



QUESTLINE

We Make Energy Engaging

Lighting Innovation Hits the Street Area and Street Lighting

Questline Academy



Meet Your Panelist

Mike Carter



Justin Kale



ENLIGHTEN



EDUCATE



ENGAGE

Agenda

- Outdoor Lighting Rocks!
- Organizations
- Standards
- Hot Topics
- Products
- Case Studies



Source: FEMP

Outdoor Lighting Rocks!

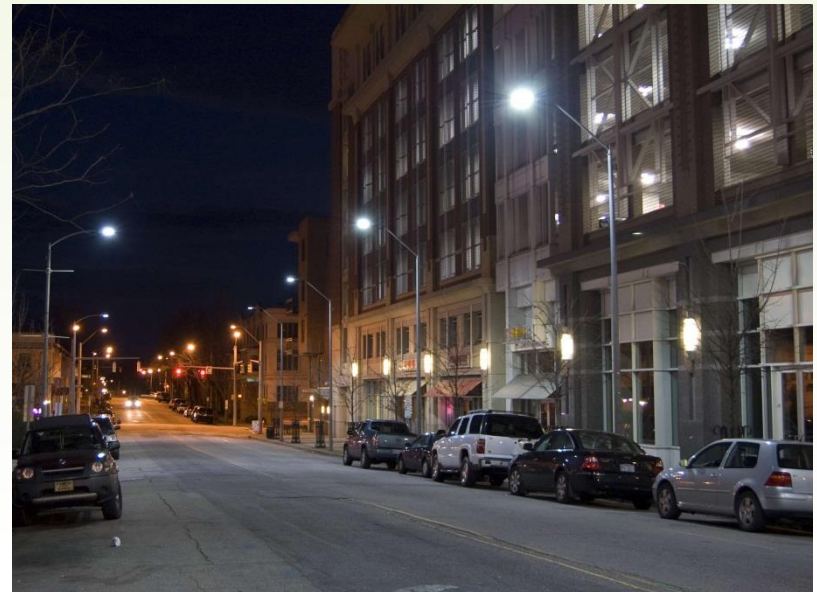
1. Safety

- Better light distribution
- Better light quality to identify colors



Before (HPS)

Source: Progress Energy



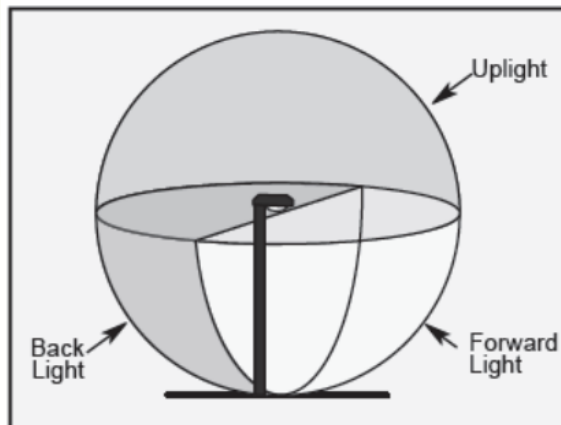
After (LED)

Source IES

Outdoor Lighting Rocks!

2. Green

- Well-designed outdoor lighting minimizes light pollution.
 - Sky glow, light trespass and glare
 - Dark-Sky Initiative
 - IDA/IESNA Model Lighting Ordinance (MLO)
 - BUG ratings (TM-15-11)
 - LEED v4
 - ASHRAE 189.1



Source IES



Source: IDA



Source: Clanton & Associates, Inc

Outdoor Lighting Rocks!

3. Aesthetics

- Customer appeal
- Brand image improvement
- Enhances architecture and foliage
- Brightest not always the best



Outdoor Lighting Rocks!

4. Productivity

- Enable tasks to be done outdoors after hours

5. Code compliance

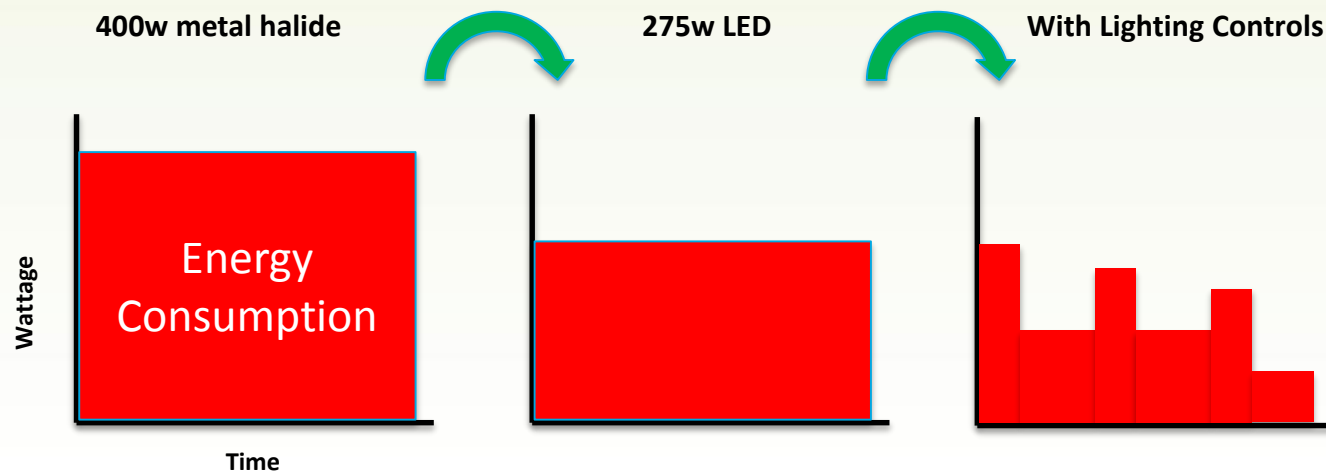
- IESNA minimum foot-candle requirements for outdoor lighting

Recommended Illuminance Targets (25-65 age group)		
Category	Vertical Candela	Horizontal Candela
Facades – High Activity		
LZ4 High	20	--
LZ3 Medium	15	--
Car Sales Lot – High Activity		
LZ4 High	30	30
LZ3 Medium	20	20

Outdoor Lighting Rocks!

6. More efficient fixtures

- Energy saving lighting controls
 - Timers, photosensors, and motion sensors



Outdoor Lighting Rocks!

7. Reliability

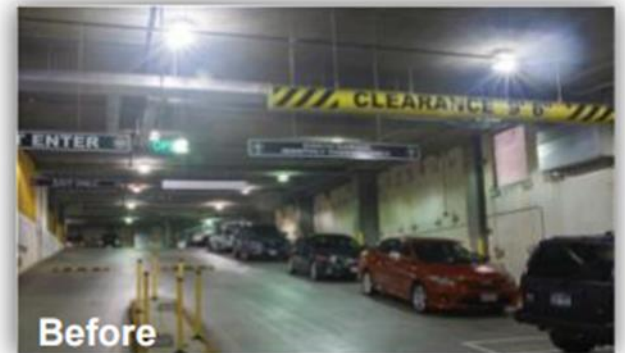
- New lighting has less downtime

8. Free publicity

- Advanced LED lighting is newsworthy
- Should receive recognition from the press



Source Architectural Area Lighting



Source: FEMP

Outdoor Lighting Rocks!

- Adoption of LEDs as of 2014

Outdoor Application	Installed Penetration (%)	Units Installed (Millions)
Area/Roadway	12.7	5.7
Parking Lot	9.7	2.8
Parking Garage	5.0	1.8
Building Exterior	11.5	7.6
Total Outdoor	10.1	8.3

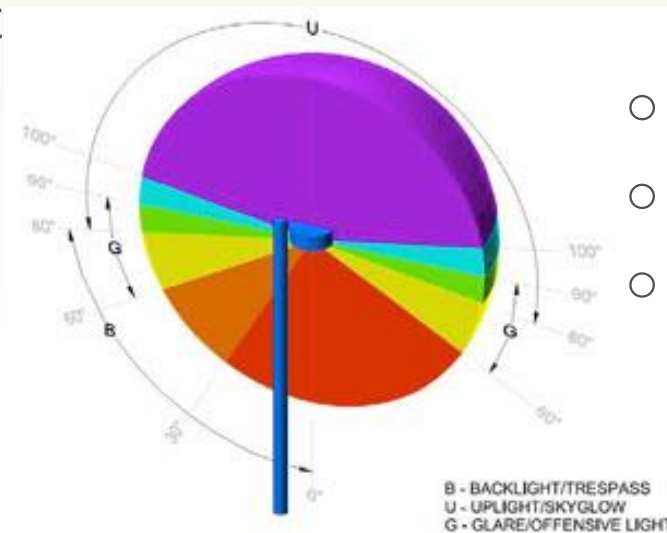
Source: DOE, Adoption of Light-Emitting Diodes (2014)

- DOE MSSLC Survey 2013
 - 62% of indicated some use of LEDs
 - 36% indicated ongoing use of mercury vapor (MV) lights!
 - The average age of all of the luminaires was 15.3 years
 - The average reported annual costs per light
 - \$96 in electricity
 - \$72 in operations and maintenance

Outdoor Lighting Design

- The challenge of good lighting design

- Lamp type
- Light output
- Light quality
 - Color Rendering Index (CRI)
 - Correlated Color Temperature (CCT)
- Fixture height
- Aesthetics
 - Accenting
 - Shadowing
 - Silhouetting
- Facade setback
- Safety
- Energy consumption
 - Lighting controls
 - Sensors
 - Timers
- Light pollution
- Biological impact
- Electrical



Source: <http://safety.fhwa.dot.gov>

Poll Question

- Which ONE of the following attributes of outdoor lighting is the highest priority for your customers?
 - a) Aesthetics
 - b) Energy consumption
 - c) Light trespass
 - d) Reliability
 - e) Safety
 - f) Other

Organizations

- Lighting Energy Efficiency in Parking (LEEP) Campaign

Case Studies

Specifications

Technical Assistance (limited)

M&V guidance

Take the LEEP - An Introduction to the Lighting Energy Efficiency in Parking Campaign

Lighting Project Evaluator

The Lighting Project Evaluator allows you to estimate the energy savings of a new lighting system against a specified energy code. This tool can also compare proposed lighting upgrades to your existing conditions.

The tool can also determine your eligibility in receiving the 1750 Tax Deduction. Just sign in and create an Energy Estimate to get instant feedback.

Log in:

Energy Estimator to compare against code

Parking Garage	Utility	State	Technology	Product	Incentive Amount
Alliant Energy	IA	LED	Fixture		\$20
Alliant Energy	IA	Controls	Occupancy Sensor		\$20
Parking Garage / Parking Lot / Property					

List of utility incentives

Design Vignettes

LED lighting facts
A Program of the U.S. DOE

Organizations

- Lighting Energy Efficiency in Parking (LEEP) Campaign
 - Six categories

Efficiency Requirements for Federal Purchases	
Category	LER*
Fuel pump canopy luminaires	70
Parking garage luminaires	70
Outdoor pole/arm-mounted area and roadway luminaires	65
Outdoor pole/arm-mounted decorative luminaires	65
Outdoor wall-mounted luminaires	60
Bollards	25
*Luminaire Efficacy Rating in lumens per watt	

Organizations

- DOE [Municipal Solid-State Street Lighting Consortium](#)

- Specifications

- Networked Outdoor Lighting Control Systems
 - LED Roadway Luminaires
 - BBA* High-Efficiency Parking Structure Lighting Specification
 - BBA LED Site (Parking Lot) Lighting Specification

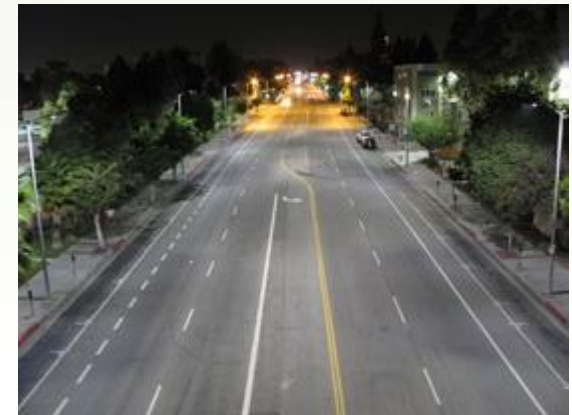


- Financial guidance

- Full life cycle cost/benefit analysis (LCCBA)
 - Retrofit Financial Analysis Tool
 - Financing options

- Demonstrations

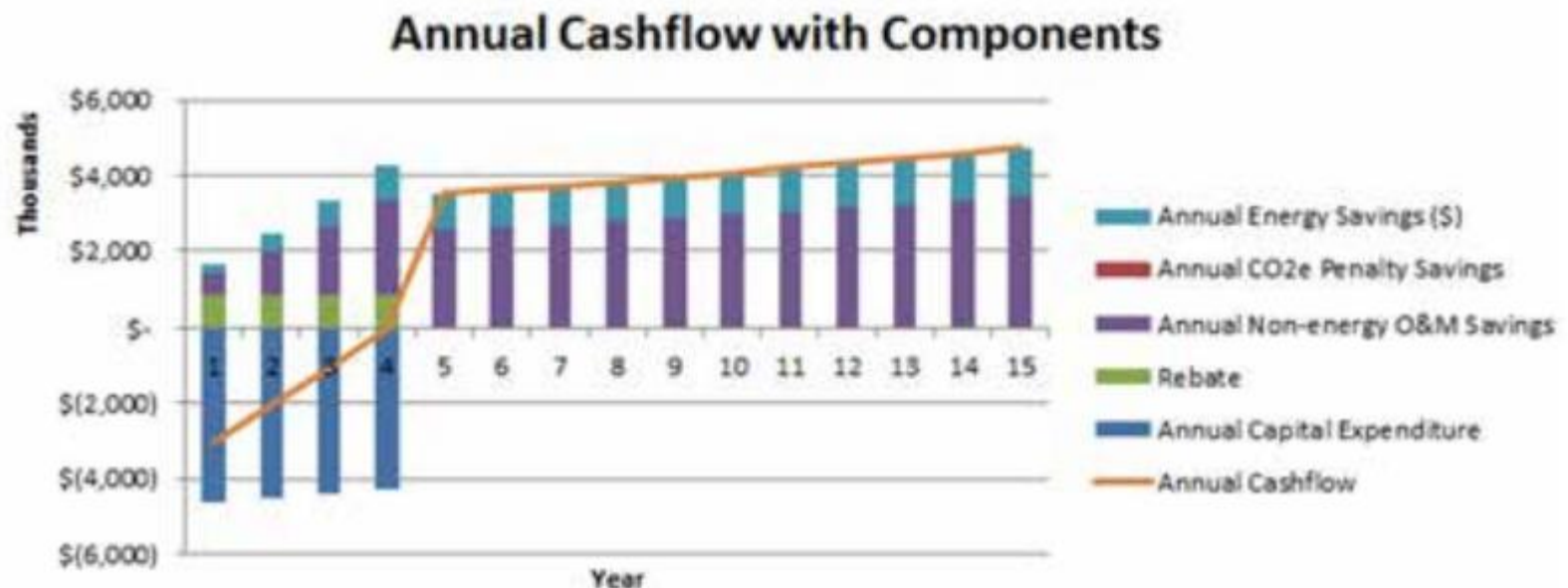
- GATEWAY demonstration reports (10)
 - Webinars
 - CALiPER testing reports



*Better Buildings Alliance

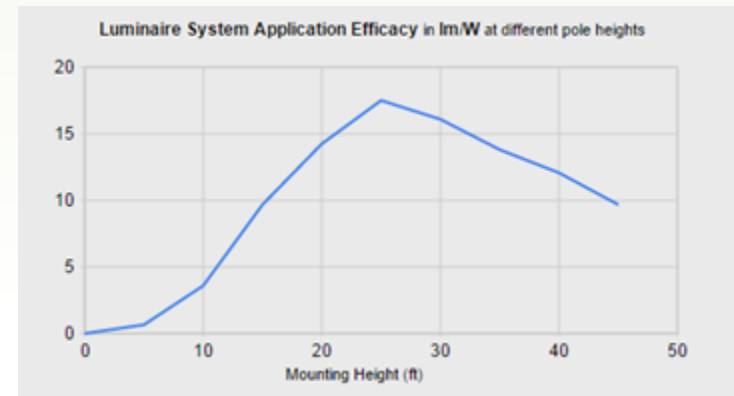
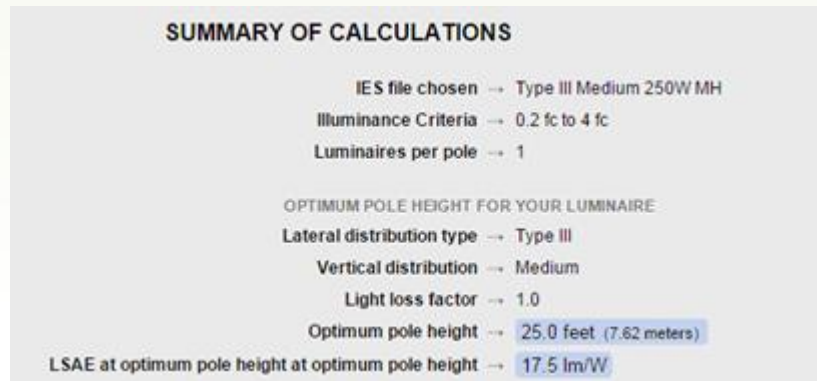
Organizations

- DOE Municipal Solid-State Street Lighting Consortium
 - [Lighting Retrofit Financial Analysis Tool](#)
 - Annual energy and energy-cost savings
 - Annual maintenance savings
 - Annual greenhouse gas reductions
 - Net present value, internal rate of return, simple payback



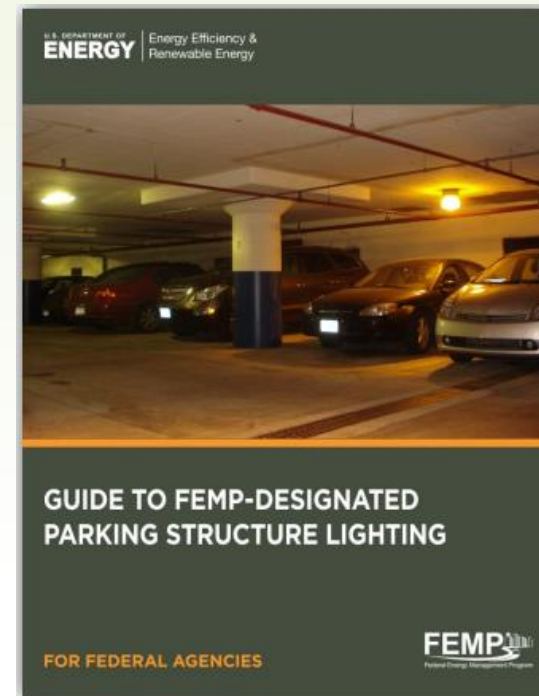
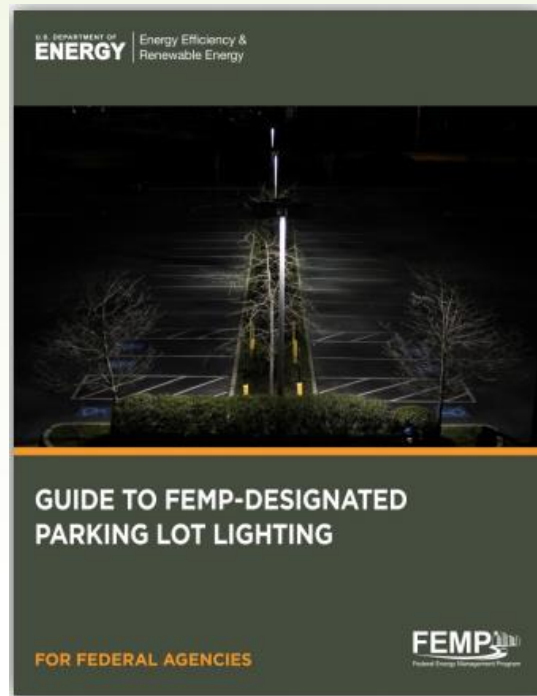
Organizations

- [Lighting Research Center](#) at RPI
 - ASSIST: Alliance for Solid-State Illumination Systems and Technologies
 - [Parking lot luminaire calculator](#)
 - The Outdoor Lighting Institute
 - October 27-28, 2015



Organizations

- [Federal Energy Management Program \(FEMP\)](#)
 - Average 0.56 kWh/sf for parking lots
 - Average 1.37 kWh/sf for parking garages

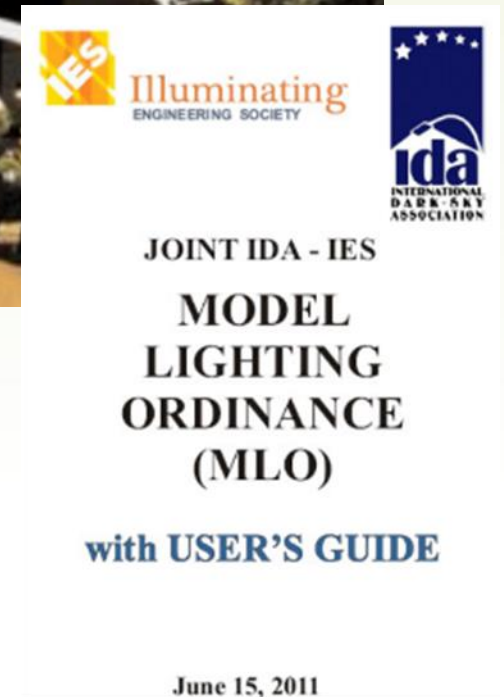
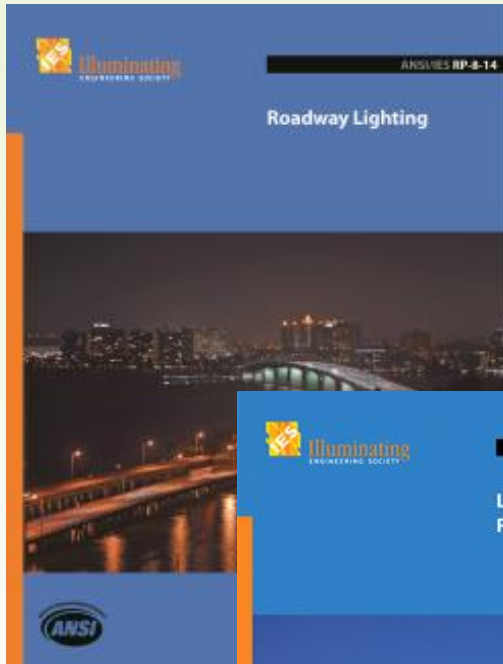


Organizations

- DOE Better Buildings [Outdoor Lighting Accelerator](#)
 - Goal of replacing 1,500,000 outdoor lighting poles
 - Fifteen charter partners
 - Develop an outdoor lighting roadmap
 - Must incorporate a system-wide analysis
 - Replacing a significant portion of the city's outdoor lighting
 - Share results and lessons learned
 - Identify a key barrier
 - DOE provides
 - Technical assistance
 - Recognition
 - Financing guidance

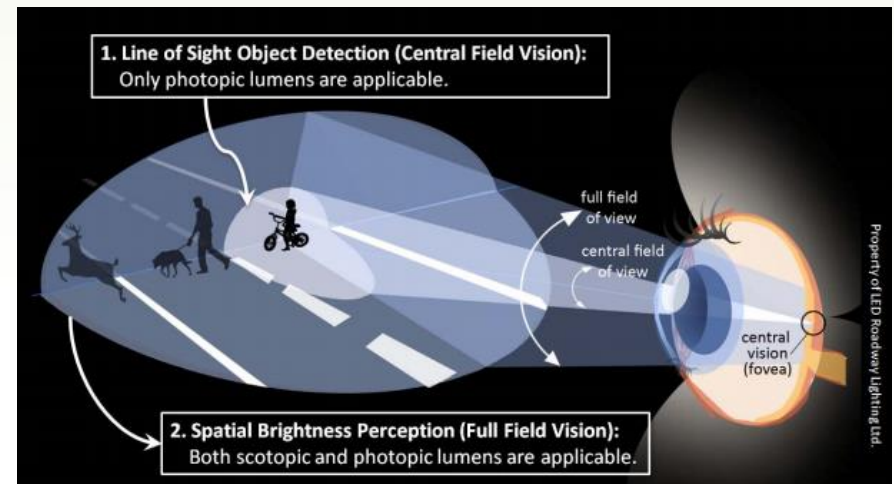


Standards



Standards

- [Recommended Practice for Roadway Lighting](#), RP-8-14
 - Design considerations
 - Glare and light pollution (skyglow)
 - Aging drivers
 - Veiling luminance ratio or disability glare (maximum 1.7 at age 65)
 - Spectral considerations (mesopic factors)
 - Visibility at low light levels
 - Restricted to off-road (walkways and bikeways) applications
 - Intersections
 - High mast lighting
 - Crosswalks



Source: LED Roadway Lighting, Ltd,

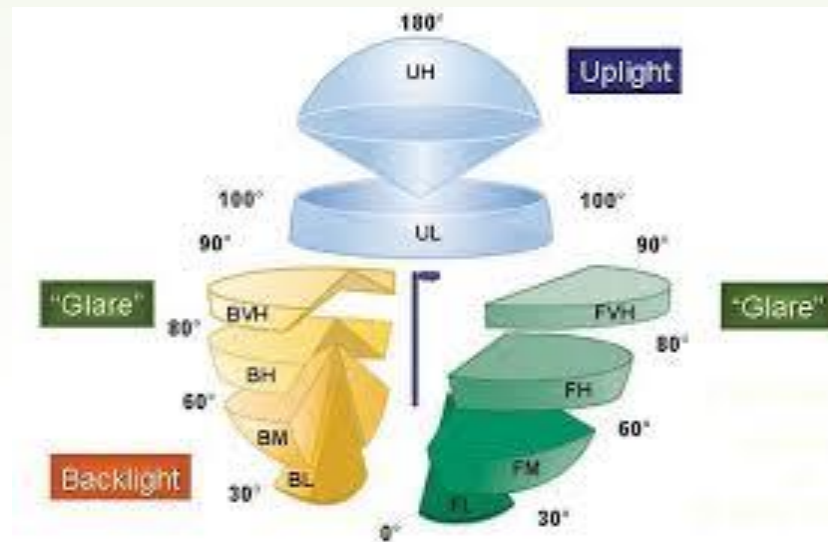
Standards

- Recommended Practice for Roadway Lighting, RP-8-14
 - Illuminance method
 - Amount of light incident on roadway surface
 - Luminance method (straight roadway sections)
 - Amount of light reflected from the pavement in the direction of the driver
 - Adaptive lighting*
 - Adjusted as time of day use changes
 - Pedestrian volumes (50% for “Low” volume)
 - Vehicle volumes
 - Underpasses and overpasses*
 - Railroad grade crossings*
 - Roundabouts*
 - Toll plazas (four distinct areas)*

*New additions

Standards

- Recommended Practice for Roadway Lighting, RP-8-14
 - IES TM-15-11 Luminaire Classification System (LCS) for Outdoor Luminaires
 - Replaces cutoff classification
 - Focus now is on zonal lumens, not angles
 - Distribution of light within three primary solid angles



Standards

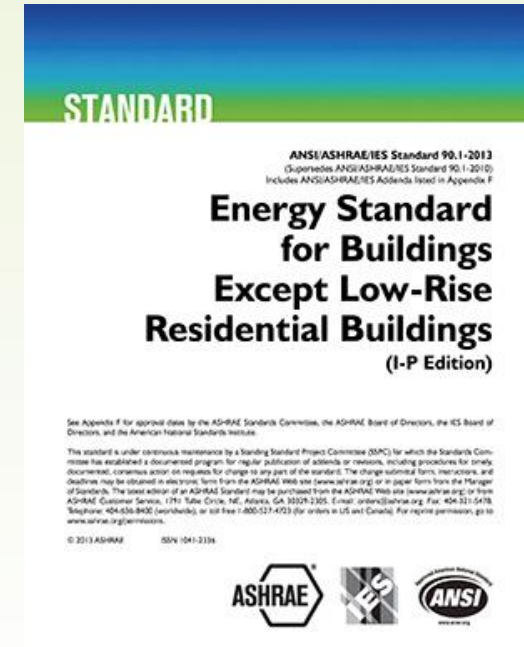
- DOE Rulemakings
 - Energy Conservation Program (ECP) for Metal Halide Lamp Fixtures; Final Rule 2014
 - Effective February 10, 2017
 - New fixtures only
 - HID **lamps** not being considered
 - Improved **ballast** efficiencies and wider coverage
 - Probe-start banned
 - Few exemptions
 - Regulated lag ballasts
 - Electronic ballasts at 480V
 - High-frequency electronic ballasts

Ballast Type	Watts	Minimum Efficiency	
		2009 EISA*	2014 Final Rule
Pulse-start	150	88%	82%
	500	88%	91%
	1000	N/A	94%

*Energy Independence and Security Act

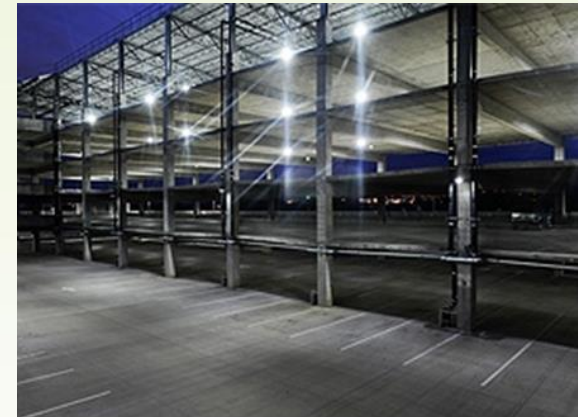
Standards

- ASHRAE/IES 90.1-2013 & IECC 2015
 - Permanently installed outdoor lighting
 - Must be controlled by a photocontrol or astronomical time switch
 - Turns off the lighting during daylight hours
 - Façade and landscape lighting turned off:
 - Between midnight and 6 a.m.,
or
 - In conjunction with business opening and closing times
 - Other outdoor lighting (advertising signage) must operate:
 - Same as façade lighting
or
 - When no activity has been detected for 15 minutes



Standards

- ASHRAE/IES 90.1-2013
 - 9.4.1.2 Parking Garage Lighting Control
 - a) Parking garage lighting shall have automatic **Full OFF** lighting controls.
 - b) Lighting power of each luminaire shall be **automatically reduced** by a minimum of 30% when there is no activity detected within a lighting zone for 20 minutes.
 - 1) Lighting zones for this requirement shall be no larger than 3600 ft².
 - c) Lighting for covered vehicle entrances and exits from buildings and parking structures
 - 1) Shall be **separately controlled** by a device
 - 2) Shall automatically reduce the lighting by at least 50% from sunset to sunrise
 - d) Light from luminaires on perimeter walls with daylighting potential shall automatically be reduced **in response to daylight**.



Source: DOE EERE

Poll Question

- Which of the following organizations is NOT a resource for outdoor lighting?
 - a) BOMA LEEP
 - b) DOE Better Buildings OLA
 - c) YMCA
 - d) DOE MSSLC
 - e) LRC ASSIST

Standards

- California Title 24-2013
 - All installed outdoor lighting must be **controlled for daylighting** by a photo-control or outdoor astronomical time switch.
 - Automatic lighting control required for all outdoor **sales area** lighting.
 - Also includes building facade, ornamental hardscape and outdoor dining lighting
 - Exterior lighting mounted below 24 feet must have motion sensors.
 - Parking garages power density reduced from 0.2 to 0.14 w/ft² max., with more allowed for ramps.
 - Backlight/Uplight/Glare (BUG) ratings for >150 watt lamps
 - Title 24 requirements triggered when:
 - ≥10% of luminaires are altered
 - ≥ 40 luminaire modifications-in-place

Hot Topics

- Mogul Base LED Lamp Performance

- The Lighting Research Center, RPI
- Market characterization for mogul base socket lamps
 - Exterior HID lighting: roadways (30% of sockets), parking lots (20%), building exterior (14%)
 - Mostly metal halide
- LED market survey
 - Relatively low power lamps
 - Averaged 54 W across all products, with a few products over 100 W
 - Roughly 30% of the average price of integral LED luminaires
- Mogul base LED lamp retrofit test results
 - 57% of the area light and roadway lamps met DLC* criteria
 - Less than 30% of the tested lamps met the DLC efficacy criteria



*Design Lights Consortium

Hot Topics

- The impact of dirt on LED luminaires
 - Light loss factor typically assumed to be 0.70.
 - Includes lumen depreciation and dirt depreciation.
 - Pacific Northwest National Laboratory
 - Long-term testing results for the 2008 installation of LED luminaires at the I-35 West Bridge in Minneapolis
 - Luminaire dirt depreciation (LDD)
 - 4% after ~5000 hours
 - 12% after ~20,300 hours (4.5 years)
 - University of Illinois at Urbana-Champaign
 - Cooper/Eaton claims 0.90 LDD
 - GE Lighting suggests 0.95 LDD
 - Michigan DOT uses 0.90 LDD
 - Indiana DOT uses 0.87 LDD
 - Virginia Tech Transportation Institute (VTTI)



Hot Topics

- Lighting Controls

- Time based

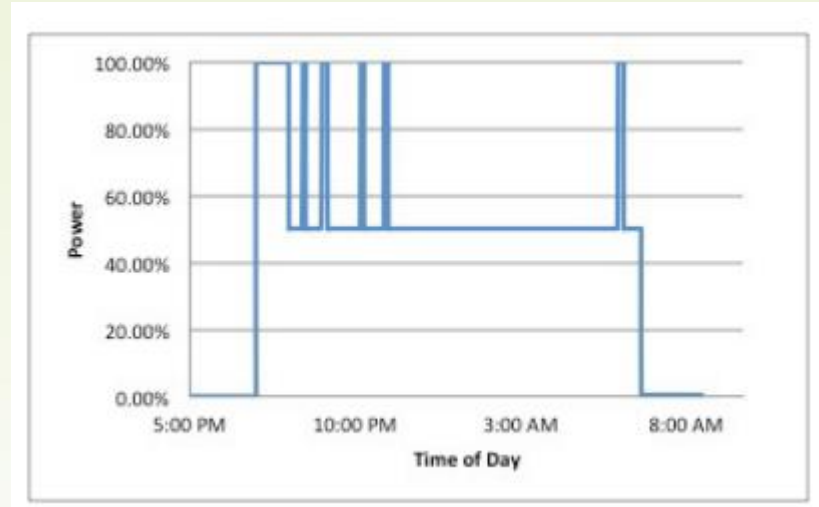
- On (@ night) / off (@ day)
 - On/off in middle of night and on in early morning

- Daylight based

- Basic on/off based on photocell
 - Sometimes the sensor fails and leads to day burners.

- Motion based

- Infrared
 - Image-based/video
 - Bluetooth ground sensor



Source: FEMP

Hot Topics

- Recycle & Reuse - HID, LED Fixtures
 - EPA considers lamps universal waste (not hazardous waste)
 - Fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps
 - However, 12 states in the US have mandatory landfill and incinerator bans for mercury-containing lamps
 - Commercial lamp recyclers
 - NEMA lamprecycle.org
 - [Association of Lighting and Mercury Recyclers](#)

LED Sports Field Lighting

KMW GigaTera SUFA

- 84,000 lumens at 800 watts (105 Lumens Per Watt)
- 70 to 80 Color Rendering Index (CRI)
- 50,000 hours life



Source: KMW GigaTera SUFA

Optogan Group (Germany)

- Eight-head Dynamic Sportfield Floodlight (DSF) system
- 187,000 lumens at 1,700 W (110 LPW)
- 5200 CCT; 75 CRI
- Wireless control



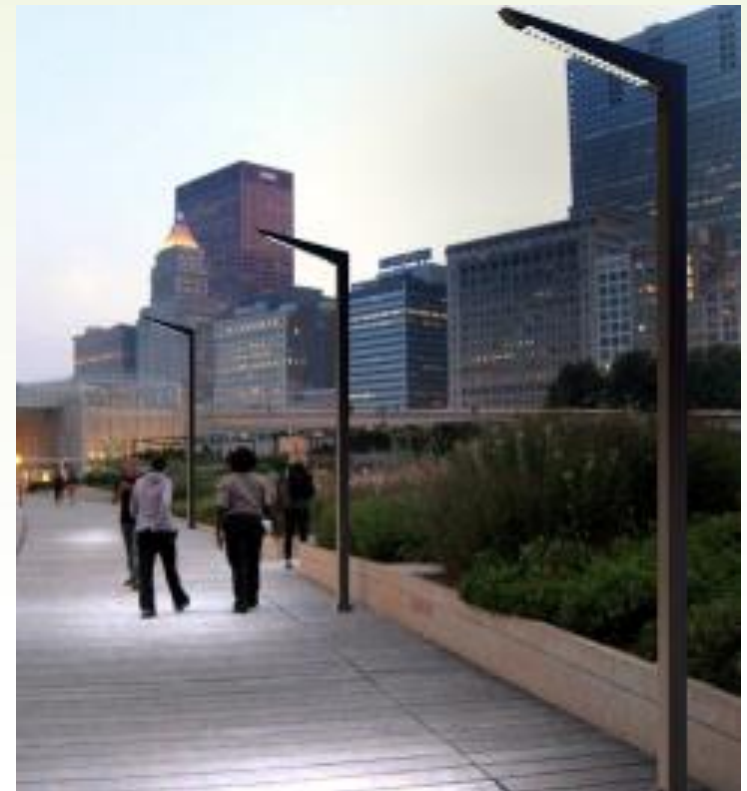
Source: Optogan Group

Parking and Area Lighting

- Color rendering and uniformity for LEDs are better than HPS
 - Minimum illuminance levels equal to HPS (perceived as better)
 - LEDs are *Dark Skies* compliant



LED (left) vs HPS (right)
Source: Beta Lighting & EERE



Source: Architectural Area Lighting

Parking Garage Lighting



Before (HPS)

Source: Progress Energy



After (LED)

Type	Watts	Lumens	LPW	CCT* (K)	CRI
LED	86	6,765	79	6,000	75
HPS	120	11,400	95	2,042	21

*Color Correlated Temperature



Used with permission of Cree, Inc.

Street Lighting

- WattStopper BULIT® Wireless Control Node
 - Adds on/off and 0-10 volt dimming control without rewiring
 - Wireless self-healing IP control network
 - Real-time energy monitoring data
- HiLumz AC LED Retrofit
 - Up to 13,000 lumens
 - 30 to 390 watts
 - AC means no driver



Source: WattStopper BULIT®



Source: HiLumz USA AC LED Retrofit

Enabling Smart Cities

- GE Lighting for Smart Cities
 - LED Evolve™ lighting fixtures
 - LightGrid™ outdoor wireless
 - Cameras
 - Predix™ software



Case Studies

- Miami Lights: Streetlight Control Network
 - FPL has 500,000 street lights across 35 counties
 - Deploying IPv6 (open standard) mesh networking control
 - 75,000 street lights in Miami-Dade County
 - Improve street light restoration response times
 - Significant energy savings
 - Decrease maintenance costs
 - Lamp failure detection
 - Longer life
 - Multi-layer security
 - Networking adds 20% extra cost but 30% extra benefits



Source: Philips Lighting

Case Studies

- New Bedford, MA
 - Population 95,000 (20 square miles)
 - \$7 million annual municipal electricity budget
 - 10,000 streetlights upgraded to LED
 - 65% less energy
 - Investment
 - \$4.2 million projected total cost
 - \$1.2 million projected NSTAR rebate:
 - \$3.0 million paid by city (over 8-9 years)
 - Projected annual savings
 - \$450,000 electricity
 - + \$100,000 maintenance
 - \$550,000 total



Source: Los Angeles Bureau of Street Lighting

Case Studies

- Safeco Field - LED Sports Lighting
 - Seattle Mariners are first MLB team to illuminate field with LEDs
 - 578 LED fixtures replaced metal halides
 - GigaTera SUFA LEDs
 - 800 watts each
 - 81 CRI
 - 60% energy savings
 - Expected 50 year life
 - MLB staff measured results:
 - Met or exceeded all standards
 - Ultra-slow motion replay without any flicker



Source: Planled

Poll Question

- How valuable has this webinar been to you?
 - a) Not valuable at all.
 - b) Slightly valuable.
 - c) Moderately valuable.
 - d) Very valuable.
 - e) Extremely valuable.

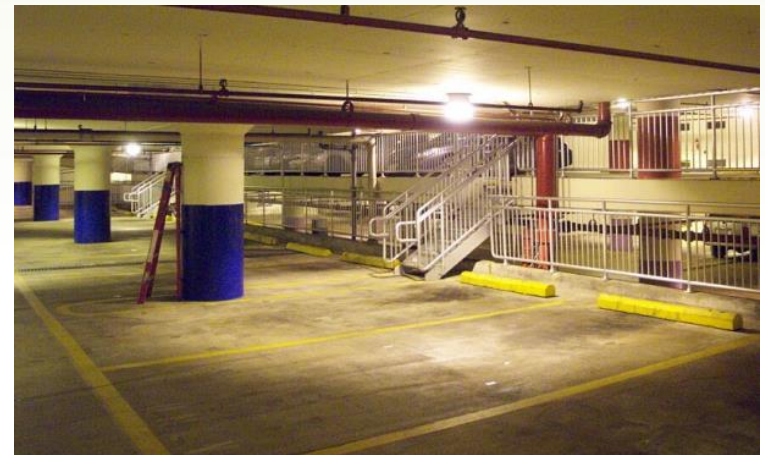
Case Studies

- Yuma Sector Border Patrol Area
 - Six luminaires on three poles
 - Hot environment
 - Sunset temperatures of 101°F to 112°F
 - Average nighttime temperature is 63°F to 68°F.
 - Incumbent lights were 1,000 watt probe-start metal halide lamps outputting 64,400 lumens
 - LED fixtures drew 398 watts and output 31,200 lumens
 - One year results:
 - Horizontal luminance decreased by 18%
 - Vertical luminance decreased by 25%



Case Studies

- U.S. Department of Labor Parking Structure
 - Six-level parking structure
 - 300 luminaires total
 - 24/7 access
 - Incumbent lights were 130 watt high-pressure sodium lamps outputting 7,750 lumens
 - LED fixtures drew 62 watts and output 4,410 lumens
 - Energy savings results:
 - 52% from the straight conversion
 - 88% by using occupancy sensor controls



Case Studies

- Clemson University
 - Street and parking lot lighting and controls
 - Kim Lighting's Altitude replaced 400 watt metal halides.
 - Used Hubbell's wiSCAPE LED controls
 - Programmable and dimmable with any networked device
 - 40% reduction in energy
 - Longer life
 - Uniform light distribution



Source: Hubbell Lighting



QUESTLINE

We Make Energy Engaging

Thank You!

Provided by Questline

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