Anchorage, AK

Residential, Italy

Pittsburg, PA

Portugal

Parking garage, Raleigh, NC

Seattle, WA

Banff, Alberta

Parking Lot

Public Park, Europe

LED Research Definition of Terms

Candela: Unit of luminous intensity. The power emitted by a light source in a particular direction. A common candle emits light with a luminous intensity of approx. one candela in all directions. One candela radiated in all directions equals $4\prod$ lumens. Symbol: cd
Foot-candle: The amount of light that actually falls on a given surface. One foot-candle is equal to one lumen per square foot.
Lumen: A unit of luminous flux which is a measure of the power of light perceived by the human eye, not a measure of the power of light emitted. In other words, lumen is indicative of the sensitivity of the human eye to different wavelengths of light. Symbol: lm
Lux: One lux is equal to one lumen per square metre, where 4π lumens is the total luminous flux of a light source of one candela of luminous intensity. The difference between the units *lumen* and *lux* is that the lux takes into account the area over which the luminous flux is spread. For example, a flux of 1000 lumens, concentrated into an area of one square metre, lights up that square metre with an illuminance of 1000 lux. The same 1000 lumens, spread out over ten square metres, produces a dimmer illuminance of only 100 lux. Mathematically, 1 lx = 1 lm/m^2.

Foot-candle	Lux
The illuminance cast on a surface by a one-candela source, one foot away	The illuminance cast on a surface by a one candela source, one meter away.

Thus, one footcandle = 10.764 lux.

For example;
One amp flowing through the potential difference of one volt = 1 watt.
V x A = W

Luminaire Efficiency: Ratio of light output emitted by the luminaire to the light output emitted by the lamps.
Luminaire Efficacy: Lumens per watt. Analogous to miles per gallon.

	Agency Research Quick View				
	Raleigh, NC	Valdez, AK	Chula Vista, CA	Los Angeles, CA	Austin, TX
Primary contact person	Eric Lamb, PE. (919) 516-2126 eric.lamb@ci.raleigh.nc.us	Laurea Robertson (907) 834-3450 lrobertson@ci.valdez.ak.us	Robert LeClair (619) 397-6163 RLeClair@ci.chula-vista.ca.us	Orlando Nova (213) 847-1826 orlando.nova@lacity.org	James Parker james.parker@austinenergy.com
Protocol Testing Required prior to pilot program?		Public evaluated two LED lights and voted for their preference.		Yes. Phase 1 evaluation available.	
What is the testing protocol?		Followed Anchorage's testing and selection and choose BetaLED.	Field monitor and evaluate energy use light/ patterns.	See LED Equipment Evaluation, Phase 1, appendix C	
Internal Research report avaialable?	See attached LED Street Lighting Test Pilot Project Report, April 13, 2009	See attached Valdez LED Street Light Initiative, appendix C. Lights were changed from low to med. setting after installation.	N/A. Used studies from LA and Caltrans	See LED Equipment Evaluation, Phase 1, appendix C	N/A. Will probably start in 6 mo.
Cost/benefit analysis available?	Anticipate frwer maintenance trips over the life of LED fixtures.	See Valdez LED Street Light Initiative, appendix C.	Potentially a 50% reduction in annual energy costs.	Project 40% energy savings	
Vendor/manufacturers considered					
Name	BetaLED	BetaLED	BetaLED, GE Lighting, Leotek, LED Roadway Lighting, Ltd.	N/A	Bid-out services
Name of contractor	Progress Enregy installed.	CVEA hired an Anchorage-based contractor to assist.	Highly recommends Patterson Brothers Lighting	City installs own lights.	Auston Energy installs their own lights and maintains
Source of financing					
Rebate program			Substantial rebates and rate reductions through SDG&E		
Bonds and grants					Applyling for Federal stimulus money
Special loans				Loans from DWP	
Other		City budget for first phase. Considering a Small City Energy Efficiency and Conversation Block Grant for next phase.	4 sample fixtures provided at manufacturer's expense. Future improvements should include LED fixtures.	Clinton Climate Initiative, **not funding**. Assisted w/ expertise and define objectives.	

	Raleigh, NC	Valdez, AK	Chula Vista, CA	Los Angeles, CA	Austin, TX
Number of street lights in the city			9000	140000+	
Type of street lights	Two 200W and seven 250W lights replaced with nine 167W lights.	See attached, appendix C			
Wattage consumption		See attached, appendix C			
Who owns and operates the street lights?	Power Company provides power and owns street lights, city leases the light poles.	Power company ownes the ights replaced so far.. City responsible for maintenance and disposal	City owns and operates. City pays for maintenance and electricity.	City owns and operates. Pays DWP for electricity.	Austin Energy
Can lights be isolated?		Lights not actually metered. City pays for electricity based on product specs.			
Overall Impression and benefit of the program.	No industry consensus for LED lighting standards. See Project Report conclusions, appendix C.	See City of Valdez LED Street Light Inititive, LED Replacement Project Report, and spreadsheet, appendix C		Exceeded the 40% reduction goal. See LED Equipment Evaluation, Phase 1, Section 5, appendix C. Also see section 4 for public comments	Some communities are creating their own standards rather than wait for IES standards. Estimated that technology will improve in about 2 years enough so that the issue is moot.

Multiple phase, multiple awards, LED street & area light project

Appendix A – Minimum Specifications and Requirements

The minimum requirements below shall be met:

1. The LED streetlight must be commercially available. Prototypes will not be accepted.

2. The fixture must use at least 40% less energy (as a system) compared to its commercially available High Pressure Sodium counterpart. Scotopic light contribution can not be considered at this time. The power draw of the luminaire (including control devices) shall not exceed .50 watts when in the off state.

3. Production capacity must be in excess of 1,500 units per month.

4. The fixture must be marked with a full production catalogue number that matches manufacturer documentation.

5. A full sheet of product specifications must be submitted. Warranty must be provided for the full replacement of the luminaire due to any failure for 5 years.

6. Fixture must be designed to meet IESNA lighting standards per RP-8. Types I, II, & III distribution patterns should be readily available. Fixture must be classified as cutoff, with no significant glare, compared to its commercially available High Pressure Sodium counterpart. IES Files must be submitted.

7. Fixture must be tested by an independent lab in accordance with LM-79 and LM-80. Documentation must be submitted.

8. The fixture must easily connect to a standard 2.5" Dia. horizontal tenon.

9. The fixture must not have any fans, liquids, or moving parts.

10. The driver must be located inside the housing, be replaceable and accessible without tools.

11. Housing must not be constructed of Polycarbonate that will change color over time.

12. Power Factor > .90

13. LED driving current < 525mA for normal operations. LED module(s)/array(s) shall deliver at least 70% of initial lumens, when installed for a minimum of 50,000 hours.

14. LED Color Temp. (4000-5000K)

15. CRI > 70

16. Smart fixture features with bi-level or tri-level or full control.

17. RoHS compliant

18. Transient Protection Per IEEE C.62.41-1991, Class A operation. The line transient shall consist of seven strikes of a 100k HZ ring wave, 6 kV level, for both common mode and differential mode.

19. Interference: Power supplies shall meet FCC 47 CFR Part 15/18 (Consumer Emission Limits).

20. Power supply shall have a Class A sound rating per ANSI Standard C63.4.

21. Output operating frequency must be ⩾ 120 Hz (to avoid visible flicker) and input operating frequency of 60 Hz.

22. Standards: ANSI C78.377.2008, IESNA LM-79-08, IESNA LM-80-08, UL standards

In addition, for the Downtown historically accurate fixtures (Acorn Globes) the following light fixture specifications supercede applicable portions of the minimum requirements above:

All of the below requirements must be met by the manufacturer before evaluation of the fixture will take place.

Correlated Color Temperature (CCT):	2600K – 3600K. Warm white light will add warmth and color to the Pier and Main Street.
LED binning deviation:	+/-200K. Once a CCT has been chosen by the manufacturer, say 2700K, all individual LED's within the system must not deviate from that point by more than 200K.
Color Rendering Index (CRI):	>85 The higher the number the better the source is at reproducing objects properly
Efficacy:	> 60 Lumen/Watt (system efficacy not chip efficiency) This includes wattages from power supplies and drivers.
Lamp Life:	>50,000 hours. Testing: Ambient temperature during testing: 25°C 6,000 hour minimum testing period 70% of initial lumens must be produced at 50,000 hours
Driver Life:	>50,000 hours.
Light Distribution:	IESNA Semi-cutoff – Type 2 or 3 and Type 5 (NEMA) Options required. A luminaire is considered semi-cutoff when no more than 5% of the light from the fixture exits at an angle of 90° and no more than 20% at an angle of 80°.
Heat Management:	Junction Temperature: <100°C. Fixture must have proper thermal management to keep LEDs below chip manufacturers maximum junction temperature to ensure long life.
Warranty:	>5 years. Light source and power supplies (system warranty)
Independent Testing:	Laboratory test results must be produced using the specific package(s), modules/arrays and power supply combinations that will be used in production and must be provided by a NVLAP or MAR certified independent laboratory.

Lumen Maintenance:	Fixture must pass LM-79 and LM-80 Lumen Maintenance Qualification Requirements from and independent testing lab.
Dimming/Switching:	Fixtures must be able to dim/tri-level switch to lower level at normal operating hours and rise to higher levels at high security times (operated by the local police department or controlled by automatic time clock). Fixtures can either dim or tri-level switch to these two conditions.
Illumination:	LED fixture must at a minimum be able to produce equivalent illumination levels of a 150W HPS lamp with 16,000 initial lumens with Type 2 or 3 and Type 5 distribution at a 16'0" mounting height. Type 5 Requirements: Minimum of 0.5fc at 25' radius and 0.2fc at 60' radius Type 2/3 Requirements: Minimum of 0.5fc at 25' in front of fixture and 60' to each side And 0.2fc at 55' in front of fixture and 85' to each side.
IES Files	Manufacture to supply IES files for both Type 2 or 3 and Type 5 fixtures so that light levels can be calculated and confirmed.

Controls & Fault Detection & Diagnosis features should include:

- Controls will have the capacity to turn on and off the fixtures.
- Controls should have the capacity to accurately report on energy usage.
- Controls should have an automated GPS/GIS reporting system or associated remote device.
- Controls sould have the capability to be coordinated with specific LED fixture(s) for dimming purposes.
- Controls should be able to provide various reports including day burners, reduction in energy or no power available.
- Controls should be controllable in the field by authorized staff and police.
- Controls signals should be secure and encrypted.
- Provide individually-addressable, bi-directional communication between each control device in the system.
- Controllers shall respond appropriately to status queries.
- Come standard with PC-based control software allowing users to control and monitor the system at no additional cost. System operational history (energy used) shall be logged and be retrievable via software so performance can be measured.

- The final data must be available in XML format for the City to download on a daily basis.
- Provide a robust scheduling system based on a self-correcting astronomical time clock allowing individual fixture control with battery backup.

The city will be making these purchases in numerous phases as we gain experience and confidence with the proposed solutions.

Multiple phase, multiple awards, LED street & area light project

Appendix B – Background information

BACKGROUND

The scope of work described herein is funded by ARRA EECBG funds. Vendor is responsible for meeting reporting requirements and purchasing requirements described in the legislation. Vendors must provide documentation of jobs created and retained as a result of the Recovery Act funding to prime recipients. For more information see www.FederalReporting.gov

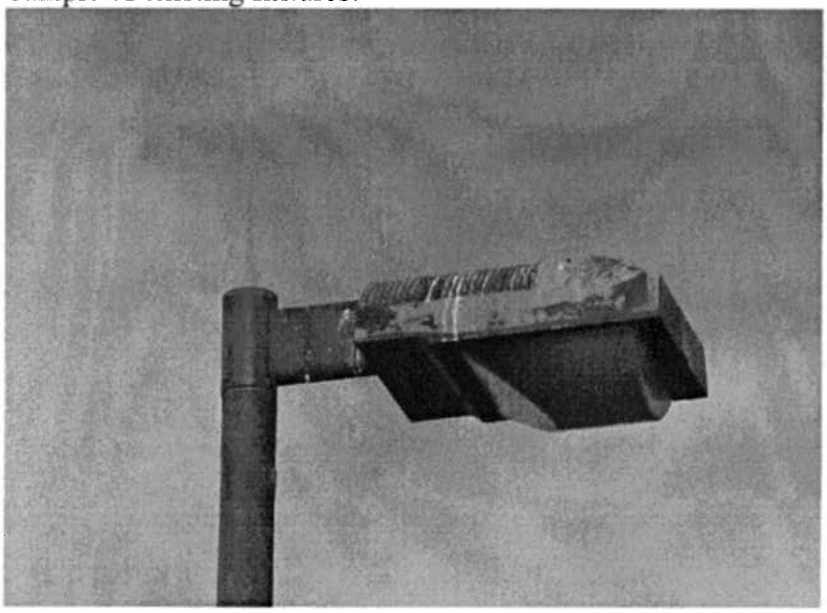
This procurement is for materials and equipment start up only. The RFP may result in multiple awards and stand alone responses for the respective scopes of work will be considered.

All equipment must be certified and documented as compliant with the Buy American provisions in ARRA legislation (or exemptions) and all other Federal government and DOE requirements.

City staff are already knowledgeable on LED light sources and designs. HB is a member of LEDcity and intends to promote and highlight the sustainability features of this project. The project locations are the city owned and operated beachfront parking lots from Seapoint to Beach Blvd west of Pacific Coast Highway and the downtown entertainment district of Main Street and adjacent streets. Additionally, there are numerous miscellaneous cobra head fixtures throughout the city which as budgets permit will be upgraded to occupancy sensored bi-level LED. See the google maps links below for project sites which are open to the public.

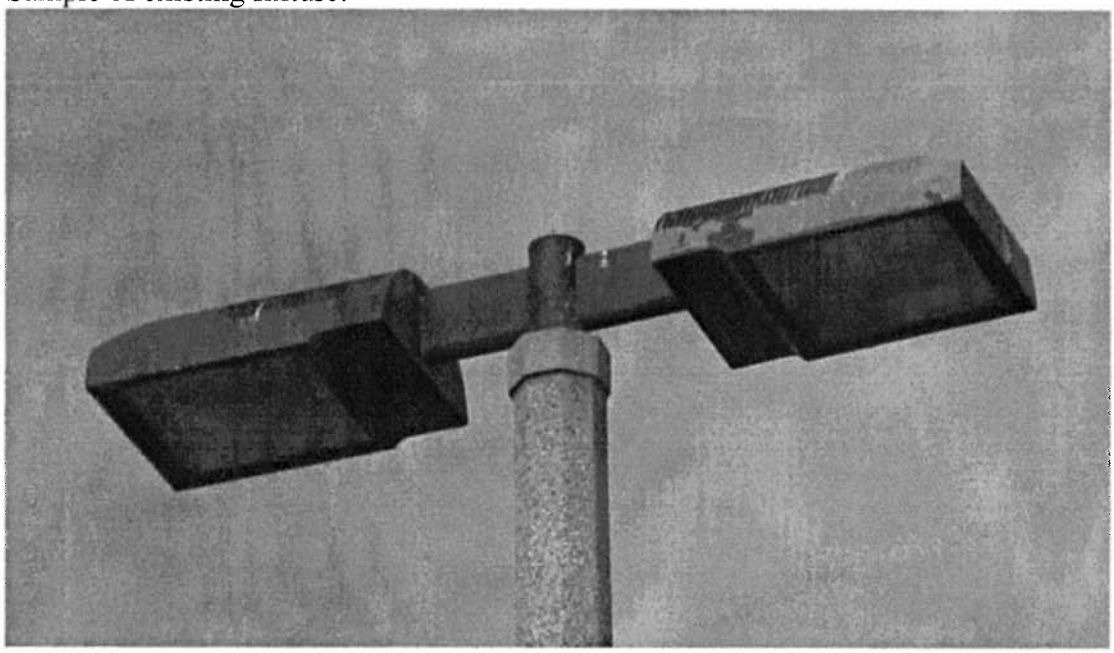
Bluff top parking lots:
http://maps.google.com/maps?f=q&source=s_q&hl=en&geocode=&q=92648&sll=37.0625,-95.677068&sspn=52.107327,78.837891&ie=UTF8&hq=&hnear=Huntington+Beach,+Orange,+California+92648&ll=33.672613,-118.022647&spn=0.006563,0.01369&t=h&z=17

Sample of existing fixtures:



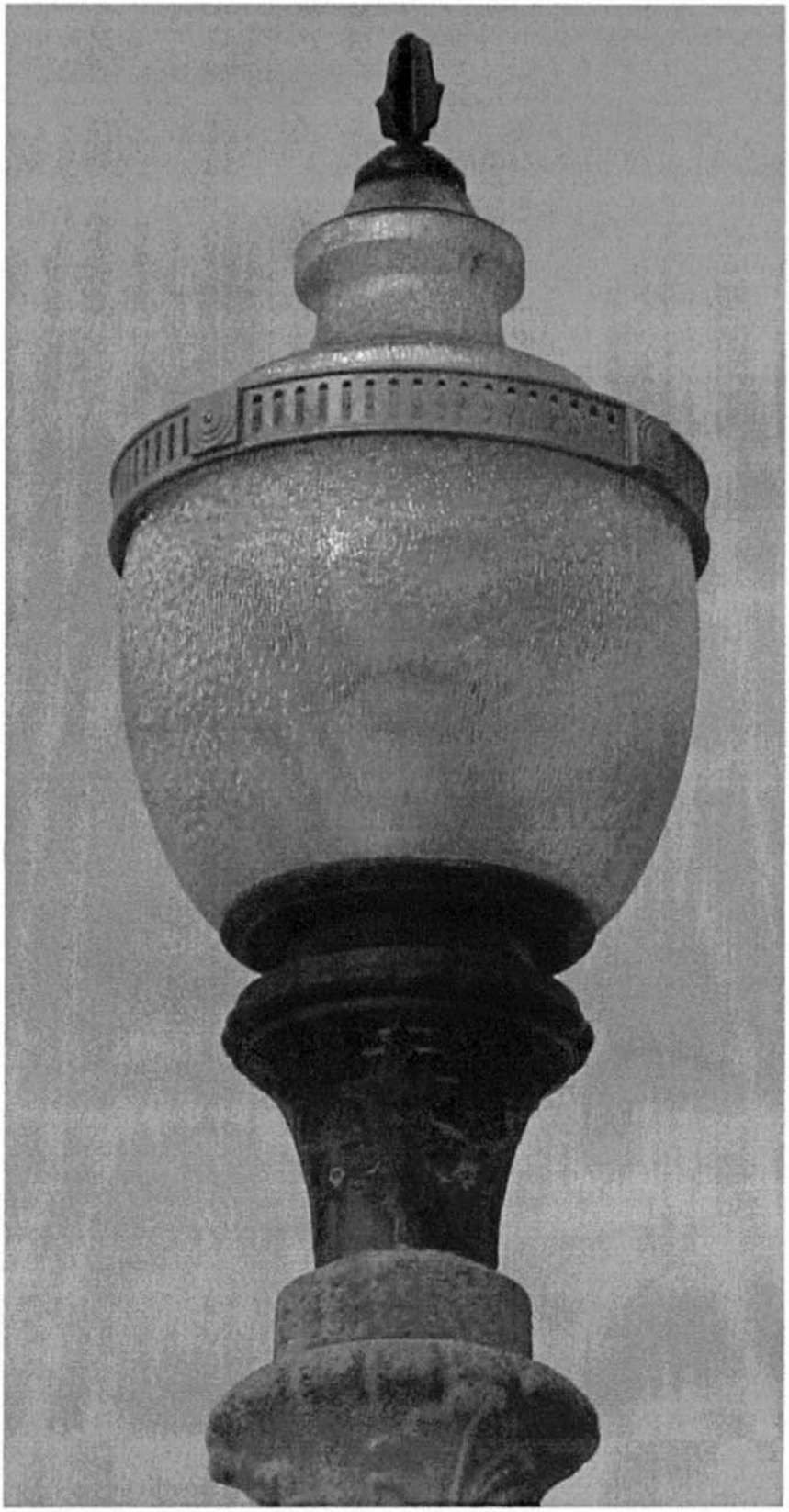
Beachfront parking lots:
http://maps.google.com/maps?f=q&source=s_q&hl=en&geocode=&q=92648&sll=37.0625,-95.677068&sspn=52.107327,78.837891&ie=UTF8&hq=&hnear=Huntington+Beach,+Orange,+California+92648&ll=33.656147,-117.999773&spn=0.006528,0.01369&t=h&z=17
Southern beachfront parking lots:
http://maps.google.com/maps?f=q&source=s_q&hl=en&geocode=&q=92648&sll=37.0625,-95.677068&sspn=52.107327,78.837891&ie=UTF8&hq=&hnear=Huntington+Beach,+Orange,+California+92648&ll=33.650851,-117.993969&spn=0.006529,0.01369&t=h&z=17

Sample of existing fixture:



Street view of Main St. streetlights:
http://maps.google.com/maps?f=q&source=s_q&hl=en&geocode=&q=92648&sll=37.0625,-95.677068&sspn=52.107327,78.837891&ie=UTF8&hq=&hnear=Huntington+Beach,+Orange,+California+92648&ll=33.657953,-118.000932&spn=0.001688,0.002406&t=h&z=19&layer=c&cbll=33.658059,-118.00107&panoid=0FAX453LOd0Okdgqe3QATA&cbp=12,230.88,,0,10.22

Sample of existing fixture:



Multiple phase, multiple awards, LED Street & area light project

Appendix C – Scope of work and evaluation process

SCOPE OF WORK

Part 1: Beach front parking lots with existing Kim Archetype fixtures - LED

1. Provide 2 demonstration fixtures for bench and field testing at the city's sole option.
2. Provide LED equipment & accessories that meets or exceeds the above specifications including replacement lenses, bird spikes and controls or bi-level with occupancy sensing features.
3. Provide long-term (3-5 yrs) and sustainable pricing commitment for additional retrofits.
4. Start-up/commissioning and staff training on controls (if necessary)

Part 2: Downtown LED Acorn Globe fixtures with tri-level features or full control

1. Provide 2-3 demonstration fixtures and controls for shop and field measurement, verification and evaluation for a minimum of 6 weeks at the city's sole option.
2. Provide eqiupment and materials for high performance, smart, historically accurate, dark sky friendly controllable or tri-level LED post top fixtures
3. Start-up/Commissioning and staff training (police, public works, energy)

Part 3: Miscellaneous (parks & roadway) bi-level with occupancy cobrahead style replacement fixtures

1. Provide 2 demonstration fixtures for bench and field testing at the city's sole option.
2. Provide equipment that meets or exceed the above specifications.
3. Provide long-term and sustainable pricing commitment for additional retrofits.
4. Start-up/Commissioning and staff training.

Provide as necessary ancillary electrical switchgear, cabinets, etc. to support the project.

Awards will be made in a series until all available funding is expended. Huntington Beach has applied for competitive funding to provide additional funding.

City of Los Angeles
Bureau of Street Lighting
LED Equipment Evaluation Procedures
11/4/2009

- **Request for Equipment Evaluation**

  In order for LED equipment to be evaluated by the Bureau of Street Lighting, interested parties must meet the **Minimum Requirements for Testing and Evaluation of LED Equipment as posted in our Web page.** You MUST submit a request (**LED Street Lighting Energy Efficiency Program contact information**) to the Bureau through the BSL Internet web page: http://bsl.lacity.org/

- **Review of Engineering and Technical Documentation**

  After making the initial request, interested parties will be asked to provide engineering and technical information related to the product. This information must show that the equipment meets the **Minimum Requirements for Testing and Evaluation of LED Equipment.** At this time, a meeting or presentation may be arranged to present the equipment and its technology to the Bureau.

- **Sample Equipment**

  One sample luminaire shall be submitted to the Energy Efficiency Division. Only complete units will be tested. Luminaires to be installed in the field shall be able to mount on a standard 2.4" diameter arm. They shall also be capable of accepting a PE cell without modification. Supplier shall be notified that the equipment will be opened and may not be returned in original condition. BSL will provide labor to evaluate the equipment, but will not be financially responsible for equipment damaged during the testing period.

  Components such as drivers and LED assemblies will not be accepted unless they are delivered in a standard commercially available housing. The complete assembly shall be identifiable by a factory catalog number.

- **Perform Lab Evaluation**

  All equipment submitted for lab testing shall be evaluated based on four different sets of criteria.
  1. Electrical performance
  2. Mechanical performance
  3. Ease of Maintenance
  4. Aesthetics

- **Perform Field evaluation**

When deemed appropriate by the Testing Engineer, the lighting supplier will be asked to submit three additional fixtures for field testing. The fixtures will be lab tested for power consumption, then moved to the field for further testing. The fixtures shall be installed with a Remote Monitoring Device (RMD) such as "ROAM or TYCO/TELEMICS", so that electrical performance data can be collected and reviewed.

A test location may be located either in the controlled environment of the Field Operations Division (FOD) yard, or on an existing street lighting pole on a City street.

If installed on a City street the following criteria should be used in identifying a suitable location:

1. Every effort shall be made to ensure public safety.
2. Fixture shall be installed as to minimize light pollution from other sources.
3. Pole height shall be "typical" so as to get the most relevant illumination readings.
4. Site should be chosen so as to minimize FOD construction work.
5. Test site shall be evaluated for possible negative impact on residents.

The test site shall remain in place for a minimum of 12 weeks. The Testing Engineer shall visit the site at the end of the 4th and 10^{th} weeks.

Field Check Week 4

The Testing Engineer shall visit the site after dark in order to ensure that the fixtures are operating as intended, and to take several types of lighting readings. Readings shall be taken at increments between 5' and 10' in a grid pattern on both the sidewalk and street. The size of the grid shall be determined based on a "typical" spacing. In the case of LED fixtures, condition of individual LED's in the fixtures will be checked for normal operation.

Field Check Week 10

The Testing Engineer shall return to the site to ensure that the fixtures are still operating as intended. At this point the Testing Engineer shall request that the FOD remove the test equipment and re-install the pre-existing street lighting equipment.

- **Perform Follow-up Lab Evaluation**

The Testing Engineer shall evaluate the equipment's field performance. Data collected through the remote monitoring equipment will be reviewed and compared to the initial lab results. Also, the equipment shall be evaluated for any damage caused by the environment.

- **Return of Equipment (if requested by supplier)**

The supplier shall be contacted regarding the conclusion of testing. Arrangements shall be made for the return of the equipment to the supplier. BSL will ship the fixture back to supplier using the suppliers shipping account. Otherwise, the fixture will be available for pick-up at FOD.

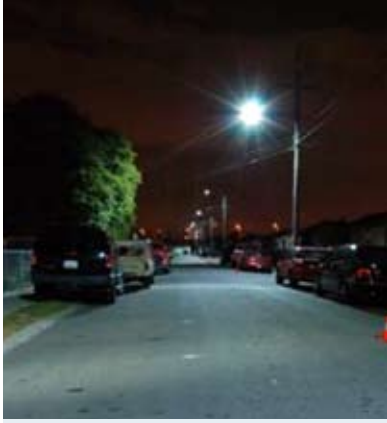
- **Prepare and Distribute Report**

  The Testing Engineer shall prepare a report per BSL standards. A copy of the report shall be sent to the supplier.

GATEWAY DEMONSTRATIONS

Outdoor Lighting with LEDs:

City of Oakland, CA Street Lighting Report Brief



Background

Recently, a number of LED products intended for outdoor applications have come on the market. The interest in this new class of products is high because of LEDs' long life and corresponding reduction in maintenance and operational costs, good color characteristics, and potential for high energy savings. Outdoor and street lighting applications typically use high-intensity discharge (HID) sources, including high-pressure sodium (HPS) or metal halide (MH). HID lamps are typically very efficacious, but have other performance drawbacks, including long restrike times, low color rendering abilities in the case of HPS, or in the case of MH, poor lumen maintenance as well as visible color shifts over time. LED-based luminaires are emerging as a viable alternative for outdoor applications.

Project Description and Results

The Oakland Street Lighting Demonstration Project was a joint project of the U.S. Department of Energy (DOE), Pacific Gas & Electric (PG&E), and the City of Oakland. For this project, the City replaced fourteen 121 Watt HPS luminaires (100 nominal Watts) with fourteen 78 Watt LED luminaires (60 nominal Watts) on three public streets in Oakland. Quantitative and qualitative light and electrical power measurements were taken on all three streets. Economic costs were estimated and qualitative satisfaction gauged with a resident survey. A preliminary parking lot installation of LED luminaires was also performed to assess the likelihood of any negative safety impacts prior to street installation.

To allow for a variety of comparisons, one of the test roadways was illuminated with relamped HPS luminaires on the eastern half and LED luminaires on the western half. An adjacent, parallel road was illuminated exclusively with LED luminaires, while a third adjacent road was entirely relamped with HPS luminaires. All luminaires have mounting heights 28.5 ft above the road surface, with spacing between poles of approximately 110 ft, 120 ft, or 165 ft. Measured illuminance levels for both the HPS and LED luminaires are shown in Table 1. The new LED luminaires drew roughly 35% (43 Watts) less than the HPS luminaires. At about 4,100 annual hours of operation, annual electrical savings are estimated to be approximately 178 kWh per luminaire replaced.

	Average Illuminance (fc)	Minimum Illuminance (fc)	Avg. to Min. Uniformity Ratio	Max. to Min. Uniformity Ratio
HPS Luminaires				
110' Spacing	1.00	0.19	5:40:1	19.00:1
120' Spacing	0.80	0.09	8.66:1	40.00:1
165' Spacing	0.47	0	>10.16:1	>60.00:1
LED Luminaires				
110' Spacing	0.58	0.19	3.11:1	6.50:1
120' Spacing	0.53	0.09	5.68:1	16.00:1
165' Spacing	0.35	0	≥7.47:1	≥26.00:1

HPS lamps are large point sources, so that even with good optical design, the area below the luminaire tends to have significantly more illuminance than points farther away. This area is often over-lighted. This over-lighting is compounded because the initial installation must also account for the future lumen depreciation of the source. Thus, the lower average illuminance levels measured under the LED luminaires do not denote inferior light

Projects investigate SSL applications that:

1) save energy relative to the incumbent technology;

2) match or better the existing illumination and visibility produced by the incumbent technology; and

3) offer economic value to users.

Visit the DOE Gateway Demonstration site at http://www.netl.doe.gov/ssl/techdemos.htm.

This Report Brief provides a summary of a full Gateway Demonstration report available on the DOE Solid State Lighting website at: http://www.netl.doe.gov/ssl/techdemos.htm.

performance. In fact, the LED luminaires maintained minimum light levels across all spacings while significantly increasing overall uniformity. Improved uniformity means that the minimum illuminance levels of the installation can be achieved with fewer, more effectively used lumens. As LEDs have a much flatter lumen depreciation curve over their lifetime in comparison with traditional light sources, the need for initial over-lighting is also reduced.

A survey of residents indicated a strong and consistent preference for the new streetlights. Much of this appears to be attributable to improved visibility for drivers and pedestrians and the overall positive effects of the new streetlights on several aspects of the neighborhood's overall appearance and nighttime safety.

Economic Performance

The LED luminaires yielded an annual combined energy and maintenance savings of $42 per luminaire when compared to HPS luminaires maintained under a spot replacement scheme, and $33 per luminaire under a group replacement scheme. The LED luminaires were assumed to have zero regular maintenance cost over the course of their useful life. In a new construction setting, where these luminaires are installed instead of HPS luminaires, the simple payback periods for the LED luminaires (based on their current cost) is between 12 and 15 years, depending on the maintenance scheme. In a retrofit setting where the LED luminaires are installed in place of HPS luminaires, the corresponding simple payback range from 20 to 26 years. A range of simple payback values for new construction based on the assumed maintenance savings are graphically illustrated in Figure 1.

Because the expected useful life of LED products corresponds to several years, empirical data does not yet exist to support the projected values. Economic and reliability claims are therefore based on the best available information from the manufacturer and DOE reports. The payback periods in this particular case study correspond to a range of roughly 50,000 to 100,000 hours of operation. It should be noted that the manufacturer provides a 5-year warranty (20,500 hours of operation at 4,100 hours per year), although a much longer useful life is anticipated.

Conclusions

The potential for energy savings from LED street lights is very large. Although the results of this assessment estimated a relatively long payback period for this specific LED street light product under current conditions, other performance attributes combined with operating cost savings may be such that longer payback periods are acceptable. These could include various benefits from improved visibility, as highlighted by a survey of residents on the new LED lighting.

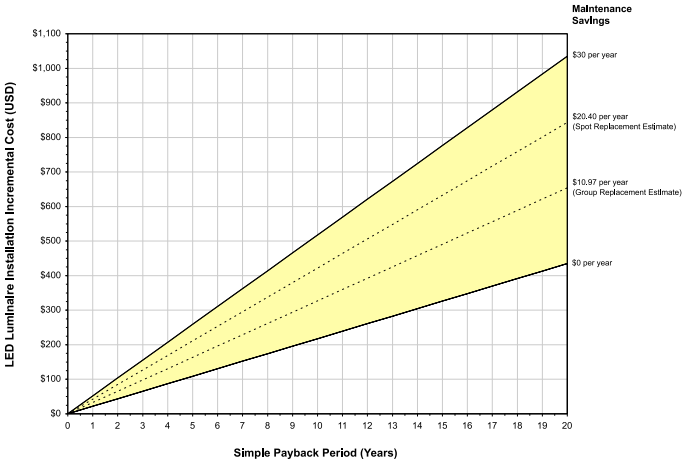


Figure 1: Estimated New Construction Luminaire Payback

For Program Information on the Web:

http://www.netl.doe.gov/ssl DOE sponsors a comprehensive program of SSL research, development, and commercialization.

For Program Information:

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Pacific Northwest National Laboratory

E-mail:

bruce.kinzey@pnl.gov, my.ton@pnl.gov

PNNL-SA-60356
May 2008

Top **10 Questions** to Ask Your **LED Supplier**

In today's confusing marketplace, finding the best LED system is a lot like comparing apples and oranges. Making an informed decision means knowing what questions to ask. To help you get started, we've put together a list of the top 10 questions you should ask your LED supplier.

Question **1:**

Is your company registered as a Department of Energy (DOE) Quality Advocate? And, have you taken the Quality Pledge for Solid State Lighting (SSL) Products?

GE is registered as a SSL Quality Advocate. Our pledge is a commitment to customers that our LED products perform as claimed and that we will support continuous improvement in SSL product quality. The CEO of our LED systems business has taken the quality pledge and you can find our company listing at **http://www.lighting-facts.com/**

Question **2:**

Whose LEDs do you use in your products? Have your products gone through an Intellectual Property (IP) clearance?

At GE, we respect the valid IP rights of others. That's why GE's products go through a rigorous patent clearing process.

Question **3:**

What is the LED manufacturer's LED performance rating and what is the rating of your LED system or final product?

GE does not base product performance ratings solely on data from the LED manufacturer. Instead, we conduct both in-house and independent laboratory tests of the LED, sub-system and complete LED system to determine actual product performance that takes into account thermal, optical and LED driver losses. We are happy to share with our customers test data relative to product performance claims.

imagination at work

Question **4:**

What precautions do you take to ensure that the LED selected for your product will meet the performance requirements for which it's rated? Can you share your data showing the LED selection/testing process?

Prior to selecting a LED for our product, we perform long-term qualification testing at multiple temperatures and operating currents where we look for trends in color shift, light output depreciation and power consumption. We then compare our test data against the LED manufacturer's claims to validate performance. If the LED test data meets our minimum standards for performance, the LED may be approved for product use.

Yes. Upon request, we can share our test data with customers.

Question **5:**

Does your product use LEDs that have been LM80 tested to demonstrate L70 life after 6000 hours of test? If yes, can you share your LM80 data and life model that was used to demonstrate the L70 life?

At GE, we strive to use LEDs that are tested to the LM80 requirements if available. Having the LM80 life data complements our comprehensive in-house testing of the LEDs. The combination of the two tests significantly increases the confidence level in providing a rated life claim for our LED systems.

Yes. Upon request, we can share LM80 test data with customers if available. Please note, not all LED manufacturers currently provide LM80 tested LEDs or are willing to share their test data.

Question **6:**

Does your LED product meet the LM79 requirements? If yes, can you provide the LM79 test report from an accredited NVLAP test lab?

When required, GE will test our LED products to LM79 standards and provide the NVLAP report upon request.

Question **7:**

Do you "design in reliability" or do you just "test for reliability" to demonstrate the long-term performance of your product? Can you share your product development reliability process?

We follow the GE Six Sigma methodology and use the 10-step Design For Reliability (DFR) process. This allows us to "design in" a specified level of reliability into our products that takes into account various stress conditions the product will see over its lifetime in a real world application. Our rigorous testing protocol helps us validate that the product will perform as designed over its rated life.

Testing is a useful tool to help validate product robustness, but "design for reliability" helps ensure that the product will perform as expected over time.

Yes. Upon request, we can share with customers our Design for Reliability process.

Question **8:**

What type of testing do you perform to validate your product life and safe operation? Can you share the test results?

To help validate product life, all new GE LED systems must undergo high-temp testing at 140°F for at least 10% of its rated life to show that the product meets or exceeds its life claim. That means a product with a rated life of 50,000 hours will be subjected to a minimum 5,000 hours of continuous testing. In addition, we also conduct high-temp, high-humidity *accelerated life testing* for up to 1,000 hours at 140°F / 90%RH. We also perform robustness testing to identify the weakest links and to ensure the product will fail in a safe manner.

Yes. Upon request, we can share our test data with customers.

Question **9:**

What actions take place in the factory to ensure your product will work properly when installed by the customer?

All GE products are manufactured in strict accordance to a detailed set of assembly instructions that includes incoming component inspection/testing and multiple production line quality checks to help ensure the final product is built to our exacting standards.

Question **10:**

How do you ensure the product will continue to meet the specification?

To help ensure long-term performance, we continue to test GE LED products for years after initial launch. At predefined intervals, we pull samples out of production and send to our NVLAP certified facility for LM79 testing.

For additional product and application information, please consult GE's Website: **www.gelighting.com**

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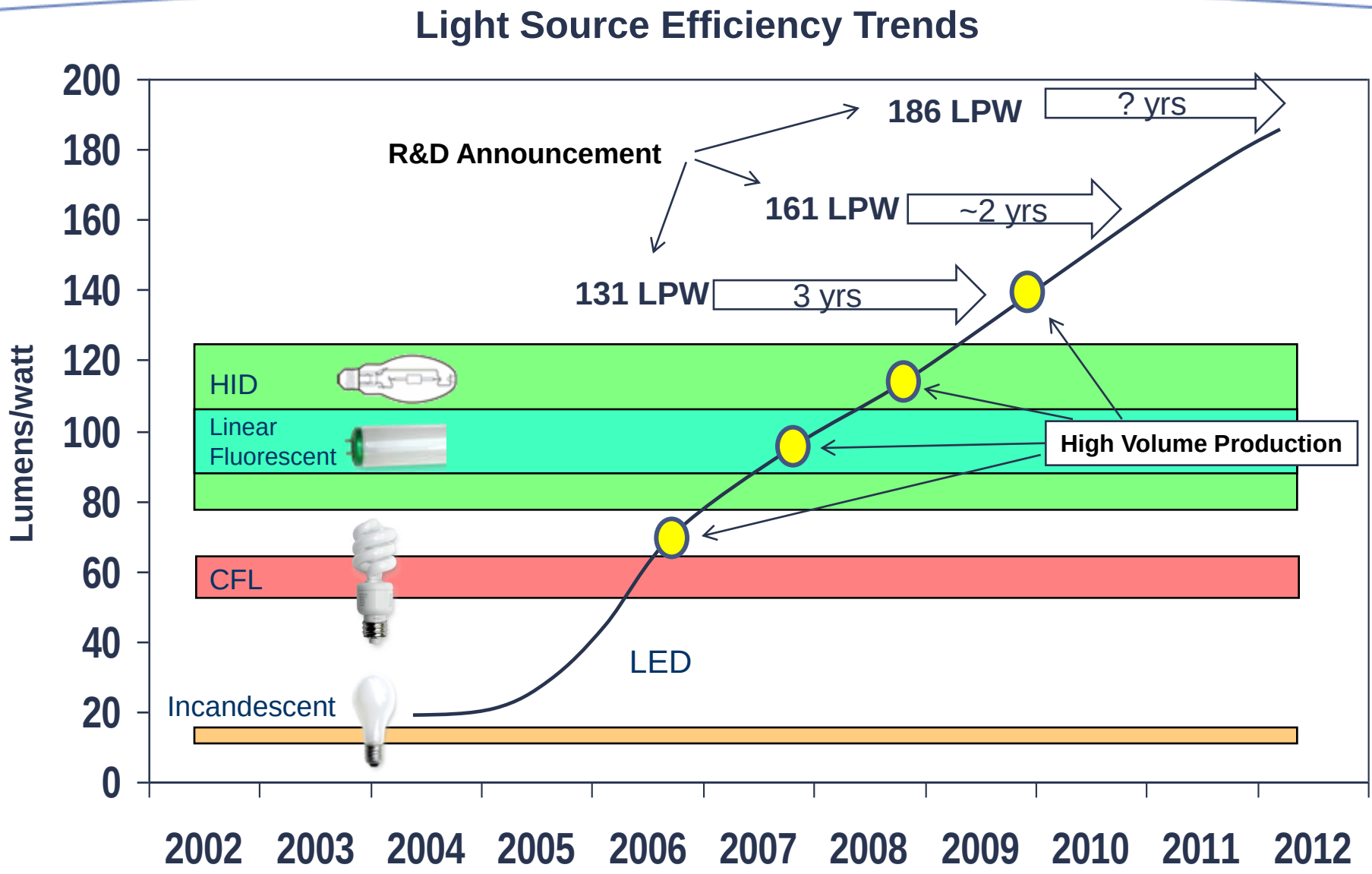
LED Performance Continues To Increase



Summary

- All the major pieces are in place:
  - Standards
  - Performance
  - LED Fixture design learning curve
- LEDs save real energy and make good economic sense in many important applications now:
  - Parking decks, canopies
  - Hazardous work areas
  - Pedestrian, bollards, etc.
  - Lower wattage street lights
  - Indoor down lights
  - Freezer cases/displays
- The next wave of new applications is starting:
  - Higher wattage roadway
  - Replacement bulbs
  - Indoor hibay
  - Residential
- Still some poor quality products as well as hyper-inflated marketing claims – education is key
  - Energy Star and LED City/University can help

ECO GREEN
THE LED SOLUTION COMPANY

"LED There Be Light" 1.877.7.ECO.GREEN

LED Specialists

Ecogreen Solutions` most vital assets are our market- leading, quality products. However, we also have the most qualified LED Lighting specialists in the business. Here at Ecogreen, we work with our manufacturing partners at the component levels, the essential building blocks that make up these sophisticated lighting products. Ecogreen Solutions` personnel are involved from, "Cradle to Grave,", that is, from the concept to the manufacturing process on all our products. From the Diode level, to the cooling aspects, light diffusions and beam patterns through to the assembly of our products, Ecogreen is involved every step of the way! In areas where we've collaborated with our manufacturing partners, our products are built to a specific spec to ensure the longest life, most efficient, highest quality products on the market. Our sales teams have over 12 yrs experience in the semiconductor field supporting the OEM, (Original Equipment Manufacturer) throughout California, Nevada and Arizona.

Ecogreen Services are in California, Nevada, Arizona, Idaho, Montana, Hawaii and soon to be in Florida. Ecogreen also has partnerships with sales and marketing organizations such as IHN Corp in the southwest and Silicon Lighting for the northwest United States. The rep organizations have extensive experience with the component technology and the history of these products, which is crucial to being successful in this market today.

LED Advantages

- **High durability** - no filament or tube to break.
- **Life span** - in properly engineered lamps, LEDs last 50,000 - 60,000 hours when driven correctly.
- **Full dim ability** – unlike fluorescent lamps, LEDs can be dimmed using pulse-width modulation (PWM - turning the light on and off very quickly at varying intervals). This also allows full color mixing in lamps with LEDs of different colors. [1], [2].
- **Mercury-free** - unlike fluorescent and most HID technologies, LEDs contain no hazardous mercury, cadmium, lead or halogen gases.
- LED's have an exceptionally long operational life. ECO Green LED lights have a projected life ranging from 35,000 to 100,000 hrs when proper heat sinking is incorporated into the fixture design and the ambient conditions of the installation are factored in, which allows for reduced maintenance and overall lifetime cost.
- LED's are vastly more efficient at 80% electrical energy converted to light while incandescent loses 80% electrical energy in the form of heat.
- LED's can operate in extreme climate and temperature conditions ranging from -40° F to 180° F without the issues involved with fluorescent technology.
- LED's produce a minimal amount of heat which allows them to be applied to a wide variety of fixture setups & designs as well as minimizing the heat radiated onto objects and people within the vicinity of the light source.
- LED's can emit light in virtually any desired color without additional color filters as can be programmed to produce an unlimited number of color pattern sequences.
- LED's produce no ultra-violet (UV) light which is ideal for sensitive or delicate illuminated objects.
- LED's are solid state devices which make them very durable. They are shock and vibration resistant due to their plastic housing.
- LED's can be designed to project light at specific angles and directions unlike incandescent bulbs which radiate in all directions without the use of reflectors.
- LED's have no delay or warm up time when switching on unlike fluorescent lamps which need time to achieve their color temperature.
- LED's have an environmentally friendly design because they require no filaments or toxic/combustible gases to produce light.

LED Street Lighting Test Project Report
April 13, 2009

Progress Energy Carolinas (PEC) installed nine LED test fixtures in October, 2008 on the 100 block of East Davie Street in downtown Raleigh in front of the Two Progress Plaza building and other businesses on this block. Two 200-watt and seven 250-watt high pressure sodium (HPS) street light fixtures were removed and nine 167-watt LEDway™ fixtures from BETA Lighting were installed on a one-for-one replacement basis using the existing pole locations and mounting height. Since the installation, PEC has observed the fixtures for proper operation. Light level (footcandle) readings were taken with the HPS and the LED fixtures and a point-by-point footcandle calculation has been prepared for the LED system.

Before and after photos of the lighting on Davie Street:

BEFORE (HPS)

AFTER (LED)

Technical findings:

- 51% footcandle reduction measured at selected points on the street with LED lighting
- 8% footcandle reduction measured at selected points on the sidewalks with LED lighting
- 43% footcandle reduction as calculated on the entire street with LED lighting
- 42% wattage reduction with LED lighting
- Uniformity (average to minimum) improved per calculations with LED lighting

100 Block of E. Davie Street with LED Lighting
Raleigh, NC

Lighting specifications:

- Each LED fixture is equipped with 60 LEDs and driven at 700 milliamps
- Current fixture cost: HPS fixture ~ $70 each; LED fixture ~ $485 each
- Billing for these test fixtures remained at the HPS rate for the City of Raleigh in lieu of having a filed rate tariff to recover the cost of the fixture. The N.C. Utilities Commission was made aware of this special billing treatment while the LED fixtures were under evaluation.

Progress Energy's observations to date:

- Visibility (to the eye) on Davie Street has improved.
- No operations problems have been observed to date with the LED fixtures.
- The installation of fixtures by linemen was easy with linemen commenting that the fixtures were lighter, more balanced and easy to install.
- The grounding wire added by Progress Energy linemen helped the fixture to meet National Electric Safety Code requirements. Feedback was provided directly to Beta for this improvement.
- The surge protection device (MOV Class C) added by Beta is a necessary protection device for the electronics in the fixture.

Progress Energy's conclusions:

- The Beta LEDway™ fixture is a viable fixture substitute for HPS cobra head fixtures. It is manufactured to utility grade fixture standards with tool-less entry.

- Progress Energy will test a more expensive photocontrol that has been designed for use with LED fixtures. It ignores stray LED light and is in line with the anticipated life of the LEDway™ fixture, light source, and driver. The objective is to reduce maintenance trips due to the extended light source life.

- While the LED light source anticipates less maintenance trips over its life, the industry has no long term maintenance experience with the performance of LED streetlights on an electrical distribution system. As with any fixture, maintenance will still be required for wires, brackets, knockdowns, adjustments, periodic cleaning, animal damage, pole maintenance, and potentially earlier fixture replacement (12 – 15 years) vs. today's replacement cycle of 20-25 years.

- Color improvements with a blue-white light and improved uniformity causes the overall visibility on Davie Street to improve for this application of LED fixtures on the existing pole spacings and mounting heights even though 43% less footcandles are present on the roadway.

- Improvement in visibility with LED lighting is currently under study by the lighting industry to assess whether and to what degree lower footcandle requirements are warranted. There is not industry consensus to date on this LED lighting standard. Without a revision of the existing industry standards there will likely be an adverse impact on the cost of LED lighting for DOT and other roads due to additional poles/light fixtures required to meet current adopted standards. Progress Energy and many others are working with the Illuminating Engineering Society to address this issue.

- Progress Energy should begin development of a tariff rate to offer an LED street lighting alternative to municipalities (using the approved LEDway™ product or an approved equivalent).

Prepared by: Robert L. Henderson, LC, CLEP

City of Valdez LED Street Light Initiative

Background

The City of Valdez currently has a contract with CVEA to power and maintain 373 street lights. They are divided into 3 classes: A, B and C. Class A and B lights have a standard wattage and are billed by the number of hours they are used. Class C lights are metered. The monthly electricity bill for A and B lights ranges between $3,000 - $5,000 depending on total hours / kilowatts used. The street department budgets $50,000 each year. Additionally the city pays CVEA a $55 dollar maintenance fee for each of the 343 Class A street lights, totaling $18,900 a year. With a projected $0.25 kW hour electricity rate, the city will expend $70,907 this year on its class A and B street lights.

Currently, most street lights in Valdez are high pressured sodium bulbs. These generally use 100 or 150 watts each. Because of the shape and design of these bulbs, the light tends to shine beyond the target areas (streets) and into people's bedrooms as well as skywards. Sodium bulbs also cast a yellowish or pinkish hue which makes true color difficult to discern. These issues were raised when the city proposed street lights in the Winterpark subdivision. Residents opposed the standard type of street light and settled for white lighting with special shields to block light from shining back into their houses.

Our LED Initiative- Why Now?

Up until recently LED technology was too expensive and unproven to make city-wide changes feasible. Now there are several US and international companies that can offer standard street light replacements to big and small cities alike. This is of particular importance in Alaska where street lights affect a large portion of our day in the winter time. After testing LED lights out on its public for several months, Anchorage has invested 2.2 million to switch out 4,000 of its high pressure sodium bulbs for LEDs. Cordova, Soldotna and Fairbanks have also begun purchasing LED street lights. Cities like Cordova and Valdez have the greatest potential for energy savings because both cities rely on expensive diesel fuel to power their street lights in the winter.

The City is currently fortunate enough to have a budget surplus. This is the best time to invest in money saving equipment for the future. Installing street lights now would pay for itself in 6-10 years and save the city exponential amounts of money as fuel costs rise.

Benefits of LEDs

The financial benefits of LEDs are widely documented, but there are other physical benefits to these types of lights as well:

- LED lights will reduce the cities street light energy consumption by 65% or more.
- LED lights will last more than 20 years. Sodium bulbs burn out in 2-3 years.
- LED lights can be easily shielded and reduce glare into people's yards and houses.
- LED lights significantly reduce glare into the sky, reducing light pollution and allowing better viewing of stars and northern lights.

- LED lights increase safety. Police are able to identify cars easier and see people in true color. In Anchorage, people felt safer under the white lights because they could see things more accurately.
- LED lights perform better the colder that it gets. Colder temperatures will actually make them brighter (a -4° F ambient temperature multiplies the lumens by 1.11) and they will last longer (life estimates of 22 years are based on 59° F and increase as ambient air temperature decreases).

Steps to Success

1. Evaluate different LED companies and light fixtures and select the best solution to street light replacement in Valdez.

    ✓ *BetaLED, the manufacturer for Anchorage, Cordova, Soldotna and Fairbanks, has a supplier in Eagle River. Anchorage has done the expensive research on these fixtures already and we can install the same types of systems here.*

2. Purchase several "tests lights" and install them in a public area of Valdez. Ask people to compare different color temperatures and decide which ones they would prefer on their streets. Advertise LED project to the public and invite public to comment on different lighting temperatures and light coverage during a set period. End LED project with a local vote for type of light desired (with coffee and cookies).

    ✓ *BetaLED and the municipality of Anchorage have graciously loaned the City of Valdez two different light fixtures, a 6000k 40-LED street light fixture and a 4300k 40-LED street light fixture. Copper Valley can install them outside City Hall on light posts 85 and 86.*

3. Order LED lights to replace type A & B street lights only. Create new maintenance contract with Copper Valley for LED lights. Create timeline and process for LED installation and set up recycling program for old street lights.

4. Enroll in **"LED City" program** to gain national recognition as a government that is saving energy, protecting the environment, reducing maintenance costs, improving light quality and saving tax dollars (http://www.ledcity.org/about-the-program/).

5. Begin steps for replacing type "C" lights and Hospital / Senior Center lights. Work with State and Valdez Central Schools to replace their lights.

Cost/Benefit Analysis

A Cost/Benefit analysis was conducted using a 0.25 electricity rate and estimating a 36% cost reduction in our maintenance contract. The city would save **$40,404** each year. The estimated cost for LED street light purchase, including shipping, is **$200,000-$225,000** depending on color temperature. Additionally, the City estimates it will cost **$196,000** dollars for CVEA to install the street light fixtures.

The replacement of all the City's Class A & B Street Lights would pay itself back in 10 years.

Detailed Cost/Benefit Analysis

Current/Proposed Street Lights. The current pattern for street light deployment is adequate but unplanned. Replacing all of the street lights is a good opportunity to standardize deployment procedures. Attached to the end of this cost benefit analysis are two example maps of how street lights can be rearranged according to standard rules (e.g. brighter lights are deployed along main thoroughfares and at street intersections while less bright street lights can be placed on cul-de-sacs and in residential areas). The proposed street light deployment saves the city $5,000 in initial materials and $1,156.51 per year in energy costs (using 0.25 electricity rate, the proposed street light deployment reduces total wattage by 1.09 kW). The following cost/benefit ratios are calculated using the proposed street lighting deployment.

BENEFITS:

For all contracted A & B HID lights (current lighting)

Watts	Fixtures				
100	136	100 x 136 =	13600		
150	209	150 x 209 =	31350		
250	7	250 x 7	1750		
400	5	400 x 5	2000		
Total	357		48700	watts	**48.7 kW**

For replacing contracted A & B lights with BetaLED fixtures (proposed lighting)

# LEDs	Watts	Fixtures				
30	39	185	39 x 185 =	7215		
40	55	166	55 x 166 =	9130		
80	106	1	106 x 1 =	106		
120	156	5	156 x 5 =	780		
		357		17231	watts	**17.231 kW**

Using the formula Kilowatt hours x number of hours turned on x electricity rate (these calculations used a rate of 0.25 cents), the following energy savings were calculated:

Current expenditure $51,987.25 – Projected expenditure $18,394.09 =

$33,593.16 Annual Savings (65% cost reduction)

The more expensive fuel gets, the more the city saves on electricity costs per year:

Elec. Rate	Annual Savings
0.20	$26,874.53
0.25	$33,593.16
0.30	$40,311.79
0.35	$47,030.42

Currently, our maintenance contract with Copper Valley Electric for class A lights costs us $55 dollars a light. With 344 A lights, that's $18,920 a year. Class B lights are charged for maintenance as it is done. For the class A light contract alone, we *may* be able to negotiate anywhere from 25-60% reduction in cost. Copper Valley has to see what type of maintenance these bulbs will require. They last at least 4 times as long as HID bulbs but the main type of maintenance Copper Valley does is on a light fixture's photocells, the mechanism responsible for turning the street lights on and off based on ambient light, and these would be transferred over to the LED lights via a photocell receptor on the new fixture.

If we estimate a 36% reduction in the maintenance contract, the city would save $6,811 annually.

Assuming a 0.25 electricity rate and a 36% reduction in their maintenance contract, the city can conservatively expect to save **$40,404 a year**.

BetaLED uses a less conservative formula to calculate total savings. They estimate a 78% reduction in energy consumption. Using a 0.25 electricity rate and a 36% reduction in our maintenance contract, BetaLED calculated the city of Valdez would save **$47,361 a year**.

COSTS:

LED lights come in a range of color temperatures. The 6000k temperature (which is standard) is generally perceived as a very bright white almost bluish light. The 4300k temperature (the fixtures that Anchorage and Cordova selected) is a warmer type of light. They both illuminate approximately the same area; the color temperature is simply a matter of preference. There is a slight cost difference between the two; the 6000k lights are cheaper by $15/light bar. Price includes a photocell receptacle and a backlight shield (an eyelid across 1/3 of the LED that minimizes light trespass). The eyelids can be pulled off if more light is desired. The fixtures have a 5 year warranty.

Cost Table

LEDs	# Fixtures	Cost ea.	6000K	Cost ea.	4300K
30	185	530	$98,050	565	$104,525
40	166	565	$93,790	625	$103,750
80	1	830	$830	890	$890
120	5	1059	$5,295	1149	$5,745
Total	357		**$197,965**		**$214,910**

BetaLED estimates shipping as an additional **$8032.50.**

Installation:

Initial installation cost estimates have been provided by Copper Valley along with a letter of understanding between Copper Valley and the City of Valdez about putting up the "trial" LED street

lights. Copper Valley will charge $545 for miscellaneous parts and installation of each light fixture. The cost to replace all 357 fixtures is $194,565.

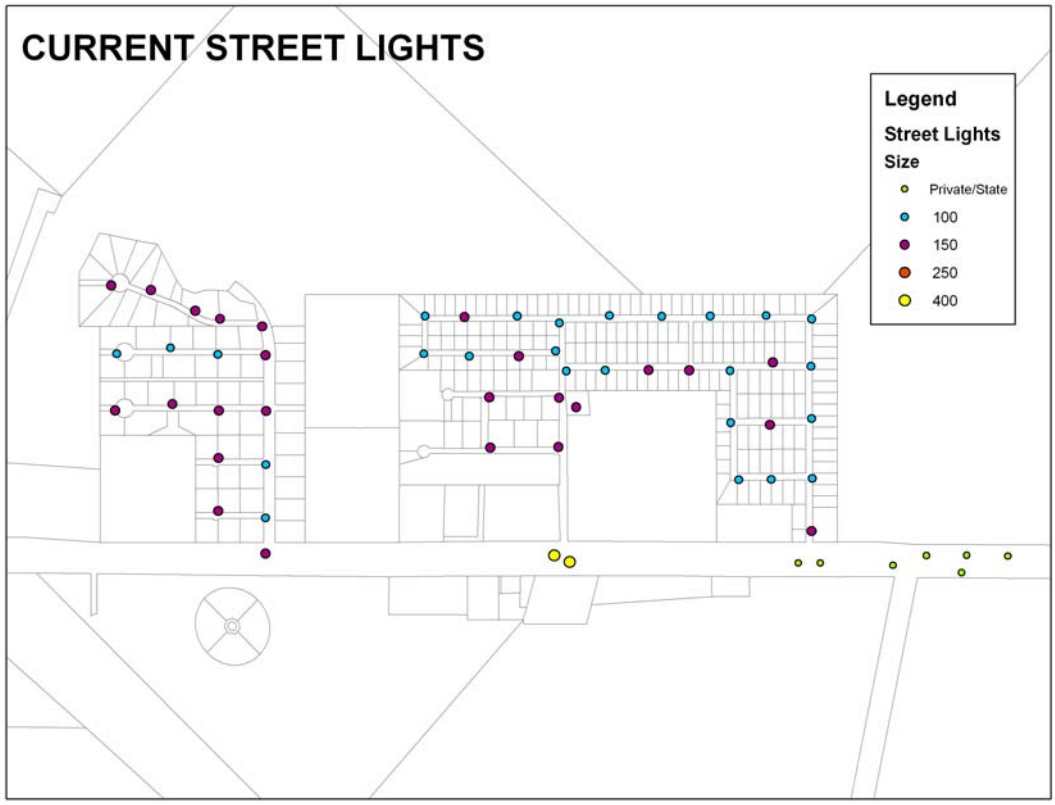
In Anchorage, a 2 man crew is replacing 30 light fixtures a day. If Copper Valley works at approximately the same rate, the street lights can be switched over in 2-3 weeks. Arctic Sales, the BetaLED supplier in Eagle River estimates 6-8 weeks for delivery. If we gave people a month to decide on color temperature, 2 months for delivery, and 1 month for installation, we could be looking at a substantial energy savings by the end of April 2009.

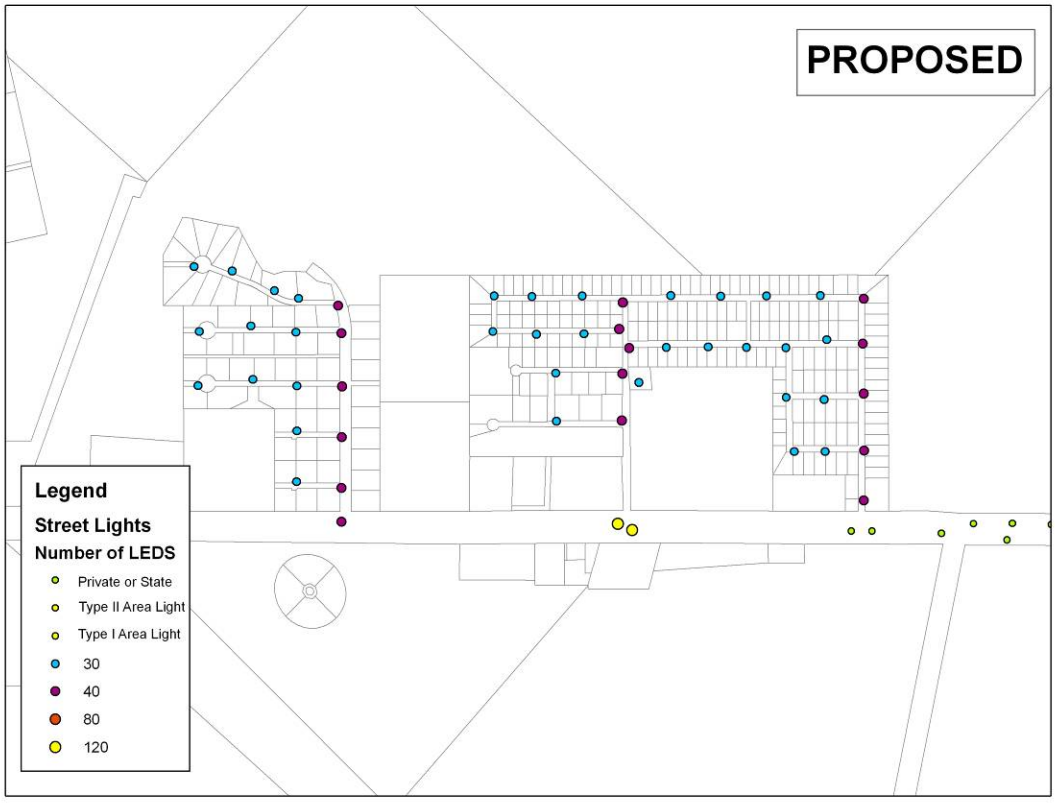
Assuming people choose the 4300K color temperature and Copper Valley charges $545 for each fixture install, the total one-time cost of this project would be: **$409,475.**

If Valdez remained at 0.25/kWh, the project would pay for itself in 10 years.

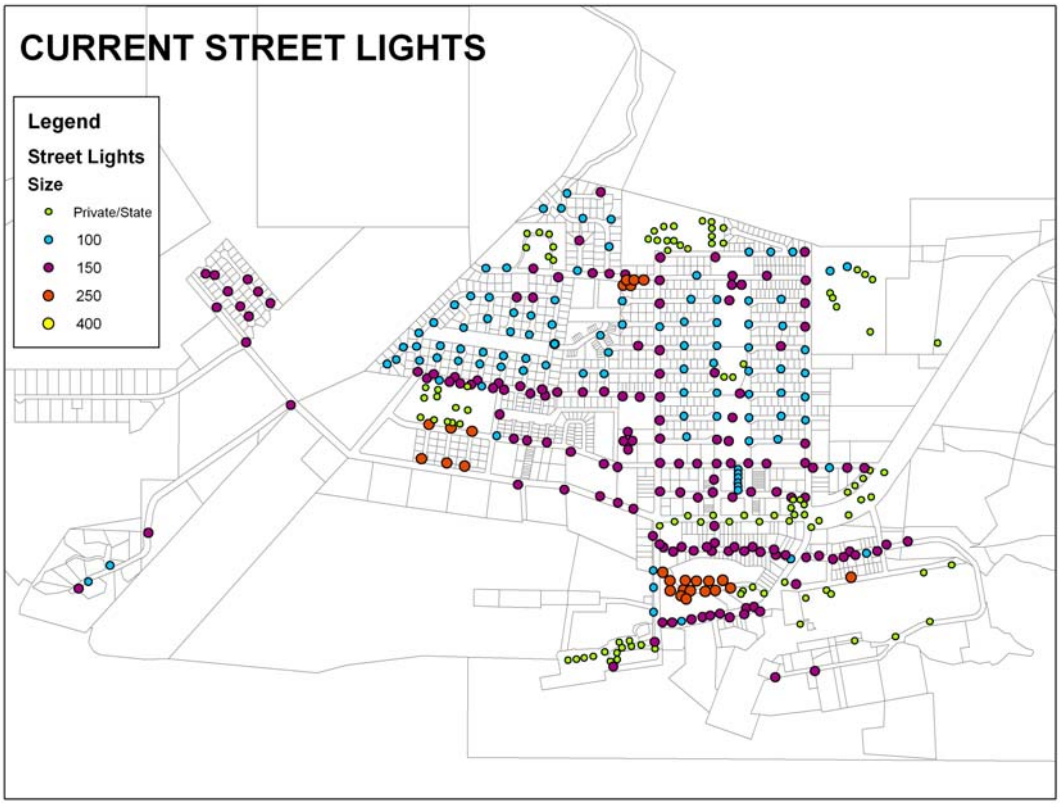
Return on investment, assuming 0.25/kWh Electricity Rate:

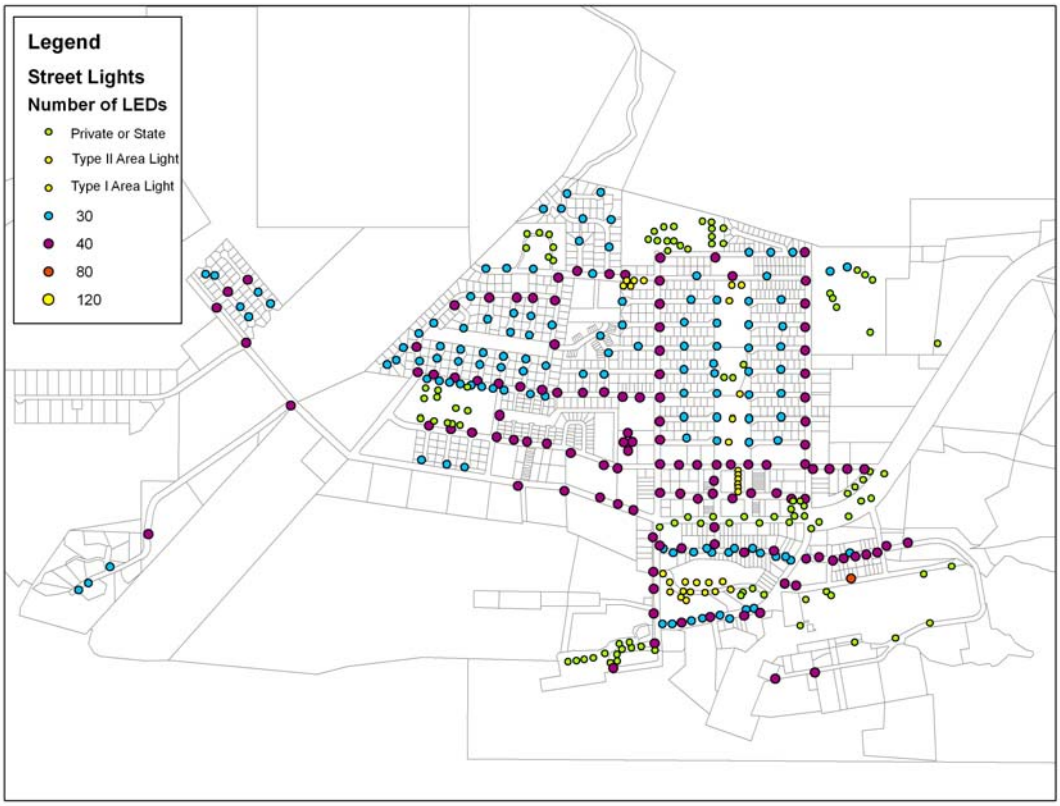
Years	Savings
5	$202,021.79
10	$404,043.58
15	$606,065.36
20	$808,087.15
25	$1,010,108.94
30	$1,212,130.73





Example #1: Robe River and Corbin Creek Subdivisions





Example #2: Street Light re-arrangement for Town.

LED Replacement Project Report

The installation of 91 LED lights took place in Mineral Creek North and Corbin Creek Subdivisions from November 30th to December 3rd. The installations were completed by 2 teams, Copper Valley Electric and City Electric, Copper Valley's contractor out of Anchorage. The majority of the LED lights were installed with backlight control on them to prevent light from going backward from the light pole into people's houses. The backlight control, after evaluating the light patterns, was removed from all the light poles adjacent to the park strip and all the light poles alone Pioneer Street. This allowed the lights at the ends of the cul-de-sacs to illuminate more of the bike paths as they went back into the park strip. Removing the backlight control did add some additional labor to the installation process but overall the installation went more smoothly and took less time than Copper Valley Electric anticipated. We expect the overall labor to be less expensive than we budgeted for.

Staff is pleased with the results of the installation process. The intersections of the Cul-de-sac roads and Hazelet/Meals show a greater amount of illumination. Many residents have called or come in to the Community Development Office to report they are delighted with the reduction of light in their yards and through their windows. We even had one request for an LED fixture to be installed out at Cottonwood subdivision because the homeowner there preferred them. Unfortunately all the lights had been installed at the time of the request. A resident out at Corbin Creek was very happy to be able to see the stars better from their yard (one of the benefits of the LED lights is the reduction in light pollution). We have also received a lot of enthusiasm about the energy savings.

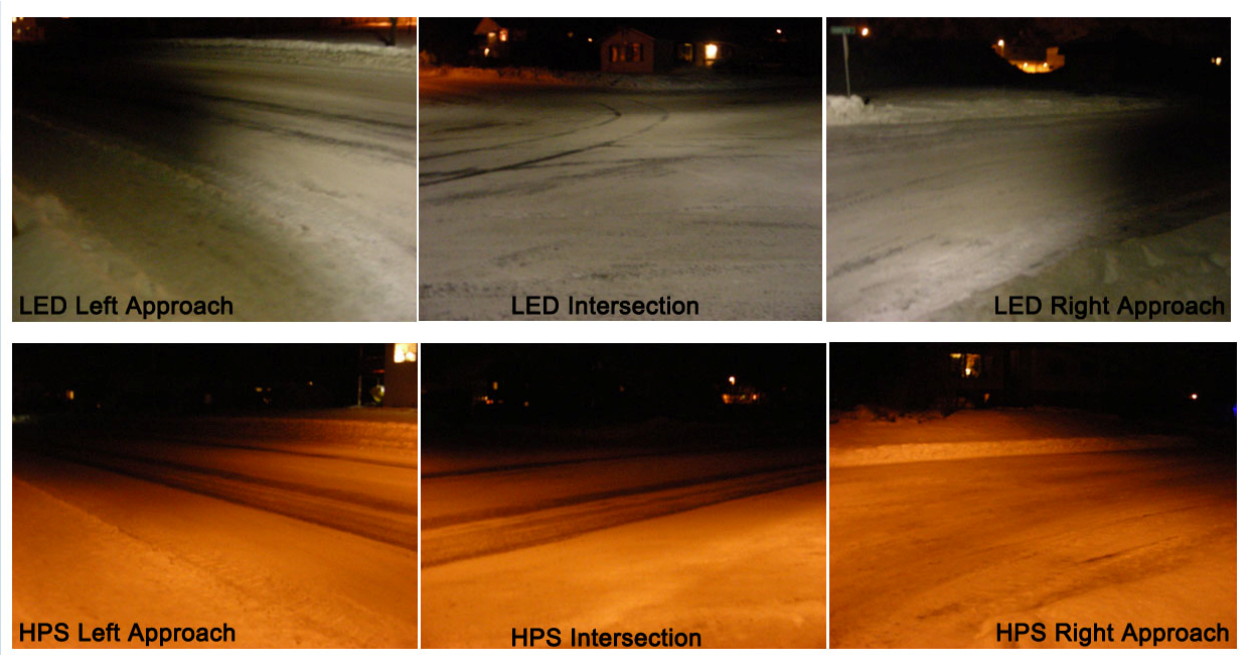
Several people have commented the lights seem dimmer and staff can identify at least two reasons some people may feel that way. LED lights are directional and do not put light out to the sides or above the light pole. Our high pressure sodium bulbs put light out in all directions. So if you look at the high pressure sodium bulbs from a distance, the look like round balls of light. Looking at the LED light fixtures from a distance, you will not see light coming back towards you. All the light is directed to the road. The fixtures themselves therefore, do not look like the round balls of light we are used to. The do in fact supply an equal or greater amount of light down to the road but the light fixtures themselves appear darker.

The second reason the LED lights poles may appear dimmer is the light poles on Hazelet and Meals are at an angle to the main streets. Because we chose to keep the backlight control on these lights (to reduce light pollution to the house at the corner of the street) there is a bit of a line on the backside of the LED fixture where the bright LED light is suddenly much darker. This does not affect the illumination of the intersection but may make the approach to the backside of the streetlight a bit darker. In residential areas, the City felt the backlight control was appropriate. In commercial areas we will order the LED fixtures without backlight control to increase luminescence.

The enrollment of the City of Valdez into the nationally recognized energy efficiency program "LED City" is underway. Staff is working with the coordinator of that program, Deb Lovig, to secure professional quality photography of the change to LED lights. We will be putting out a national press release detailing the progress of our LED program shortly. It will be sent to all the major national news associations and, depending on the news load of the day, may make it onto some pretty big stages.

Copper Valley will reduce our street light bill by the appropriate amount starting with our December electric bill. Staff would just like to say thank you to Copper Valley for all the work and time they took into making this project happen. Not only did they facilitate the replacement process, they are also

putting the energy reduction benefits into effect immediately. We have heard reports that other LED cities have had some difficulties with their electric companies agreeing to reduce the rates despite the LED lights being installed for years. So, we're glad we have Copper Valley and we think they did a great installation job. Staff looks forward to working with them again as we move forward with the next phase of this project.



City Electric left a High Pressure Sodium Bulb (HPS) up at Nabesna until their installation was completed. This allowed direct comparison of HPS bulb light coverage and LED light coverage (Nabesna & Oumalik Intersections Compared). You can see the backlight control on the LED lights for the LED left approach and LED Right approach. You can also see the increased illumination of the intersection. In the LED picture the snow bank on the other side it faintly lid by the white light. In the HPS intersection there is no trace of the far snow bank.

The Backlight control at the Hazelet intersections causes less light to trespass into the adjacent property. The LED fixture light does not reach the bottom of the house. The HPS fixture on the right floods the adjacent properties yard and illuminates the entire side of the house. The LED light on the left is running at 84 watts (or lower*) and the HPS light on the right is running at 150 watts (or higher*). That a 44% energy reduction between the two light poles.

***It is likely the energy reduction is actually more than 44%. The way that Anchorage proved a 60% energy reduction using a higher wattage LED light than ours was to put a meter on a few of their light poles. The metering showed the HPS bulbs were actually using more wattage than they were rated for and the LED lights were using less wattage than they were rated for.**

Benefits																
First Step: Replace Group A and B unmetered lights owned by CVEA and the City									525mA							
Watts	fixtures							LEDs	Watts	fixtures						
100	136		100 x 136 =	13600				30	60	185	39 x 136	11100				
150	209		150 x 209 =	31350				40	84	166	55 x 209	13944				
250	7		250 x 7	1750				80	106	1	106 x 7	106				
400	5		400 x 5	2000				120	156	5	156 x 5	780				
Total	357			48700	watts	48.7	kW			357		25930	watts	25.93	kW	
														22.77		
														0.467556		
Savings to replace all A + B City Lights																
Energy Costs are estimates using a 0.25 rate. The rate will be increasing this winter.																
48.7 kW x 4270 (hours burning annually) x 0.25 (rate) =						**51987.25**	dollars/yr		22.77 kW x 4270 (hours burning annually) x 0.25 (rate)					**27680.28**	dollars/yr	
									=							
											24306.98	dollars/yr		**47%**	Total Savings	

10. Costs/Benefits

Costs			
LEDs	# Fixtures	Cost ea.	6000K
30	185	535	98975
40	166	595	98770
80	1	890	890
120	5	1149	5745
	357		204380

Installation:

$450 x 357 fixtures 160650

Total Cost: 365030

11.7 years to pay for installation.

Years	Savings
5	$155,590.88
10	$311,181.75
15	$466,772.63
20	$622,363.50
25	$777,954.38
30	$933,545.25

City of Los Angeles LED Pilot Project

Minimum Requirements for Testing and Evaluation of LED Equipment

In accordance with the "LED Pilot Project", the Bureau of Street Lighting will be administering an ongoing LED testing and evaluation program.

Periodically, new LED streetlights will be brought into our testing lab for mechanical and electrical evaluation. Some of those fixtures will be moved to a public street for lighting evaluation and will be monitored over a period of at least 12 weeks.

Due to the large number of fixtures being submitted for evaluation, we have developed a minimum set of requirements for all new LED streetlights. These requirements must be met before we can accept the equipment into our program.

If your LED streetlight meets the following requirements, enter your contact information and a brief description of your product in the electronic form provided on this webpage.

Energy Savings
The fixture must use approximately 45% less energy compared to its commercially available High Pressure Sodium counterpart. (See Chart below for actual wattage targets). Scotopic light contribution can not be considered at this time as the Bureau is using recommended lighting levels and uniformity ratios set forth in IESNA-RP-8-2000.

Maximum LED Power Consumption to Achieve the desired Energy Savings
100W HPS lamp and ballast uses: 138W **LED replacement should use less than: 73W**
150W HPS lamp and ballast uses: 190W **LED replacement should use less than: 115W**
200W HPS lamp and ballast uses: 240W **LED replacement should use less than: 145W**
310W HPS lamp and ballast uses: 365W **LED replacement should use less than: 225W**
400W HPS lamp and ballast uses: 465W **LED replacement should use less than: 280W**

Production

The LED streetlight must be commercially available. Prototypes will not be accepted.

Documentation

The fixture must be marked with a full production catalogue number that matches manufacturer documentation.

A full sheet of product specifications must be submitted. Warranty information must be included.

Fixture must be tested by an independent lab that is currently approved by DOE for their Caliper testing program (a list of labs can be found here: http://www1.eere.energy.gov/buildings/ssl/test_labs.html). Testing must be performed in accordance with all LM-79 guidelines, and locked IES files must be provided. **Test results must match color temperature submitted.**

Illumination Requirements
Fixture must be designed to meet IESNA lighting standards per RP-8-00. Type II & III distribution patterns should be readily available. The following table may be used for "typical" lighting calculations.

Typical Roadway Characteristics					
Lamp Size:	100W HPS	150W HPS	200W HPS	310W HPS*	400W HPS*
Mounting Height:	26' 8"	29'7"-32"7"	30'-33'	30' to 40'	30' to 40'
Spacing:	50'-170'	130'–140'	125'-140'	110' to 160'	120' to 180'
Configuration:	One-sided	Staggered	Opposite	Staggered or Opposite	Staggered or Opposite
Roadway Classification:	Local	Collector	Major	Major	Major
Roadway Width:	30'-40'	40'-50'	50'-70'	>70'	>80'
Sidewalk Width:	10'-12'	10'-12'	10'-15'	8'-20'	10'-20'

* These fixtures must also be suitable for use at signalized intersections.

Fixture must be classified as cutoff, or equivalent per IES TM-15-2007

There should be no significant glare, when compared to its commercially available High Pressure Sodium counterpart.

Mechanical and Electrical Requirements
The fixture must have a standard 3 prong twist-lock photocell receptacle per ANSI/NEMA C-136.10. The receptacle must rotate.

The fixture must meet the following ingress protection requirements:
Optical assembly - IEC standard IP66
Driver Compartment - IEC standard IP54
Housing - IEC standard IP54

The fixture must easily connect to a standard 2.4” diameter horizontal tenon.

The fixture must not have any fans or moving parts.

The driver must be located inside the housing, but shall be easily accessible.

Neither housing nor lens shall be constructed of polycarbonate /plastic that will discolor over time.

Power Factor > .90

LED Color Temp. (4000 ±275°K)

CRI ≥ 65

All components shall be UL approved.

The fixture must have transient protection.

The driver and LED arrays shall be designed for multi-current input operation. LED units with dimmable driver and a device to perform wireless remote monitoring are highly desirable.

Office of the Mayor
City of Los Angeles

ANTONIO R. VILLARAIGOSA

FOR IMMEDIATE RELEASE **Contact: Juan Bustamante**
February 16, 2009 **(213) 978-0741**

MAYOR VILLARAIGOSA, PRESIDENT CLINTON LIGHT THE WAY TO A GREENER LA

Green street light program – largest environmentally friendly LED lights project ever undertaken by a city – will reduce CO2 emissions by 40,500 tons and save the City of Los Angeles $10 million annually

LOS ANGELES – In a partnership between the Clinton Climate Initiative and the City of Los Angeles, President Bill Clinton and Mayor Antonio Villaraigosa today announced the largest LED (light-emitting diode) green street light program ever undertaken by a city, which will reduce CO2 emissions by 40,500 tons and save $10 million annually.

"I am proud that the Clinton Climate Initiative is helping the City of Los Angeles replace 140,000 streetlights with LED units at a time when energy cost savings are just as important as saving our planet," President Clinton said. "This partnership is a tremendous example of how cities can cut costs, while also making a significant impact in the fight against climate change. I thank Mayor Villaraigosa and the city for their leadership."

“With the green street light program, we are lighting the way to a greener LA,” Mayor Villaraigosa said. “Reducing LA’s contribution to global warming will bring multiple benefits to Angelenos; we’ll save money on energy costs and reduce our dependence on fossil fuels.”

“I want to thank President Clinton who was instrumental in making the green street light program happen, and of course for his leadership, which has rallied the resolve of the entire world community to halt global climate change.”

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The green street light program will replace 140,000 of the City's traditional street lights with environmentally friendly LED lights: providing a 40% energy savings, reducing maintenance and energy costs, and reducing carbon dioxide emissions by 40,500 tons per year – the equivalent of taking 6,700 cars off the road.

Currently, the City's 140,000 street lights use 168 gigawatt hours of electricity at an annual cost of $15 million, emitting 120,000 metric tons of carbon dioxide.

In early 2008, the Mayor's Office established a collaborative working relationship with the Clinton Climate Initiative (CCI) to study the Mayor's environmental initiatives.

The Mayor's Office and the Bureau of Street Lighting collaborated with CCI's Outdoor Lighting Program to review the latest technology, financing strategies and public private implementation models for LED retrofits. CCI's modeling and technology analysis, as well as its financial advisory, served as key reference sources for the development of this comprehensive retrofit plan.

"This project showcases how government can address environmental and economic challenges with creative problem-solving," said Ed Ebrahimian, General Manager of the Bureau of Street Lighting. "The Bureau of Street Lighting is proud to play a part in greening Los Angeles."

To be completed within five years, the project is funded through a combination of energy rebates, the street lighting assessment fund and loans - which will be repaid over seven years entirely through savings in energy and maintenance costs. In the eighth year, after the loan is repaid, the City will save $10 million annually through the more efficient and modern LED lighting.

While typical streetlight lamps will last from four to six years, LED fixtures have a longer life span, estimated from 10 to 12 years. The new LED streetlight units are more durable and damage-resistant than other technologies, greatly reducing the City's maintenance costs and providing more reliable lighting for City residents. The new LED fixtures will also be installed with remote monitoring units which will automatically report streetlight failures directly to the Bureau of Street Lighting for immediate repair.

Street lighting costs represent one of the largest components of a city government's utility bill, often accounting for 10 percent to 38 percent of the total bill. With nearly 35 million street lights in the United States, about 1 percent of all electricity is used by street lighting systems. CCI currently is building upon its efforts with Los Angeles and working with other cities on large-scale street lighting retrofit projects.

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GREEN LA

By reducing energy demand and displacing the use of dirty coal, the LED Street Lighting Program furthers Mayor Villaraigosa's goal of turning Los Angeles into the greenest big city in the country. On May 15, 2007, Mayor Villaraigosa unveiled GREEN LA – An Action Plan to Lead the Nation in Fighting Global Warming. GREEN LA sets Los Angeles on a course to reduce the City's greenhouse gas emissions 35 percent below 1990 levels by 2030, going beyond the targets of the Kyoto Protocol and representing the most ambitious goal of any large US city. The cornerstone of GREEN LA is increasing the City's use of renewable energy to 35 percent by 2020.

Clinton Climate Initiative

In August 2006, the William J. Clinton Foundation launched the Clinton Climate Initiative (CCI) to make a difference in the fight against climate change in practical, measurable and significant ways. In its first phase, CCI is serving as the exclusive implementing partner of the C40 Large Cities Climate Leadership Group, an association of large cities around the world that have pledged to accelerate their efforts to reduce greenhouse gas emissions. CCI's Outdoor Lighting Program works with C40 partner cities to improve the energy efficiency of street and traffic light systems through a combination of technical, purchasing and project assistance.

# # #

BUREAU OF STREET LIGHTING
General Specifications for Solid State Lighting LED Roadway Luminaires
LED Equivalent Replacement for 150 W HPS
Issue Date: 1/28/2011

Luminaire Requirements:	
Correlated Color Temperature (CCT)	Nominal CCT (°K) 4000 +/-275
Color Rendering Index (CRI)	Luminaires shall have a minimum CRI of 65.
Off-state Power Consumption	The power draw of the luminaire (including PE or remote control devices) shall not exceed 2.50 watts when in the off state.
On-state Power Consumption	Shall not consume more than (not including optional monitoring/control device): - 115 W for Equivalent Replacement of 150 W HPS
Warranty	A warranty must be provided for the full replacement of the luminaire due to any failure for six (6) years. The warranty shall provide for the repair or replacement of defective electrical parts (including light source and power supplies/drivers) for a minimum of eight (8) years from the date of purchase.
Weight	Luminaire shall not weigh more than 22 pounds.
Operating Environment	Luminaire shall be able to operate normally in temperatures from -20° C to 50° C.
Cooling System	Shall consist of a heat sink with no fans, pumps, or liquids, and shall be resistant to debris buildup that does not degrade heat dissipation performance.
Dimensions (Approx.)	26” long x 16” wide x 7” tall
Housing	Shall be primarily constructed of metal. Finish shall be gray in color, powder coated and rust resistant. Driver must be mounted internally and be replaceable. Driver must be accessible without tools. All screws shall be stainless steel. Captive screws are needed on any components that require maintenance after installation. No parts shall be constructed of polycarbonate unless it is UV stabilized (lens discoloration shall be considered a failure under warranty). Ingress Protection shall be rated a minimum of IP54.
IESNA Luminaire Classification	Using TM-15: B2 U2 G2
Mounting Arm Connection	Luminaires shall mount on 2.375” O.D. horizontal tenon with no more than four 9/16" hex bolts and two piece clamp with vertical tilt adjustment range of +/- 5%.
PE Cell Receptacle	Luminaires shall have a 3-prong twist-lock photo-control receptacle in accordance with ANSI C136.10. The PE socket needs to be able to rotate, so that the PE window can always be positioned to face the North direction.
House Shield	Shall provide option for house side light control.

LED Module/Array Requirements:	
Lumen Depreciation of LED Light Sources	LED module(s)/array(s) shall deliver at least 70% of initial lumens, when installed for a minimum of 50,000 hours. Assembly shall be rated a minimum of IP66.
Light Distribution	Should be in accordance with IESNA Type II Medium Lighting Distribution.

Power Supply/Driver Requirements:	
Power Factor	Power supply should have a minimum Power Factor of .90
Max amperage at LED	Maximum rating DC Forward Current at T_A 25˚ C should be 1000 mA. Maximum amperage at LED must not exceed driver current to meet Lumen Depreciation value described above and initial lumen values required below, and shall not exceed 700 mA per mm^2 of chip. Standard factory setting shall be 525 mA, as delivered from the factory. The Driver and LED arrays shall be designed for multi-current input operation, with switchable ratings at 350 mA, 525 mA and 700 mA.
Transient Protection	Per IEEE C.62.41-2-2002, Class A operation. The line transient shall consist of seven strikes of a 100k HZ ring wave, 10 kV level, for both common mode and differential mode. It should also meet test procedure in accordance with IEEE C62.45.
Operating Temperature	Power Supply shall operate between -20° C and 50° C.
Frequency	Output operating frequency must be ≥ 120 Hz (to avoid visible flicker) and input operating frequency of 60 Hz.
Interference	Power supplies shall meet FCC 47 CFR Part 15/18 (Consumer Emission Limits).
Noise and Ingress Protection	Power supply shall have a Class A sound rating per ANSI Standard C63.4. Assembly or compartment shall be rated a minimum of IP54.

Roadway Application Requirements:	
Minimum Light Output	For Equivalent Replacement of 150 W HPS, LED luminaire shall deliver a minimum of 5950 lumens (initial)
Luminaire Efficacy	$= \frac{\text{Luminaire Light Output(includes fixture efficiency and thermal effects)}}{\text{Luminaire Input Power}}$
Minimum Luminaire Efficacy	55 lm/W

Measurement/Performance/Safety Standards:	
ANSI C78.377.2008	Specifications for the Chromaticity of Solid State Lighting Products.
IESNA LM-79-08	IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
IESNA LM-80-08 (Recommended)	IESNA Approved Method for Measuring Lumen Maintenance of LED Lighting Sources.
UL Standards (Latest Approved)	• **8750** Light-Emitting Diode (LED) Light Sources for Use in Lighting Products • **1598** Luminaires • **1012** Power Units Other Than Class 2 • **1310** Class 2 Power Units • **2108** Low Voltage Lighting Systems • All components shall be UL approved

Pre-qualifications for Bidding:

1. The following fixtures have been pre-approved in the City's LED Pilot Project: (This information will not be displayed at this time)
2. Before the contract can be awarded, the winning bidder shall provide three production samples to the City at no cost for final testing.
3. Upon delivery, quality control testing will be performed by the Bureau of Street Lighting. Testing will be done in accordance with the City's "Special Specifications for the Construction of Street Lighting Systems" (The Blue Book).

Delivery Requirements:

Subsequent orders placed in response to this bid must comply with the following deliveries and quantities:

<u>Delivery time after orders are placed must not exceed 8 weeks</u>

The City of Los Angeles reserves the right to order additional fixtures (up to 20,000 units) with this contract, with the option to renegotiate the unit price as the cost of LED fixtures are reduced in the market place.

Penalties:

If the units are not delivered per the above delivery requirements, a penalty of $100 per day per unit will be assessed. If the bidder cannot deliver, the City will have the right to cancel the contract and go to the next qualified bidder.