SPEER

The South-central Partnership for Energy Efficiency as a Resource

Street Lighting Retrofit Implementation Guide

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About the South-central Partnership for Energy Efficiency as a Resource (SPEER)

SPEER is a regional non-profit organization dedicated to increasing and accelerating the adoption of energy efficient products, technologies, and services in Texas and Oklahoma. Much of SPEER's work focuses on finding the best market-based approaches to increase energy efficiency and overcoming persistent market barriers. The views expressed in this paper do not necessarily reflect the views of all of SPEER's members, funders, or supporters. For more information about SPEER, please visit: www.eepartnership.org

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I. INTRODUCTION

Cities have been able to reap substantial savings as a result of retrofitting street lights, in both energy and maintenance savings. By replacing existing street lights with LED-based lamps, cities or utilities can cut energy and operations costs by 40 – 60%. While the process for retrofitting city street lighting is cumbersome, SPEER has worked with member energy service companies (ESCO's) to create business cases that involve cities with proposed or completed projects to demonstrate it is more than worthwhile for cities to pursue these retrofit projects. At a time when many municipalities are facing budget shortfalls, reevaluating how a city pays for street lighting may be an excellent way to save money.

The process outlined below, and described in detail in this guide, is for cities interested in pursuing LED retrofits of street lighting. SPEER compiled this information by interviewing cities, utilities, and energy service companies in the region, as well as reviewing publicly available information. This implementation guide will be used to promote street lighting retrofit projects to cities, counties, and utilities in our region.

Municipal Street Lighting Retrofit Process

1. Determine the availability of LED tariffs
2. Coordinate with all relevant municipal departments and any local utility to conduct an inventory of street lighting in the city
3. Identify any financial incentives
4. Do a high level test of project viability
5. Define the scope of work
6. Explore financial options for retrofit projects
7. Survey potential contractors and develop a specification list for retrofit fixtures
8. Issue a Request for Quote (RFQ)
9. Document the savings of the project after completion

Supporting Business Cases

Actual business cases were obtained to demonstrate the benefits of these retrofit projects. The first was designed by SPEER member company Opterra Energy Services, and highlighted their successful LED retrofit project with the City of Arlington, Texas. The second business case was designed by another SPEER member company Ameresco, and builds upon their many years of experience in city performance contracting. This business case highlights the critical role that LED tariff design plays in project financial outcomes. The Ameresco case study also makes the case for "virtual metering" which can potentially lower the cost for LED retrofits by using newer, less expensive technology to track useage than traditional utility metering.

II. Background & Overview

Street lighting is a significant share of municipals electricity consumption and a major expense item on city budgets, so the potential to capture substantial savings by initiating a project to install and maintain LED street lights is great. **LED street lighting retrofits are estimated to save between 40% and 65% in municipal energy costs**. LED costs continue to improve, as does testing and the reliability of LED for street lighting applications. Several industry pilots are now reporting better than expected outcomes on several parameters such as glare, lighting control, reduced maintenance, etc. And LEDs have been designed to replace all major forms of streetlights: High Pressure Sodium, Metal Halide, and Mercury Vapor. The opportunity for cost savings is even higher when reduced maintenance is factored in and the potential for if upgrades such as advanced networked lighting controls are considered.

Cities in Texas, as well as many around the U.S., are evaluating their current installed outdoor area and street lighting. El Paso, San Antonio, Houston, Arlington, Harlingen, and more have made the upgrade to high efficiency LED street lighting. During these retrofit projects cities found there is often a mix of city owned and utility owned streetlights. Street lighting retrofit projects tend to start with city owned fixtures and lights and then expand, depending on the utility tariffs[1] in place. To date, LED tariff design is a significant barrier for project financial outcomes in most of the utility service territories in Texas. ESCOs report that many projects still "*don't work*" financially, due to the inadequate design of appropriate LED tariffs that capture the lower-wattage retrofit savings. Cities interested in retrofit projects need to know that they have options; they can work with their utility to identify types of lighting for new installations, as well as replacements that can occur on an incremental, end-of -life basis.

Today, utilities have tremendous opportunity to get in front of the trend by working with cities to create a win/win situation that bridges city expectations of reliability and savings from LED retrofits to the business interests of the utility providing the service. Cities are increasingly adopting policies such as the Model Lighting Ordinance developed by the International Dark-Sky Association (IDA) and Illuminating Engineering Society (IES), which specify Design Lights Consortium eligible fixtures.

III. The Process

1. **Determine the availability of an LED rate or tariffs.** Researching the appropriate rate options for street lighting with the utility will provide the city with the options available for retrofit projects. This information is usually publicly available and in most cases rates that are based on whether street lighting is utility or city owned, metered or unmetered, and then broken down by type and/or wattage of fixture. Review any maintenance agreements as part of this process.

[1] **Tariff** — The schedule of a utility, municipally-owned utility, or electric cooperative containing all rates and charges stated separately by type of service, the rules and regulations of the utility, and any contracts that affect rates, charges, terms or conditions of service.
http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/ch25complete.pdf

Figure 1. Whether a LED tariff exists is the first of many questions, others are: Does the LED rate reflect the anticipated savings if a fixture were to be retrofitted? For example, does a tariff exist for the most common retrofit of 100-Watt HPS to a comparably more efficient LED of 50 watt?

Figure 1: *An example of LED area lighting rate for utility-owned lighting in Texas.*

Lamp Size		kWh per month		Charge per Lamp
50-55 watt (comparable to 100 watt HPS	LED	19	kWh per month	$9.60
100-110 watt (comparable to 250 watt HPS)	LED	38	kWh per month	$20.00
100 watt	HPS*	45	kWh per month	$ 8.15
250 watt	HPS*	110	kWh per month	$16.30
175 watt	Metal Halide*	78	kWh per month	$ 8.15
175 watt	Mercury Vapor*	75	kWh per month	$ 8.15

2. **Cities need to coordinate with their utility, city financing office, and others as needed to conduct an inventory of all street lighting in the city.** The inventory should include the number of lights, the type of light installed and the ownership and maintenance responsibilities, as detailed below. It is noteworthy that energy service companies (ESCO's) often include a detailed inventory with GIS mapping as part of their retrofit contract. Cities with utility owned and operated lighting, should contact their provider for the information listed below.
   - Inventory: number of street lights, fixture type, & wattage (number of metal halide, high pressure sodium, mercury vapor, other). For example: 325 100-Watt HPS
   - For each street light, document whether it is utility owned or city owned, metered or unmetered, and who maintains it. Ownership and operation structures vary city to city, county to county and state to state so it is important to capture this information during the audit phase. There are many cities that own and maintain all of their street lighting, some that may own the lights, but contract out for operations and maintenance, and there are also some electric utilities that own and operate street lighting for cities.

3. **Identify any financial incentives**. Contact the utility commercial energy efficiency program for information and an application. Cities that pay into ratepayer-funded energy efficiency programs on their local utility bill may be eligible for LED retrofit or other commercial efficiency incentives. This can help to decrease the amount spent and/or financed by the city to complete the project.

4. **Do a high-level project financial viability test.** LED lighting in general is one of the most common and cost-effective retrofit options available for improving financial and environmental performance in facilities. It is an important next step to complete a high-level project financial viability test; this will provide the city or utility with the proper information about how the finances of the project will work. Outdoor LED useful life estimates range from 10 to 15 or more years, depending on the application. It is important to note that some lighting experts recommend completing a detailed financial analysis, see below for guidelines and details, in place of a high level analysis.

   Importantly, once the payback for capital cost is recouped, the energy cost savings is then fully realized monthly for the remaining life of the fixture, often earning an attractive rate of return. If the lighting tariff is a barrier to a retrofit project that would otherwise make financial sense, it is then time to complete a detailed financial analysis to present to the utility, or collaborate with other cities with similar barriers and negotiate collectively with the utility for a win/win outcome.

5. **Define the scope of work.** Completing a detailed financial analysis will help define the scope of the project. It is important that the city and the utility work together to review of any maintenance agreements for any of the street lighting to be retrofitted. Whether a city is considering doing the project internally, financing the work internally or planning to utilize an ESCO or other outside contractor, completing a detailed financial analysis of the project will put the city in a more informed position for negotiating with the utility or soliciting contracts.

   A Retrofit Financial Analysis Calculator was collaboratively developed by the DOE Municipal Solid-State Street Lighting Consortium, the Clinton Climate Initiative, the Federal Energy Management Program (FEMP) and DOE Better Buildings for conducting economic analysis of lighting upgrades. The link to this tool provides you with not only the tool, but also provides guidance, a quick start guide and the methodology in the tool. This tool assists with the detailed financial analysis of retrofitting street and parking facility lighting with more-efficient alternatives. Cities or utilities can use the tool to compute annualized energy and energy-cost savings, maintenance savings, greenhouse gas reductions, net present value, and simple cash payback associated with potential lighting upgrades. This information is what will then need to be shared with city leadership and utilities to create buy-in for retrofit projects, as well as negotiate tariffs in an effort to ensure that the project evaluation is transparent and supported by both the city and the utility.

   The financial analysis will also provide cities with valuable information allowing them to prioritize projects, often favoring those with the best metrics for immediate action, then use savings to invest in other efficiency. However, considering more comprehensive retrofit initiatives, or taking a “portfolio perspective,” is a way for projects with more immediate savings to support efficiencies that have a longer return on investment. There are experts that

recommend completing a detailed analysis on retrofitting everything before breaking down retrofits into smaller projects. This approach often works well in performance contracting.

6. **Explore available financing options..** While LED street lighting costs have significantly decreased in recent years, there are still significant upfront labor and material costs for a retrofit project. There are many financing options available some include possible state or federal grants, vendor financing, tax-exempt lease purchase agreements, utility retrofit options, energy service company performance contracts, and in Texas the State Energy Conservation Office (SECO) offers Loan Star Revolving Loans for public facilities, with loans as low as 1-2% per annum for qualifying projects. According to one report, the City of San Antonio utilized the Loan Star Revolving Loan Fund to finance a $1.7M conversion of LED traffic signals and pedestrian lights, achieving an annual savings of $878,000.There are also performance contracting options that give cities a turn-key process with guaranteed savings. In Texas, cities are encouraged to "implement any energy efficiency that pays for itself" through performance contracts.

7. **Survey lighting contractors or suppliers to develop a preliminary specification list for retrofit fixtures.** Discuss the specification list with potential installers such as the utility, internal teams, or 3rd party service providers to arrive at an informed decision. Most lighting experts recommend a brief pilot stage of two or three small retrofit projects including a few different lighting suppliers before making a final decision for a major retrofit. At this time the city should solicit feedback from the community, maintenance personnel, contractors, or others involved in the process. Ensure that final fixtures meet reputable third-party testing lab guidelines, such as the Design Lights Consortium.

An example of an LED roadway retrofit for high pressure sodium.

8. **Issue a Request for Quote (RFQ)** for the cost of equipment and supplies that will be installed by the city, or a Request for Proposal (RFP) for a full-service contract with a third party. If the city is seeking a third party contract, the purchase and installation of the selected fixtures as well as, warranty provisions, compliance with city procurement policies, and a maintenance agreement, should the city be interested in one, will all be included in the RFP. Carefully interview potential contractors for reputation, years in business, and references.

9. **Project completion and documentation of actual project savings**. In order to make the case for the project's success and potential future projects, the city must document and socialize the actual savings of the project after completion. It is important to include the co-benefits that are important to your community such as avoided power emissions and improved air quality, as well as the associated energy savings. EPA continues to maintain an easy-to-use GHG equivalency calculator for calculating these impacts. If the city has contracted with a third-party provider, consider adding this requirement to the contract. Documenting and publishing the success of a lighting retrofit project is often a cornerstone in building the case for future similar projects and helping other cities complete similar projects.

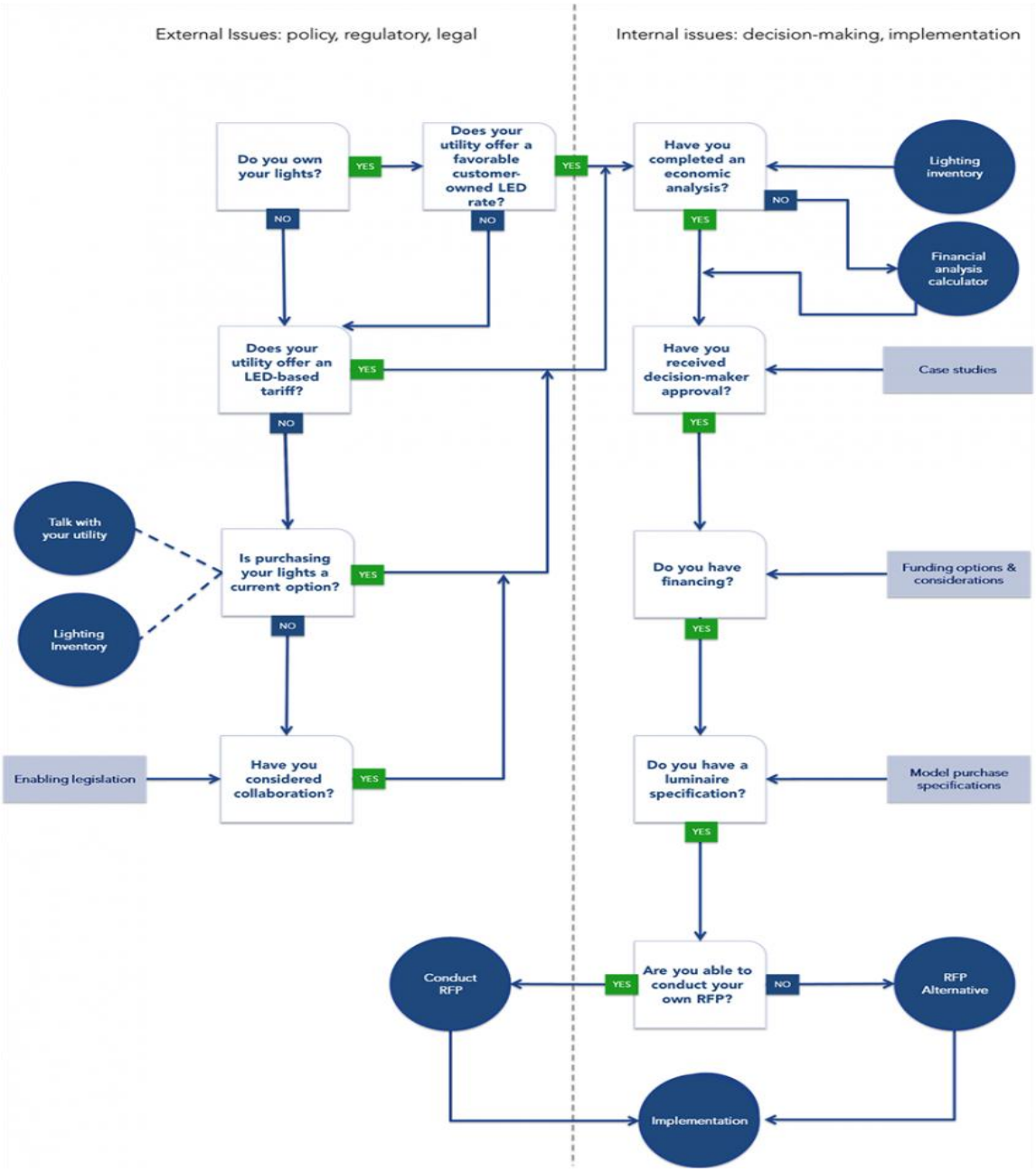
IV. Additional Resources

SPEER maintains a menu of resources available for cities in our region to assist them in energy efficiency projects.

Department of Energy Decision Tree Diagram

DOE created a visual decision tree interactive tool which highlights the major steps of the process, reproduced below.

Department of Energy's Outdoor Lighting Decision Tree Tool



[2] Solution at a Glance: Outdoor Lighting Decision Tree Tool: Successful Approaches of Cities, States, and Regional Groups https://betterbuildingssolutioncenter.energy.gov/solutions-at-a-glance/outdoor-lighting-decision-tree-tool-successful-approaches-cities-states-and

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LED Street Lighting Business Case

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City-Owned LED Street Lighting in Texas: *Unlocking a Substantial Economic Opportunity with Performance Contracting*

Abstract

Light-emitting diode (LED) street lighting has seen significant adoption recently in cities across the U.S., and it is not hard to see why. LED lights reduce energy consumption from comparable high-pressure sodium (HPS) fixtures by 55 to 60 percent. LED lights also provide superior illumination with a high color rendering index (CRI), excellent light distribution, and improved peripheral vision for drivers. With expected lives of over 100,000 hours (15 to 20 years), LED lights also significantly reduce maintenance for cities that make the switch.

Utilizing a performance contract is one proven model to perform street lighting retrofits in cities like yours. The performance contracting model allows your city to leverage the electricity savings generated by the LED lighting conversion and to not have to find cash in your budget to make the improvements. This turnkey process also saves your city time because you can contract the GIS auditing, lighting design, engineering, and materials all under one contract.

Utilizing the performance contracting model, the energy services company (ESCO) is responsible for all aspects of project design and performance, while the city and ESCO work together to design and develop the specific scope of work. All project outcomes (light levels, cost, energy savings, etc.) are known before project approval by the city council. City councils also like the guaranteed maximum price structure of a performance contract because they know exactly what the cost will be when they approve the project.

Example Business Case

To demonstrate what a potential LED streetlight project cash flow can look like under a performance contract, we have modeled a representative city in the Oncor service territory in Texas. The numbers are shown for representative purposes only, and are built on the following assumptions:

- Fixture ownership: City
- Financing: Tax Exempt Lease Purchase – 3.15 percent interest
- Financing Term: 15 years
- Utility Rate: Published Oncor Street Lighting Service Tariff
  Retail energy rate of $0.03652 per kWh
- City Population: 100,000
- Approximate quantities: 7,600 fixtures split with the following distribution
  - 15 percent - 400 W HPS
  - 20 percent - 250 W HPS
  - 10 percent - 200 W HPS
  - 10percent - 175 W Mercury Vapor
  - 5 percent - 150 W HPS
  - 40 percent - 100 W HPS
- Includes engineering study to GIS map existing fixtures
- Includes turnkey installation, materials, project management, and light level commissioning

Tariff Considerations

Currently, LED project paybacks in the Oncor service area are artificially longer than they should be because existing service tariffs and LED tariffs for unmetered service do not properly account for wattage drops below 100-watt fixtures. This is also the case with other "LED tariffs" in Texas, including those provided by member-owned cooperatives. This is particularly detrimental to project economics when one of the most common existing fixtures in a city is a 100-watt HPS fixture. A typical LED retrofit for 100-watt HPS fixtures will replace each HPS fixture with a 31-watt LED fixture. Although the retrofit provides a significant efficiency gain in true power consumption, under the existing tariffs and LED tariffs, there is minimal economic benefit attributable to the project. This is due to the LED category for unmetered service having only one category of LED fixtures from zero to 100 watts.

> Table 1. Missing Watt Categories for LED Tariffs

This table illustrates the missing watt categories for existing LED tariffs and is typical for Texas utilities.

Table 1. Missing Watt Categories for LED Tariffs

Points of Delivery (POD) Charge: $57.41 per governmental entity served by the Competitive Retailer.

Lamp	Watts	Lumens	kWh	Schedule			Rectangular*	Post-Top*
				A	B*	C* and D		
Mercury Vapor * (See Note 1)	175	7,900	70	$10.49	$14.88	$1.53	$26.77	$9.63
	400	21,000	150	$11.47	$20.06	$3.14	N.A.	N.A.
	1,000	63,000	370	$14.55	$24.30	$7.56	N.A.	N.A.
Sodium Vapor	100	9,500	40	$10.19	$14.59	$0.92	$26.54	$9.34
	150	16,000	70	$10.71	$16.24	$1.53	N.A.	N.A.
	200	22,000	80	$10.78	$19.37	$1.73	N.A.	N.A.
	250	27,500	100	$11.00	$19.60	$2.13	$25.69	N.A.
	400	50,000	160	$12.49	$22.23	$3.34	N.A.	N.A.
	1,000*	140,000	375	$14.51	$24.28	$7.66	N.A	N.A.
Metal Halide	150	14,000	65	$12.42	N.A	$1.43	N.A.	N.A.
	175 (see note 2)	14,000	65	$12.42	$18.80	$1.43	N.A.	N.A.
	250	25,000	100	$14.26	$22.29	$2.13	$36.62	N.A.
	400	36,000	160	$14.74	$23.04	$3.34	$36.62	N.A.
	1,000*	110,000	370	$17.75	$26.03	$7.56	$40.98	N.A.
LED/Low Wattage (See Note 3)	100		40	N.A.	N.A.	$0.92	N.A.	N.A.

Note: Oncor tariff information is from the Public Utility Commission of Texas website, dated March 1, 2016. Tariff details are attached. Rates may have changed. It is recommended that you contact your account manager to get a copy of the appropriate tariff for your city.

> Table 2. Existing Tariff Analysis for City-owned Street Lights [Unmetered]

Table 2 illustrates the retail energy savings for the project when calculated using the existing tariff for unmetered service. Notice that the highest quantity of existing fixtures are 100-watt HPS, but there are zero savings associated with that fixture replacement in the current tariff structure.

Table 2. Existing Tariff Analysis for City-owned Street Lights [Unmetered]

Zero savings attributed to 100-W HPS retrofit

Existing Fixture Description	Existing Fixture Watts	Existing Quantity	Retrofit Description	Retrofit Fixture Watts	Existing Monthly kWh per Rate Code	Retrofit Monthly kWh per Rate Code	Existing kWh	Retrofit kWh	kWh Savings	Retail Energy Savings ($)
400 HPS	480	1,144	215 W LED fixture	215	160	80	2,196,480	1,098,240	1,098,240	$ 40,108
250 HPS	300	1,464	141 W LED fixture	141	100	70	1,756,800	1,229,760	527,040	$ 19,248
200 HPS	240	799	Split 73 W & 141 W	107	80	40	767,040	383,520	383,520	$ 14,006
175 Mercury Vapor	210	563	Assume same as 150 HPS	73	70	40	472,920	270,240	202,680	$ 7,402
150 HPS	180	91	73 W LED fixture	73	70	40	76,440	43,680	32,760	$ 1,196
100 HPS	120	2,522	31 W LED fixture	31	40	40	1,210,560	1,210,560	-	$ -
Existing LED	40	671	No Retrofit	40	40	40	322,080	322,080	-	$ -
							6,802,320	4,558,080	2,244,240	$ 81,960

> Table 3. 2017 Rate Case Submission

A revised Oncor tariff has been proposed and submitted to the PUCT that includes separate wattage categories for LED lamps. This revised tariff includes five separate wattage ranges for LED lamps and provides nearly a 50% increase in retail energy benefit for the same scope of work in this example.

Table 3. Proposed Tariff with LED Watt Categories

Points of Delivery (POD) Charge: $68.00 per governmental entity served by the Competitive Retailer.

Lamp	Watts	Lumens	kWh	Schedule			Rectangular*	Post-Top*
				A	B*	C* and D		
Mercury Vapor * (See Note 1)	175	7,900	70	$10.54	$15.31	$1.61	$23.93	$11.63
	400	21,000	150	$11.73	$19.25	$3.25	N.A.	N.A.
	1,000	63,000	370	$14.84	$23.46	$7.76	N.A.	N.A.
Sodium Vapor	100	9,500	40	$10.19	$14.97	$0.99	$23.83	$10.91
	150	16,000	70	$10.74	$18.25	$1.61	N.A.	N.A.
	200	22,000	80	$10.94	$18.47	$1.81	N.A.	N.A.
	250	27,500	100	$11.16	$18.68	$2.22	$25.94	N.A.
	400	50,000	160	$12.50	$21.11	$3.45	N.A.	N.A.
	1,000*	140,000	375	$15.15	$23.31	$7.87	N.A	N.A.
Metal Halide *	150	14,000	65	$12.29	N.A	$1.50	N.A.	N.A.
	175 (see note 2)	14,000	65	$12.29	$20.50	$1.50	N.A.	N.A.
	250	25,000	100	$14.00	$22.31	$2.22	N.A.	N.A.
	400	36,000	160	$14.44	$22.31	$3.45	$33.75	N.A.
	1,000*	110,000	370	$17.66	$25.58	$7.76	$37.00	N.A.

LED Street Lighting Options

Lamp	Wattage Range	kWh	Schedule A LED Street Lighting				Schedule D LED Street Lighting
			Cobra Head (See Note 3)	Rectangular (See Note 4)	Post – Top (See Note 4)	Historical (See Note 4)	
LED	0 - 55	15	$11.42	$24.45	$16.02	$28.30	$0.48
LED	56 - 100	30	$11.79	$25.10	$15.95	$27.91	$0.78
LED	101 - 140	45	$12.20	N/A	N/A	N/A	$1.09
LED	141 - 180	55	$12.43	$25.38	N/A	N/A	$1.30
LED	181 - 265	80	$15.02	N/A	N/A	N/A	$1.81

> Table 4. Proposed Tariff Analysis for City-owned Street Lights [Unmetered]

Table 4 illustrates the dollar savings for the project when calculated using the proposed tariff for unmetered service. Notice the additional savings that can be generated from the 250-watt and 100-watt HPS fixture retrofits.

Table 4. Proposed Tariff Analysis for City-owned Street Lights [Unmetered]

Existing Fixture Description	Existing Fixture Watts	Existing Quantity	Retrofit Description	Retrofit Fixture Watts	Existing Monthly kWh per Rate Code	Retrofit Monthly kWh per Rate Code	Existing kWh	Retrofit kWh	kWh Savings	Retail Energy Savings ($)
400 HPS	480	1,144	215 W LED fixture	215	160	80	2,196,480	1,098,240	1,098,240	$ 40,108
250 HPS	300	1,464	141 W LED fixture	141	100	55	1,756,800	966,240	790,560	$ 28,871
200 HPS	240	799	Split 73 W & 141 W	107	80	45	767,040	431,460	335,580	$ 12,255
175 Mercury Vapor	210	563	Assume same as 150 HPS	73	70	30	472,920	202,680	270,240	$ 9,869
150 HPS	180	91	73 W LED fixture	73	70	30	76,440	32,760	43,680	$ 1,595
100 HPS	120	2,522	31 W LED fixture	31	40	15	1,210,560	453,960	756,600	$ 27,631
Existing LED	40	671	No Retrofit	40	40	40	322,080	322,080	-	$ -
							6,802,320	3,507,420	3,294,900	$120,330

Reduced kWh due to multiple wattage ranges in the proposed tariff

Savings attributed to 100-W HPS retrofit

As you can see the proposed tariff creates a significant economic benefit for undertaking the same scope of work by more accurately billing for the actual energy consumption of the new LED lamps. In addition to retail energy savings, LED retrofits also provide for facility charge savings and maintenance savings. These two savings categories have not been detailed in this document, but are reflected in the proforma shown below.

Most ESCO companies will consider facility charge savings and as part of the energy savings because they will show up on your electric bill. These savings are included as part of the guaranteed energy savings shown below. Maintenance savings, however, can vary greatly based upon individual City maintenance plans and are typically provided to the ESCO by the City. For this example, maintenance savings were based on the material savings that come from not needing to replace 10% of the existing HPS lamps and ballasts annually. In some situations, the O&M savings can be significantly higher, particularly if the City is outsourcing their streetlight maintenance to a third party.

Project Costs for Proforma

Table 5. Input Costs for Sample Proforma

Initial Project Costs:		
Detailed Energy Audit	$	80,000
Performance and Payment Bond (if applicable), Permits	$	35,625
Implementation Costs	$	2,577,734
Total Initial Project Costs	**$**	**2,693,359**
Taxes	$	-
Total Ameresco Contract Amount	**$**	**2,693,359**
3rd Party Engineer Fee	**$**	**5,000**
Total Project Cost	**$**	**2,698,359**

Conclusion

In closing, although every street lighting retrofit situation is unique, there are some common elements to all projects that make them successful for all parties involved. Cities and citizens are increasingly demanding energy and resource efficient solutions that improve the environmental performance of their cities while also saving taxpayers money. In order for LED street lighting to work for a majority of projects, cities must work together with their utilities, city councils, and the Public Utilities Commission to ensure that LED tariff design is fair and captures an appropriate amount of savings for city customers and members.

Table 6. Sample Pro Forma

Table 6. Sample Pro Forma

Proforma	Initial Values	Year 1	2	3	4	5	6	7	8	9	10
1 Projected Annual Energy Cost Savings	$ 200,456	$ 206,470	$ 212,664	$ 219,044	$ 225,615	$ 232,383	$ 239,355	$ 246,536	$ 253,932	$ 261,550	$ 269,396
2 Guaranteed Energy Cost Savings	$ 180,410	$ 185,823	$ 191,397	$ 197,139	$ 203,053	$ 209,145	$ 215,419	$ 221,882	$ 228,538	$ 235,395	$ 242,456
3 O&M Savings	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118
4 Utility Rebates (Note 4)		$ -									
5 Total Project Savings (Line 2 + Line 3 + Line 4)	**$ 207,528**	**$ 212,941**	**$ 218,515**	**$ 224,257**	**$ 230,171**	**$ 236,263**	**$ 242,537**	**$ 249,000**	**$ 255,656**	**$ 262,513**	**$ 269,574**
6 Payments for Financing Equipment		$ 192,108	$ 197,166	$ 202,371	$ 207,727	$ 213,239	$ 218,909	$ 224,744	$ 230,747	$ 236,925	$ 243,280
7 Payments for Measurement and Verification Service	$ 12,405	$ 12,901	$ 13,417	$ 13,954	$ 14,512	$ 15,092	$ 15,696	$ 16,324	$ 16,977	$ 17,656	$ 18,362
8 Payments for Operation and Maintenance Services	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9 Total Payments		**$ 205,009**	**$ 210,583**	**$ 216,325**	**$ 222,239**	**$ 228,331**	**$ 234,605**	**$ 241,068**	**$ 247,724**	**$ 254,581**	**$ 261,642**
10 Net Annual Benefit		**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**
11 Cumulative Cash Flow	**$ 1,791,596**	$ 7,932	$ 15,864	$ 23,796	$ 31,727	$ 39,659	$ 47,591	$ 55,523	$ 63,455	$ 71,387	$ 79,319
12 **Net Present Value of Cash Flow**	**$ 93,002**										
13 Interest Rate	3.25%										
14 Discount Rate	3.25%										
15											

Line #	11	12	13	14	15	16	17	18	19	20	Totals
1 Projected Annual Energy Cost Savings	$ 277,478	$ 285,802	$ 294,376	$ 303,208	$ 312,304	$ 321,673	$ 331,323	$ 341,263	$ 351,501	$ 362,046	$ 5,547,918
2 Guaranteed Energy Cost Savings	$ 249,730	$ 257,222	$ 264,939	$ 272,887	$ 281,074	$ 289,506	$ 298,191	$ 307,137	$ 316,351	$ 325,841	$ 4,993,125
3 O&M Savings	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 27,118	$ 542,360
4 Utility Rebates (Note 4)											$ -
5 Total Project Savings (Line 2 + Line 3 + Line 4)	**$ 276,848**	**$ 284,340**	**$ 292,057**	**$ 300,005**	**$ 308,192**	**$ 316,624**	**$ 325,309**	**$ 334,255**	**$ 343,469**	**$ 352,959**	**$ 5,535,485**
6 Payments for Financing Equipment	$ 249,820	$ 256,548	$ 263,471	$ 270,593	$ 277,920	$ -	$ -	$ -	$ -	$ -	$ 3,485,569
7 Payments for Measurement and Verification Service	$ 19,096	$ 19,860	$ 20,654	$ 21,480	$ 22,339	$ -	$ -	$ -	$ -	$ -	$ 258,320
8 Payments for Operation and Maintenance Services	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9 Total Payments	**$ 268,916**	**$ 276,408**	**$ 284,125**	**$ 292,073**	**$ 300,259**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 3,743,889**
10 Net Annual Benefit	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,932**	**$ 7,933**	**$ 316,624**	**$ 325,309**	**$ 334,255**	**$ 343,469**	**$ 352,959**	**$ 1,791,596**
11 Cumulative Cash Flow	$ 87,251	$ 95,183	$ 103,115	$ 111,047	$ 118,980	$ 435,604	$ 760,913	$ 1,095,168	$ 1,438,637	$ 1,791,596	

OPTERRA
ENERGY SERVICES

City of Arlington

"The City of Arlington is pleased to take this step in a Public-Private Partnership with OpTerra to improve our energy efficiency reflecting strong financial stewardship while also bringing economic development to the American Dream City. This partnership with OpTerra Energy Services will help make us a greener city through guaranteed savings."

Robert Cluck, Former Mayor, City of Arlington

The Opportunity

Incorporated in 1884, the City of Arlington, Texas, known as "The American Dream City," is located at the heart of the Dallas/Fort Worth/Arlington metroplex. While Arlington started as a small rural farming community, the growing city is now home to more than 365,000 residents. In an effort to become a more sustainable city, Arlington leaders worked to maximize the efficiency of existing transportation systems, reduce energy and maintenance costs, and improve streetlight reliability by converting City-owned streetlights to LED. The City operates streetlights under rate schedule 6.1.1.1.8 for Lighting Service within Oncor's Tariff for Retail Delivery Service.

The Partnership

Phase I

In May 2014, the City of Arlington began exploring a comprehensive energy program in partnership with OpTerra. The program was designed and developed by a Texas-based team of OpTerra engineers alongside City management, with a key focus on retrofitting 10,500 of Arlington's streetlights with LEDs. Prior to the retrofits, City streetlights consumed 20 percent of City-wide electricity and the City was paying millions to keep the lights burning and maintained. During the first phase of the LED conversion, crews retrofitted streetlights along major arterials throughout Arlington. The first phase of LED installations was completed in just six months, which resulted in a 45 percent reduction in energy use.

As a result of Phase I, a total of 10,500 streetlights have been retrofitted from the previous 150 watt, 175 watt and 200 watt High-Intensity Discharge (HID) and High Pressure Sodium (HPS) streetlights to modern, high efficiency, 70-watt LED cobra head style fixtures. The conversion has resulted in significant operation and maintenance

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By the Numbers

- **$18MM** in energy savings over 15 years
- A total of **11,223 LED streetlights** installed
- Energy efficiency upgrades for more than **30 buildings**
- Decreases CO2 emissions by **2,162 metric tons** – the equivalent to removing more than **385 cars** from the road every year
- Reduces the City's water consumption by more than **3.5 million gallons** every year
- Reduces the City's energy use by more than **2.5 million kilowatt-hours** each year

The Technical Scope

Phase I

- Installed 10,500 LED streetlights in major arterials throughout the City
- Installed seven-pin receptacles with the LED streetlights for future smart city advancement
- Modernized HVAC control system with the latest automated Direct Digital Control (DDC) system
- Performed mechanical upgrades including replaced chillers, cooling towers and boilers
- Performed domestic water retrofits and installed new jail flush valves

Phase II

- Retrofitted 320 ornamental lighting fixtures with LEDs in the Entertainment District
- Retrofitted 403 streetlights with LEDs along State Highway 360 and on Interstate 30 overpasses
- Installed new LED high-mast fixtures along State Highway 420
- Retrofitted 920 interior/exterior lights with LEDs
- Installed new HVAC rooftop units

Program Timeline

MAY 2014
OpTerra implemented the first streetlight pilots in Arlington.

DECEMBER 2014
The City of Arlington signed a contract with OpTerra to implement Phase I.

MARCH 2015
Construction began on the largest streetlight conversion project in the southwest, retrofitting 10,500 streetlights with LEDs.

DECEMBER 2015
The Arlington City Council approved the financing and signed the contract to implement Phase II.

OCTOBER 2016
OpTerra completed construction of Phase II which included more LED streetlight retrofits and energy efficiency upgrades.

FEBRUARY 2017
The City and OpTerra continue to explore scopes for additional phases work encompassing LED streetlight retrofits in Arlington's residential areas.

savings due to the long life cycle of the LED fixtures. The LEDs have a rated life cycle of approximately 100,000 hours compared with HID lamps that generally have a life of less than 25,000 hours. Over the course of the 25-year life of the LED fixture, every HID fixture would have a lamp changed about four times. The LED conversion not only creates energy and cost savings for the City, but also standardizes the fixtures along streets to a single fixture, reducing the number of fixture types kept in inventory and improving efficiencies in maintenance.

All streetlight data is recorded in a streetlight database with pole locations and fixture information, further contributing to ease of maintenance. Additionally, OpTerra is paving the way for more connected, intelligent control of the streetlighting in the future; the seven-pin receptacles installed provide a solid foundation for smart city advancement in Arlington.

Phase I was financed with the help of a tax-exempt municipal lease, set at 2.5 percent over 15 years. As part of the investment plan, the City bundled implementation of the streetlights with energy efficiency performance upgrades in 21 City facilities, including the Ott Cribbs Public Safety Center and the Elzie Odom Recreation Center. Additionally, OpTerra replaced aging air conditioning equipment, modernized control systems, and implemented water conservation measures.

Phase II

Propelled by the success of the rapid construction of Phase I, occurring in a six-month period during off hours, the City entered into a second phase of work with OpTerra. Phase II included decorative LED streetlight retrofits in the Entertainment District, on Interstate overpasses, and along several state highways. To boost occupant comfort while saving costs, the City installed new HVAC rooftop units at several City buildings. Additionally, new LED interior and exterior lights were installed in City buildings, providing brighter, better quality light for residents and visitors.

By utilizing a performance contracting model, no upfront costs were required from the City and the energy savings that resulted from the first phase of work contributed directly to the financial feasibility of the program's second phase. OpTerra guarantees the energy savings resulting from all of the energy efficiency improvements. Phase II was also financed using a tax-exempt municipal lease, but set at 2.3 percent and over a 17-year period.

The Impact

Demonstrating a commitment to sustainability and serving as a model for other municipalities in the region, Arlington is the first major city in the Southwest to retrofit dated, HPS streetlights with contemporary, more effective, and high-performing LED fixtures. As a result of both program phases, the City is projected to generate savings of more than $18 million over 15 years and the new LED streetlights save the City $15,000 in maintenance costs annually.

The program has not only been a boon for the City from a financial and public safety perspective; it has also transformed Arlington into a greener city. The full program decreases the City's energy use by more than 2.5 million kilowatt hours annually – enough to power 237 homes' electricity use for one year. The City's water consumption is also reduced by more than 3,500,000 gallons every year – enough water to fill more than five Olympic-sized swimming pools.

The extensive LED streetlight installation places the City of Arlington at the forefront of leading technology and sustainability initiatives in Texas. With a higher color

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temperature light than the legacy yellow sodium vapor lights, the new LED fixtures also enhance pedestrian and driver safety at night. The new LED fixtures save energy, ease maintenance, and redirect utility budget costs to support other initiatives that improve the quality of life of Arlingtonians.

Additional Phases

The City is contemplating additional work on the remaining streetlights that have not been converted to LED including residential areas. The potential for additional streetlight retrofits is spurred on by a new tariff that supports lower LED wattages. By exploring additional work Arlington is on track to become fully lit by LED streetlighting from neighborhood to neighborhood in the near future.

Watch our video, **Lighting Up Arlington: City-Wide LED Streetlight Transformation** http://bit.ly/2iVg84J

ENERGY CONSERVATION MEASURE	TOTAL PROJECT COST ($)	TOTAL YEAR 1 SAVINGS ($)
Streetlighting	$6,870,000	$509,000
Mechanical Systems	$3,070,000	$117,000
Interior Lighting	$1,820,000	$196,000
Controls	$1,290,000	$38,000
Water Conservation	$370,000	$35,000
Electrical	$290,000	$48,000
	$13,710,000	**$943,000**

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