



**NYSERDA**



# **LED Street Lighting Academy**

**Talking Tech – How LED Street Lights Compare**

**October 8, 2019**

# Introduction

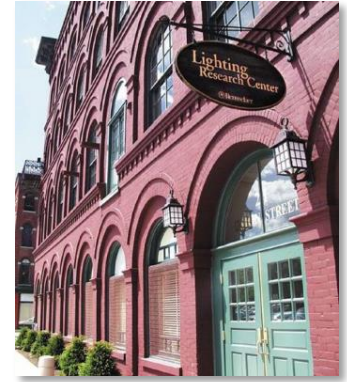
# About the Lighting Research Center

*Advancing the effective use of light  
for society and the environment*



30,000 sq. ft.  
research center  
and laboratory

Established in 1988 by  
the New York State  
Energy Research and  
Development Authority  
(NYSERDA)



40-60 concurrent projects  
in field and lab

~30 full-time faculty and staff

Focus Areas: Energy, Technology  
Development, Human Health,  
Lighting Benefits, Transportation  
and Safety, Product Testing, Plant  
Health, Design



15 graduate students

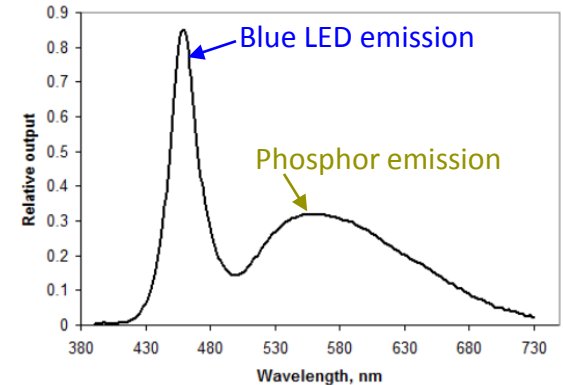
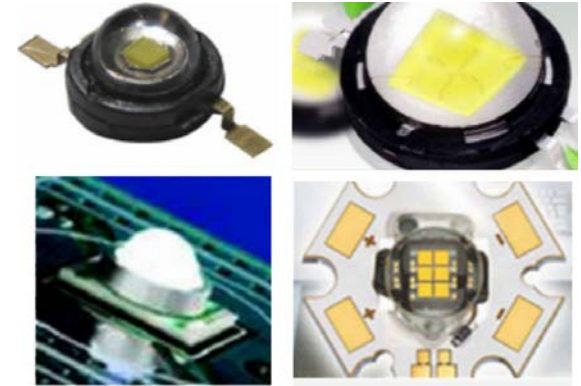
# Outline for Today's Webinar

- What are LEDs and what are their advantages?
- How are LED street lights categorized?
- What LED wattages should replace existing street lights?
- What maintenance issues do LED street lights have?
- What questions should be asked when considering LED street lighting?
- Questions and answers

# What are LEDs?

# Light Emitting Diodes (LEDs)

- LEDs are small, electronic semiconductor sources
- Available in variety of colors
- “White” light is most commonly created by blue LEDs in conjunction with a phosphor that converts some blue light to yellow, resulting in white light
  - Also called phosphor-converted LEDs



# LED Lamp Shapes and Sizes

End users do not typically buy LED chips or packages, but entire lighting systems

- Includes, LEDs, driver, optics and mechanical components

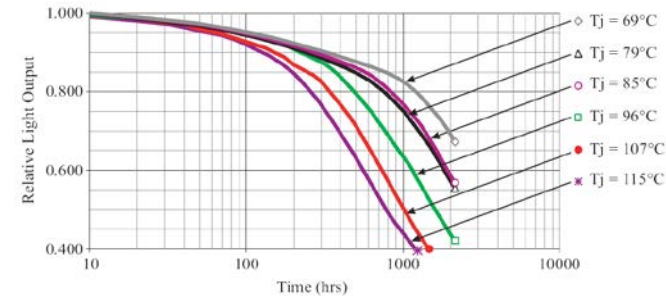
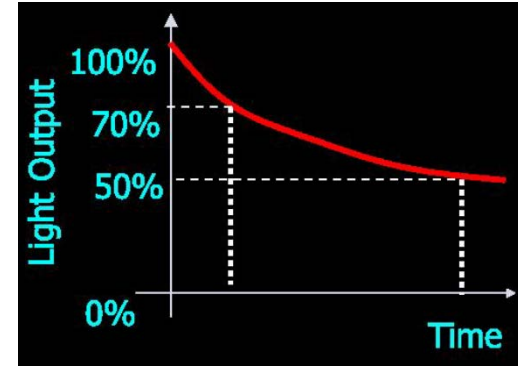
LED mogul screwbase lamps are available for use with existing street light fixtures

- May result in heat build-up
- Usually does not provide a compatible distribution of light



# LED Life

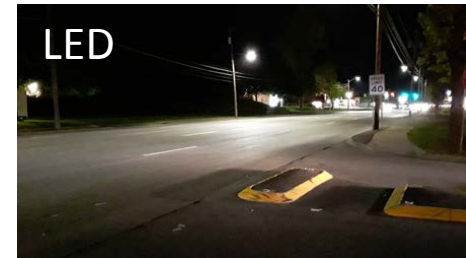
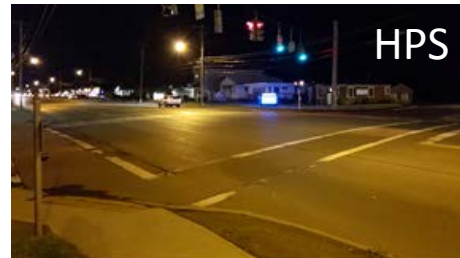
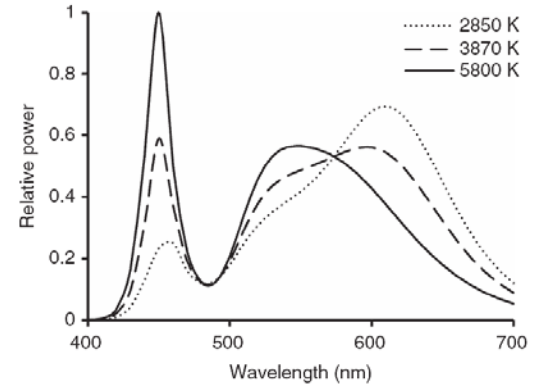
- LED life ratings range from 30,000 to 85,000+ hours
  - 7-10 years of operation for street lighting
- LEDs do not typically “burn out” but exhibit lumen depreciation over time
  - High temperatures accelerate this
- Life definition does not consider other components of an LED system or luminaire





# LED Color

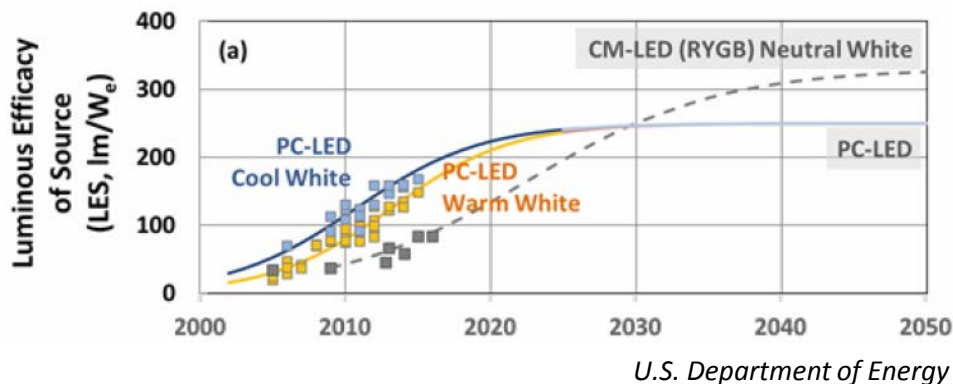
- LED street lighting luminaires are often available in several correlated color temperatures (CCTs) from 2700 to 5000 K
  - In comparison, high pressure sodium (HPS) is around 2100 K and mercury vapor lamps are often approximately 4000-5000 K
- Color rendering is substantially better than under sodium or mercury vapor lamps



# LED Efficacy

Efficacies of LEDs have been continuing to increase steadily for two decades

- Differences between “warm” (<3000 K) and “cool” (>4000 K) white LEDs are shrinking



# LED Light Output and Distribution



- Street lighting luminaires typically produce thousands or ten-thousands of lumens, while typical individual LEDs might produce hundreds of lumens at most
- LED street lights generally contain arrays of LEDs each with reflectors or lenses forming part of the overall distribution
- Higher efficacy can result in longer pole spacing (280 ft versus 220 ft with HPS)
- Many LED street lights have drivers that make them dimmable

# LED: Comparison to Other Light Sources

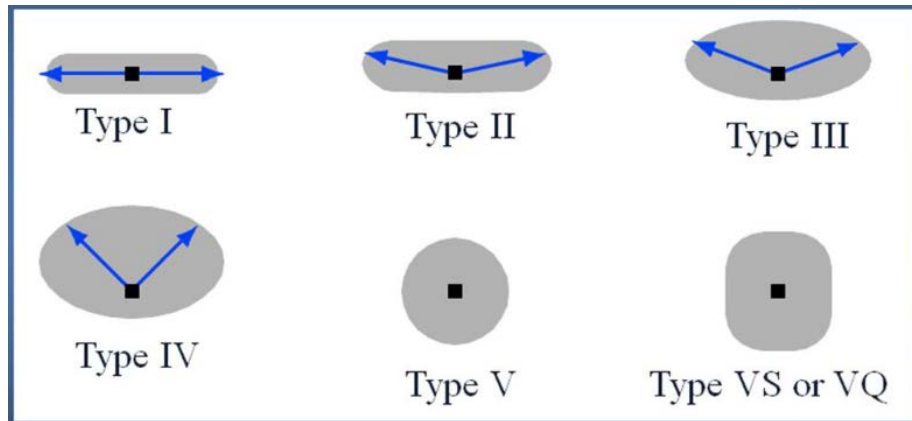
Lamp Type	Life (hours)	Efficacy (lm/W)	CCT	CRI
High Pressure Sodium (HPS)	24,000 – 40,000	64 - 140	1,900 – 2,100	21 – 30
Mercury Vapor (MV)	16,000 – 24,000	25 - 58	3,900 – 5,900	15 – 50
Metal Halide (MH)	5,000 – 40,000	44 - 124	2,900 – 5,000	55 – 95
Low Pressure Sodium (LPS)	18,000	100 - 178	1,700	0
Plasma	3,000 – 50,000	50 - 110	3,200 – 7,650	70 – 95
Induction	60,000 – 100,000	47 - 88	2,700 – 5,000	80
LEDs	25,000 – 100,000	60 - 160	2,900 – 6,500	60 - 90

# Street Light Types

# Luminaire Distribution Categories

## Lateral distribution types

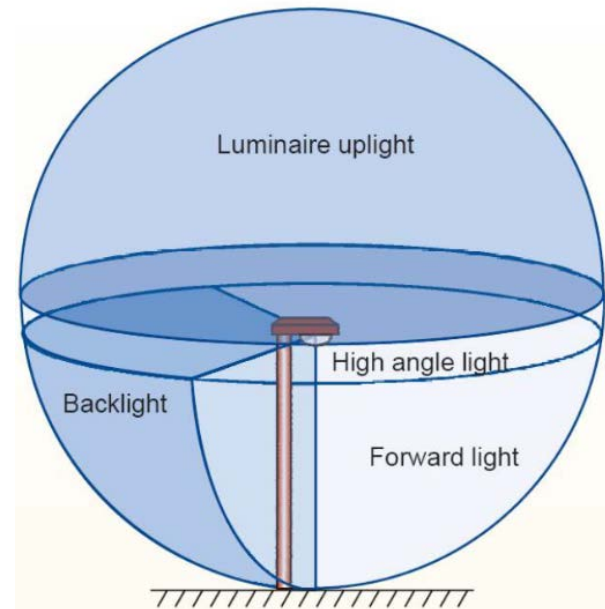
- Denoted by Roman numerals
- As the luminaire type numeral increases, the distribution throws more light “across” the road
- Types I, II, III are more common for street and highway lighting; Types III, IV and V for area lighting



# Luminaire Distribution Categories

“BUG” rating system (IES TM-15)

- Characterizes distribution for negative impacts of light
- B: backlight (behind the luminaire, onto adjacent properties)
- U: uplight (into the sky)
- G: glare (high angle light)



# Luminaire Shapes and Sizes

## “Cobrahead” style

- Functional class for street lighting; now have flat lenses or recessed LED sources
- Usually mounted 20-40 feet above ground



## Post-top luminaires

- Often decorative in appearance; “acorn” or “lantern” shapes are common
- Usually mounted 10-20 feet above ground

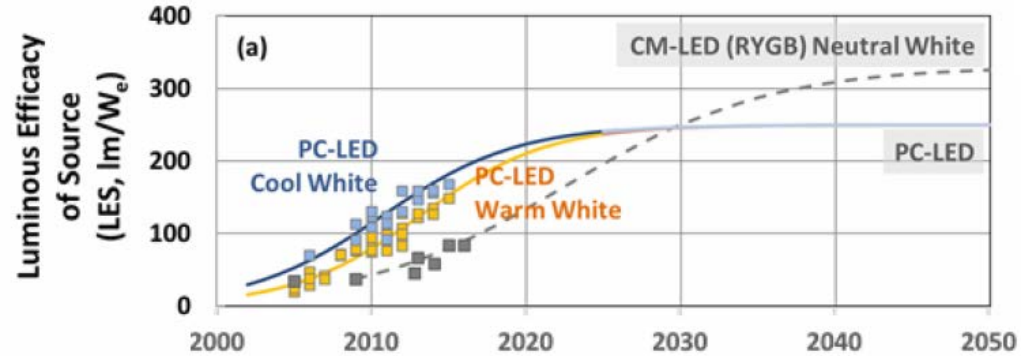




# LED Replacement Wattages

# A Moving Target

- Because LED efficacy is still changing, the correct wattage in 2019 may not be the correct wattage in 2021 or later
- Basing “equivalent” LEDs on lumen output rather than wattage may be more appropriate



# Utility Defined “Equivalent” Street Lights

- Some utilities suggest various lumen / wattage ranges for LED conversions from sodium street lighting
- One example in New York State:
  - 70 W HPS or 100 W HPS: 2001-4000 lumen / 25 W LED
  - 150 W HPS: 4001-8000 lumen / 48 W LED
  - 250 W HPS: 8001-14,000 lumen / 96 W LED
  - 400 W HPS: 20,001-30,000 lumen / 210 W LED

# Basis of “Equivalency”

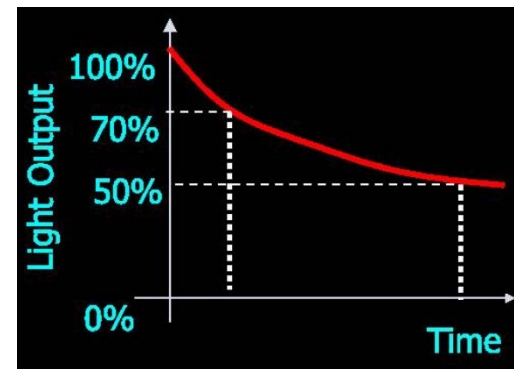
- Based solely on lumens, the “equivalent” LED luminaires may result in lower illuminances along the street
  - 15%-20% lower based on limited analysis
  - Possibly, even lower light levels along sidewalks
- Compared to HPS street lighting, increased brightness perception under white illumination compared to yellowish sodium illumination may offset lower lumens, but not recognized by IES practices



# LED Maintenance Issues

# When is Replacement Needed?

- Many LED street lights have warranty periods of 5 years; some have 10 years
  - Warranty may only cover selected issues
  - Corresponds to ~20,000 to ~44,000 hours of operation
- Failure mechanisms for LEDs differ from conventional street lights
- Not only LEDs but driver or other components can fail



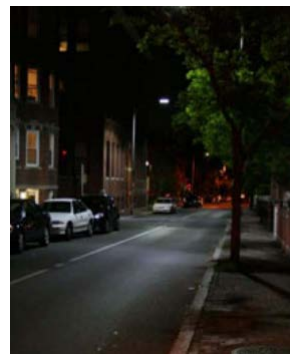
# Lamp versus Luminaire Replacement



- Unlike conventional HPS street lights, most LED street lights have an integral light source
  - A few have replaceable LED modules
  - Usually, the driver could also be replaced
- Generally, the entire luminaire will be replaced when the street light fails

# Equipment for Replacement

- If street lighting is not owned by the utility, the municipality must perform maintenance or hire someone to do it
- Requires appropriate equipment and trained personnel
- In locations with tree belts, trimming is necessary to maintain lighting performance and avoid shadows





# Questions to Ask about LED Street Lights

# What is the Ownership Model?

- Will the municipality or the electric utility own the street lights after conversion to LED?
  - For utility-owned street lighting, overall savings will not match energy savings ( $> 50\%$ ) because the tariff includes purchase, installation, maintenance costs as well as energy
  - For municipal-owned street lighting, the energy bill savings are larger but the municipality must purchase, install and maintain the lighting



# What LED Options are Available?

- Most utilities have a limited selection of LED luminaires available
  - 4-6 lumen / wattage categories
  - One or two CCT options
- New York State may have lists of LED luminaires and volume pricing
- Ask about warranty for municipal-owned street lighting



# What Light Levels Will There Be?



- For retrofit situations, what is the existing light level and uniformity?
- What are these expected to be with the replacement LED street lights? Assumptions?
- Will the lighting conditions meet municipal standards (if any)?
  - Street lighting on utility poles almost never meets IES recommendations
- Will the luminaires illuminate sidewalks or other off-street areas?

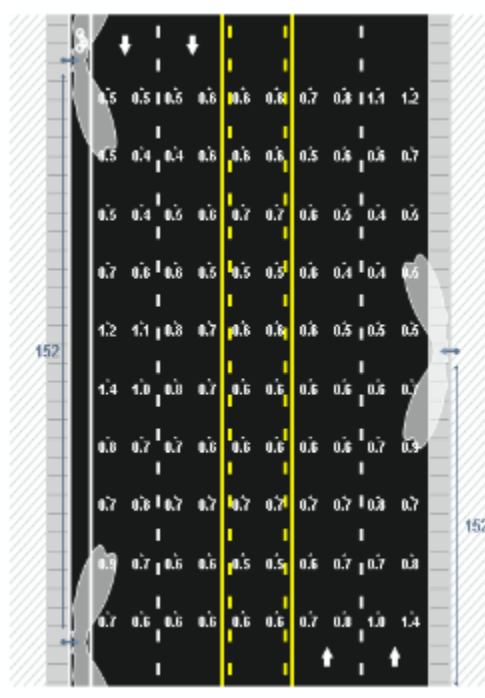
# What Areas Will Be Lighted?

- Recall that some LED street lights efficiently illuminate the road surface
- Sidewalks, driveways or other off-street locations may not be factored into light level analyses



# What Tools are Used to Select LED Options?

- Simple online software tools are available to estimate light levels for specific street lighting geometries
- Remember: Garbage in, garbage out!



Description:	Baseline
<b>Road Geometry</b>	
Number of Lanes	6
Lane Width	3.3
Median Width	4
<b>Light Geometry:</b>	
Pole Placement	Median mounted
Luminaire Mounting Height	8
Pole Spacing	28
Pole Setback	0
Arm length	3
<b>Pavement Type (only required for luminance calculations)</b>	
Road Surface Type	R3

# Thank You!

## Questions & Answers