Equipment is special order materials ("SOM") and not Company's standard stock. Customer will purchase and stock replacement SOM and spare parts. When replacement equipment or spare parts are installed from Customer's inventory, the Company will credit Customer in the amount of the then current material cost of Company standard street lighting equipment.

B. Customer will maintain an initial inventory of at least ___ posts and ___ luminaires and any other materials agreed to by Company and Customer, and will replenish the stock as the same are drawn from inventory. Costs of initial inventory are included in this Agreement. The Customer agrees to work with the Company to adjust inventory levels from time to time to correspond to actual replacement material needs. If Customer fails to maintain the required inventory, Company, after 30 days' notice to Customer, may (but is not required to) order replacement SOM and Customer will reimburse Company for such costs. Customer's acknowledges that failure to maintain required inventory could result in extended outages due to SOM lead times.

C. The inventory will be stored at ____. Access to the Customers inventory site must be provided between the hours of 9:00 am to 4:00 pm, Monday through Friday with the exceptions of federal Holidays. Customer shall name an authorized representative to contact regarding inventory: levels, access, usage, transactions, and provide the following contact information to the Company:

Name: ____________________________ Title: ________________________________

Phone Number:____________________ Email: _______________________________

The Customer will notify the Company of any changes in the Authorized Customer Representative. The Customer must comply with SOM manufacturer's recommended inventory storage guidelines and practices. Damaged SOM will not be installed by the Company.

D. In the event that SOM is damaged by a third party, the Company may (but is not required to) pursue a damage claim against such third party for collection of all labor and stock replacement value associated with the damage claim. Company will promptly notify Customer as to whether Company will pursue such claim.

E. In the event that SOM becomes obsolete or no longer manufactured, the Customer will be allowed to select new alternate SOM that is compatible with the Company's existing infrastructure.

12. Experimental Emerging Lighting Technology ("EELT") Terms:

All or a portion of the Equipment consists of EELT: (check one) ☐YES ☐NO

If "Yes" is checked, Customer and Company agree to the following additional terms.

A. Should the Company experience excessive EELT equipment failures, not supported by EELT manufacturer warrantees, the Company will replace the EELT equipment with other Company supported Solid State or High Intensity Discharge luminaires at the Company's discretion. The full cost to complete these replacements to standard street lighting equipment will be the responsibility of the Customer.

B. The annual billing lamp charges for the EELT equipment has been calculated by the Company are based upon the estimated energy and maintenance cost expected with the Customer's specific pilot project EELT equipment. .

C. Upon the approval of any future MPSC Option I tariff for EELT street lighting equipment, the approved rate schedules will automatically apply for service continuation to the Customer under Option 1 Municipal Street Lighting Rate, as approved by the MPSC. The terms of this paragraph C replace in its entirety <u>Section 7</u> of the Master Agreement with respect to any EELT equipment purchased under this Agreement.

****

Company and Customer have executed this Purchase Agreement as of the date first written above.

Company:	Customer:
The Detroit Edison Company	[Customer Name]
By: ______________________________	By: ______________________________
Name: ___________________________	Name: ___________________________
Title:______________________________	Title:______________________________

Attachment 1 to Purchase Agreement

Map of Location

[To be attached]

MPSC Case No.: U-17767
Respondent: Legal
Requestor: MSLC-1
Question No.: MSLCDE-1.2 Supplemental
Page: 1 of 1

Question: For each municipality currently receiving Municipal Street Lighting service from DTE, provide the current or last franchise agreement, contract, or other document authorizing DTE to provide Municipal Street Lighting service to that municipality.

Answer: DTE objects for the reason that the information requested is not relevant, is unduly burdensome nor is it reasonably calculated to lead to the discovery of admissible evidence. In addition, DTE objects for the reason that the information requested consists of confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its customers competitive harm.

Contracts are available for review onsite in the Company's Lansing office. Please see attached file "U-17767 MSLCDE-1 LED by Municipality.xlsx" (this file was also provided in Company response to MSLCDE-1.22b Supplemental) for a listing of all municipalities with installed LED technology as of May 4, 2015.

Please see attached files "U-17767 MSLCDE-1.2 Acquisition Agreement.pdf" and "U-17767 MSLCDE-1.2 Master Agreement for SL.pdf".

MPSC Case No.:	U-17767
Respondent:	Legal / K. A. Holmes
Requestor:	MSLC-1
Question No.:	MSLCDE-1.22c Supplemental
Page:	1 of 1

Question: Provide any documents possessed by DTE that support your response. Provide a list of any and all municipalities in which DTE has converted municipal street lights to LED technology. For each such municipality, provide:

c. The amount charged for municipal street lighting using the converted LED lights monthly for any and all of 2014, pursuant to the Experimental Emerging Lighting Technology Provision.

Answer: DTE objects for the reason that the information requested consists of confidential, proprietary, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its customers competitive harm.

Subject to this objection and without waiving this objection, DTE would answer as follows:

Please see the attached file "U-17767 MSLCDE-1 Q22 c and d Supplemental.xslx." This file includes a tab labeled 'MSLCE 1.22 LED rates' (submitted in the original response) showing the monthly charges for LED lamps that were converted prior to May 2013, and the monthly charges for LED lamps converted after May 2013. The current rate information for the Company's most popular HID technology offerings is also included.

In an effort to provide the specific municipality information requested, a query of the billing system was performed to extract detailed lighting profiles by muncipality and the associated charges for 2014. However, this detail is unavailable, as a field for the LED lamps in the billing system defaulted to show all LEDs as though they are billed to one customer in reports. Customer contracts are available for review onsite in the Company's Lansing office.

MPSC Case No.: U-17767
Respondent: Legal/ K. A. Holmes
Requestor: MSLC-1
Question No.: MSLCDE-1.22d
Supplemental
Page: 1 of 1

Question: Provide any documents possessed by DTE that support your response. Provide a list of any and all municipalities in which DTE has converted municipal street lights to LED technology. For each such municipality, provide:

d. Calculations showing the monthly charges DTE projects it will charge on a monthly basis for municipal street lighting service using the converted lights, pursuant to the proposed LED lighting tariffs in this case.

Answer: DTE objects for the reason that the information requested consists of confidential, proprietary, or commercial information, the disclosure of which would cause DTE, its ratepayers, and its customers competitive harm.

Subject to this objection and without waiving this objection, DTE would answer as follows: Please see the attached file “U-17767 MSLCDE-1 Q22 LED rates.xslx.” This file shows a detailed calculation of the total proposed monthly LED charge for each lamp type, showing both the fixture charge and energy charge components.

See also response to MSLCDE-1.22c Supplemental. In an effort to provide additional information, a report was generated outside of the billing system to show the total number of lamps by technology source for each community. This report is on the tab labeled ‘Muni profiles’ within the attached file named “U-17767 MSLCDE-1 Q22 c and d Supplemental.xlsx”. This report, along with the current rates and detailed calculation of the projected rates shown on tab named ‘MSLCDE 1.22 LED rates’ indicates how municipalities may be impacted by the proposed rates.

U-17767 May 22, 2015 - Testimony of D. Jester - Exhibit: MSLC 24
Source: MSLCDE 1.22c & d Supplemental as Modified by Jester - Page 1 of 3

E1 Street Lighting Option 1 Overhead Rates

	Question 22, part c		Question 22, part c		Calculation of proposed monthly LED charges								
	Annual Charge for LED conversions done prior to May 2013	Monthly Charge for LED conversions done prior to May 2013	Annual Charge for LED conversions done after May 2013	Monthly Charge for LED conversions done after May 2013	Wattage	Monthly kwh	Energy Rate (cent/kwh)	Energy Charge	Fixture Charge	Total monthly charge	Proposed Effective rate	% Increase/ (Decrease) for conversion after May 2013	% Increase/ (Decrease) for conversion before May 2013
						kwh							
30 - 39 Watt LED	$ 87.78	$ 7.32	$ 129.58	$ 10.80	35	12.25	0.05372	$ 0.66	$ 11.57	$ 12.23	146.74	13%	67%
40 - 49 Watt LED	$ 92.06	$ 7.67	$ 132.32	$ 11.03	45	15.75	0.05372	$ 0.85	$ 11.64	$ 12.49	149.86	13%	63%
50 - 59 Watt LED	$ 96.21	$ 8.02	$ 135.06	$ 11.26	55	19.25	0.05372	$ 1.03	$ 11.71	$ 12.75	152.97	13%	59%
60 - 69 Watt LED	$ 100.48	$ 8.37	$ 137.80	$ 11.48	65	22.75	0.05372	$ 1.22	$ 11.79	$ 13.01	156.09	13%	55%
70 - 79 Watt LED	$ 104.76	$ 8.73	$ 140.54	$ 11.71	75	26.25	0.05372	$ 1.41	$ 11.86	$ 13.27	159.21	13%	52%
80 - 89 Watt LED	$ 108.91	$ 9.08	$ 143.28	$ 11.94	85	29.75	0.05372	$ 1.60	$ 11.95	$ 13.55	162.57	13%	49%
90 - 99 Watt LED	$ 113.18	$ 9.43	$ 146.01	$ 12.17	95	33.25	0.05372	$ 1.79	$ 12.02	$ 13.81	165.69	13%	46%
100 - 109 Watt LED	$ 117.33	$ 9.78	$ 148.75	$ 12.40	105	36.75	0.05372	$ 1.97	$ 12.11	$ 14.09	169.05	14%	44%
110 - 119 Watt LED	$ 121.61	$ 10.13	$ 151.49	$ 12.62	115	40.25	0.05372	$ 2.16	$ 12.22	$ 14.38	172.54	14%	42%
120 - 129 Watt LED	$ 125.76	$ 10.48	$ 154.23	$ 12.85	125	43.75	0.05372	$ 2.35	$ 12.33	$ 14.68	176.15	14%	40%
130 - 139 Watt LED	$ 130.04	$ 10.84	$ 156.97	$ 13.08	135	47.25	0.05372	$ 2.54	$ 12.45	$ 14.99	179.88	15%	38%
140 - 149 Watt LED	$ 134.19	$ 11.18	$ 159.71	$ 13.31	145	50.75	0.05372	$ 2.73	$ 12.51	$ 15.24	182.87	15%	36%
150 - 159 Watt LED	$ 138.34	$ 11.53	$ 162.45	$ 13.54	155	54.25	0.05372	$ 2.91	$ 12.56	$ 15.48	185.74	14%	34%
160 - 169 Watt LED	$ 142.61	$ 11.88	$ 165.18	$ 13.77	165	57.75	0.05372	$ 3.10	$ 12.63	$ 15.73	188.74	14%	32%
170 - 179 Watt LED	$ 146.76	$ 12.23	$ 167.92	$ 13.99	175	61.25	0.05372	$ 3.29	$ 12.69	$ 15.98	191.73	14%	31%
180 - 189 Watt LED	$ 151.04	$ 12.59	$ 170.66	$ 14.22	185	64.75	0.05372	$ 3.48	$ 12.75	$ 16.23	194.73	14%	29%
190 - 199 Watt LED	$ 155.19	$ 12.93	$ 173.40	$ 14.45	195	68.25	0.05372	$ 3.67	$ 12.81	$ 16.48	197.72	14%	27%
200 - 209 Watt LED	$ 159.46	$ 13.29	$ 176.14	$ 14.68	205	71.75	0.05372	$ 3.85	$ 12.88	$ 16.74	200.84	14%	26%
210 - 219 Watt LED	$ 163.74	$ 13.65	$ 178.88	$ 14.91	215	75.25	0.05372	$ 4.04	$ 12.96	$ 17.01	204.08	14%	25%
220 - 229 Watt LED	$ 167.89	$ 13.99	$ 181.61	$ 15.13	225	78.75	0.05372	$ 4.23	$ 13.05	$ 17.28	207.32	14%	23%
230 - 239 Watt LED	$ 172.17	$ 14.35	$ 184.35	$ 15.36	235	82.25	0.05372	$ 4.42	$ 13.13	$ 17.55	210.56	14%	22%
240 - 249 Watt LED	$ 176.19	$ 14.68	$ 187.09	$ 15.59	245	85.75	0.05372	$ 4.61	$ 13.21	$ 17.82	213.80	14%	21%
250 - 259 Watt LED	$ 180.47	$ 15.04	$ 189.83	$ 15.82	255	89.25	0.05372	$ 4.79	$ 13.29	$ 18.09	217.04	14%	20%
260 - 269 Watt LED	$ 184.62	$ 15.39	$ 192.57	$ 16.05	265	92.75	0.05372	$ 4.98	$ 13.37	$ 18.36	220.28	14%	19%
270 - 279 Watt LED	$ 188.89	$ 15.74	$ 195.31	$ 16.28	275	96.25	0.05372	$ 5.17	$ 13.47	$ 18.64	223.64	15%	18%
280 - 289 Watt LED	$ 193.17	$ 16.10	$ 198.04	$ 16.50	285	99.75	0.05372	$ 5.36	$ 13.55	$ 18.91	226.88	15%	17%
290 - 299 Watt LED	$ 197.32	$ 16.44	$ 200.78	$ 16.73	295	103.25	0.05372	$ 5.55	$ 13.63	$ 19.18	230.12	15%	17%
300 - 309 Watt LED	$ 201.59	$ 16.80	$ 203.52	$ 16.96	305	106.75	0.05372	$ 5.73	$ 13.71	$ 19.45	233.36	15%	16%
310 - 319 Watt LED	$ 205.74	$ 17.15	$ 206.26	$ 17.19	315	110.25	0.05372	$ 5.92	$ 13.80	$ 19.73	236.72	15%	15%
320 - 329 Watt LED	$ 210.02	$ 17.50	$ 209.00	$ 17.42	325	113.75	0.05372	$ 6.11	$ 13.89	$ 20.00	239.96	15%	14%

E1 Street Lighting Option 1 Underground Rates

	conversions done prior to May 2013	conversions done prior to May 2013	conversions done after May 2013	conversions done after May 2013	Wattage	Monthly kwh	Energy Rate (cent/kwh)	Energy Charge	Fixture Charge	Total monthly charge	Proposed Effective rate	% Increase/ (Decrease)	% Increase/ (Decrease)
30 - 39 Watt LED	261.71		284.58	23.72	35	12.25	0.05372	0.7	24.28	24.94	299.24	5%	
40 - 49 Watt LED	266.61		287.32	23.94	45	15.75	0.05372	0.8	24.33	25.18	302.11	5%	
50 - 59 Watt LED	271.52		290.06	24.17	55	19.25	0.05372	1.0	24.38	25.41	304.98	5%	
60 - 69 Watt LED	276.42		292.80	24.40	65	22.75	0.05372	1.2	24.43	25.65	307.85	5%	
70 - 79 Watt LED	281.33		295.54	24.63	75	26.25	0.05372	1.4	24.48	25.89	310.72	5%	
80 - 89 Watt LED	286.23		298.28	24.86	85	29.75	0.05372	1.6	24.54	26.14	313.71	5%	
90 - 99 Watt LED	291.13		301.01	25.08	95	33.25	0.05372	1.8	24.61	26.39	316.71	5%	
100 - 109 Watt LED	296.16		303.75	25.31	105	36.75	0.05372	2.0	24.68	26.65	319.83	5%	
110 - 119 Watt LED	300.94		306.49	25.54	115	40.25	0.05372	2.2	24.76	26.92	323.07	5%	
120 - 129 Watt LED	305.85		309.23	25.77	125	43.75	0.05372	2.4	24.84	27.19	326.31	6%	
130 - 139 Watt LED	310.75		311.97	26.00	135	47.25	0.05372	2.5	24.92	27.46	329.55	6%	
140 - 149 Watt LED	315.66		314.71	26.23	145	50.75	0.05372	2.7	24.96	27.69	332.29	6%	
150 - 159 Watt LED	320.56		317.45	26.45	155	54.25	0.05372	2.9	25.02	27.93	335.16	6%	
160 - 169 Watt LED	325.47		320.18	26.68	165	57.75	0.05372	3.1	25.06	28.16	337.91	6%	
170 - 179 Watt LED	330.37		322.92	26.91	175	61.25	0.05372	3.3	25.11	28.40	340.78	6%	
180 - 189 Watt LED	335.28		325.66	27.14	185	64.75	0.05372	3.5	25.15	28.63	343.53	5%	
190 - 199 Watt LED	340.18		328.40	27.37	195	68.25	0.05372	3.7	25.20	28.87	346.40	5%	
200 - 209 Watt LED	345.09		331.14	27.59	205	71.75	0.05372	3.9	25.25	29.11	349.27	5%	
210 - 219 Watt LED	350.12		333.88	27.82	215	75.25	0.05372	4.0	25.31	29.36	352.27	6%	
220 - 229 Watt LED	354.89		336.61	28.05	225	78.75	0.05372	4.2	25.37	29.61	355.26	6%	
230 - 239 Watt LED	359.93		339.35	28.28	235	82.25	0.05372	4.4	25.44	29.85	358.26	6%	
240 - 249 Watt LED	364.7		342.09	28.51	245	85.75	0.05372	4.6	25.50	30.10	361.25	6%	
250 - 259 Watt LED	369.73		344.83	28.74	255	89.25	0.05372	4.8	25.56	30.35	364.24	6%	
260 - 269 Watt LED	374.51		347.57	28.96	265	92.75	0.05372	5.0	25.62	30.60	367.24	6%	
270 - 279 Watt LED	379.42		350.31	29.19	275	96.25	0.05372	5.2	25.68	30.85	370.23	6%	
280 - 289 Watt LED	384.32		353.04	29.42	285	99.75	0.05372	5.4	25.74	31.10	373.23	6%	
290 - 299 Watt LED	389.23		355.78	29.65	295	103.25	0.05372	5.5	25.81	31.35	376.22	6%	
300 - 309 Watt LED	394.26		358.52	29.88	305	106.75	0.05372	5.7	25.89	31.62	379.46	6%	
310 - 319 Watt LED	399.04		361.26	30.10	315	110.25	0.05372	5.9	25.95	31.87	382.46	6%	
320 - 329 Watt LED	404.07		364.00	30.33	325	113.75	0.05372	6.1	26.01	32.12	385.45	6%	
Mercury Vapor 175 W				16.76	205	71.75	0.05372	$ 3.85	$ 14.09	$ 17.94	215.33	7%	
Mercury Vapor 400 W				25.13	455	159.25	0.05372	$ 8.55	18.28	$ 26.83	322.02	7%	
HPS 100W				15.33	138	48.3	0.05372	$ 2.59	9.95	$ 12.54	150.54	-18%	
HPS 250 W				19.55	295	103.25	0.05372	$ 5.55	12.96	$ 18.51	222.08	-5%	

E1 Street Lighting Option 3 - Energy Only

	conversions done prior to May 2013	conversions done prior to May 2013	conversions done after May 2013	conversions done after May 2013	Wattage	Monthly kwh	Energy Rate (cent/kwh)	Energy Charge	Fixture Charge	Total monthly charge	Proposed Effective rate	% Increase/ (Decrease)	% Increase/ (Decrease)
						Monthly	Energy Rate	Monthly					
Wattage		Monthly Charge				kwh	(cent/kwh)	Charge					
30 - 39 Watt LED	35	$ 1.26			35	12.25	0.0772	$ 0.95					
40 - 49 Watt LED	45	$ 1.62			45	15.75	0.0772	$ 1.22					
50 - 59 Watt LED	55	$ 1.98			55	19.25	0.0772	$ 1.49					
60 - 69 Watt LED	65	$ 2.34			65	22.75	0.0772	$ 1.76					
70 - 79 Watt LED	75	$ 2.70			75	26.25	0.0772	$ 2.03					
80 - 89 Watt LED	85	$ 3.06			85	29.75	0.0772	$ 2.30					
90 - 99 Watt LED	95	$ 3.42			95	33.25	0.0772	$ 2.57					
100 - 109 Watt LED	105	$ 3.78			105	36.75	0.0772	$ 2.84					
110 - 119 Watt LED	115	$ 4.14			115	40.25	0.0772	$ 3.11					
120 - 129 Watt LED	125	$ 4.50			125	43.75	0.0772	$ 3.38					
130 - 139 Watt LED	135	$ 4.86			135	47.25	0.0772	$ 3.65					
140 - 149 Watt LED	145	$ 5.22			145	50.75	0.0772	$ 3.92					
150 - 159 Watt LED	155	$ 5.58			155	54.25	0.0772	$ 4.19					
160 - 169 Watt LED	165	$ 5.94			165	57.75	0.0772	$ 4.46					
170 - 179 Watt LED	175	$ 6.30			175	61.25	0.0772	$ 4.73					
180 - 189 Watt LED	185	$ 6.66			185	64.75	0.0772	$ 5.00					
190 - 199 Watt LED	195	$ 7.02			195	68.25	0.0772	$ 5.27					
200 - 209 Watt LED	205	$ 7.38			205	71.75	0.0772	$ 5.54					
210 - 219 Watt LED	215	$ 7.74			215	75.25	0.0772	$ 5.81					
220 - 229 Watt LED	225	$ 8.10			225	78.75	0.0772	$ 6.08					
230 - 239 Watt LED	235	$ 8.46			235	82.25	0.0772	$ 6.35					
240 - 249 Watt LED	245	$ 8.82			245	85.75	0.0772	$ 6.62					
250 - 259 Watt LED	255	$ 9.18			255	89.25	0.0772	$ 6.89					
260 - 269 Watt LED	265	$ 9.54			265	92.75	0.0772	$ 7.16					
270 - 279 Watt LED	275	$ 9.90			275	96.25	0.0772	$ 7.43					
280 - 289 Watt LED	285	$ 10.26			285	99.75	0.0772	$ 7.70					
290 - 299 Watt LED	295	$ 10.62			295	103.25	0.0772	$ 7.97					
300 - 309 Watt LED	305	$ 10.98			305	106.75	0.0772	$ 8.24					
310 - 319 Watt LED	315	$ 11.34			315	110.25	0.0772	$ 8.51					
320 - 329 Watt LED	325	$ 11.70			325	113.75	0.0772	$ 8.78					
Mercury Vapor 175 W				33.78	205	71.75	0.05372	$ 3.85	$ 32.41	$ 36.26	435.17	7%	
Mercury Vapor 400 W				44.34	455	159.25	0.05372	$ 8.55	38.94	$ 47.49	569.94	7%	
HPS 100W				27.51	138	48.3	0.05372	$ 2.59	26.74	$ 29.33	352.02	7%	
HPS 250 W				35.05	295	103.25	0.05372	$ 5.55	27.46	$ 33.01	396.08	-6%	

MPSC Case No.: U-17767
Respondent: K. D. Johnston
Requestor: MSLC-1
Question No.: MSLCDE-1.17
Page: 1 of 1

Question: Please provide any documents possessed by DTE that describe its plans to replace, upgrade, or otherwise provide for continuation of municipal street lighting when its existing Mercury Vapor and Metal Halide street lights become obsolete. If such plans have not been documented, please describe DTE's current plan.

Answer: DTE does not have any documents describing detailed plans to replace, upgrade or otherwise provide for continuation of service when the technologies become obsolete. DTE's projected capital costs on Exhibit A-9, Schedule B6.4 reflect a continuation of its series conversion project, costs associated with outage restoration, post replacement, etc as well as some contribution to converting Mercury Vapor and Metal Halide to other technologies. DTE's current plan is to continue to partner with municipal customers in its conversion of potentially obsolete lighting technologies. The pace of the conversion is largely driven by customer demand. DTE is obligated to implement the lighting tariff in all of the lighting projects including the conversion projects.

MPSC Case No.:	U-17767
Respondent:	K. D. Johnston
Requestor:	MSLC-1
Question No.:	MSLCDE-1.18
Page:	1 of 1

Question: Please explain the relationship between DTE's current plan for continuation of municipal street lighting when its existing Mercury Vapor and Metal Halide street lights become obsolete and DTE's current and planned capital expenditures as detailed in Exhibit A-9 and testified to by Witness R. M. Tomina on page RMT-21, lines 4-12.

Answer: Please see response to question MSLCDE-1.17

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MPSC Case No.: U-17767
Respondent: Legal / K. D. Johnston
Requestor: MSLC-2
Question No.: MSLC/DE-2.25
Supplemental
Page: 1 of 1

Question: For the period of 2013 to 2015, please provide any DTE internal and external business plans, presentations, marketing material, feasibility studies, lighting conversion financial analyses, customer economic studies, conversion financial models, and correspondence to senior leadership as created or prepared by or for DTE as it relates to Municipal Street Lighting.

Answer: DTE objects for the reason that the information requested consists of private customer information, confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which would cause DTE and its customers competitive harm. Subject to this objection, and without waiving this objection, DTE would answer as follows:

See attached presentation made on March 10, 2015 as well as other recent presentations/documents regarding the Community Lighting business. Also included are various marketing materials provided to customers.

No additional information is available. The Company does not prepare a multi-year financial plan for the outdoor lighting or municipal lighting business.

MPSC Case No.: U-17767
Respondent: R. M. Tomina
Requestor: MSLC-2
Question No.: MSLC/DE-2.26
Supplemental
Page: 1 of 1

Question: Please provide any financial planning, budgeting, forecasting, and profit and loss statements for Municipal Street Lighting for the period 2013-2015 or that include any portion of the test year in this case. Please include documents referencing annual plans/budgets, 5 year projections, and quarterly financial updates.

Answer: See attached budget information for 2013 through 2016 in "U-17767 MSLCDE-2.26 CL".

No additional information is available for Municipal Street Lighting.

MPSC Case No.: U-17767
Respondent: R. M. Tomina
Requestor: MSLC-2
Question No.: MSLC/DE-2.27
Supplemental
Page: 1 of 1

Question: Does the Company periodically prepare a multi-year financial plan, business plan, or forecast for its outdoor lighting or municipal lighting business (for example, annual plans of revenue, expenses, and capital with five-year forecasts)? If so, please provide all such plans that include forecasts for any portion of the test year in this case.

Answer: See response to MSLC/DE-2.26.

No additional information is available. The Company does not prepare a multi-year financial plan for the outdoor lighting or municipal lighting business.

MPSC Case No.:	U-17767
Respondent:	R. M. Tomina
Requestor:	MSLC-2
Question No.:	MSLC/DE-2.44
	Supplemental
Page:	1 of 1

Question: Refer to the Company's answer to question MSLCDE – 1.9 within the Company's response to the Municipal Lighting Coalition's First Discovery Request and to Witness Tomina's Exhibit A-9, Schedule B6.4. Provide any work papers prepared by or for the Company in developing the projected capital investment per year shown in Exhibit A-9, Schedule B6.4 and any materials used for internal presentation of these projections.

Answer: See attachment "U-17767 MSLC-2.44 Community Lighting" which reflects monthly historical capital spend for Community Lighting. The projected dollars for 2015 basically reflect no change from the 2014 actuals/projections.

There are no internal workpapers or presentations for the capital cost projections.

U-17767 May 22, 2015
Testimony of D. Jester
Exhibit: MSLC 26
Source: City of Warren website
Page 1 of 1

RESOLUTION

WHEREAS, ***THE CITY OF WARREN*** *has converted nine percent of its streetlights to LED lighting and spends nearly two-hundred fifty thousand dollars on street lighting each month; and*

WHEREAS, ***LED*** *lighting is more efficient than other forms of lighting and uses less energy which creates a more sustainable environment and makes Michigan more competitive; and*

WHEREAS, ***LED*** *lighting is brighter than high-pressure sodium lights and thus creates a greater atmosphere of safety in the City of Warren; and*

WHEREAS, *municipalities like Warren made investments in street lighting with the expectation of receiving energy savings and planned to continue to convert lightning to save energy and bring down the cost to taxpayers; and*

WHEREAS, *efficient street lighting helps reduce our energy usage which reduces our emissions of greenhouse gases and creates a planet that is more environmentally sustainable; and*

WHEREAS, *DTE Energy is seeking a rate increase which will raise costs to the city on LED lighting and also the same rate case now before the Michigan Public Service Commission (Rate Case U-17767) will cause in increase in residential customers' rates in the city; and*

WHEREAS, *the reduction of energy usage is made even more important because seventy-five percent of our energy is carbon-intensive and pollution laden energy that comes from coal, while the national average is only thirty-seven percent; and*

WHEREAS, *adding additional pollution controls to the outdated coal plants that provide electricity to the City of Warren is a major additional expense that is part of the three hundred and seventy million dollars the company needs which is the reason the residential rates are going up; and*

WHEREAS, *a comprehensive approach is needed from DTE Energy that will properly account for the actual costs of LED street lighting, protect ratepayers from unnecessary increase, and put us on an environmentally sustainable path which will create a competitive economy.*

NOW, THEREFORE, LET IT BE RESOLVED *that the City of Warren City Council stands together in calling upon our utility company to eliminate its proposed increases on LED street lighting and to move towards more renewable energy to help eliminate the severity of future rate increases, which will keep our economy competitive.*

RESOLUTION DECLARED ADOPTED this ***12th Day of MAY, 2015****.*

Cecil D. St. Pierre, Jr., Council President
Patrick Green, Council Vice President
Scott C. Stevens, Council Secretary, Mayor Pro Tem
Keith J. Sadowski, Council Assistant Secretary
Robert Boccomino, Councilman
Kelly Colegio, Councilwoman
Steven G. Warner, Councilman

S T A T E O F M I C H I G A N

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

****

In the matter of the Application of	)	
DTE ELECTRIC COMPANY	)	Case No. U-17767
for authority to increase its rates, amend	)	(Paperless/e-file)
its rate schedules and rules governing the	)	
distribution and supply of electric energy,	)	
and for miscellaneous accounting authority_/		

Direct Testimony

And Exhibit

of

Nathan Geisler

On behalf of the

Municipal Street Lighting Coalition

May 22, 2015

Q. State your name, business name and address.

A. My name is Nathan Geisler. I am employed by the city of Ann Arbor with offices located at 301 E. Huron Street, Ann Arbor, MI 48107-8647.

Q. On whose behalf are you appearing in this case?

A. I am appearing here on behalf of the Municipal Street Lighting Coalition, of which the City of Ann Arbor is a member.

Q. Summarize your experience related to this case.

A. I am the Energy Programs Analyst for the City of Ann Arbor. The City has maintained an Energy Office and Energy Commission since the mid-1980s, and my role is to further energy conservation, efficiency, and opportunities for renewable energy generation in the community and for municipal operations. I have managed or supported over $2M in federal, state, and foundation grants to further these aims. I work closely with our Field Operations unit that maintains traffic signals and streetlights throughout Ann Arbor, and meet regularly with our utility, DTE Energy, on streetlight issues. I have been involved with our efforts to upgrade streetlights to LEDs since starting work with the City in 2009, both within our own inventory and within the inventory owned by DTE. Along with other staff we evaluate the economic and environmental factors that inform decisions around streetlight upgrades.

Q. Have you testified before this commission or as an expert in any other proceeding?

A. No

Q. Are you sponsoring any exhibits?

A. I am sponsoring Exhibit MSLC-27, the Ann Arbor LED Lighting Summary. It is also available at http://www.a2gov.org/departments/systems-planning/energy/Documents/LED_Summary.pdf

Q. What is the City of Ann Arbor's interest in this case?

A. Ann Arbor currently maintains over 2,200 City-owned streetlights and pays for another 5,300 streetlights owned and maintained by DTE. Thus, nearly one third of total lights are City-owned, yet these account for less than 5 percent of our total DTE streetlight bill, since the City pays for only the energy for these lights. The remaining DTE lights make-up ninety-five percent of streetlight charges to the City. DTE costs exceed $1.5M annually to the City's General Fund, which is the funding source (cities in general use) for police and fire protective services. As a result of steady cost increases, by 2006 a moratorium was placed on adding additional light costs to the system to contain expenditures that were being diverted away from these and other core city services. LEDs have proven to be a cost-saving option that reduces General Fund expenses while simultaneously advancing Ann Arbor's commitment to sustainability and to mitigating the environmental side effects of energy waste.

Municipal street lighting is transforming rapidly, warranting more than periodic rate review set by the utility's own pace of scheduling or revenue recoupment. Technological advancement of light fixtures, experienced and expected pricing reductions for LEDs, and the competing effect that associated expenses have with maintaining public safety and welfare services point to the unique level of scrutiny warranted when the matter of streetlight rates is before the Michigan Public Service Commission.

Q. Please summarize the City of Ann Arbor's experience with LED lighting?

A. The City of Ann Arbor began testing LED streetlights after successful installation of traffic signals in the early 2000s. In 2007 and 2008, after gaining familiarity with the new technology and with successful designs, a full conversion of downtown pedestrian globe-style metal halide lights began. These were some of the first large-scale LED installations for street lighting anywhere in the world. The City received various awards and recognitions for this initiative. As is now well-known, the energy consumption of an LED luminaire compared to a conventional alternative is typically 50% or less, with operational lives estimated at 5 to 10 times that of HID and other long-established, less-efficient technologies. The City of Ann Arbor has invested heavily in LEDs, and has found, through careful specifications of products, that the claims on life and performance that persist within the industry have been mostly very accurate.

It was understood that the bulk of the savings from early conversions is found in avoided maintenance, alongside the drastic drop in energy demand costs. A City-produced white paper on the LED globe conversion project is included with this testimony (MSLC-27), which figures avoided maintenance to make up as much as over 80% of project savings. Rapid payback periods for LED investments on a variety of conventional light types are now commonplace. A careful consideration of the utility's accounting for maintenance savings and windfalls from LEDs should hopefully be reflected in proposed and adopted rates.

Q. What maintenance requirements and costs has the City of Ann Arbor experienced with its city-owned lights?

A. To gauge the effect on streetlight maintenance expenses, the City has compared internal reporting of streetlight maintenance tickets, looking at a baseline year of 2006, before LED conversions began, to recent years with widespread LED conversions underway. The 2006 totals for streetlight maintenance came to an hours-equivalent of 20 days' (486 hours) time across that year. In 2012, when the share of the City-owned inventory of LEDs was up to around 80% of City fixtures, maintenance time was reduced 41% compared to 2006. Averaging the last two years (2013 and 2014) this number was around 8 equivalent days' time per year; or a reduction of around 60% from 2006. The City has converted around 90% of our streetlights to LED as of 2015.

When applying the above person hours with base wages and combining equipment usage and depreciation, for 2006 before any LED conversions, average costs for maintenance per light equaled $18.84/year. For 2013, with the majority of City fixtures being LEDs, average costs for maintenance per light equaled $7.09/year.

The average hourly wage for the total staff enlisted for maintenance work on streetlights is $29.30/hour or $61.24 fully-loaded with overhead. So, at fully-burdened rates yearly maintenance costs, per light, equal $32.95 in 2006 and $12.41 in 2013.

In 2006 the averaged visit time for maintenance for each submitted ticket was 3.7 hours. In the last three years, visit times averaged 2.1 hours. [Equipment costs for bucket trucks per hour equal $26.68 and are combined with worker time in figuring per light, per year costs above.]

Our experience of nearly a decade now has borne out that LEDs are saving the City time and money. Fixtures prices are dropping, warranties are longer (Ann Arbor requires ten years minimum) and forecasted lives to 20 years are purported in a number of fixtures now, including many installed in Ann Arbor.

Q. Do you have any other particular concerns about this case?

A. There are concerns that the ability to convert more LEDs may be significantly stalled due to the rate schedule proposal in case U-17767. The argument will be made elsewhere and in greater detail by the Municipal Coalition that reduced rates for high pressure sodium lights as proposed and coupled with increased rates for utility-owned LEDs will dis-incentivize if not outright halt wider scale adoption of LEDs. Where will this leave the City with regard to addressing DTE's inventory that, as already stated, comprises ninety-five percent of our street lighting costs from the utility? Most of the DTE inventory remaining in Ann Arbor is high pressure sodium, not mercury vapor lights, which remain more viable/attractive for conversions.

Ann Arbor is known for setting strong City Council and Mayor-approved goals related to reducing community carbon emissions and around sustainability broadly. Pitting the choice between LEDs and HPS in stark economic contrast as the rate proposal by DTE does, undermines any hope we or other communities have toward setting a positive path and example towards sustainability. Few energy efficiency alternatives offer the dramatic (50% or better) savings potential that have come with the LED revolution.

Part of the MPSC's current mission to "Promote the state's economic growth and enhance the quality of life of its communities through adoption of new technologies…" will be tested in this case. Ann Arbor believes and evidence strongly supports that energy efficiency creates economic multipliers through savings to communities, and LEDs have been embraced for enhancing quality of life in our City for nearly a decade. Though hardly a new technology any longer, adoption of LEDs remains largely unrealized despite the tremendous benefits described herein and experienced in Ann Arbor.

Q. Does that complete your testimony?

A. Yes

U-17767 May 22, 2015
Testimony of N. Geisler
Exhibit: MSLC 27
Source: City of Ann Arbor

ANN ARBOR'S LED STREETLIGHT PROGRAM

SUMMARY

The City of Ann Arbor is installing LED streetlights in order to reduce lighting costs and greenhouse gas emissions. After successfully piloting an LED replacement for our downtown "globe" lights, the City received a $630,000 grant from the Ann Arbor Downtown Development Authority to fund retrofits for over 1,000 downtown lights. This initial installation will save the City over $100,000 per year, reducing annual greenhouse gas emissions by 267 tonnes CO_2e. In addition, testing will continue on LED replacements for neighborhood streetlights, with the eventual goal of replacing all of our public lighting with LEDs. Full implementation of LEDs would cut Ann Arbor's public lighting energy use in half and reduce greenhouse gas emissions by 2,200 tonnes CO_2e annually.

PROJECT HISTORY

Funding for public lighting is increasingly difficult as electric costs rise and available municipal funds get tighter. In its 2005-2006 budget, the City of Ann Arbor established a moratorium on new street lighting to help keep costs under control. City staff were tasked with finding ways to reduce public lighting costs. Like other cities, Ann Arbor had already replaced all its incandescent traffic signals with LEDs (light-emitting diodes). As with the traffic signals, LED streetlights, if the technology was sufficiently developed, could create significant energy and maintenance savings since LEDs reduce lighting energy requirements by one-half or more and last five times longer than conventional outdoor lighting technologies. In 2005, Ann Arbor committed to investigate LEDs for outdoor public lighting purposes as part of the ICLEI Great Lakes Climate Policy Project.

Initial research into past efforts with LED outdoor lighting in other municipalities like Honolulu and San Diego revealed failed efforts. These tests found that LED products had high costs and poor light output. To assess the current LED technologies, the city invited numerous LED manufacturers to provide test lights, which the City then installed at its own expense to evaluate the performance. Early lighting tests in 2006 were performed in the City Hall parking lot and showed improvement over the older LED technologies. Over the next two years, more successful technologies were demonstrated on city streets in the downtown area and in neighborhoods. Over the last two years of testing, city staff has seen a tremendous improvement in light output and color rendition from LED lighting manufacturers. While lighting distribution and uniformity remain a problem for the highly directional LEDs, we have found applications where the LED technology is ready to replace existing public lighting today.

Tests on LED replacements for our downtown pedestrian "globe" lights have been very successful. This retrofit globe from Lumecon houses LEDs on four panels that face down and out, directing the light toward the street and away from the sky. Each fixture draws 56 watts and is expected to last ten years, replacing fixtures that use 120 watts and only last two years. These globe lights are mounted on ten-foot poles. As a test, 25 of these LED globes, purchased with help from our Downtown Development Authority (DDA), were installed to light one complete block in the Ann Arbor downtown.

With five times the lifetime and less than half the energy use, the lights have a 4.4 year payback. We are now planning to retrofit all of these downtown lights over the next two years. Funding for the downtown light conversions is being provided by a $630,000 grant from the DDA. The downtown LED project will reduce annual greenhouse gas emissions by 267 tonnes CO_2e and save the city over $100,000 annually. The DDA grant will be administered through the Ann Arbor Municipal Energy Fund, which ensures that a portion of the savings from the retrofits is paid back to the fund to pay for future retrofits.

Meanwhile, Ann Arbor will continue to test possible LED replacements for the remainder of our streetlights. If the project succeeds in retrofitting all of the streetlights in Ann Arbor, the annual greenhouse gas emissions reduction is expected to be around 2,200 tonnes CO_2e annually. All of the test installations have signs requesting public input, and the response from the community has been overwhelmingly positive. There seems to be agreement that Ann Arbor's LED streetlight future will indeed be bright.

MORE INFORMATION: BENEFITS OF LEDS

The primary benefits of LEDs are their reduced energy consumption, longer lifetime, directionality and controllability. The energy savings are 50% or more and the lifetime is estimated at 5 times longer which yields the excellent payback time of 4.4 years. The "instant-on" and dimming ability of LEDs will offer additional energy savings through control strategies that can brighten and dim based on time of day, ambient light, or any other control parameters desired. Motion sensors can turn LEDs on or off instantly, allowing lighting to be used only when needed. Typical outdoor lighting (MH or HPS) has a re-strike time of a few minutes before they can turn on and therefore cannot be used with motion sensors. The City of Ann Arbor is partnering with lighting control companies to explore these new possibilities with LED lights. Finally, because LEDs emit directional light, we have more control over what we light (streets and sidewalks) and what we don't (the night sky). This makes for easier compliance with the Dark Skies Initiative, which aims to reduce light pollution and its associated wildlife impacts.

Our test globe LED fixtures use half the energy of the bulbs they replace and cobrahead fixtures use 50 to 80 percent less energy than our current cobraheads. This reduces emissions of mercury from coal power plants which leads directly to reduced CO2 emissions. Full implementation of LED streetlights could cut Ann Arbor's greenhouse gas emissions by over 2,200 tonnes CO_2-equivalent emissions.

One of the greatest advantages of LED fixtures is their lifetime, which reduces maintenance costs. At a ten-year lifetime (compared to two years for a metal halide bulb), city staff will need to change far fewer bulbs, ballasts, and igniters. In fact, maintenance savings alone are sufficient to make LED fixtures cheaper on a lifecycle basis than conventional fixtures.

MORE INFORMATION: LIFE-CYCLE COST ANALYSIS

Continue with existing bulbs (2 year life)

	Number	Cost	
Bulb replacements	5	$37	$186
Bulb labor & equip	5	$211	$1,056
Ballast (10 yr life)	1	$59	$59
Igniter (10 yr life)	1	$35	$35
Energy cost (4,380 kWh)			$325
			$1,661

Change to LED bulb (10 year life)

	Number	Cost	
Bulb replacements	1	$460	$460
Bulb labor & equip	1	$56	$56
Energy cost (2,100 kWh)			$182
			$698

10-year Maintenance saving	**$819**
10-year Energy saving	**$143**
Total	**$962**

Each LED replacement bulb saves $962 in energy and maintenance costs over its ten-year lifetime. At this savings rate, the new bulb pays for itself in 4.4 years ($423 / $96). This analysis is based on our downtown globe lights, but initial inquiries into cobrahead fixtures suggest that the results will be even better.

MORE INFORMATION: TEST INSTALLATIONS

The first test fixtures that the City received and installed in our City Hall parking lot in the summer of 2005 were unimpressive. We got the sense that LED lighting manufacturers were not quite ready to meet our public lighting needs. Over the following year, however, the test fixtures we received from manufacturers increased markedly in quality and today Ann Arbor is seriously considering moving to LEDs for public lighting.

The second test installation consists of a series of overhead streetlights (called "cobraheads" because of their shape) in a residential neighborhood. These fixtures have not been purchased yet as the block of downtown globes have, but are instead on loan from the manufacturers. Wattages vary from 50 to 80 watts for fixtures that replace 250-watt fixtures. Manufacturers of cobrahead replacements currently installed for testing include **Holophane, IntenCity, Leotek, Lumecon, and Millenia Technologies**.

Holophane cobrahead

Lumecon globes

To evaluate these fixtures, Ann Arbor is employing a four-part test process, with lights being assessed on light output, heat management (which affects lifetime), and general public input.

Light Output: The cobrahead replacements are installed on a residential street where the spacing allows for each fixture's light output to be judged independent of adjacent fixtures but where different fixtures can be easily compared. City staff is measuring light output and plans are in the works for a more involved public input process to evaluate the fixtures' aesthetics.

Heat Management: One of the most attractive characteristics of LEDs is their long lifetime, but this lifetime depends directly on the fixture's operating temperature. As a result, heat management testing is vital to identifying fixtures that achieve our goal of a ten-year life. City staff is measuring the operating temperature of fixtures to project the useful life of different test fixtures.

Energy Consumption: Each light is tested for electricity use in watts to verify energy savings.

Public Input: All the test installations have signs requesting public input, and the response from the community has been overwhelmingly positive (81 of 83 responses). The 81 positive responses emphasized the lack of light spilling out onto yards and house faces ("light trespass"). One negative response commented that the light was too harsh. The other negative comment reflects a minority opinion about the purpose of public lighting, objecting that the LED cobrahead no longer lit up their garage and yard and that the globe LEDs were creating a "dark cavern" through the downtown.

Test light public input sign

CONTACT INFORMATION

City of Ann Arbor
(734) 794-6000
Energy Office: Andrew Brix (energy@a2gov.org)

Holophane
www.holophane.com

IntenCity Lighting, Inc.
(479) 229-0013
www.intencitylighting.com

LEDTronics
(800) 579-4875

Leotek
(888) 806-1188
www.leotek.com

Lumecon LLC
(877) 564-3133
www.lumecon.com
Municipal: bobhahn@lumecon.com

Millenia Technologies
www.milleniatechnologies.com
Roger Lang: (217) 887-2770

MoonCell Inc.
(540) 429-6155
www.mooncell.com

Relume Technologies
(248) 969-3800
www.relume.com
Commercial Signage: Bill Langhorst (wlanghorst@relume.com)

3. Please indicate whether Mr. Jester performed an analysis of the purchased cost of LED lights from vendors that provide a 5-year warranty compared to LED lights from vendors that provide a 10-year warranty. If the answer is “yes,” provide Mr. Jester’s analysis.

Mr. Jester did not perform an independent analysis but is aware that DTE has found a 10-year warranty to be cost effective and requires a 10-year warranty on its purchases of LED lights. In addition, documentation produced in response to Item 5(a) below demonstrates that Boston and Seattle each utilize 10-year warranties on their current LED acquisitions. Boston indicates that in their “Fourth Phase” that has continued since April 2013, all of their LED lights have a 10-year warranty.

WITNESS – Douglas Jester

4. On page 21, lines 4-7 of Mr. Jester's testimony, he states as follows: "I note that using the weighted average cost of capital proposed by the Company in this case would result in a levelized fixed charge equal to approximately 74.9% of the fixed charges proposed by the Company for LED rates." Please provide the supporting calculations for the 74.9% figure referenced by Mr. Jester.

RESPONSE - Please see the Excel spreadsheet titled KPSC 2016-00370 Jester Levelization Ratio Workpaper.

WITNESS – Douglas Jester

Year	Value	Earnings	Depreciation	Income Tax	Property Tax	RR	Discount	Discounted RR	
1	$ 1,000.00	$ 72.91	$ 40.00	$ 34.69	$ 18.24	$ 165.84	1	$ 165.84	
2	$ 960.00	$ 69.99	$ 40.00	$ 33.30	$ 17.51	$ 160.81	0.92709	$ 149.08	
3	$ 920.00	$ 67.08	$ 40.00	$ 31.91	$ 16.78	$ 155.77	0.859496	$ 133.89	
4	$ 880.00	$ 64.16	$ 40.00	$ 30.53	$ 16.05	$ 150.74	0.79683	$ 120.11	
5	$ 840.00	$ 61.24	$ 40.00	$ 29.14	$ 15.32	$ 145.71	0.738733	$ 107.64	
6	$ 800.00	$ 58.33	$ 40.00	$ 27.75	$ 14.59	$ 140.67	0.684872	$ 96.34	
7	$ 760.00	$ 55.41	$ 40.00	$ 26.36	$ 13.86	$ 135.64	0.634938	$ 86.12	
8	$ 720.00	$ 52.50	$ 40.00	$ 24.98	$ 13.13	$ 130.60	0.588645	$ 76.88	
9	$ 680.00	$ 49.58	$ 40.00	$ 23.59	$ 12.40	$ 125.57	0.545727	$ 68.53	
10	$ 640.00	$ 46.66	$ 40.00	$ 22.20	$ 11.67	$ 120.54	0.505938	$ 60.98	
11	$ 600.00	$ 43.75	$ 40.00	$ 20.81	$ 10.94	$ 115.50	0.46905	$ 54.18	
12	$ 560.00	$ 40.83	$ 40.00	$ 19.43	$ 10.21	$ 110.47	0.434851	$ 48.04	
13	$ 520.00	$ 37.91	$ 40.00	$ 18.04	$ 9.48	$ 105.44	0.403146	$ 42.51	
14	$ 480.00	$ 35.00	$ 40.00	$ 16.65	$ 8.76	$ 100.40	0.373753	$ 37.53	
15	$ 440.00	$ 32.08	$ 40.00	$ 15.26	$ 8.03	$ 95.37	0.346503	$ 33.05	
16	$ 400.00	$ 29.16	$ 40.00	$ 13.88	$ 7.30	$ 90.34	0.321239	$ 29.02	
17	$ 360.00	$ 26.25	$ 40.00	$ 12.49	$ 6.57	$ 85.30	0.297818	$ 25.40	
18	$ 320.00	$ 23.33	$ 40.00	$ 11.10	$ 5.84	$ 80.27	0.276104	$ 22.16	
19	$ 280.00	$ 20.41	$ 40.00	$ 9.71	$ 5.11	$ 75.24	0.255973	$ 19.26	
20	$ 240.00	$ 17.50	$ 40.00	$ 8.33	$ 4.38	$ 70.20	0.23731	$ 16.66	
21	$ 200.00	$ 14.58	$ 40.00	$ 6.94	$ 3.65	$ 65.17	0.220008	$ 14.34	
22	$ 160.00	$ 11.67	$ 40.00	$ 5.55	$ 2.92	$ 60.13	0.203967	$ 12.27	
23	$ 120.00	$ 8.75	$ 40.00	$ 4.16	$ 2.19	$ 55.10	0.189096	$ 10.42	
24	$ 80.00	$ 5.83	$ 40.00	$ 2.78	$ 1.46	$ 50.07	0.175309	$ 8.78	
25	$ 40.00	$ 2.92	$ 40.00	$ 1.39	$ 0.73	$ 45.03	0.162527	$ 7.32	
							11.64892	$ 1,446.33	$ 124.16
									74.9%

5. On page 24, lines 1-5, of Mr. Jester's testimony, he states as follows: "The Cities of Boston, Seattle, and Las Vegas are typically using long-life LED fixtures and photocell with anticipated 20-year life in current installations, reflecting their experience. It should be possible, and cost-effective, for Kentucky Utilities to use LED fixtures with an anticipated lifecycle consistent with an assumed 25-year depreciation schedule." Please provide the following information regarding Mr. Jester's statements:

a. Provide documents from Boston, Seattle, and Las Vegas where the city has stated that it anticipates a 20-year life for their current LED installations.

b. Please indicate whether the Cities of Boston, Seattle and Las Angeles performed a cost benefit analysis in support of their selection of LED lights that had a 20-year life. If so, provide a copy of the Cities' or utility's cost benefit analyses.

c. Please provide all analysis conducted by Mr. Jester demonstrating that it should be cost-effective for Kentucky Utilities to use LED fixtures with an anticipated lifecycle with an assumed 25-year depreciation schedule.

d. Please indicate whether the LED lights for the Cities of Boston, Seattle and Las Vegas were installed by (i) an investor-owned utility or by (ii) the Cities or the Cities' municipal utilities.

RESPONSES -

a. Representatives of these cities indicated that they anticipated a 20-year life for their LED installations during a webinar sponsored by the US Department of Energy in 2014. Mr. Jester's testimony is based on their remarks, slides for which are attached.

b. LFUCG presumes that this question intended to refer to Las Vegas. Mr. Jester is not aware whether or not the Cities of Boston, Seattle, and Las Vegas have produced reports containing cost-benefit analyses in support of their selection of LED lights and is not in possession of any such analyses by these cities. Their street lighting managers spoke concretely that their decisions were based on life-cycle cost considerations.

c. Mr. Jester has not performed such an analysis. However, in view of the range of long-lived LED lighting products by a number of vendors, it is unlikely that all of these products are cost-ineffective. He expects that when Kentucky Utilities solicits proposals from lighting vendors, it will examine the cost-effectiveness of offered products including those for which a long depreciation schedule will be appropriate.

d. Street lights in the Cities of Boston, Seattle, and Las Vegas are installed by the cities or the cities' municipal utilities. They therefore lack a profit motive to understate the expected life of this equipment.

WITNESS – Douglas Jester

Maintenance Practices for LED Street Lights

Glenn Cooper
Associate Electrical Engineer
City of Boston –Public Works Department
Street Lighting Section

Maintenance Practices for LED Street Lights
Status of Program - 2014

- As of March 31, 2014 – over 33,000 Installs have been completed
- Over next fiscal year – 8,000 to 10,000 additional conversions will be completed
- Balance of system (21,000 lights) to be completed by end of Fiscal Year 2017 (June 2017). We anticipate that all 64,000 electric lights will be completed

Maintenance Practices for LED lights
Lights Installed

- All of the lights currently installed in Boston are still under Manufacturers Warrantee
  - Initial 23,000 units have a five year Warrantee which includes
    - Complete replacement of unit not just the defective component
    - All shipping charges returns and replacements are paid for by the Manufacturer

Maintenance Practices for LED Street Lights What we have learned thus far

- Initial installation performed November 2010 to March 2011
  - All units installed were cobra Head style installations – Mercury Vapor Lamp Source
  - 3000 Units installed primarily on Residential Streets
    - Of the 3000 initial installs, there have been 97 defective units returned to this manufacturer
      - This equates to a 3 % defective rate over the three and a half year installation

Maintenance Practices for LED Street Lights
Sample of first unit installed in Boston

Maintenance Practices for LED Street Lights

- Second Installation - April 2011 through November 2012
- Again all units installed were Cobra Head Style – Mercury and Sodium Vapor Lamp Source
  - 20,000 lights installed on Residential, collector and Commercial streets throughout the City of Boston
    - Of the 20,000 lights installed, 156 were returned as defective This equates to a .8% defective rate over the past 2 ½ - 3 years

Maintenance Practices for LED Street Lights
Typical Unit installed in Second Phase of Conversion

Maintenance Practices for LED Street Lights

- Third Phase of LED Conversions November 2012 to April 2013
  - Units were to replace all Mercury Vapor Post Top Luminaires – Approximately 3000 units of this classification were targeted
  - Specifically in Downtown residential areas
  - Neighborhood very pleased with installation
  - Units have five year warrantee
  - To date 88 units have been defective
    This equates to   2.9 % defective rate over the past 1 ½ years

Maintenance Practices for LED Street Lighting Typical unit in third phase of LED Conversion

Maintenance Practices for LED Street Lights

- Fourth Phase (April 2013 to Date)
  - Replacement of 10,000 of what we call in Boston the Shoe box or Rectilinear Luminaire. Mercury Vapor and Sodium Vapor Street Lights are targeted
  - First units to offer 10 year total replacement Warrantee.
    - Unit dates back to the 1960's
    - Units on Residential Streets City-wide
    - To date 6,000 units have been completed
    - Of the 6,000, 30 units have been defective
      This amounts thus far to a defect rate of .5 %over the past year
    - All installation failure rates have been acceptable within industry standards.

Maintenance Practices for LED Street Lights
Out with the old

Maintenance Practices for LED Street Lights
In with the new

Maintenance Practices for LED Street Lights

- What have we learned thus far (Engineering)
  - Not all Luminaires are created equal.
    - Specifications are critical to ensure that the products used are of the highest quality available
    - Write specifications that are clear and concise
    - Even with the best Specifications issues arise during installation
      - Minor issues have occurred with the units but the Manufacturers are quick to analyze and revise the manufacturing process

Maintenance Practice for LED Street Lights

- Defects in LED units thus far
  - Majority of failures have been in the driver assembly. These units were replaced by the Manufacturer
  - One manufacturer had exhibited leakage in the LED chamber causing the LED board to fail
  - One Manufacturer's unit started to flash or strobe. This is currently under investigation between the City and the Manufacturer
  - There has been a rise in what we call Major system Failures, but these aren't related to LED installs but due to the aging infrastructure in the City

Maintenance Practices for LED Street Lights

- Impact of LED Installations
  - Decrease of the number of Complaints regarding outages.
    - Prior to Conversion, City responded to over 9000 complaints for light outages
    - FY14 we anticipate to see the number drop to 6500 based on current trends
    - As conversion goes forward, we anticipate the number to drop
    - Crews will switch to Deferred Maintenance such as replacement of old damaged cable, pole replacements and re-splicing of underground cables. Some splices in ground still have friction tape as the primary insulator
    - Complaints even today are still filed by Constituents who feel that they are getting less light then before. Once we explain how LED lights work, they are generally satisfied

Maintenance Practices of LED Street Lights

- Impact on Inventory
  - In process of reduction of Inventory prior to our relocation to a new facility along with the conversion to LED
    - Auctioning off obsolete equipment – HPSV, MV and MH Cobra Heads
    - Reducing overall inventory by 30% due to LED installation along with smaller interim facility
    - Updating inventory processes to streamline operation based on a Kanban system
    - Look into the bar coding of all future street lighting equipment to keep a more up to date inventory system

Maintenance Practices of LED Street Lights

- Inventory
  - Future Inventory
    - With the constant changes in LED technology, we are unsure as to how the future stock room will look
    - Assumptions:
      - There will be an inventory of complete luminaires for replacement of luminaires that reach the 70% threshold as well as replacements due to motor vehicle accidents
      - Inventory of drivers for each luminaire in our inventory. As LED chips reach there optimal output, we anticipate the number of drivers required for inventory should decrease
      - Increase of infrastructure inventory as we switch from luminaire maintenance to infrastructure maintenance. Such items would consist of cable, connectors, conduit, splicing kits

Maintenance Practices for LED Street Lights

- Future recommendations and practices
  - Prior to conversion to LED, existing infrastructure should be investigated and if necessary, replace old components as part of the conversion. It will reduce call backs
  - Consider using long life photocells. It may cost a few dollars more, but it will reduce the need for crews to revisit the location to replace the photocell. One repeat trip back will more than pay for the photocell
  - Ensure that Manufacturer can provide a house shield to minimize light trespass
  - Utilize the same color temperature on all luminaires regardless of roadway types. Uniformity is key to any successful lighting project

Questions or Comments

Glenn Cooper

Associate Electrical Engineer

City of Boston – Public Works Department – Street Lighting Section

Email: glenn.cooper@ boston.gov

Seattle City Light

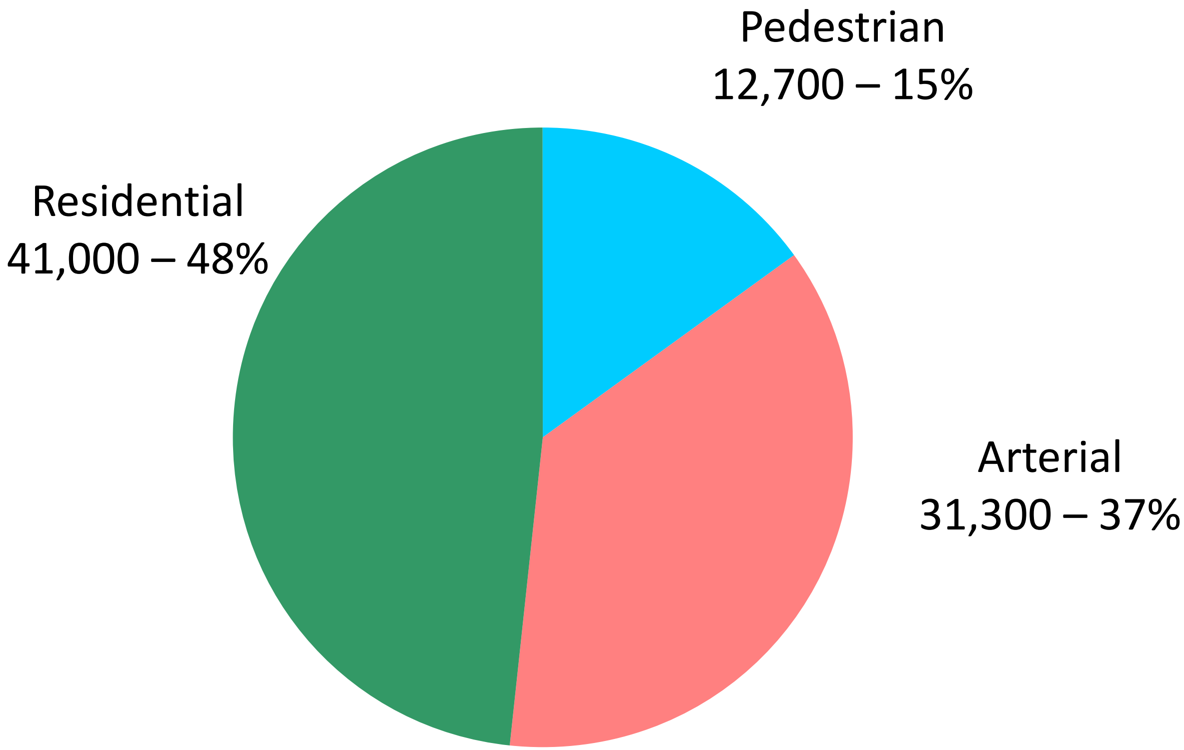
An LED conversion story

Steve Crume

Streetlight Engineering Manager

MSSLC Maintenance Webinar | April 14, 2014

SCL Lighting Types by Use
(Streetlights are City Light's 5th largest customer)



85,000 Total Fixtures

Seattle City Light

Streetlight system maintenance costs

- 4-year re-lamping cycle (HPS)
  - 21,000 re-lamps per year
- Annual cost for labor and materials
  - $1.4 million

Annual O&M cost of HPS system = $14.4 million

- Total annual cost of HPS system
  - Operation $13 million
  - Maintenance $1.4 million

- $14.4 million

Difficulty maintaining a fully operating system

- Slow repair response to streetlight failures
  - Up to 4 months to respond to one streetlight
- At one point, there were 5,000 trouble tickets in queue
  - Hence the scheduled re-lamping every 4 years
- Installed fixtures exceeded design life
  - Caused ballast inefficiency
  - Affected light output

Mayor's Accountability Agreement

- Improve customer experience and rate predictability
- Continue conservation and environmental stewardship leadership
- Enhance organizational performance

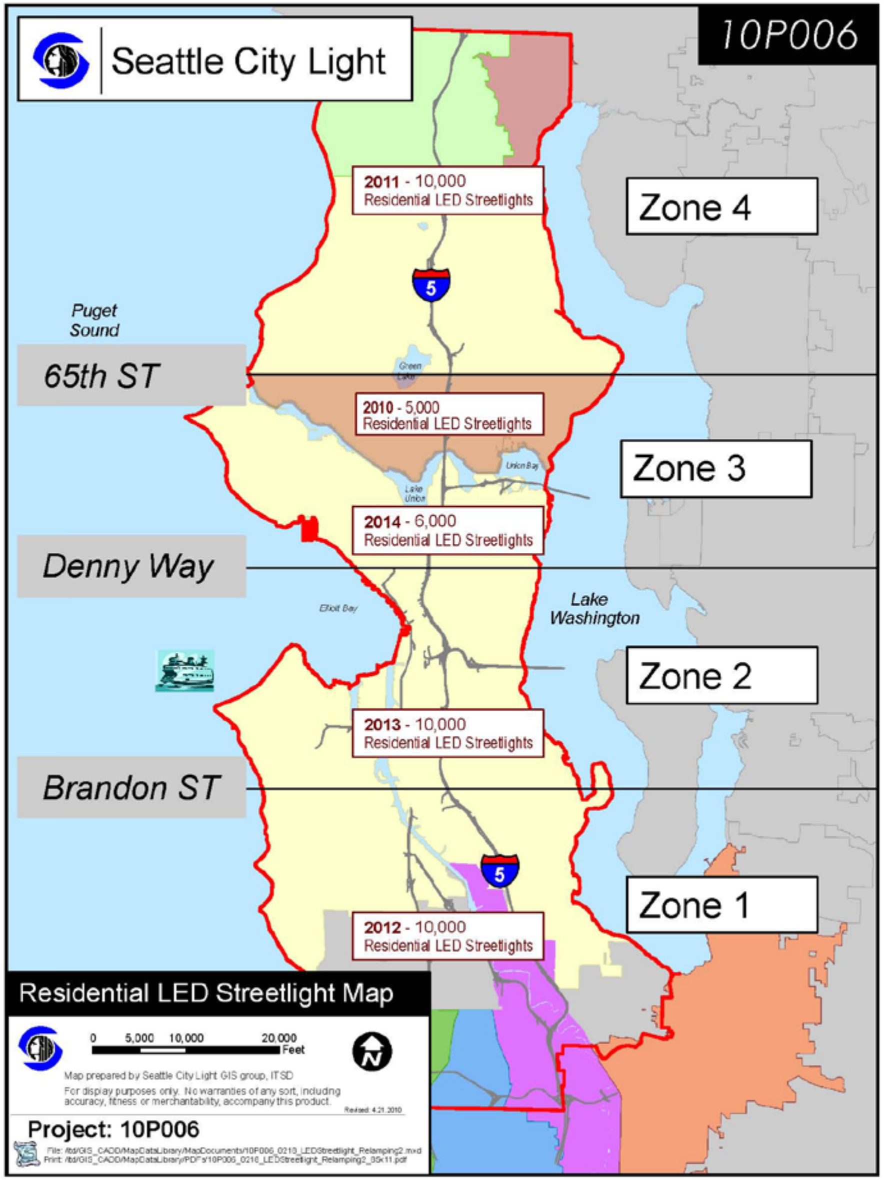
In 2009, we began exploring LED technology

- Longer life
- Less maintenance
- Energy efficient
- Whiter light

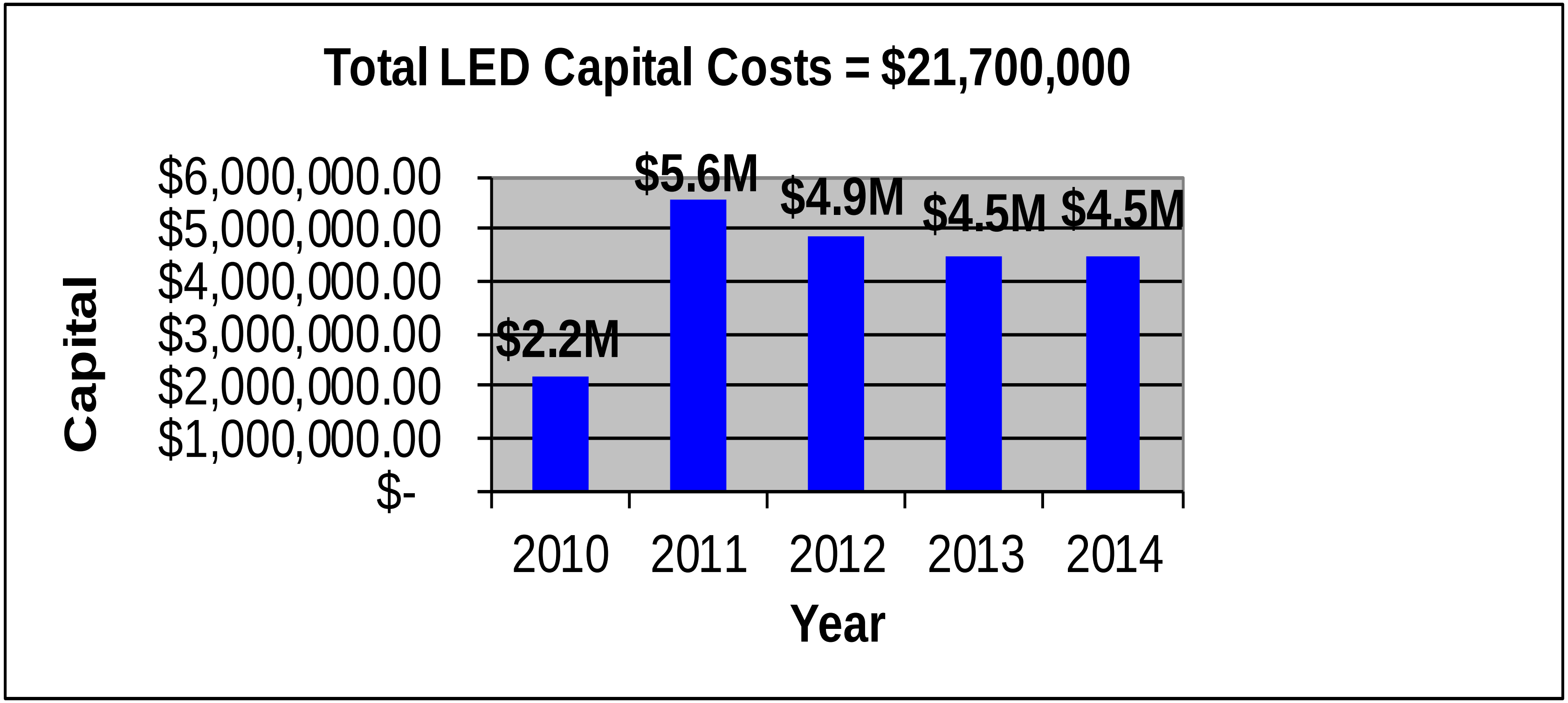
Initial LED goals

- Reduce energy use by 40%
- Reduce carbon footprint
- Lower maintenance costs
- Improve customer service
- Increase system reliability
- Improve operation on bridges (vibration resistance)

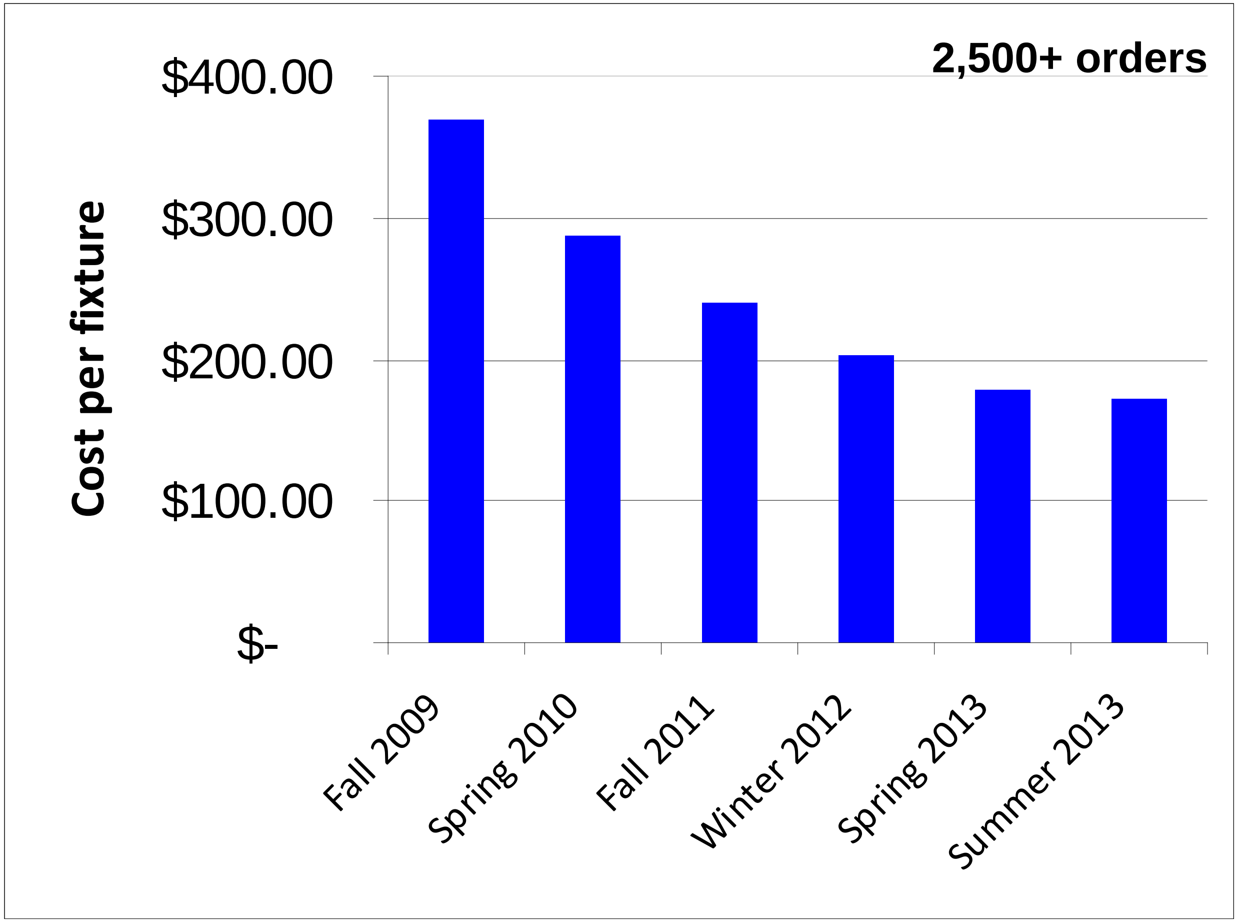
41,000 Total Residential LED Streetlights Converted



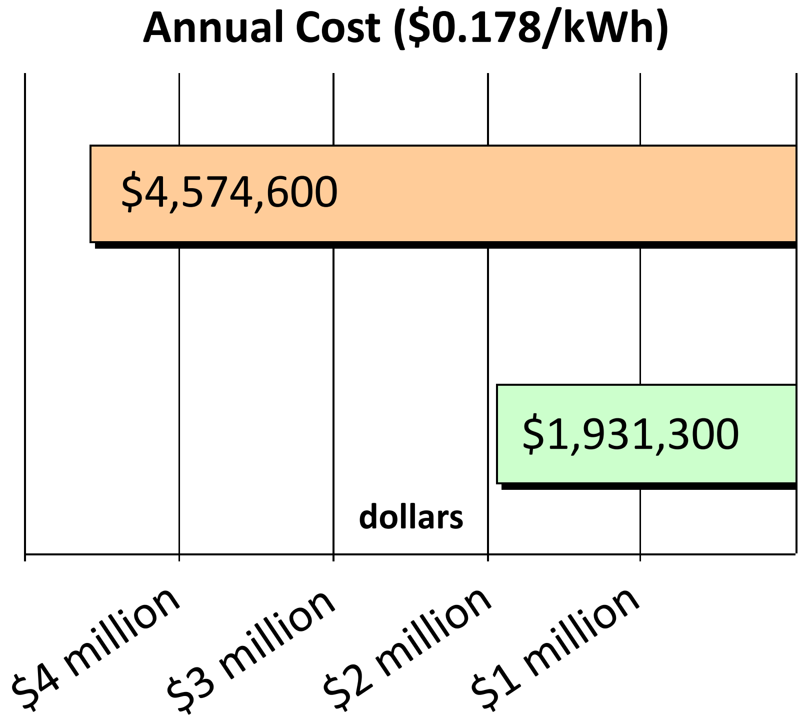
Investment on LED Conversion

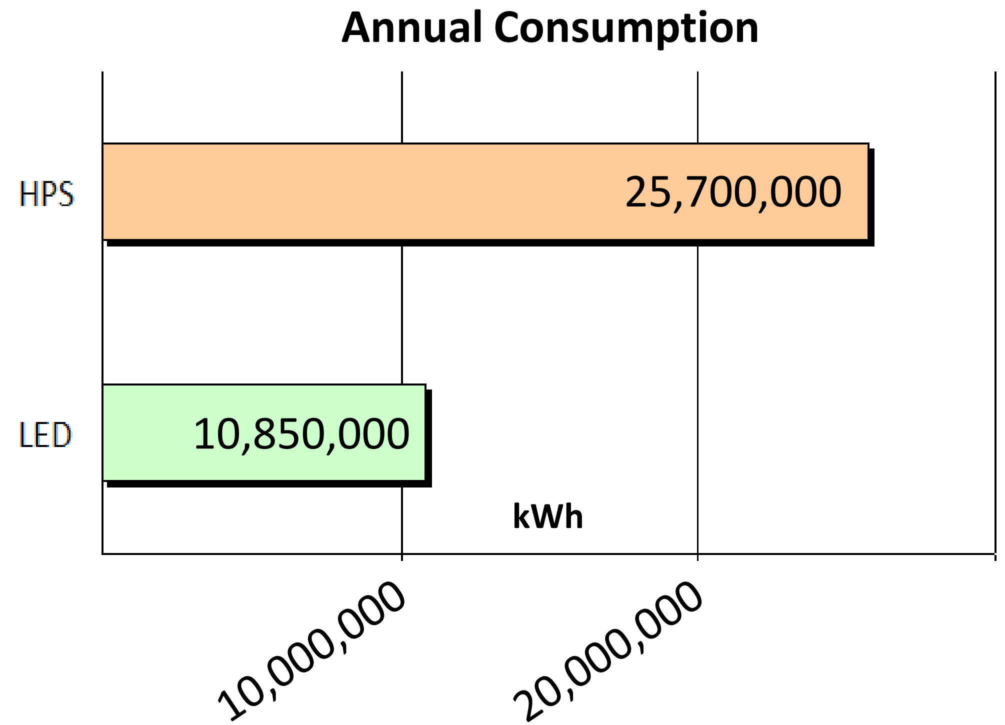


Residential LED fixture costs decreased by half in 4 years



To date:





$2,643,300 savings

14,850,000 kWh savings

Seattle City Light

LED Streetlight Program Savings

Residential LED Installations				
	Units Converted	Savings Per LED	Monthly Savings	Annual Savings at end of period
All Residential Streets Completed	41,000	$ 5.16	$211,560.00	$2,538,720.00

Cleaning Costs (prorated based on 1 cleaning cycle every 7.5 years) ($246,000.00)

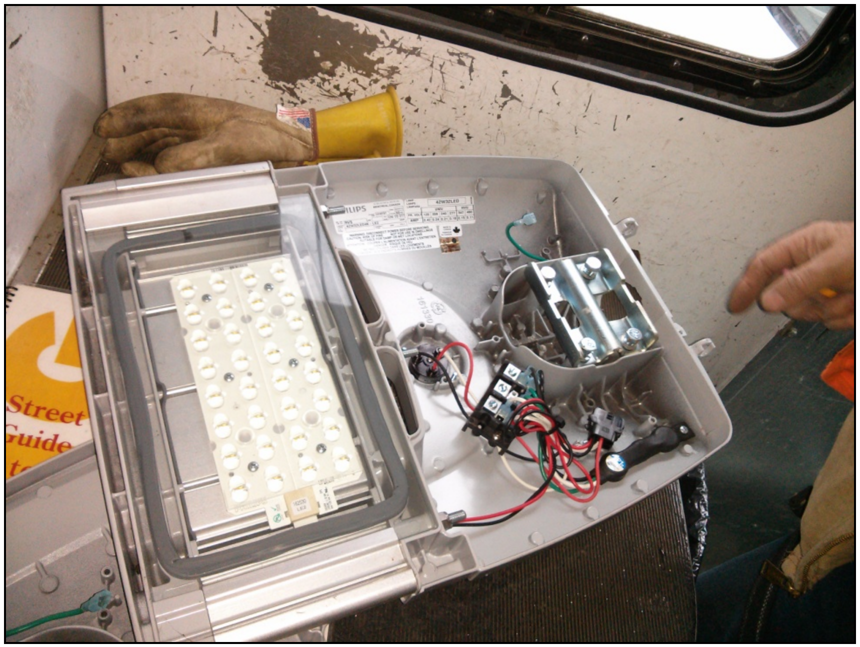
Residential conversions are completed with arterial conversions ramping up

2013	Arterial conversion has begun with 1800 units
2014 – 2018	Arterial LED conversion *
2019+	Decorative/pedestrian, and flood lighting LED conversion

Lessons learned from the field

- Customer Complaints
    - Color Quality
    - Light Trespass
    - Visibility
  - Remedy
    - Installing shields
    - Lowering drive current
- Compatibility issues between fixture and PE cell
  - Remedied by additional training

1. Specify design requirements
2. Datasheet/test report evaluation
3. **Sample request**
4. **Fixture/housing analysis | Mock-up**
5. In-situ light level evaluation



- Lab study to confirm light-level claims
- Evaluate each fixture for handling issues

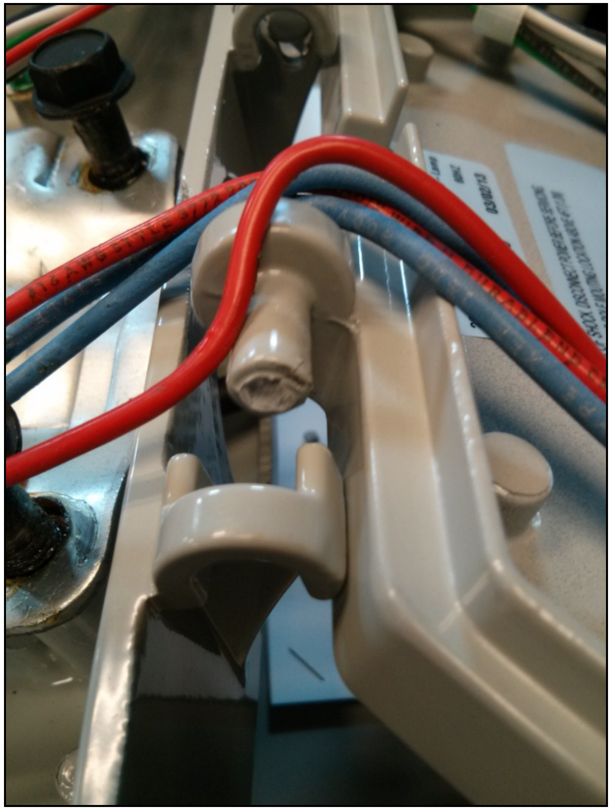
Fixture count: **10**

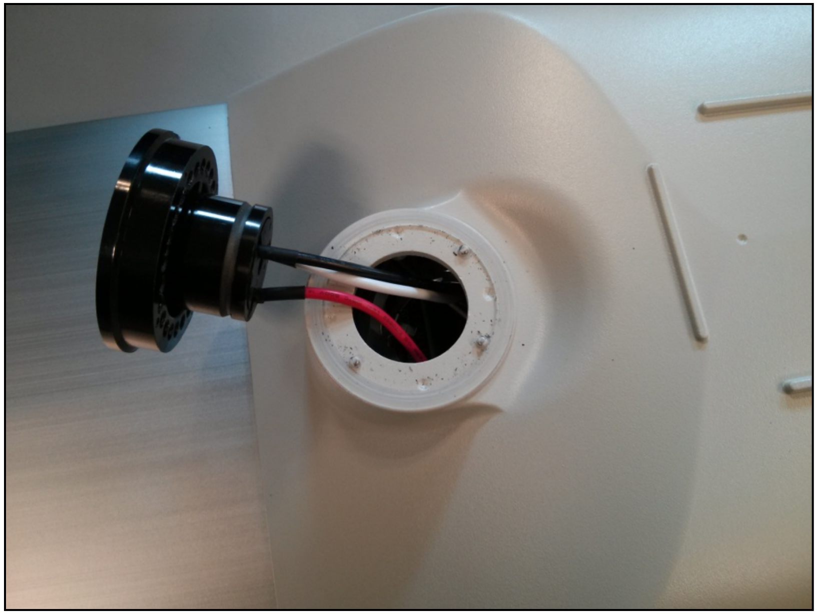
1. Specify design requirements
2. Datasheet/test report evaluation

3. Sample request

4. Fixture/housing analysis | Mock-up

5. In-situ light level evaluation





Fixture count: **3**

Seattle City Light

Other maintenance considerations

- 10 year warranty on new luminaires
- Use 20 year life photocells
- Reduces load on streetlight circuits
- Eliminates vibration caused failures on bridge structures
- LED conversion & group re-lamping have reduced outages from several thousand to less than 200

Resources

- Department of Energy

  Municipal Solid-State Street Lighting

  http://www1.eere.energy.gov/buildings/ssl/consortium.html

- Illuminating Engineering Society

  ies.org

- Seattle City Light

  seattle.gov/light/engstd

Thank you!

Steve Crume

Streetlight Engineering Manager

Seattle City Light

Stephen.Crume@seattle.gov

Seattle City Light

City of Las Vegas Street Light Upgrade

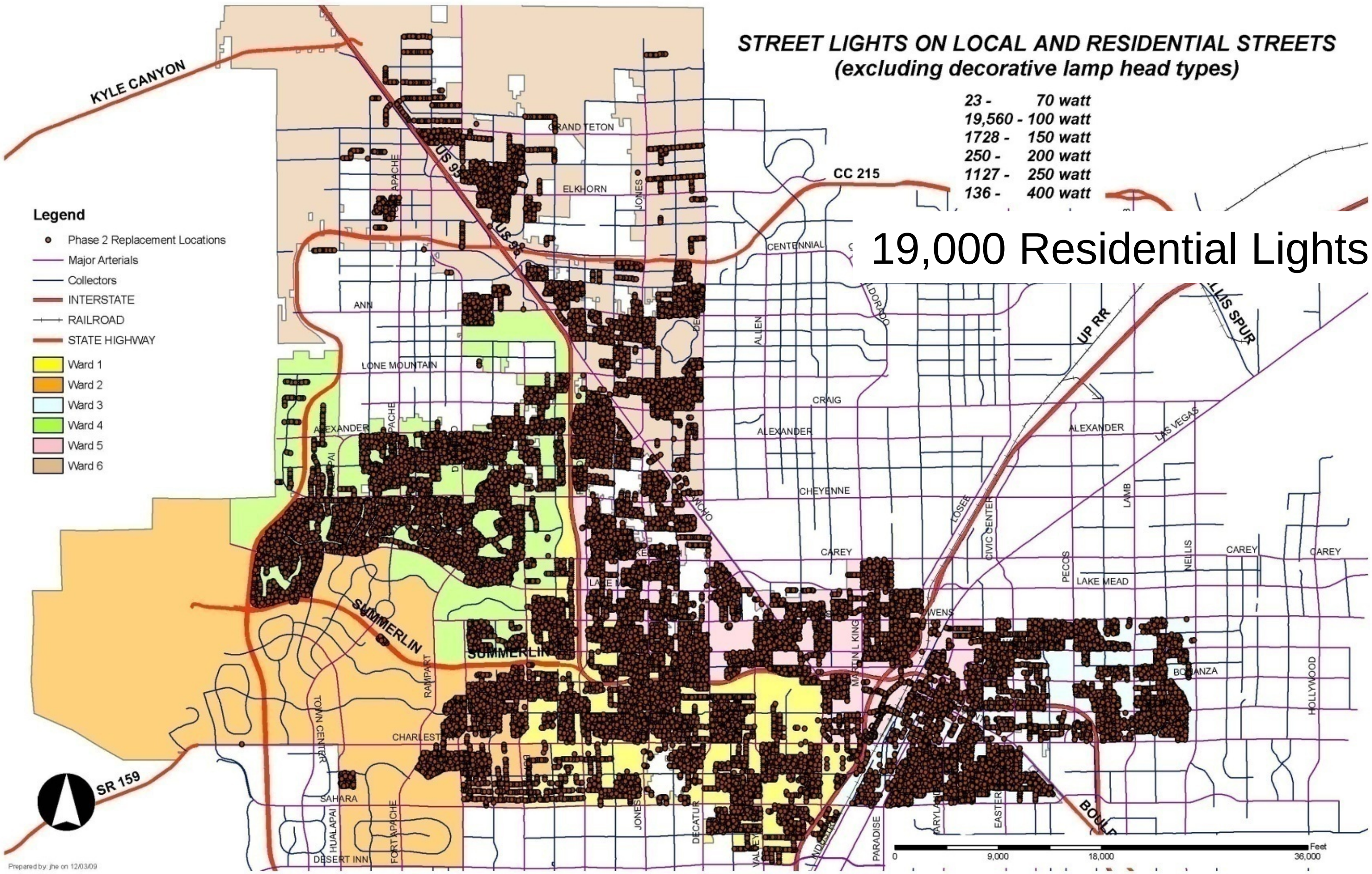
Patrick Batte’ AIA LEED AP
City of Las Vegas
Architectural Project Manager

City of Las Vegas

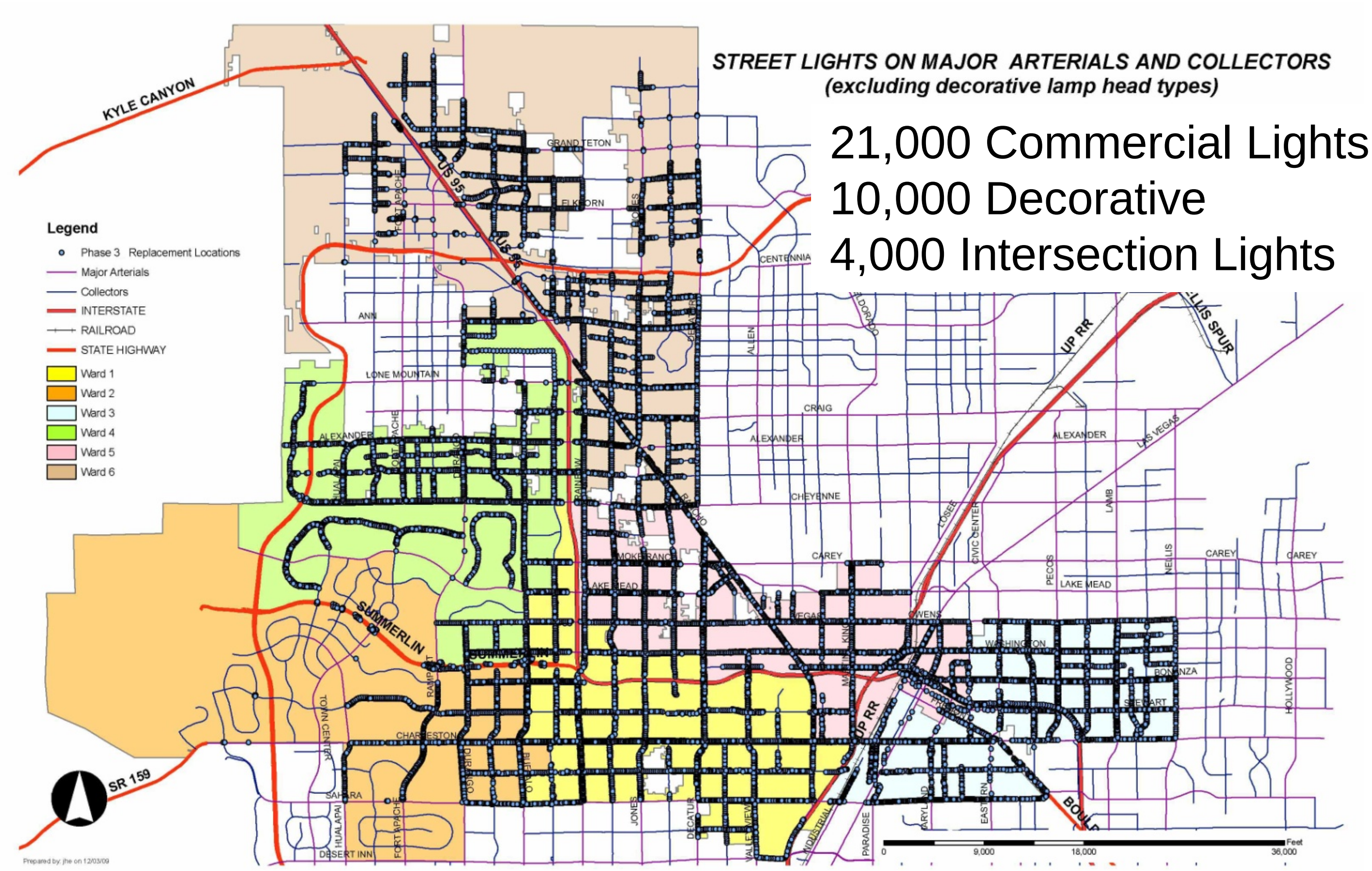
- 600,000 Habitants
- 135.9 Sq. Miles
- Six Districts (Wards)
- Part of Las Vegas Valley with a population of 2,000,000
- 54,000 Streetlights Total
- 19,000 Residential Streets-Converted to LED May 2013
- 21,000 Commercial Streets-Converted to LED May 2013
- 4,000 Intersections- 2014
- 10,000 Decorative Commercial Lights-2015

All Public Lighting is Metered

City of Las Vegas



City of Las Vegas



21,000 Commercial Lights
10,000 Decorative
4,000 Intersection Lights

Streetlight Upgrade-Testing Phase

- 4 month process-5 Different Products
- City staff Measured Illumination Levels by RP-8.
- Testing of Brands Occurred at Same Location
- Additional Fixture - Staff Examination for Service and Maintenance

Staff lab evaluation of fixture type for service and maintenance

Streetlight Upgrade-Evaluation Phase

- Percentage Point System based on five categories /

1. Durability-10%
2. Serviceability-20%
3. Energy Savings-20%
4. Illumination Evaluation-25%
5. Cost-15%

City of Las Vegas Street Light Fixture Evaluation and Testing RFP — RFP No. 100240-TF

Equipment Evaluation Score Card

Local

FIXTURE	Durability - Section 1.0/10%							Serviceability - Section 2.0/20%												Energy Savings - Section 3.0/30%								Lighting Evaluation - Section 4.0/25%			Cost - Section 5.0/15%	
	1.1	1.2	1.3	1.4	1.5	1.6	Total Weighted	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	Total Weighted	3.1	3.2	3.3	3.4	3.5	3.6	3.7	Total Weighted	4.1	4.2	Total Weighted	5.0	Total Weighted
A	5	5	5	2	6	6	5.80	10	10	10	0	5	10	5	5	5	0	1	13.56	5	5	0	3	0	0	0	11.82	10	8	22.5	0.66	9.9
B	5	5	0	3	5	5	4.60	10	10	0	10	5	10	5	5	0	10	5	15.56	5	0	0	3	4	0	0	10.91	10	10	25	0.71	10.66
C	5	5	5	3	5	4	5.40	10	0	10	10	5	10	0	0	5	10	1	13.56	5	5	0	3	0	0	0	11.82	10	6	20	0.23	3.50
D	5	5	5	10	7	8	8.0	10	10	10	10	5	10	5	5	5	10	10	20.00	5	5	0	3	4	0	0	15.45	10	8	22.5	0.66	9.92
E	5	5	0	8	10	6	6.80	10	10	10	10	5	10	5	5	5	10	7	19.33	5	0	0	3	4	0	0	10.91	0	5	6.25	1.0	15

A zero score in any evaluation section marked yellow indicates failure to meet minimum requirements listed in the RFP

Arterial

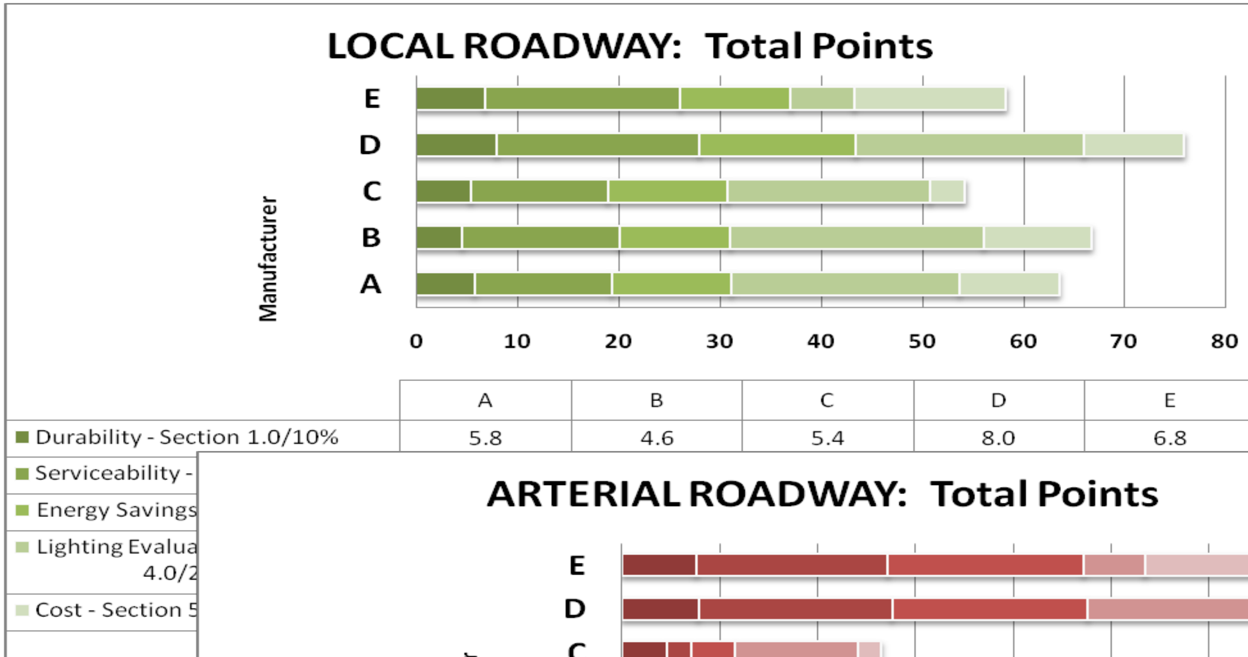
FIXTURE	Durability - Section 1.0/10%							Serviceability - Section 2.0/20%												Energy Savings - Section 3.0/30%								Lighting Evaluation - Section 4.0/25%			Cost - Section 5.0/15%	
	1.1	1.2	1.3	1.4	1.5	1.6	Total Weighted	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10	2.11	Total Weighted	3.1	3.2	3.3	3.4	3.5	3.6	3.7	Total Weighted	4.1	4.2	Total Weighted	5.0	Total Weighted
A	5	5	5	2	2	6	5.00	10	10	10	10	5	10	5	5	5	10	7	19.33	5	0	0	3	0	0	0	7.27	9	5	17.5	0.75	11.3
B	5	5	5	9	5	5	6.80	10	10	10	10	5	10	5	5	5	10	9	19.78	5	5	0	3	4	0	0	15.45	0	10	12.5	0.42	6.2
C	5	5	5	1	3	4	4.60	0	0	0	0	5	0	0	5	0	0	1	2.44	5	0	0	0	0	0	0	4.55	0	10	12.5	0.16	2.4
D	5	5	5	9	7	8	7.80	10	10	10	10	5	10	5	5	5	10	9	19.78	5	5	0	3	4	5	0	20.00	8	6	17.5	0.44	6.6
E	5	5	5	7	10	6	7.60	10	10	10	10	5	10	5	5	5	10	8	19.56	5	5	0	3	4	5	0	20.00	0	5	6.25	1	15.0

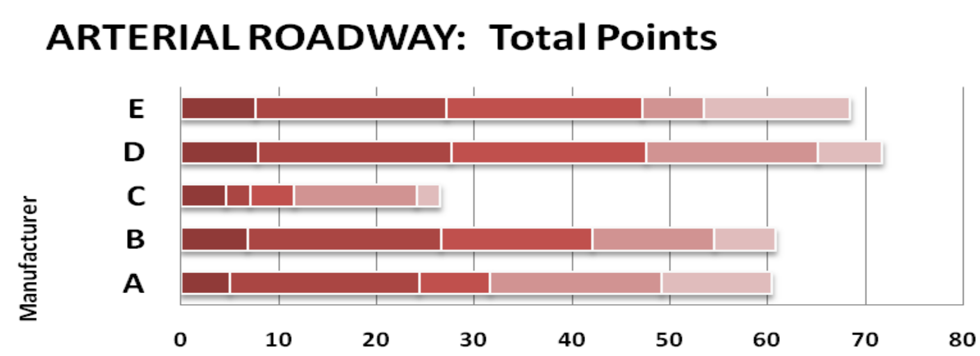
2.6 - Tooless entry (Section 4Q)
2.10- Weight greater than 25 lbs.(Section 4V)
3.5-Power savings greater than 40% of HPS fixture (Section 3.1)
4.1-Illumination distribution meeting RTC (Section 3A, 4H)

Streetlight Upgrade-Evaluation Phase-Service/ Maintenance Category

- M1 – Luminarie have a slim, low profile design?
- M2 – Is Luminarie constructed of Extruded aluminum with cast aluminum components?
- M4 – Is Luminarie equipped with a shorting cap for future 3-prong twist lock socket?
- M5 – Is Luminaire able to be mounted on standard horizontal tenon?
- M6 – Is Luminaire adjustable for fixture leveling (+/- 5 degrees)?
- M7 – Is the ballast/driver located within the housing and easily accessible.
- M8 – Is Luminaire clearly labeled with full catalog number?
- M10 – Is Luminaire equipped with integrated bubble level?
- M11 – Are all serviceable parts free from sharp edges or corners?
- M12 – Luminaire weight. Actual weight of the fixture.
- M13 – Is internal wiring rated for 105 degree Celsius and routed away from heat generating components?
- M14 – Are all covers provided for access to serviceable parts securely attached but easily removable?

Streetlight Upgrade-Evaluation Phase





	A	B	C	D	E
Durability - Section 1.0/10%	5.0	6.8	4.6	7.8	7.6
Serviceability - Section 2.0/20%	19.3	19.8	2.4	19.8	19.6
Energy Savings - Section 3.0/30%	7.3	15.5	4.5	20.0	20.0
Lighting Evaluation - Section 4.0/25%	17.5	12.5	12.5	17.5	6.3
Cost - Section 5.0/15%	11.3	6.2	2.4	6.6	15.0

Street Light Upgrade
Contract and Installation Phase

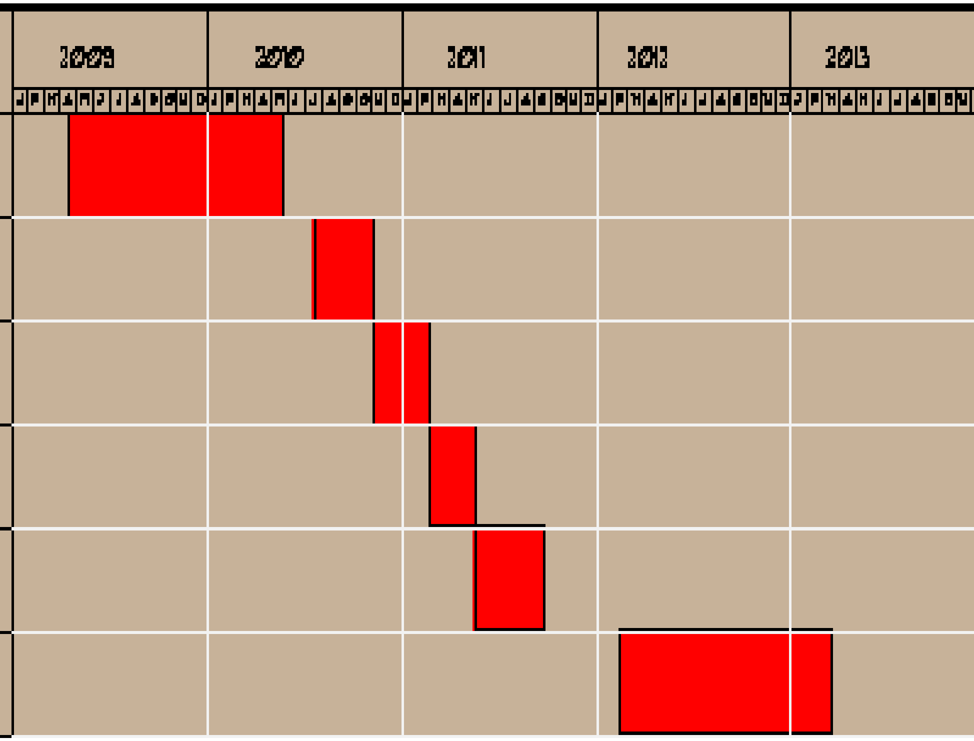
- 6,600 LED Lights-1st Phase:

•**Started May 2011 Completed September 2011**

33,400 LED Lights-2nd Phase:

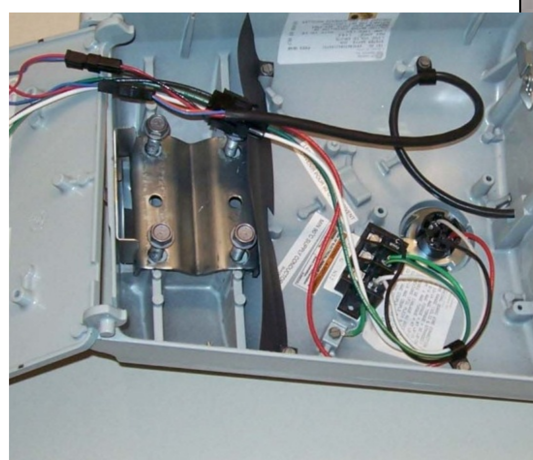
•**Started February 2012 Completed May 2013**

TASK	CALENDAR DAYS	START	FINISH
PROGRAM DEVELOPMENT FUNDING	401 DAYS	4-15-09	5-20-10
SOLICITATION RFP PROCESS	90 DAYS	7-15-10	10-12-10
TESTING	120 DAYS	10-13-10	2-9-11
EVALUATION AND SELECTION	95 DAYS	2-10-11	5-15-11
CONTRACT AND INSTALL 6,600 LIGHTS	123 DAYS	5-16-11	9-15-11
CONTRACT AND INSTALL 33,400 LIGHTS	461 DAYS	2-10-12	5-15-13



Streetlight Upgrade-Lessons Learned

- Existing Infrastructure- old conductors, large wire unable to fuse at new terminal blocks. Manufacturer built UL listed terminal block with intergretated fuse.
- Light trespass- Complaints regarding reduced light on private property. Masking used in lieu of shields. Public outreach a solution.
- Bubble Level- Not effective on bottom of fixture. On top of fixture or omit.
- Cul de sac – Directional light from LED coverage issues.
- Viability –Vegetation still a cause of lighting issues.



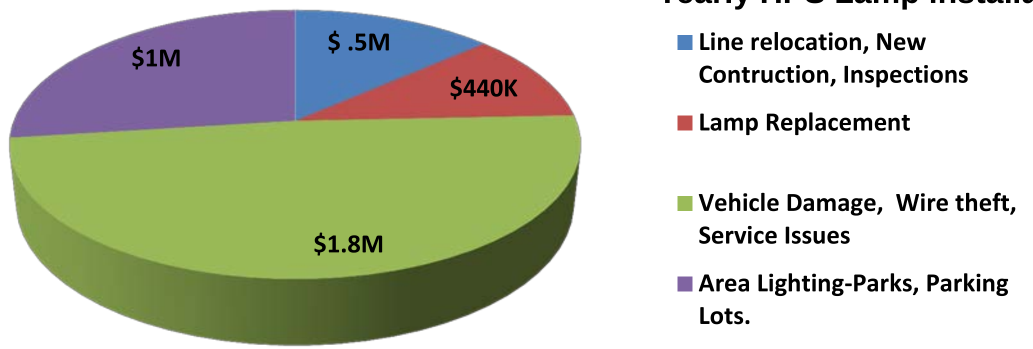
Streetlight Upgrade-Maintenance-Moving Forward

- Outages and Public Complaints-80% reduction in service call requests.
- Warranty replacement- Less than .05%
- Staff Reduction by Attrition- Staff reassigned to repairs and other deferred maintenance issues, such as photocell relocation and replacement,circuit repairs, infrastructure upgrades,installations,retrained to maintain and program traffic signals.
- Improving Customer Service-Staff being trained to provide better service with more time to dedicate on other assets.
- Improved Inventory Control- less bulbs, and miscellanous parts in warehouse. GIS Database more accurate regarding field fixtures and quanities. 30% storage area reduction.

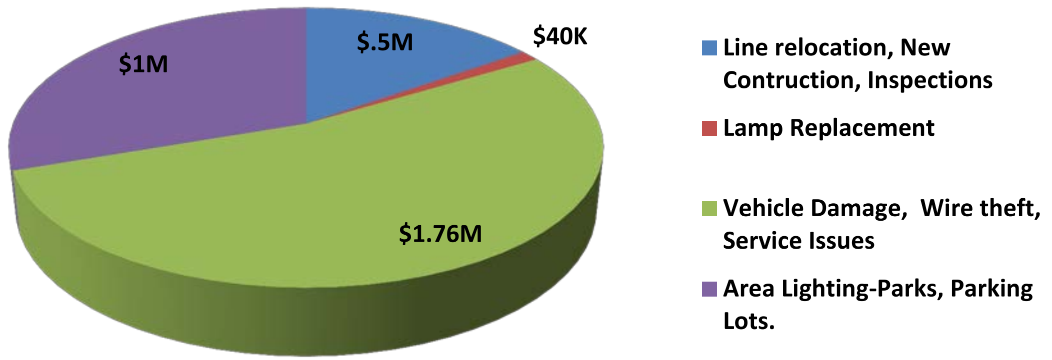
Streetlight Upgrade-Maintenance-Moving Forward

City of Las Vegas Maintenance Costs 2010 $3.74M Budget

Yearly HPS Lamp installation Cycle 7,000 units

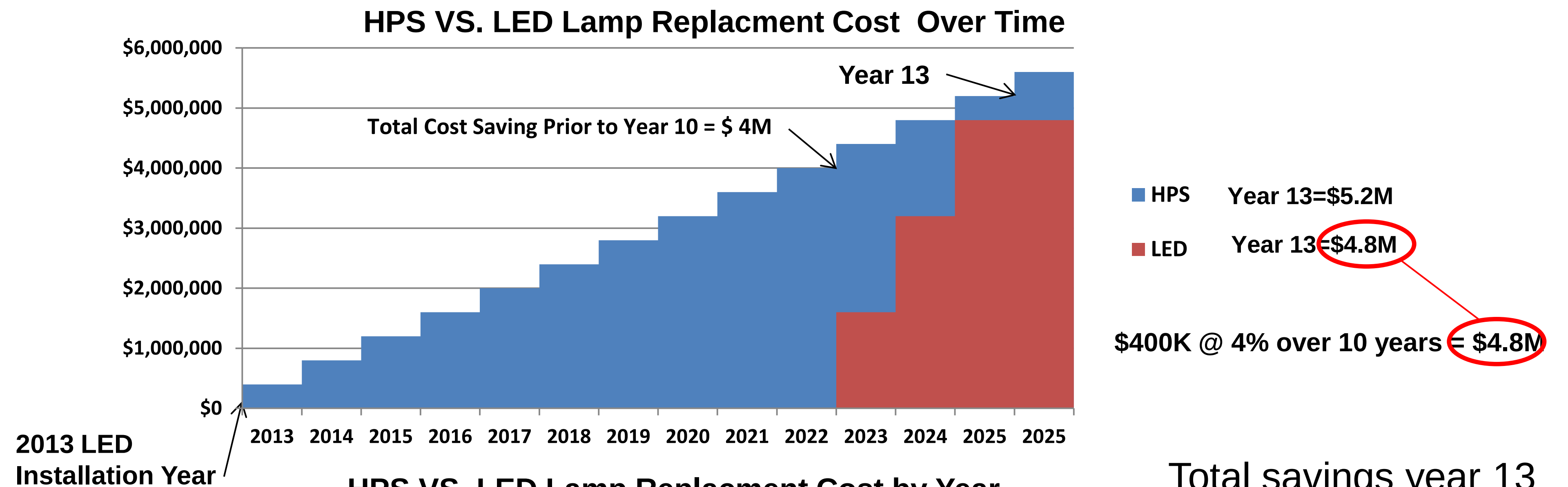


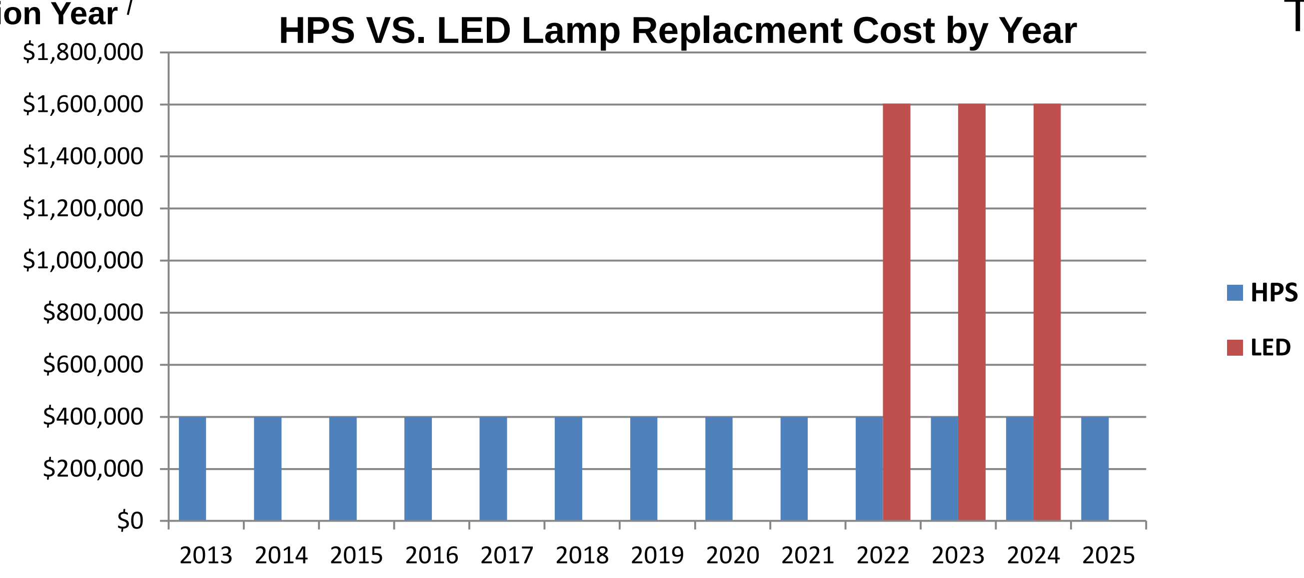
City of Las Vegas Maintenance Costs 2013 $3.3M Budget



Streetlight Upgrade-Maintenance Budget

- Plan Ahead for LED Replacement- Require a future retrofit in specifications.



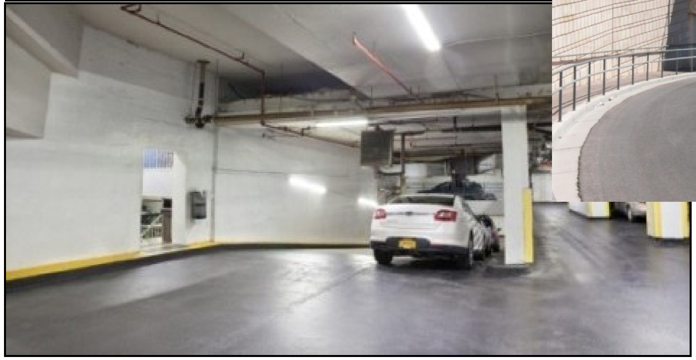


Total savings year 13

HPS $5.2M
LED $4.0 M
$1.2 M

Future- 2014-2016

- Intersections 4,000 – (8) 120W replacing (4) 400W
- Bridges and Underpass Locations.
- Parking Garages
- 10,000 Decorative Lights to LED – RFP Process
- Replace 12,000 Lights on 200 City Properties with LED
- Inverse ratio photo cell 1.5fc turn on (ANSI standard) and a .9 fc turn off. previous type a 1.5 fc on with a 1.5 fc X 1.5 = 2.25 fc off. saves about .5 hr/fixture/day on the back end (dawn).


Thank you!

Questions?

Patrick Batte'
Project Manager – Department of Public Works

pbatte@lasvegasnevada.gov

6. Please indicate whether Mr. Jester is aware of any utility that experienced a complete life-cycle of an LED installation. If the answer is "yes," please provide the name of the utility and the any documentation upon which Mr. Jester relies to support his answer.

RESPONSE - Mr. Jester is not aware of any utility that has experienced a full life-cycle of LED lights, particularly since LED lights with 10-year warranties and 25-year lumen depreciation schedules have not been on the market for 10 years.

WITNESS – Douglas Jester

7. Please indicate whether Mr. Jester has at any time performed any analysis of the lifespan of LEDs used in street lighting applications. If the answer is “yes,” provide Mr. Jester’s analysis.

RESPONSE - Mr. Jester has relied upon regular reading of the LED lighting literature.

WITNESS – Douglas Jester

8. Please indicate whether Mr. Jester has at any time performed any analysis of the costs to maintain LEDs used in street lighting applications. If the answer is “yes,” provide Mr. Jester’s analysis.

In preparation for his testimony in Michigan Public Service Commission case U-17767, Mr. Jester examined maintenance data provided by the City of Ann Arbor, and testified to by Mr. Nathan Geisler, which can be found at http://efile.mpsc.state.mi.us/efile/docs/17767/0291.pdf. It should be noted that the City of Ann Arbor defines as maintenance certain expenditures which most utilities would capitalize and that the City of Ann Arbor was an “early adopter” so it is reporting on lights whose technical performance is far surpassed by those currently on the market.

WITNESS – Douglas Jester

9. Refer to page 25, line 7 of Mr. Jester's testimony. Please indicate whether Mr. Jester has conducted any analysis of features of LEDs used in street lighting applications, as compared to traditional street lighting options, including assessment of the capabilities or costs of remote detection or other sensors. If the answer is "yes," provide Mr. Jester's analysis.

Please refer to Exhibit MSL 14 in response to Item 2. As an example of product literature on this topic, see the attached file "Streetlighting Control" by Itron.

WITNESS – Douglas Jester

Streetlight Control

DEVICE FEATURES

- » Cost effective two-way remote controllable & programmable
- » Over four million individual addresses with remote programmability
- » Remote test functions
- » All devices come with a ANSI C136.10-2010 standard three pole twist lock connector for standard lighting
- » 5 PIN connector is used for dimming (3 pole plug plus 2 PINS)
- » Internal Diagnostics
- » Historical Event Counters

CONTROL FUNCTIONALITY

- » Control strategies may be defined for each group, subgroup, or individual devices
- » Devices may be assigned to multiple sets of groups and subgroups
- » Control events may be targeted for each or all group, subgroup, or individual devices
- » Enable/Disable Photo Cell capability
- » Time of Day ON/OFF settings
- » Intuitive "Horizon" GUI for scheduling and execution of control events
- » Automated reporting via web and desktop viewing capability

Itron Streetlight Control Device

Circuitry:	Microprocessor-controlled
Non-Volatile Memory:	512K EEPROM

COMMUNICATION

Type:	Cellular, Cisco CG 900 MHz Mesh, WiFi
Regulatory Compliance:	FCC Pending Cellular Operation – Verizon Network Certified Pending

ADDRESS CODES

Individual Address:	4,194,304 (222) possibilities
Common Individual Address:	Common to all units
Extended Address:	16,384 (214) possibilities
Upper Address:	128 (27) possibilities
Lower Address:	128 (27) possibilities
Address Assignment (Remote):	From one up to 8 upper and associated lower extended addresses

TIME OUT DURATION

Time Out Duration:	One of 16 preprogrammed intervals from 6 minutes to 120 minutes
Time Out Tolerance:	±10 seconds, +20%/-0%, ±20%, user selectable

POWER REQUIREMENTS

Power Input:	240VAC ±20% (192-288); 60 Hz
Internal DC Power:	+5VDC derived from 240 VAC/10 VAC step down transformer
Power Consumption:	7.5 watts maximum at 240 VAC with full load

CONTROL DEVICE ENCLOSURE

Type: Dimensions:	High-impact molded Lexan for raintight operation. 3 " Diameter x 5 ¼" Height

OPERATING ENVIRONMENT

Relative Humidity:	Up to 95% (non-condensing)
Operating Temperature:	-30 °C to 70 °C
Storage Temperature:	-40 °C to 85 °C

MISCELLANEOUS

Surge Withstand Capability:	Meets and exceeds ANSI C37.90a, 1974 requirements.

All devices are 100% Factory Tested and Inspected in accordance with Factory Acceptance

Testing Procedures mutually determined with each utility.

Specifications subject to change

Join us in creating a more **resourceful world.**
To learn more visit **itron.com**

CORPORATE HQ
2111 North Molter Road
Liberty Lake, WA 99019 USA
Phone: 1.800.635.5461
Fax: 1.509.891.3355

AFFIDAVIT

The undersigned, Douglas B. Jester, being duly sworn, deposes and says that he is a principal of 5 Lakes Energy LLC, and that he has supervised the preparation of the foregoing responses to the Commission Staff's Initial Request for Information and Data Request of Kentucky Utilities to Lexington-Fayette Urban County Government, and that the responses are true and accurate to the best of his knowledge, information, and belief formed after a reasonable inquiry

Douglas B Jester

Douglas B. Jester, Affiant

NOTARY CERTIFICATE

STATE OF MICHIGAN

COUNTY OF Ingham

Subscribed, acknowledged and sworn to before me by Douglas B. Jester on this 29th day of March, 2017.

My commission expires: Sept. 23. 2023.

LINDSI L. CHAPMAN
Notary Public, State of Michigan
County of Ingham
My Commission Expires Sep. 23, 2023
Acting in the County of ______

Lindsi L Chapman

NOTARY PUBLIC