

# LED Parking and Area Lighting

Pole-Mounted Area and Parking Lighting

Wall-Mounted Area Lighting

## Emerging Technologies Showcase

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August 22, 2012

Sponsored by BPA's E3T Program



# Presentation Outline

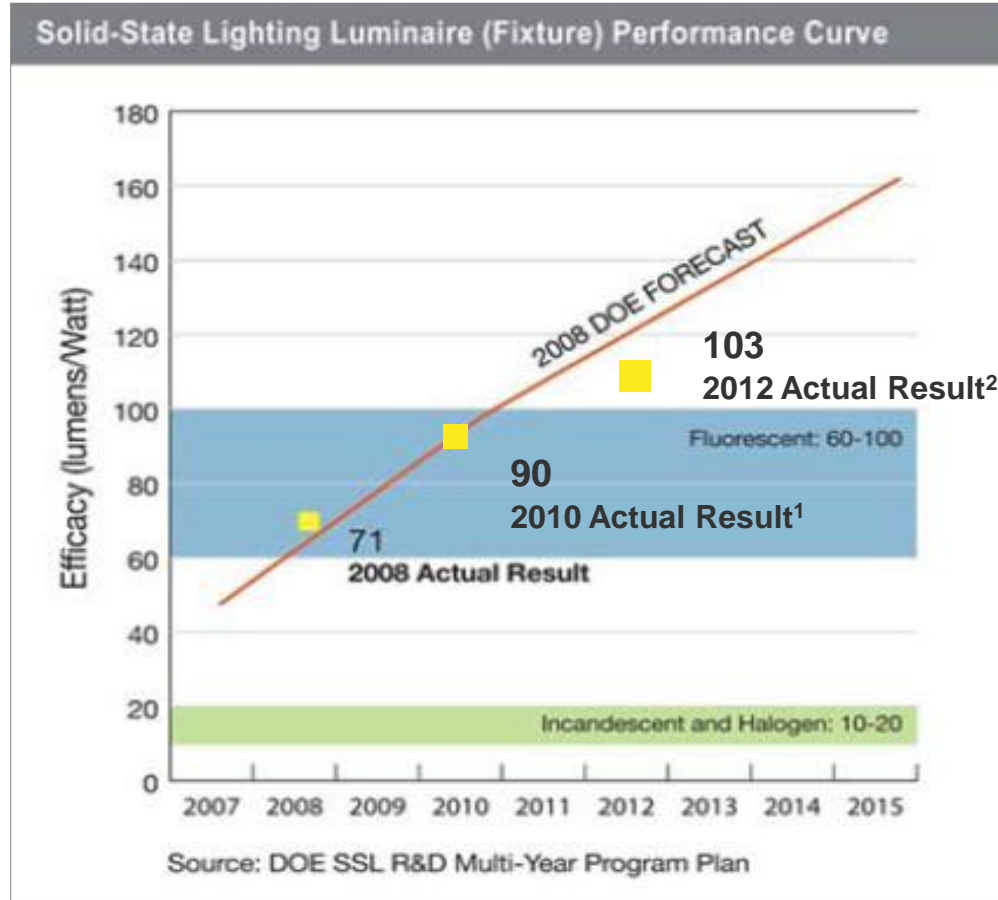
- LED lighting considerations
- Current state of LED parking and area lighting
- Case study examples
- BPA incentives

# LED Outdoor Lighting

Why so much  
interest?



# Rapidly Advancing Technology

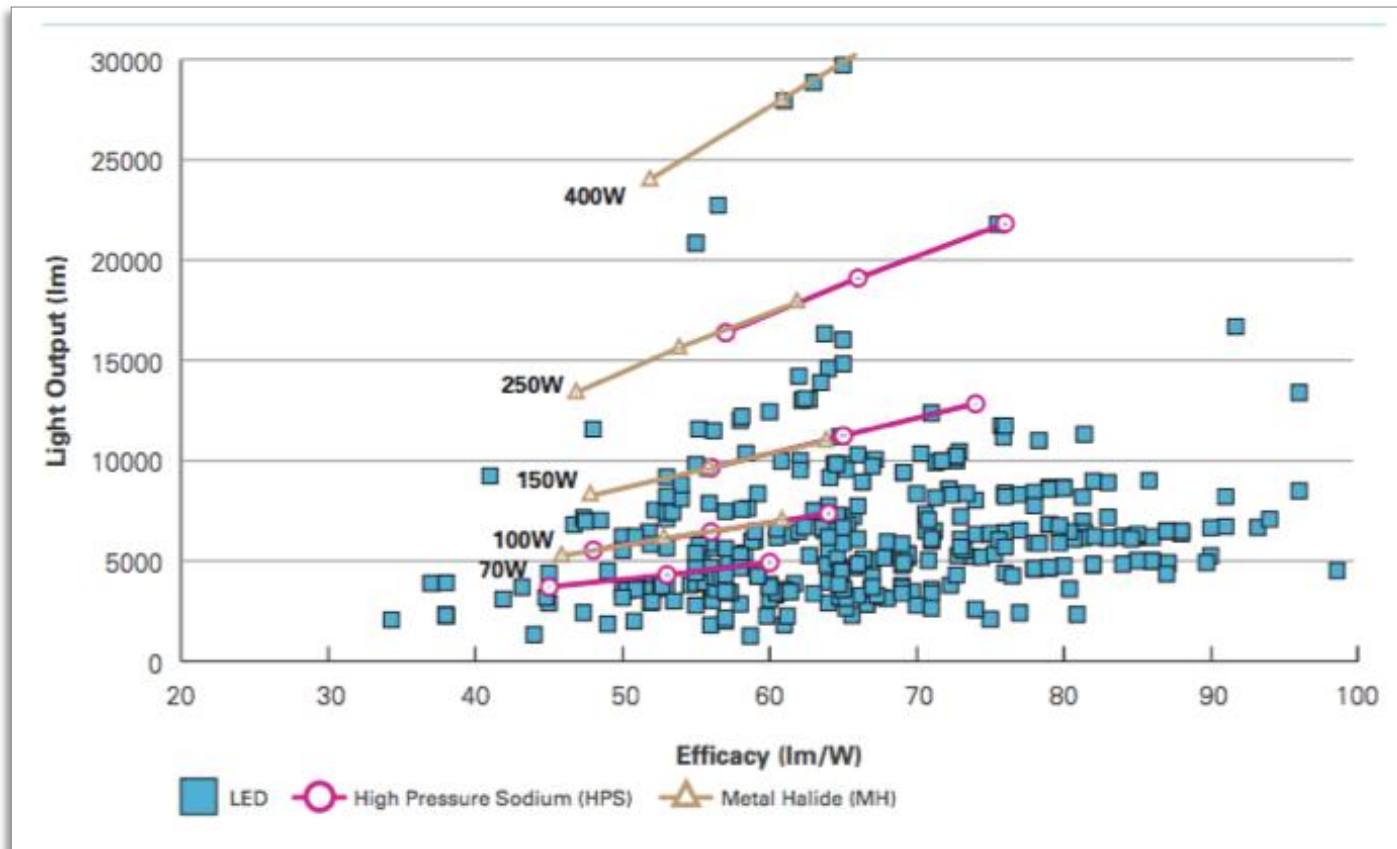


<sup>1</sup>CALiPER Round 11

<sup>2</sup>DLC List, August 2012

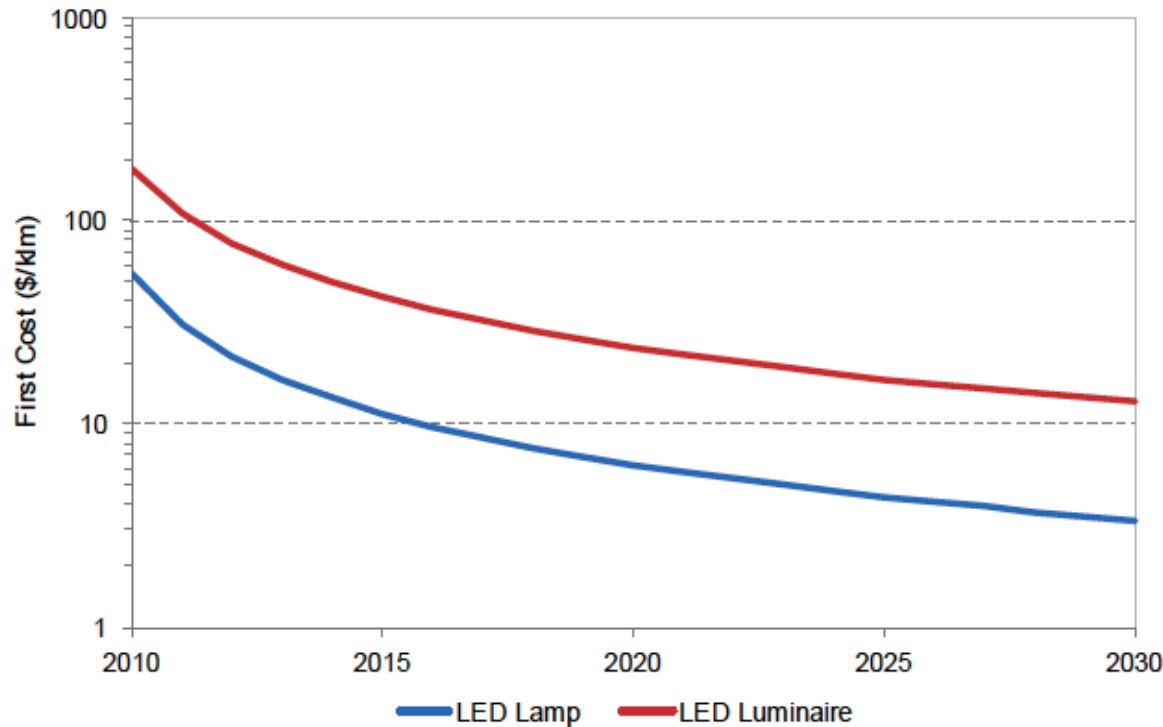
# Rapidly Advancing Technology

Outdoor Area and Roadway Luminaire Light Output and Efficacy



Source: LED Lighting Facts Product Snapshot: LED Luminaires, December 2011

# Rapidly Declining Price



2010: \$181/klm  
2020: \$24/klm  
= 85% drop anticipated  
in 10 years

## LED Price (\$/klm) Improvement

Source: Navigant Consulting, "Energy Savings Potential of Solid-State Lighting in General Illumination Applications." U.S. Department of Energy, January 2012.

# LED Considerations: Advantages

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



# LED Considerations: Issues

- Variable product quality
- Unproven long-term performance
- Dimming and control compatibility
- High first cost

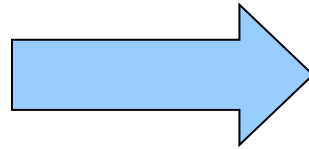


# LED Luminaire Efficacy

LED energy efficiency is a function of:



LED device efficacy



+

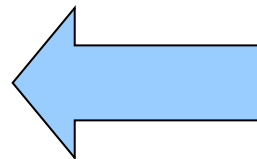


Thermal management

+



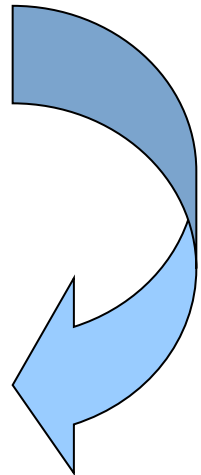
Driver/power supply efficiency



+



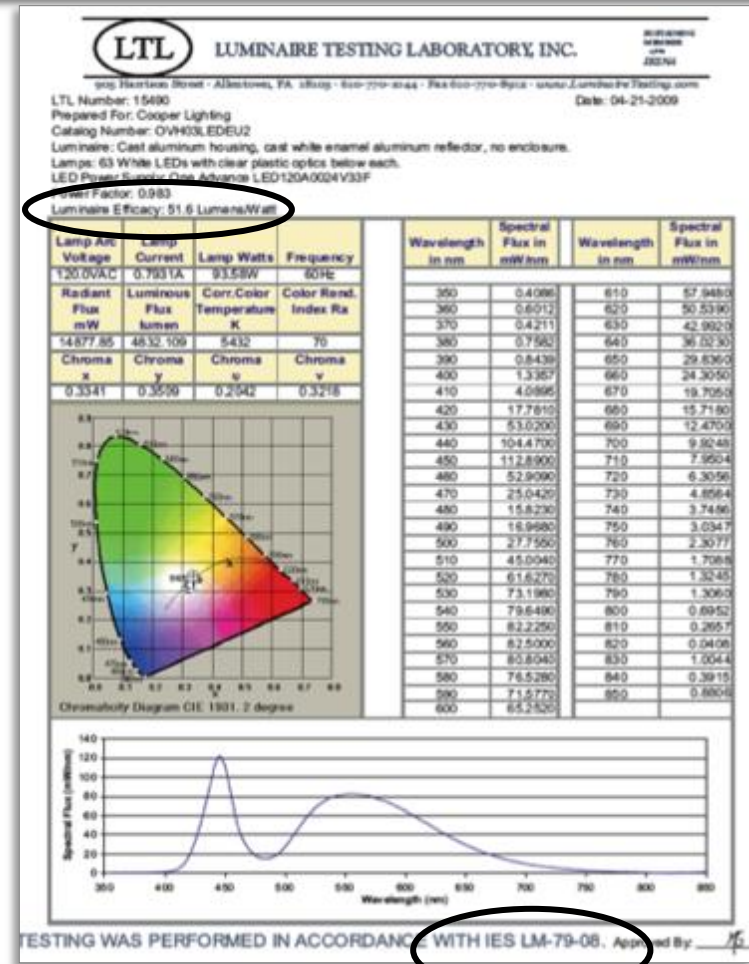
Luminaire design



# LED Luminaire Photometric Performance

## IESNA LM-79

- Performance data for entire integral luminaire
  - Electrical characteristics
  - Light output
  - Luminous intensity distribution
  - Color characteristics
- DOE Fact Sheet: Interpreting LM-79



# LED “Life” Based on Lumen Maintenance

- LED life = hours to 70% of initial lumens  
Rated life for incumbent lighting sources =  
the time when 50% of the lamps in a statistically valid  
sample have failed
- IESNA LM-80: device level lumen maintenance data,  
6,000-hour test
- In-situ test is needed to predict LED life in a particular  
luminaire
- IESNA TM-21: procedure for predicting  
lumen maintenance



# Application Performance

Lumens delivered to the task area per input watts of the luminaire

Lumens delivered are a function of the light source and luminaire efficiency

Verify performance for the intended specific application using computer modeling software such as Visual or AGI32



## Strong Relationship Between Output, Price

Higher lumen output means more LEDs, more heat sink material, larger housing, etc.

Much stronger correlation between output and price than with conventional technologies

Cost effectiveness challenging for higher lumen output products



# System Reliability

## What is the weakest link?

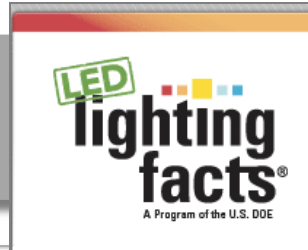
- Light source
- Power source (Driver)
- Lens, if any
- Housing
- Photocell



Accelerated salt fog testing to  
5,000+ hours



# Market and Performance Status



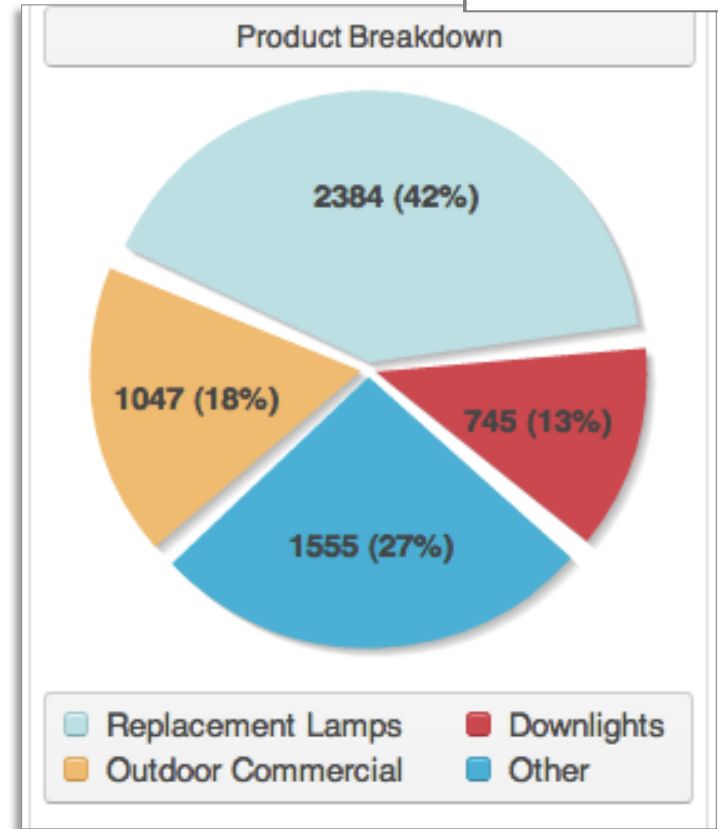
## LED Lighting Facts<sup>®</sup>

### Truth in Advertising

Lighting Facts<sup>®</sup> showcases LED luminaire manufacturers who commit to testing products and reporting performance results according to industry standards.

Currently **>1,000** outdoor LED products listed with LED Lighting Facts

<http://www.lightingfacts.com>



# DesignLights Consortium

Specifications for outdoor pole-mounted area and roadway and wall-mounted area luminaires

Over **9,000** area and roadway products listed  
(August 2012)





# New and Improved Products



## Pole-mounted Area/Roadway

- Higher efficacy
- Lower color temperature (~ 4100K)

Total Outdoor Area/Roadway Products = 545

Efficacy	Total Products	Products with CCT < 4500K
> 60 lm/W	430	205
> 70 lm/W	274	148
> 80 lm/W	138	72

# New and Improved Products

- BetaLED
  - Lumens: 15,814
  - Watts: 191.3
  - lm/W: 82.7
  - CCT: 4403 K
- Hubbell (Beacon Lighting)
  - Lumens: 2,338
  - Watts: 28.9
  - lm/W: 80.9
  - CCT: 4459 K



BetaLED Edge Area Light



Beacon Genesis

# New and Improved Products



## Wall-mounted Area (Wall Packs)

Improved efficacy and lower CCT, but not as significant as for area/roadway

Total Wall Pack Products = 204

Efficacy	Total Products	Products with CCT < 4500K
> 50 lm/W	160	68
> 60 lm/W	122	60
> 70 lm/W	72	52

## New and Improved Products

### Cooper Lighting

- Lumens: 2,273
- Watts: 31.4
- lm/W: 72.4
- CCT: 3458 K



XTOR Crosstour LED

### Lithonia Lighting

- Lumens: 4,027
- Watts: 47
- lm/W: 86
- CCT: 4000 K



MRW Series

# Parking Lot and Parking Garage Controls



Photos: courtesy of CLTC

# Parking Lot and Parking Garage Controls

Adaptive Lighting

Occupancy Sensor

Bi-level LED

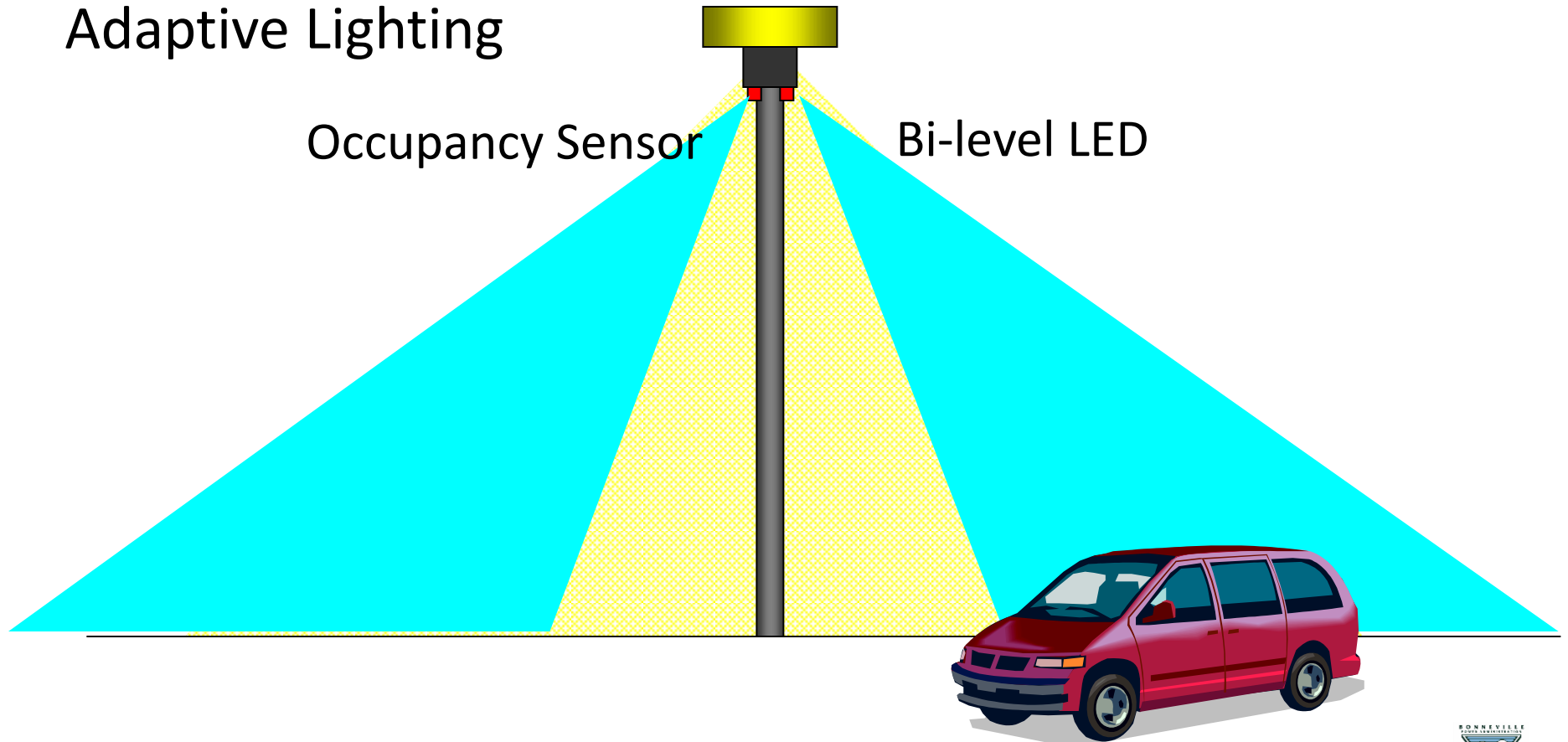


Image: courtesy of CLTC

# Parking Lot and Parking Garage Controls

- Occupancy based, bi-level control
- Potential benefits
  - Reduced energy use
  - Reduced maintenance
  - Enhanced security
- Integrated, commercial products available

# Resources

## Department of Energy Solid-State Lighting

### LED Basics

- Energy Efficiency
- Thermal Management
- Lifetime
- Color Quality
- Basics

### Measurement Series

- SSL Standards
- CRI and LEDs
- Luminaire Efficacy
- Luminaire Reliability

### Application Series

- Recessed Downlights
- Undercabinet
- Portable Desk/Task
- Using LEDs
- Dimming LEDs
- Outdoor Lighting

### GATEWAY Demonstration Reports

### CALiPER Reports





# Resources

## Commercial Building Energy Alliances

- Lighting Performance Specifications
  - LED Site Lighting
    - Projects under way: Home Depot, Walmart  
Lowe's
  - High Efficiency Parking Structure Lighting
    - Projects under way: Westfield, Kohl's,  
others



# Case Studies

## Nike World Headquarters, Beaverton, OR

- DOE GATEWAY Demonstration
- Bi-Level LED Parking Lot Retrofit
- Over 350 fixtures
  - Base case: 200, 250, 400 W Metal Halide
  - Retrofit: BetaLED Edge Area Light with integral occupancy sensor

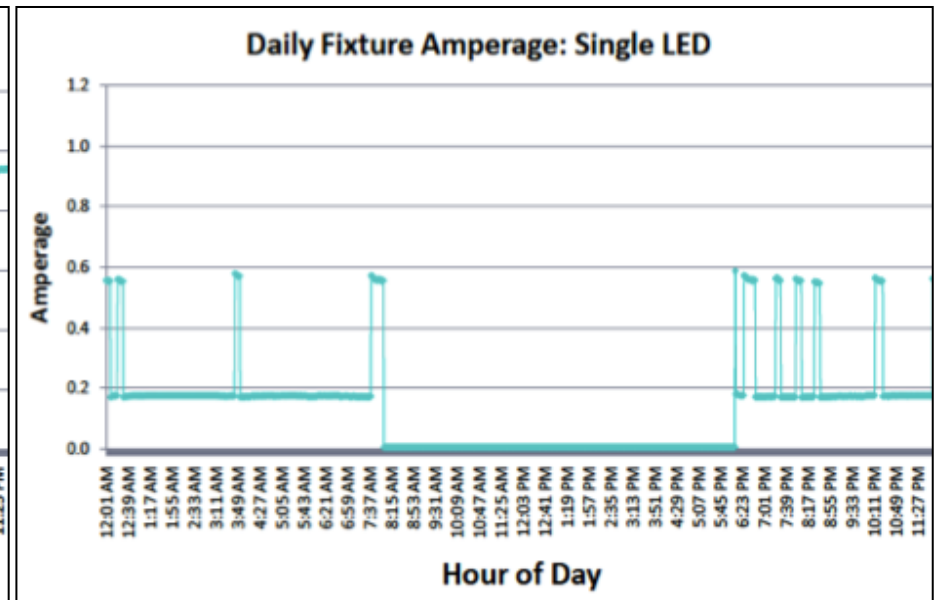
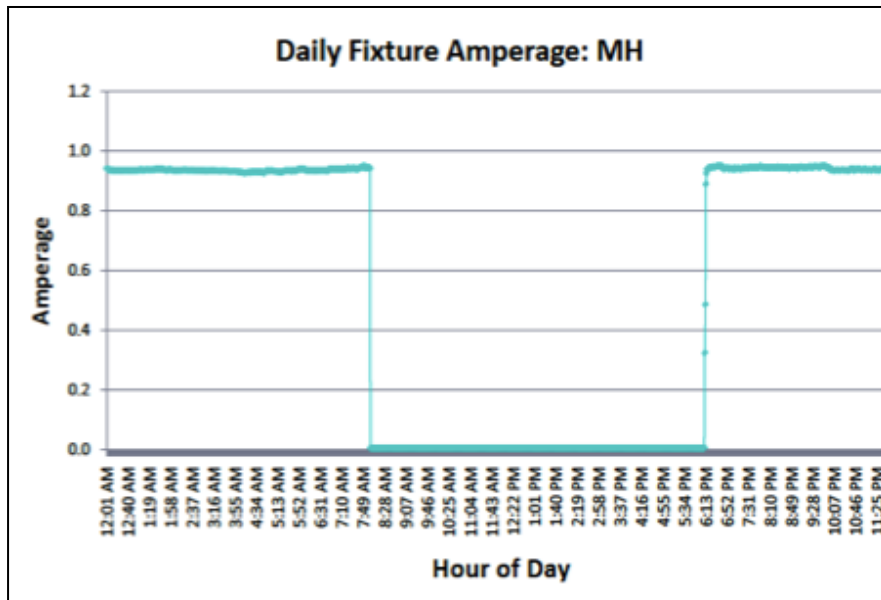


# Nike World Headquarters, Beaverton, OR

- Fixtures installed spring/summer 2009
- Color temperature: 6000K
- CRI: 70
- Bi-level operation
  - Low: 45 W, 4,200 lumens
  - High: 137 W, 9,380 lumens



# Nike World Headquarters, Beaverton, OR



Source: DOE SSL R&D Workshop, February 2011



# Nike World Headquarters, Beaverton, OR

## Measured Power Consumption

Fixture	MH	LED High	LED Low
Power (W)	239	137	45
Savings		102	194
Percent Reduction		<b>43%</b>	<b>81%</b>

# Nike World Headquarters, Beaverton, OR

## Measured Lighting Operation

	MH	LED High	LED Low
Percent Hours	100%	<b>26.2%</b>	<b>73.8%</b>

## Estimated Energy Savings

	MH	LED	Energy Savings	Percent Savings
Energy Use (kWh/year) <sup>1</sup>	1,047	302	745	<b>71%</b>

<sup>1</sup> Assuming 4,380 hours/year

# Nike World Headquarters, Beaverton, OR

## Interesting Findings

Variability in factory-set occupancy sensor delay time off

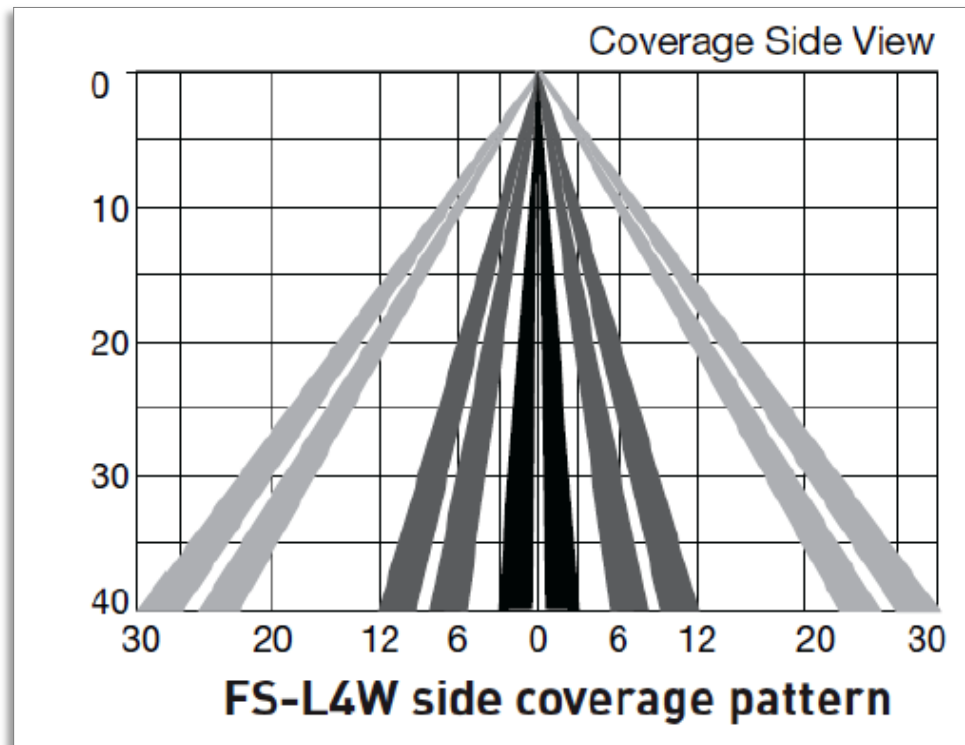
Fixture Number	Delay Luminaire 1	Delay Luminaire 2
12-1	15 minute	
12-2	30 minute	
12-3	10 minute	
10-1	15 minute	30 second
10-2	30 seconds	30 seconds
10-3	10 minute	10 minute
10-4	10 minute	10 minute

Source: DOE SSL R&D Workshop, February 2011

# Nike World Headquarters, Beaverton, OR

## Interesting Findings

Matching coverage pattern to pole spacing





# Nike World Headquarters, Beaverton, OR

## Interesting Findings

Application specifics - wind and trees



Source: DOE SSL R&D Workshop, February 2011

# Nike World Headquarters, Beaverton, OR

## Summary

- Great application for this technology
- Satisfied customer
- Significant energy savings
- Considerations
  - Installation environment
  - Appropriate sensor technology
  - Appropriate sensor settings
  - System maintenance

# T.J. Maxx, Manchester, NH

- Bi-Level LED parking lot retrofit
- Base Case: 22, 400 W HPS and 6, 400W MH
- Retrofit:
  - 25 BetaLED Edge Area Light with integral occupancy sensor
  - 235 W on high setting<sup>1</sup>
  - 78 W on low setting<sup>1</sup>

<sup>1</sup> Per manufacturer's cut sheet



# T.J. Maxx, Manchester, NH

## Measured Power Consumption

Fixture	Avg HPS/MH	LED High	LED Low
Power (W)	490	234	118 <sup>1</sup>
Savings		256	372
Percent Reduction		<b>52%</b>	<b>76%</b>

<sup>1</sup> Note measured value differs from manufacturer's cut sheet

# T.J. Maxx, Manchester, NH

## Lighting Performance

Fixture	Avg Illum (fc)	Min Illum (fc)	Avg to Min
Existing	3.81	0.60	6.34:1
LED High	2.03	1.03	1.97:1
LED Low	0.94	0.48	1.96:1

Meets the “basic” minimum horizontal illuminance of 0.2 footcandle (fc) recommended by the IESNA RP-20-98, Lighting for Parking Lots

# T.J. Maxx, Manchester, NH



**Base Case**



**Retrofit with LED, High Power**

Source: DOE Gateway Demonstration

# T.J. Maxx, Manchester, NH

## Economic Performance

Retrofit Scenario	Equipment Cost (\$)	Maintenance Cost (\$)	Annual Energy Cost (\$/yr)	Total Savings (\$/yr)	Payback (yr)
Existing	\$0	\$11,000	\$8,097	\$0	NA
Bi-Level LED	\$47,125	\$1,250	\$2,591	\$15,256	~3.1

Source: DOE Gateway Demonstration



# Walmart – New Construction

## LED Parking Lot Installation

Item	Current LED Design
Fixtures	74
Pole Height	42 ft
# of Poles	30

Comparison	Energy Savings	Simple Payback @ \$0.056 / kWh	Simple Payback @ \$0.1022 / kWh*
LED vs. 1,000-W PMH	71%	4.6 years	2.7 years
LED vs. 400-W PMH	56%	2.7 years	1.9 years

\* The average national electricity rate of \$0.1022/kWh provides a comparison for other sites.



# BPA Incentives - Current

- LED Outdoor Lighting Incentives included in calculator, V2.3. Can be downloaded here:  
<http://www.bpa.gov/energy/n/projects/lighting/>
- Effective April 2012

Application	Program Requirements			
Exterior General Lighting	Min Wattage Savings	QPL Req'd	Measure Number	Incentive
Wall Packs, Parking Lot, Bollards, Sconces	≥ 50 %	Yes	F21	\$50
Other one-time w pre-approval	Measures not otherwise listed. One time deemed incentive for pre-approved measures.		M	varies

# BPA Incentives - Future

- LED Outdoor Lighting Incentives will be expanded
- Incentive amounts TBD
- Effective January 2013

Application	Program Requirements			
Exterior General Lighting	Min lm/W	Min Wattage Savings	QPL Req'd	Measure Number
Includes: Parking lot, Street, Wall Packs, Bollards, Floods, Barn / Yard, Pole Lamps	≥ 65 l/w	≥ 50 %	Yes	F4 – F8

# Questions?

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- John Wilson, BPA  
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[lighting@bpa.gov](mailto:lighting@bpa.gov)

# Next Webinar

## Emerging Technologies Showcase

- Image Processing Occupancy Sensors (IPOS)
- Wednesday, September 19, 2012
- 12:00 noon to 1:00 p.m. Pacific time

More information about emerging technologies:

E3T database: [www.E3Tnw.org](http://www.E3Tnw.org)

E3T Program: [www.bpa.gov/energy/n/emerging\\_technology/](http://www.bpa.gov/energy/n/emerging_technology/)

Conduit: [www.ConduitNW.org](http://www.ConduitNW.org)