LED Technical Advisory Group (TAG)

LED Street Lighting

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LED Street Lighting

Presentation Outline

- Current Status of LED Street Lighting Products
- CALiPER Results
- Design Considerations
- Program Recommendations
LED Outdoor Lighting

Why so much interest?

Leotek Electronics USA introduces LED street light for under $200

Milpitas, CA – Leotek Electronics USA Corp., a leading supplier of LED street lights, announces the release and availability of the ECBobra-head™ designed to replace traditional high intensity discharge “cobra-head” style roadway luminaires. The ECBobra-head™ utilizes new state-of-the-art light emitters.

Read more http://www.ledsmagazine.com/press/35225
Rapidly Advancing Technology

Solid-State Lighting Luminaire (Fixture) Performance Curve

- 2008 DOE FORECAST
- 2010 Actual Result
- 2012 Actual Result

1. CALiPER Round 11
2. DLC List, May 2012
Rapidly Advancing Technology - Efficacy

Figure 4b. Outdoor Product Efficacy Trends (80th Percentile, 3-Quarter Moving Average)

LED Lighting Facts Product Snapshot: LED Luminaires, December 2011
Rapidly Advancing Technology – Lm Output

Figure 5. Outdoor Area and Roadway Luminaire Light Output and Efficacy

LED Lighting Facts Product Snapshot: LED Luminaires, December 2011
Rapidly Advancing Technology

Figure 8. Outdoor Luminaire CRI and CCT

LED Lighting Facts Product Snapshot: LED Luminaires, December 2011
Rapidly Declining Price

LED Price ($/klm) Improvement

Rapidly Declining Price

Real World Experience – Residential Fixtures

● Seattle: for purchases of 2,500 units

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<th>Fall 2009</th>
<th>Spring 2010</th>
<th>Fall 2011</th>
<th>Winter 2012</th>
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<tr>
<td>Price</td>
<td>$369</td>
<td>$289</td>
<td>$239</td>
<td>$219</td>
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● price reduction of 41% in 2 years

● Leotek recently announced LED street lights for under $200

● Simple paybacks of 6 – 9 years typical
Early Adoption of LED Street Lighting

Over 1,000 completed or planned installations in 49 states

Noteworthy:

- **Los Angeles**: Installed to date: **80,000+** | Total Project Plan: **140,000**
- **Seattle**: Installed to date: **21,000** | Total Project Plan: **72,000**
- **Boston**: Installed to date: **18,000** | Total Project Plan: **64,000**
- **Los Vegas**: Installed to Date: **8,500** | total Project plan: **52,000**
- **Austin**: Installed to Date: **320** | Total Project Plan: **70,000**
- **New York City**: Installed to Date: **400** | Total Project Plan: **7000**
- **Tampa**: Installed to Date: **143** | Total Project Plan: **143**
- **Dallas/Fort Worth**: Installed to Date: **541** | Total Project Plan: **551**
  (Oncor)
New and Improved Products

- Major manufacturers are all joining the market
  - First BetaLED, Leotek, Lighting Science Group
  - Now:
    - GE
    - Philips Lumec
    - Sylvania
    - Cooper
    - King
    - Hubbell (Beacon)
Next Generation Luminaires 2010

SCHX5 LED | EVOLUCIA, INC.
www.evolucialighting.com

The SCHX5 LED street/area light employs EvoLucia’s Aimed Optics™ technology to efficiently direct light to a target area. The SCHX5 performs with an industry-high Fitted Target Efficacy score of 57 to put the most foot-candles on the ground, in the pattern required, with the best uniformity, using the fewest LEDs and the least power consumed.

Model Number: SCHX5/80-43/PAL/T2/277/LG

Judging Comments
The judges applauded the glare control, uniformity, and efficacy of the SCHX5 LED. The judges did express some concern about high angle glare control.

Luminaire Testing
- Light Output: 6596 lumens
- Power: 78.6 watts
- Efficacy: 83.9 lm/W
- CCT: 4440K, CRI: 76
- Luminaire Testing Laboratory – Report #18528 and #19255
Next Generation Luminaires 2010

RoadStar | PHILIPS ROADWAY LIGHTING
www.philips.com/roadwaylighting

LED RoadStar luminaire with Dynadimmer dimming technology has a durable IP66 sealed construction, excellent thermal management, and resistance to the elements. An earlier version received recognition in the 2008 competition.

Model Number: GPLM-180W98LED4K-LE2-120-CDMG-CP12-PH8-NP

Judging Comments
The wide distribution, shielding, and affordability of the RoadStar impressed the judges, but the panel did express some concern about glare control.

Luminaire Testing
• Light Output: 14208 lumens
• Power: 200.5 watts
• Efficacy: 70.8 lm/W
• CCT: 4172K, CRI: 68
• Spectralux Laboratory – Report #L1009015-C1 and #L1009012-R1
DesignLights Consortium

- Specifications for Outdoor Pole/Arm Mounted Area and Roadway Luminaires
- Over 3,500 area and roadway listed (May 2012)
Lots of marketing hype, but where do we get the truth?
- Which products are good? Which products aren’t?
- How do they compare to what we know?
Luminaire Efficacy is NOT the Whole Story

Consider illuminance, throw, application needs…

Courtesy PNNL
Measured Overall Luminaire Wattage

Courtesy PNNL
Light Output and Average Illuminance*

*Benchmarks*
- 6540 lm, 0.7 fc
- 3960 lm, 0.3 fc
- 3561 lm, 0.2 fc

*SSL*
- 970 lm, 0.1 fc
- 2549 lm, 0.1 fc
- 7004 lm, 0.5 fc

*SSL*
- 4994 lm, 0.6 fc
- 4469 lm, 0.4 fc
- 3994 lm, 0.3 fc

*Average illuminance calculation based on 24-foot wide 2-lane street with 27-foot high, luminaires set back 6-foot and spaced 170-foot on center

Courtesy PNNL
Uniformity of Light Distribution (Avg:Min)

* Uniformity calculation based on 24-foot wide 2-lane street with 27-foot high, luminaires set back 6-foot and spaced 170-foot on center

Courtesy PNNL
CALiPER Round 11 Take Aways

- Consider overall luminaire performance, initial and projected over life
- Analyze performance of complete lighting system
  - Application criteria: mounting height, spacing, street width, etc.
  - Total input watts
  - Total light output
  - Average illuminance and uniformity
  - Light distribution, Glare, Color
- **5 out of 6 meet manufacturer claims**

*CAUTION: Equivalency claims may be valid for specific installations, but not all*
Application Performance

- **Critical** for selecting appropriate product.
- **Verify** the lighting performance for the intended specific application using computer modeling software, such as Visual or AGI32.
Initial versus Maintained Lumens

- Product information and LM79 tests provide initial lumen output.
- Design must take into account maintained lumens.
  - HPS: 80% lumen maintenance after ~24,000 hrs.
  - LED: lumen maintenance curves vary by manufacturer. Can get 70% lumen maintenance at 50,000 to 100,000 hours and longer.
- Controls could be used to provide maintain lumen output throughout the life of the LED luminaire.
The primary goal of the Consortium is education

- Many factors go into the selection of appropriate lighting
- Selection should be based on facts and available data to the greatest extent possible and not on hype or hearsay
- Bring everyone up the learning curve together and quickly

Membership –

- Over 360 municipalities, utilities, energy efficiency organizations
- Consultants and others

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

- **Share Information**
  - Publish results from demonstrations
  - Webcasts, teleconferences
  - Regional Workshops

- **Resources**
  - Model Specification for LED Roadway Lighting
  - Retrofit Lighting Financial Tool
  - SSL Street Lighting Controls Performance Specification (in development)

[http://www.ssl.energy.gov/consortium.html](http://www.ssl.energy.gov/consortium.html)
Resources

- LED Lighting Facts®
- Truth in Advertising
  - Lighting Facts® showcases LED luminaire manufacturers who commit to testing products and reporting performance results according to industry standards.
- Over 5,100 products listed
  - 500 Outdoor Area/Roadway Luminaires

http://www.lightingfacts.com/
Resources

Design Lights Consortium

- Consistent, national qualification process
- Over 20 utilities nationwide
- Qualifies products only where no Energy Star category exists

http://www.designlights.org
LED Street Light Advantages

- Energy efficient
- Optical control
- White light source (mesopic lighting)
- Controllable
- Long life
- Rugged source
LED Street Light Issues

- Rate schedules
- Cost
- Long term performance
- Product quality
- Component maintenance
- Photocell life versus LED life
- Application performance critical
Program Recommendations

- Assist with rate schedule development and revisions
  - Review schedules developed by others
  - PG&E: 5 watt increments
- Consider group purchasing
  - PG&E offers turnkey installations
- Offer technical support as part of incentive program
Program Recommendations

- Use incentive structure that assures savings
  - Review incentive structures developed by others (PG&E, SMUD, Eff Vermont)
  - PG&E prescriptive: maximum LED wattage allowed
- Additional research
  - CCT and health effects
  - Cost effectiveness of higher wattage replacements
  - Failure mechanisms for photocells