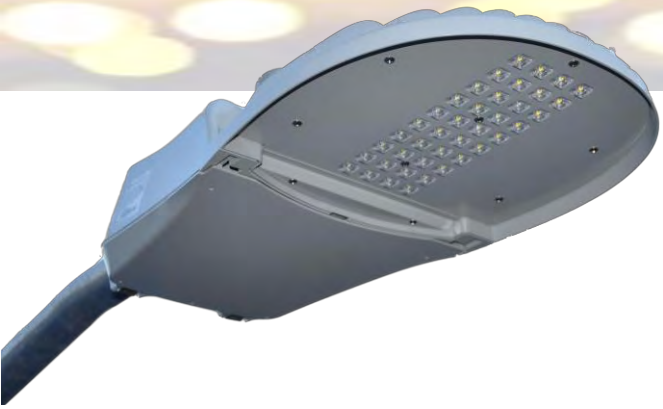
A Municipal Guide for Converting to LED Street Lighting



A Step-by-Step Approach to Improving Outdoor Lighting, Saving Energy and Reducing Maintenance Costs.

Algona, Iowa

Before: 250W HPS (295 System Watts)

After: 104W and 176W LED

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Introduction

Driven by the promise of significant energy and maintenance savings provided by Light Emitting Diode (LED) technology, many cities are struggling with effectively implementing LED's in their street lighting. There still remains much confusion and misinformation pertaining to this technology. Furthermore much of the available literature is written in highly scientific jargon targeting an academic audience.

This document is intended as a practical, user friendly, step-by-step guide for individuals responsible for municipal street lighting who may lack a formal lighting background. Thus, the use of lighting jargon in this guide has been minimized.

Note on controls/monitoring systems.

While the potential exists for additional energy savings from the control systems offered by several manufacturers, there is currently no industry standard communication protocol for these systems. Consequently the street lighting control systems on the market today are proprietary and most municipalities have been reluctant to risk standardizing on any of these systems. Also, these systems currently add an additional level of complexity and cost to the street lighting system. Because of these critical issues, we have not yet seen widespread adoption of these systems in the market and therefore controls/monitoring systems are not included in this guide.

It should be noted, however, that many luminaire manufacturers do offer replaceable "power doors" on their street lights which offer the potential for easy replacement in the future with the necessary control equipment. This would allow for a simple luminaire upgrade to include controls when these critical issues are resolved and the systems become more viable. If a city felt they might wish to add a street lighting control system in the future, they may choose to add this "Power Door" feature to the preliminary specification recommended in Step 6.

Step 1 – Decide if LED street lighting makes sense for your community

The first step for any city considering converting their high pressure sodium or mercury vapor street lighting system to LEDs is to evaluate the actual data and draw on the experiences of other communities. Fortunately hundreds of communities throughout North America have already installed some LED street lighting and there is considerable evidence now that at the very least LED street lights will provide the following benefits compared to HID:

- Improved nighttime visibility and safety through better color rendering, more uniform lighting distributions and the elimination of many dark areas between poles.
- Reduced direct and reflected uplight which are the primary causes of urban sky glow.
- 40-80% energy savings (depending on incumbent lighting source and lighting design criteria).
- 50-75% street lighting maintenance savings.

On the downside, there are two major obstacles to an LED street lighting conversion project:

- The first cost of an LED street light conversion will require a significant capital outlay. LED lights are considerably (2-4 times) more expensive than conventional HID "cobra-head" style lights.
- Because of the lack of standardized wattages and the complexities of getting new rates approved, most regulated Investor Owned Utilities (IOU's) today don't offer LED street light tariffs for unmetered street lights. Therefore, even if a city converts all of the street lights to LEDs and reduces the power consumption by 50% or greater, most IOUs will only reduce the street lighting bill slightly or not at all. However most IOU's are aware of the benefits provided by LED technology in street lighting and many are working to develop these tariffs.

It is highly recommended that cities begin networking with other cities who have installed LED street lights as early as possible in the process to help confirm the desired objectives and avoid the pitfalls. A good starting place is the Municipal Solid State Street Lighting Consortium (http://www1.eere.energy.gov/buildings/ssl/consortium.html). The MSSLC is funded by the U.S. Department of Energy and is simply a consortium of communities who share experiences and best practices pertaining to LED street lighting. They hold regular workshops throughout the United States and are an excellent resource for technical information.

In addition, at the end of this guide is a partial list of cities, utilities and DOTs that have successfully installed LED street lights.

In spite of the advantages offered by LED street lights, the reality is that many cities may simply lack the personnel to administer these types of projects. Like similar projects, this will usually require development of specifications, preparation of bid documents, and overseeing the implementation of the project.

Finally, the project itself will require some sources of funding which are discussed in Step 3. Some cities may simply be forced to conclude that for financial reasons this project may have to be deferred.

If it is determined that the city lacks the resources to proceed with a street light conversion project, it is recommended that the city consider purchasing just four LED street lights from two or three different manufacturers to test. Many manufacturers offer special pricing programs for these test installations. By putting up (See Step 7 for details on a test) eight or twelve LED street lights you can quickly begin to educate yourself on the technology, the mechanics of the products, the differences in the illumination quality, etc. In addition, you can begin to obtain community feedback (positive and negative) on the lighting quality. In the future when you are able to proceed with this initiative you will have gained valuable experience and not be starting from scratch.

Step 2 - Define the scope of the project

For smaller communities it may be economical to convert all of the street lights at once. Larger cities typically find doing the project in stages is more practical. Defining the scope of the project is best done as follows:

a. Complete an audit of your current street light inventory and light levels.
In many cases cities do not have complete and current knowledge of the extent of their street lighting inventory. Ideally this would include the following:

- Every pole with GPS location.
- The style of luminaire(s) (cobra-head, decorative acorn, decorative teardrop etc.) on each pole.
- The lamp source and wattage of each luminaire.
- Identification of responsibility for ownership and maintenance of each luminaire (city or utility).
- Typical light levels and uniformity provided by each type of luminaire on each type of roadway. A lighting designer with roadway lighting experience or some street lighting manufacturers' representatives may be able to assist you with this if required.

b. If street lights are owned by an IOU, confirm that they offer LED tariffs and/or rebates. This will substantially impact the financial viability of the project.

c. Evaluate the internal resources of the city to determine whether you have the capacity for a complete street lighting retrofit program. Most cities have done their relighting projects in stages such as starting with lower wattage cobra-head products in areas with the greatest need for improved lighting. Also, unlike HID units, lower wattage LED lights are substantially lower cost than higher wattage units.

Because of the high initial cost, replacing decorative lights typically offer financial returns substantially lower than cobra-head units and consequently are often deferred to the later stages.

Step 3 – Determine the funding source

It is wise to carefully consider the funding source early in the process. Today the initial cost of LED street lights is considerably higher than HID lights. In addition, they will typically take several years to pay for themselves in energy and maintenance savings. Here are a few potential sources of funding that have been used or considered by other cities:

- Self Funding
  - If a city has its own municipal utility it may be possible to borrow the funds from the utility and pay it back over several years (typically 5-7) out of the savings in energy and maintenance.
  - With current interest rates, it may also be highly attractive to issue bonds or arrange financing through private capital markets.

- Federal Government
  - Many cities were able to take advantage of block grants in the 2009 American Recovery and Reinvestment Act (ARRA) for these projects. While the ARRA funds are now mostly gone, cities may find other federal grants in the form of matching funds, etc. The MSSLC may be a good resource for identifying these.

- State Programs
  - Many states have grants and low interest loan programs available for energy saving projects.

- Utility Programs
  - Pacific Gas and Electric in Northern California currently has the most comprehensive LED street lighting conversion program in the U.S. This program includes special tariffs, rebates and even a turnkey installation program. Many other IOU's are also developing LED conversion programs for their customer's street lights as well their own.

- ESCO's
  - Large Energy Saving Contractors (ESCO's) are now offering complete turnkey installation programs. They can finance the project as well as purchase and install the lights. The city can pay for this over many years out of energy and maintenance savings as well as any potential energy rebates.

- Manufacturers' Programs
  - Several large street lighting manufacturers are also willing to help finance these projects accepting payments over several years. It is wise to ask the manufacturers about their programs and possibly include these terms in the bid documents.

Certainly two or even three of these options can be combined to achieve the most favorable financing package for the project.

Step 4 – Complete the financial analysis

A preliminary analysis of the financial payback can be done pretty quickly.

The formula for Simple Financial Payback is = $\frac{\text{Initial Cost of the Program}}{\text{Annual Savings in Energy and Maintenance}}$

Example: Replacing (1,000) 100W HPS Cobra-head Style Street Lights with $.10 kWh energy rate.

Initial Cost:

- Cost of new LED luminaires = $230 X 1,000 = $230,000
- Cost of installation = (4 luminaires per hour installed at $200 per hour for two person crew) $50 X 1,000 = $50,000
- Cost of bid, administration, misc. = $10,000
- Less utility rebates = $75 X 1,000 = ($75,000)
- Total Initial Cost = $215,000

Annual Savings:

- Annual Energy Savings = 1,000 street lights X 4,000 hours per year X 75W per luminaire savings X .10 kWh rate = $30,000
- Annual Maintenance Savings = 1,000 street lights X $25 per fixture per year savings (assuming 4 year cycle of HID spot relamping, cleaning, changing igniters, ballasts, photocells, etc. vs. LED 10 year cleaning cycle and occasional photocell and driver replacements) = $25,000.

Total Annual Savings = $30,000 + $25,000 = $55,000

Simple Payback = $215,000/$55,000 = 3.91 years.

Typically programs with paybacks under 5 years should certainly be done and paybacks over 10 years are usually deferred. However, because of the urgency of global climate change, many communities (especially where the electrical energy source is fossil fuel based) are even proceeding with energy saving programs that have very long financial payback periods. Also if the funding source is a federal or state grant, it will normally make sense for the city to proceed with the project regardless of the payback.

If the payback seems favorable it will probably be desirable to complete a more rigorous financial analysis to determine Return On Investment (ROI) and the Net Present Value (NPV) of the project. The MSSLC offers a more comprehensive on-line tool for helping with these calculations here: http://www1.eere.energy.gov/buildings/ssl/financial-tool.html.

Step 5 - Determine if street lights are going to be purchased by the city direct or through the installing contractor

Generally speaking the most cost effective method for these projects is for the city to buy the luminaires directly and have them installed by their own crews or by an outside contractor. Some cities however prefer the simplicity of having a single contractor provide a complete turnkey solution which may also include financing, labor warranties, etc. This approach will normally have a longer financial payback. Also, if the "turnkey solution" is chosen, the contractor may attempt to provide a lower quality street light. It is imperative therefore to list the acceptable products clearly in the bid documents (see Step 9).

Many cities have found it helpful to network with other communities that have completed their LED conversions to help determine how to best purchase the street lights.

Step 6 – Develop a simple, <u>preliminary</u> specification to help narrow down the fixture selection

Below is a sample of a basic, twelve item specification that would normally eliminate most of the very poor quality products and unreliable suppliers. All major U.S. manufacturers that have any significant experience with LED street lighting should have no difficulty in meeting this specification.

<u>LED "Cobra-Head" Style Luminaire Preliminary Specification</u>

I. Luminaire shall mount to a 1¼" to 2" (1⅝ " to 2⅜" O.D.) diameter mast arm.

II. Luminaires shall have an Effective Projective Area (EPA) not to exceed the EPA rating of the luminaire being replaced.

III. EMI meets or exceeds FCC 47 CFR Part 15. Transient voltage complies with ANSI C62.41 Cat. C High.

IV. Luminaires shall pass the 3G vibration test per ANSI C136.31-2001

IV. Paint finish shall equal or exceed a rating of six per ATSM D1654 after 1000 hours of salt spray testing per ASTM B117. VI.

V. LEDs shall have a CCT of 4000K ± 300K

VII. Luminaires shall produce 0 light at or above 90°.

VIII. Luminaires shall be listed by Lighting Facts.

IX. Luminaires shall be qualified by the DesignLights Consortium

X. Luminaires shall be listed by a Nationally Recognized Testing Laboratory as suitable for wet location applications.

XI. Manufacturer shall provide a minimum five year limited warranty.

XII. Luminaires shall meet the lighting levels and uniformity requirements shown in the scenarios below:

- Scenario A

  *Replacement of **100W HPS** luminaires in local/residential applications with a low pedestrian conflict classification*
  *Road width – **40'***
  *Pole Mounting Height - **25'***
  *Pole Spacings – **150'** Single Side of Street*
  *Mounting Arm – **8'***
  *Pole Set Back from Street – **2'***
  *Light Loss Factor in Calculations - **.85***

  Minimum Required Average Illuminance - **.4** fc
  Average to Minimum Uniformity - ***6*** to 1

- Scenario B

  *Replacement of **150W HPS** luminaires in collector/commercial applications with a medium pedestrian conflict classification*
  *Road width – **55'***
  *Pole Mounting Height: - **30'***
  *Pole Spacings – **175'** Staggered Opposite Sides of Street*
  *Mounting Arm – **8'***
  *Pole Set Back from Street – **2'***
  *Light Loss Factor in Calculations - **.85***

  Minimum Required Average Illuminance - ***.9*** fc
  Average to Minimum Uniformity - ***4*** to 1

Specification Explained:

I. Luminaire shall mount to a 1¼" to 2" (1⅝ " to 2⅜" O.D.) diameter mast arm
This is the standard range of pipe sizes to which both HID or LED "cobra-head" style fixtures mount.

II. Luminaires shall have an Effective Projective Area (EPA) not to exceed the EPA rating of the luminaire being replaced.
This specification assures that the wind load rating of the luminaire won't be larger than the replacement HID cobra-head and potentially compromise the pole. Typically luminaires with an EPA at or below .9 ft^2 will comply with this.

III. EMI meets or exceeds FCC 47 CFR Part 15. Transient voltage complies with ANSI C62.41 Cat. C High.
This is an FCC requirement to make sure that the electronics in the luminaire won't interfere with broadcast or cable systems, etc.

IV. Luminaires shall pass the 3G vibration test per ANSI C136.31-2001
This is the industry standard test that ensures the luminaire will remain on the mast arm in spite of normal vibrations.

V. Paint finish shall exceed a rating of six per ATSM D1654 after 1000 hours of salt spray testing per ASTM B117.

This is especially important in coastal regions to ensure that the finish won't fail resulting in premature corrosion of the housing.

VI. LEDs shall have a CCT (correlated color temperature) of 4000K ± 300K

4000K is considered a "neutral white" (not too yellow or too blue) color of light similar to both moonlight and metal halide (which is usually used in retail parking lots). Although 6000K is also sometimes used in street lighting, many people find this unnatural and too blue which is why the 4000K enjoys wide market acceptance and is much more common.

VII. Luminaires shall produce 0 light at or above 90°.

With traditional HID cobra-heads there was a tradeoff between drop refractor type lenses and flat glass lenses (previously classified as "full cutoff"). Drop lens units typically produced wider pole spacings and more uniform lighting patterns. Flat glass units usually had less uplight (which contributes to sky glow), better control of light trespass into residential windows, and lower high angle glare. One of the great benefits of LED lights is you can now "have it all". With the precise optical control capability of LEDs it is now possible to achieve the uniformity and spacings of the HID drop glass units as well as the elimination of direct uplight, reduced glare, and light trespass control provided by the flat glass units. Therefore there is really no reason today to accept anything other than a "full cutoff style" street light with zero light above 90°.

VIII. Luminaires shall be listed by Lighting Facts.

Sponsored by the U.S. Department of Energy (DOE), LED Lighting Facts is a voluntary pledge program to assure that LED lighting products are represented accurately in the market. Lighting Facts will publish performance results provided by the manufacturer in five areas—lumens, efficacy, watts, correlated color temperature (CCT), and color rendering index (CRI)—as measured by the industry standard for testing photometric performance, IES LM-79-2008. By adding this to the specification, the municipality is relieved of the burden of having to obtain and evaluate this data.

IX. Luminaires shall be qualified by the DesignLights Consortium.

The DLC is a collaboration of utility companies and regional energy efficiency organizations that evaluate luminaire manufacturers' LED data (LM-80), and their in situ thermal tests. If the manufacturer provides this product data to the DLC and it demonstrates the product meets the DLC criteria for projected LED life, they will add the product to their list of qualified products. By adding this to the specification, the municipality is relieved of the burden of having to obtain and evaluate all of this data. Also, DLC qualification is usually required to qualify for most utility programs or rebates.

Note: Neither Lighting Facts nor the DLC evaluates actual products and their listing provides no assurance of product quality in the areas of meeting the desired lighting levels, mechanical features, etc.

X. Luminaires shall be listed by a Nationally Recognized Testing Laboratory as suitable for wet location applications.

Requiring a label from UL, ETL, or CSA, etc. assures that the product has passed industry standard tests for product safety. The thermal and environmental tests performed for the wet location rating assure the product was suitably designed for outdoor applications. Also, the National Electric Code requires electric lights to have this label.

XI. Manufacturer shall provide a minimum five year limited warranty.

The warranty should cover the entire luminaire - especially failures of the LEDs (usually 10% or more LED failures constitute a luminaire failure), power supply, and paint finish. The industry standard today for LED street light warranties is 5 years. Many manufacturers may be willing to offer longer warranties, but they will usually charge a premium for this. As with most "extended warranties" these are not generally a good value because a) failure rates are likely to be relatively low during the precise period of the extension, and b) after five years the product pricing is likely to be lower than current prices (as is the case for most electronic products). Therefore it will likely be more cost effective to simply buy the lower cost replacement product at that time.

XII. Luminaires shall meet the lighting levels and uniformity requirements shown in the scenarios below:

It is a good idea to specify some application-based lighting criteria.

*The scenarios listed are typical but are by no means standard. It may be useful to simply list these scenarios in the initial specification, but it would normally be preferable to replace the values in **bold underline** with the actual mounting heights, pole spacings, etc. that exist in your community. To create the design to verify the lighting criteria is achieved by each manufacturer, the same LM-79 IES file should be used that was submitted to gain listing by Lighting Facts.*

Notes:

1) The footcandle and uniformity values shown in the specification are derived from the Illuminating Engineering Societies (IES) RP-8 Recommended Practice for Roadway Lighting. This is the industry standard for lighting roadways. However, many communities today do not light to this standard. Also, if these values are not being achieved currently with HID lights, it may not be realistic to achieve these lighting levels when converting to LEDs. Those communities instead typically try to achieve light levels that are as good as or better than what had existed with the incumbent technology.

2) There is considerable research suggesting that, especially at low light levels, humans have better visibility under the white light produced by LEDs than the yellow light produced by high pressure sodium. Many people believe therefore the overall "photopic light levels" (what a standard light meter reads) can be lowered when converting to LEDs without reducing visibility to achieve further energy savings. While not disputing the validity of the research, the IES does not yet specifically endorse this design approach in street lighting.

Step 7 - Invite manufacturers to present their products for testing and preliminary evaluation

Contacting manufactures and inviting them in to present their luminaires and data is very important. Wherever possible, it is also advisable to include the maintenance department in these meetings.

Generally the most successful LED street lighting conversion projects have been in cities that began dialogues with several manufacturers early in the process. They invited them to present their products and photometric analysis to determine:

a. Compliance with the spec
b. Visual product quality
c. Apparent ease of installation and maintenance
d. Experience, integrity, and solvency of manufacturer

The vast majority of LED cobra-head street lights installed in the U.S. are from these manufacturers:

- American Electric Lighting
- Beta/Cree
- Cooper Lighting
- General Electric
- Hadco Philips
- Holophane
- LED Roadway
- Leotek Electronics USA
- Lighting Sciences Group
- LSI
- Philips Roadway

In addition, it is recommended that local lighting representatives be encouraged to bring in any additional luminaires which comply with the preliminary specification. As with most solid state technologies, there are many new products constantly being introduced that offer new features. It is wise however to consider the stability and experience of the manufacturer when evaluating quality, service capability, and value of the warranty.

Step 8 – Test the preferred luminaires in a residential street application

Based on the results of the preliminary evaluation in Step 7, it is a good idea to identify between three and seven potential manufacturers who presented products that met the specification and offered mechanical or performance features that the city found desirable. These might include things like tool-less access to the electrical compartment, replaceable power door for future control system, appealing daytime form, or new higher efficiency LEDs.

A good location for a street light test is a low traffic residential location with existing 70W or 100W HPS cobra heads, consistent single-sided pole spacings and minimal trees.

After this area is identified invite the selected manufacturers to run the lighting calculations with their product's IES files for your test installation (1.0 light loss factor to facilitate verification) using the precise street width, pole locations and mounting height. The proposed products should meet your lighting design criteria such as RP-8 or your existing HID light levels for this application.

Many manufacturers have discount programs to sell a few street lights for these types of test installations. It is recommended that four luminaires from each manufacturer be purchased. These samples should be visually evaluated prior to installation. Particular attention should be given to packaging. If there is insufficient cartoning, luminaires may be damaged in shipments. However, excessive packaging will greatly slow down the installation as extra trips will be required to pick up additional luminaires and return carton material for recycling.

After inspecting the sample products replace four adjacent HID luminaires with the four purchased products and repeat for all of the manufacturers in the selected test location. If possible test for the actual power consumption (system watts) of each of the units prior to or during installation.

To test lighting performance use a light meter designed to read measurements to .01 fc to take measurements at grade below the luminaires, across the street from the luminaires, at the point between the luminaires, and the opposite side of the street from the midpoint of the luminaires. Compare these values with the manufacturer's calculations. This will allow you to confirm the manufacturers' calculations and evaluate the energy use and efficiency of each light. The most important metric of efficiency is the wattage required to provide the desired light levels. In other words, "footcandles on your street/per watt" is more important than "lumens per watt".

There is also a strong subjective element to street lighting and it is very wise to obtain input from everyone involved in the project. After the test units are installed invite feedback from city council, public works department, maintenance department or installing contractors, local citizens etc. on ease of installation, quality of illumination, light trespass, glare, and other issues that are deemed important.

Step 9 – Issue and award bid

Based on the results from the test installation select the products that are acceptable. Now writing the specification becomes very simple. You can use the original preliminary specification and simply add the selected manufacturers' names and part numbers. Generally speaking, the more products you allow the more favorable the pricing will be. Therefore you should certainly list at least two products and federal contracts may require at least three. It should be added in the bid documents that no other products will be considered since you have completed your evaluation.

If the decision in Step 5 was to purchase the luminaires directly using the city's own crews for installation the Request for Quote (RFQ) will be for luminaires only. If an outside contractor is being used there will need to be a separate RFQ for "installation labor only". Finally, if a contractor is being selected for a complete turnkey installation then a single RFQ can be issued for furnishing and installing the luminaires.

Notes:

- If there is a significant preference for one or more of the "acceptable" luminaires, it may be desirable to develop a "weighting point system" where price is only one of the factors in selecting the luminaire. Additional weight can be given to specific product features, application efficiency ("footcandles per watt on the test area"), manufacturer's experience, etc. This would allow the flexibility to purchase the luminaire with the preferred features if it is only slightly higher priced than the unit with the lowest bid.
- If your utility offers a "turnkey option", it is usually wise to get a competitive bid as their programs can be quite expensive.
- It is usually a good idea to include a reasonable delivery requirement in the RFQ as well (eg. "Luminaires shall be delivered to the City Maintenance Yard within 60 business days of project award"). During the preliminary product evaluation phase, you can simply ask the suppliers what their typical delivery would be on the quantity on the RFQ. Similarly you can informally survey local contractors to determine what kind of a schedule they would normally require for this type of project.

Based on how you structured your awards (material only point system, furnish and install, etc.), you should issue the award after you have completed the evaluation of the bids per your normal award process.

Step 10 – Implement project

If the city's own crews are doing the installation this will obviously require more oversight than if an outside contractor is used. Some cities have used a combination of their own personnel and an outside contractor to install the luminaires. Based on cost and project schedule this can add significant flexibility to the project.

Networking with other cities who have had similar projects can provide a good basis for evaluating the number of installs per day that should be achieved. In addition, they can be an excellent source for suggestions on creating the most efficient crews, staging material, etc.

Post award communication with the luminaire manufacturer is also a key element for success. It is highly recommended to have a meeting with the manufacturer (or their representative) and the contractor (if applicable) immediately after the award. An additional luminaire sample should be provided at that meeting representing the exact model that will be furnished on the job. This should include any special wiring configurations, paint finish, labeling, accessories, carton, etc. This will avoid any misunderstanding of exactly what is being ordered and delivered.

Delivery should also be discussed. A realistic schedule should be developed that will allow the manufacturer to deliver the products consistent with the city's ability to have them installed. Often on large projects, storage is a critical issue. If the project becomes delayed due to weather or other unforeseen circumstances and the city does not have the facilities to store the luminaires, contingency arrangements should be made.

Step 11 – Develop long term maintenance program

Unlike traditional HID lamps, LEDs don't typically fail by "burning out" after some period of time. Rather, over long periods of time LEDs will gradually simply become dimmer. However, the better LEDs used in street lights on the market today may still be producing over 80% of their initial light after 100,000 hours (25 years in typical applications) in the field.

Although it is impossible to predict the lighting technology in 15-20 years, certainly the LEDs on the market today will no longer be available. We can further reasonably assume if the lights need to be replaced, the light source products on the market in 15+ years will be considerably more efficient, physically different, and not mechanically compatible with current luminaires. Consequently it really doesn't make any sense to plan for "changing light bulbs" as you would for HID lamps. Therefore, there is really no practical advantage to specifying "replaceable LEDs" or "modular light engines", etc. At some point it will simply make economic sense to replace the luminaires with the latest technology product available.

Given the very long life of LEDs, there is a paradigm shift on how we consider designing a long term maintenance program. There are two major issues worth considering – 1) Spot replacement of components and 2) Luminaire cleaning.

Spot Replacement of Components

Unlike HID systems where there are failures of lamps, igniters, ballasts, and photocontrols; with LED systems only power supplies (drivers) and photocontrols are normally subject to replacement. Today's power supplies are typically rated for 100,000 hour life and the expectation is that replacements will be very rare – probably less than 1% over the 100,000 hour life of the system.

Because of the projected long life of these systems it may not be practical to stock replacement "power supplies" or "power doors". Because the entire luminaire is typically covered by the manufacturer's warranty for the first 5 years, it will probably just make sense to replace the complete unit in the event of an occasional failure. Also, this will allow the greatest flexibility when different manufacturers or different product generations are used in the city.

There are also now "long life photocells" on the market designed to last up to twenty years. While these have a considerable price premium over conventional photocontrols, it may be a worthwhile investment if they don't have to be replaced as frequently.

Luminaire Cleaning

Like all luminaires LED street lights are subject to dirt depreciation that will reduce light output over time. Unfortunately, because LED street lighting is still relatively new there is no extensive field data that would prescribe a precise cleaning program for various environments. Much less heat is generated on the lenses by LEDs than HID lamps so less dust will normally adhere and fuse to the lens than has been historically experienced in outdoor luminaires. For this reason we would expect to see considerably lower Luminaire Dirt Deprecation (LDD) on LED luminaires.

Given the lack of data regarding the necessity for cleaning luminaires a reasonable program such as the following would seem to make sense:

A. As soon as luminaires are installed check the light levels directly below the luminaires at grade at several pole locations. For accuracy, it is advisable to use a light meter designed to read measurements to .01 fc. Log this data.

B. On an annual basis recheck the light levels at the exact locations and compare the data.

    - Try to test at the same time of year to avoid any temperature caused discrepancy.
    - LEDs will often initially increase their light output before they begin their depreciation so it is not uncommon to have readings after one year be higher than when first installed.

C. After a few years when the light levels have dropped by more than 10% try a high pressure wash on the lens from the ground and then recheck the light levels. If there is no significant improvement it may be necessary to visit the luminaires and wash the lenses with a wet cloth.

D. Continue to check the light levels periodically and ultimately design a luminaire cleaning program based on the frequency required to maintain the desired illumination levels.

Resources

- Municipal Solid State Street Lighting Consortium -
  http://www1.eere.energy.gov/buildings/ssl/consortium.html

- Illuminating Engineering Society
  RP-8 – Guide to Roadway Lighting is available for ordering
  http://www.ies.org/

- DesignLights Consortium
  http://www.designlights.org/

- LED Lighting Facts – A Program of the United States Department of Energy
  http://www.lightingfacts.com/

- Leotek Electronics USA –
  This LED Street Lighting Guide is available on line without charge.
  http://leotek.com/

Partial List of LED Street Lighting Installations

Municipalities

- Algona, IA
- Bakersfield, CA
- Bell, CA
- Boston, MA
- Brooklyn Park, MN
- Chula Vista, CA
- Colton, CA
- Davis, CA
- Fremont, CA
- Galt, CA
- Gering, NE
- Greeneville, NC
- Hayward, CA
- Hollister, CA
- Holyoke, MA
- Hoover, AL
- Huntington Beach, CA
- Iowa City, IA
- Kinston, NC
- Lima, OH
- Lompoc, CA
- Longview, WA
- Los Angeles, CA
- Madison, WI
- Marysville, WA
- Middleboro, KY
- Milpitas, CA
- Modesto, CA
- Monaca, PA
- Nether Providence Township, PA
- New Haven, CT
- New Orleans, LA
- Novato, CA
- Oakley, CA
- Olympia, WA
- Ontario, CA
- Oroville, CA
- Palo Alto, CA
- Phoenixville, PA
- Pittsburgh, PA
- Pocahontas, IA
- Reading, PA
- Redding, CA
- Redmond, WA
- Redondo Beach, CA
- Rocklin, CA
- San Jose, CA
- Santa Ana, CA
- San Ramon, CA
- Sausalito, CA
- Seattle, WA
- Spencer, IA
- Springfield, OR
- Tulare, CA
- Tuscaloosa, AL
- Upper Marion Township, PA
- Vallejo, CA
- Ventura, CA
- Watsonville, CA
- Wauwatosa, WI
- Weimer, TX
- West Fargo, ND
- West Lake Village, CA
- West Palm Beach, FL
- Wrangell, AK

An American Success Story

Focusing 100% on LED technology, Leotek Electronics was founded in 1992 in the heart of Silicon Valley, California. Leotek was instrumental in revolutionizing the traffic signal business and saving cities millions of dollars in energy and maintenance costs while reducing the green house gases required for powering incandescent traffic signals. Today Leotek is a leading supplier of traffic signals in North America having shipped over 4 million units in the last decade.

Recognizing the benefits of LEDs over HID sources, in 2006 Leotek introduced their first LED street light. Through product innovation and superior service, today Leotek is now also a leading supplier of LED street lights in the United States.

Leotek Electronics USA Corp. | San Jose, CA

In 2007, Leotek was acquired by the Lite-On Corporation. This $6 billion electronics company provides financial stability and the customer assurance that Leotek will be around for generations to honor any warranty claims and continue innovating exceptional LED products.

GREEN Cobra™

- **Clean Daytime Form with Proven Market Acceptance**
- **"Full Cutoff" Optics with the Performance of a Drop Lens**
- **Tool-less Access to Electrical Compartment**
- **Over 100,000 Units Now Installed Throughout the USA**

ECobra-head™

- **Leotek's Newest LED Roadway Luminaire**
- **Utilizing State-of-the-Art LED Technology**
- **Replaces up to 1000W HID**
- **Reduces Energy Consumption by Over 50%**
- **Surprisingly Affordable**