

LED LIGHTING: ENERGY EFFICIENT & PLANET FRIENDLY



Outdoor Lighting Issues & Opportunities

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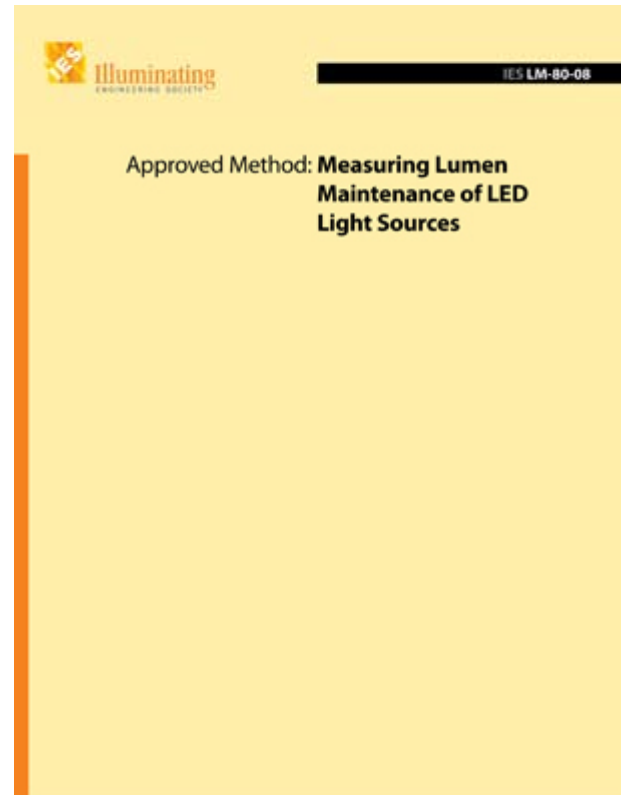
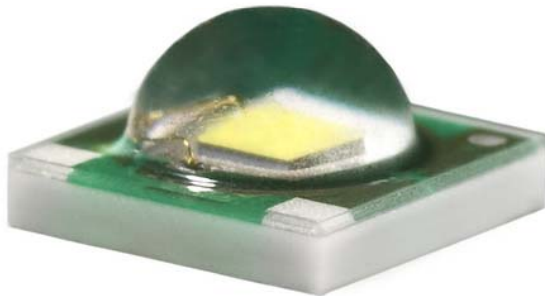


Outline

- LM-80 & LED Lifetime
- “Blue” Light
- Energy Star for Outdoor Lighting

LM-80 is...

- IES LM-80-2008 covers the measurement of lumen maintenance of LED packages, arrays and modules

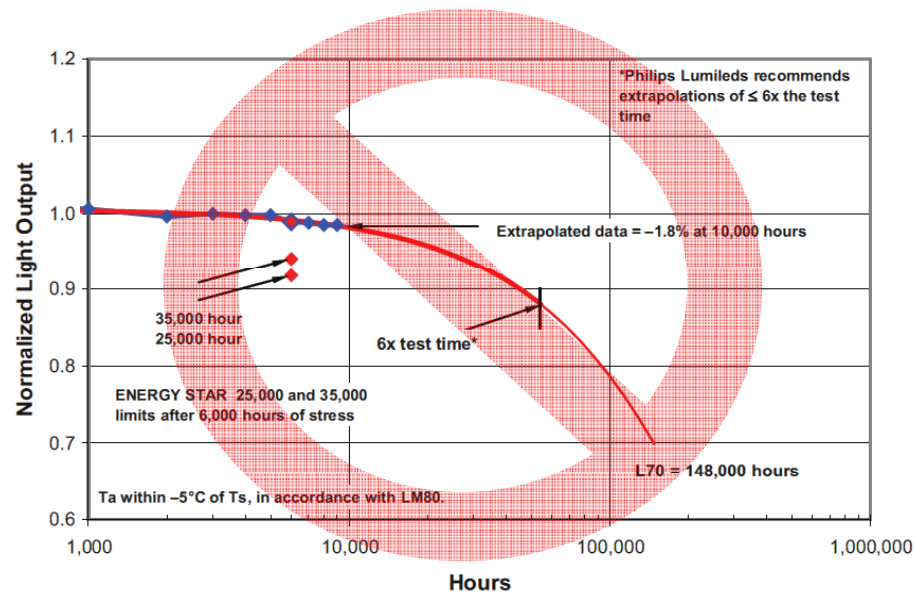
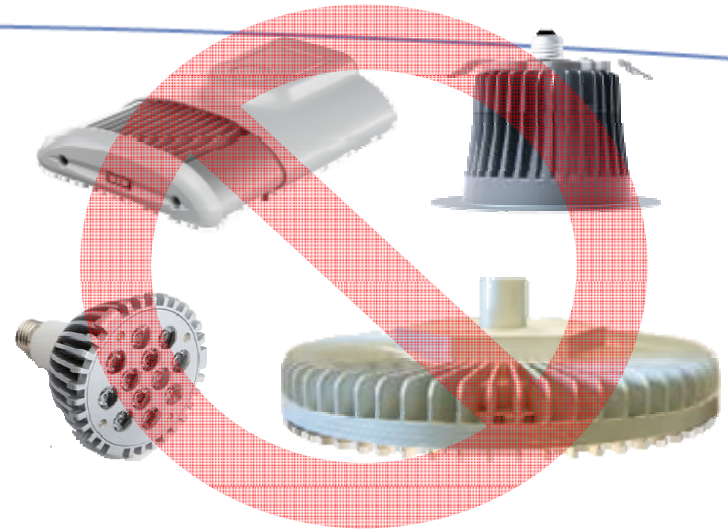


An “LM-80 Test Report” is...

[illegible]

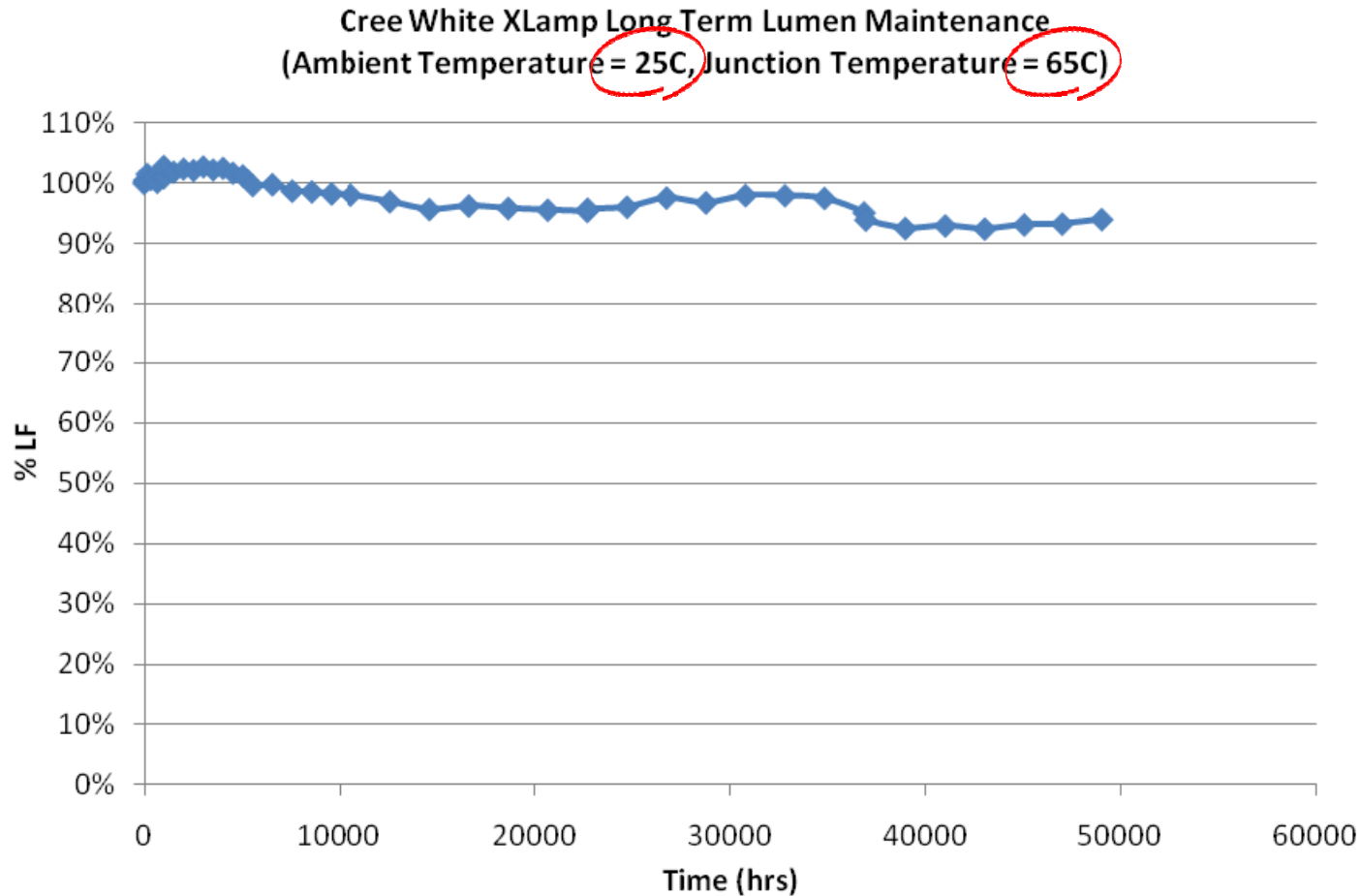
LM-80 is NOT...

- Applicable to LED luminaires or lamps
- Able to provide guidance for estimating or extrapolating LED lamp lumen maintenance beyond 6,000 hours



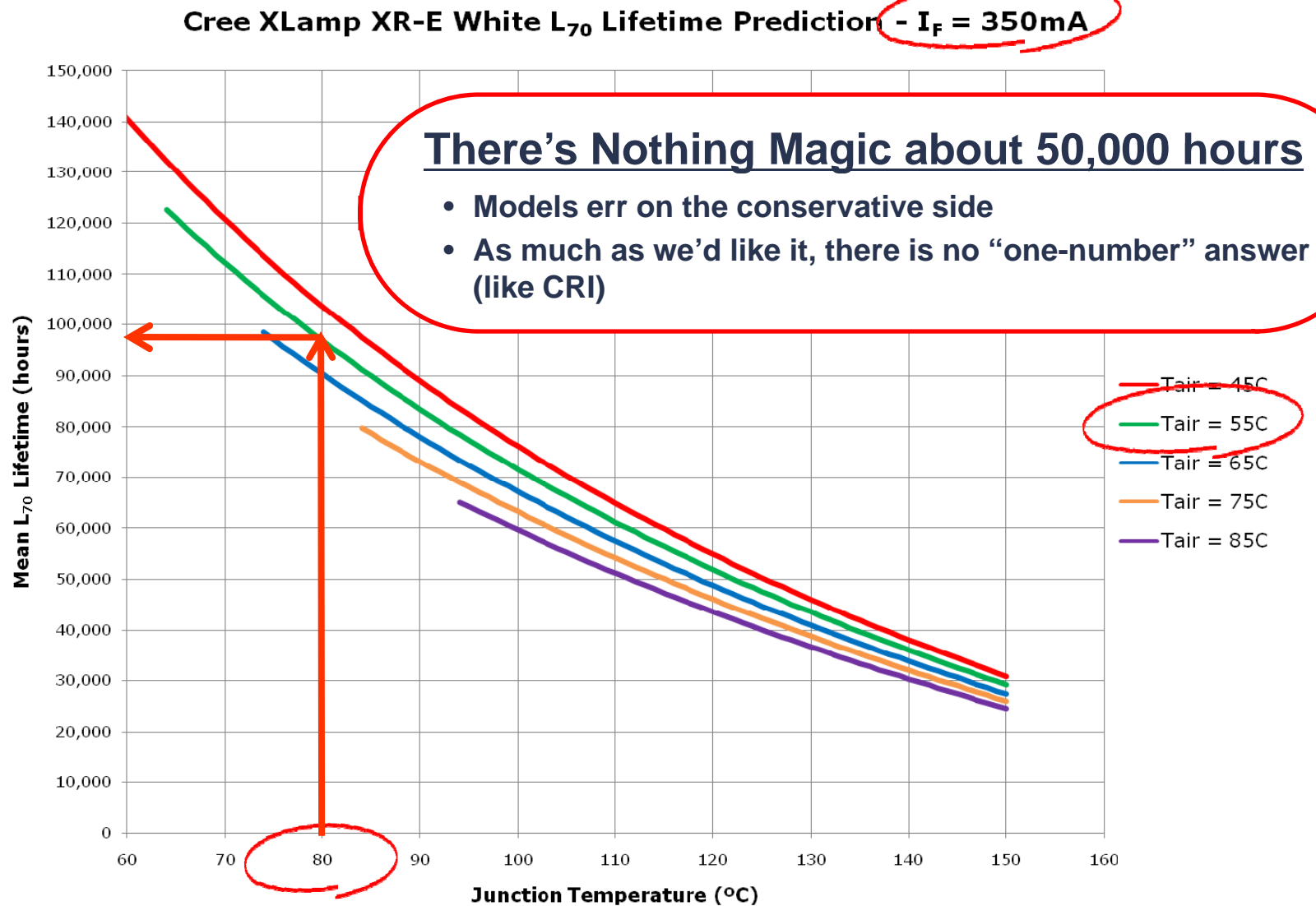
LEDs Last Forever!!

[under ideal conditions]



Well-designed systems with Lighting-class LEDs at low T_A , T_J will run a very, very long time...

Supplier LED Lamp Lifetime Projection



Standards in Development – TM-21

- IES is currently developing a supplemental document to LM-80 called TM-21
- TM-21 will utilize LM-80 data to provide mathematical models for predicting LED lamp lumen maintenance
- TM-21 is still 3-6 months away from adoption



LED Lamps

LED Lifetime Is Irrelevant

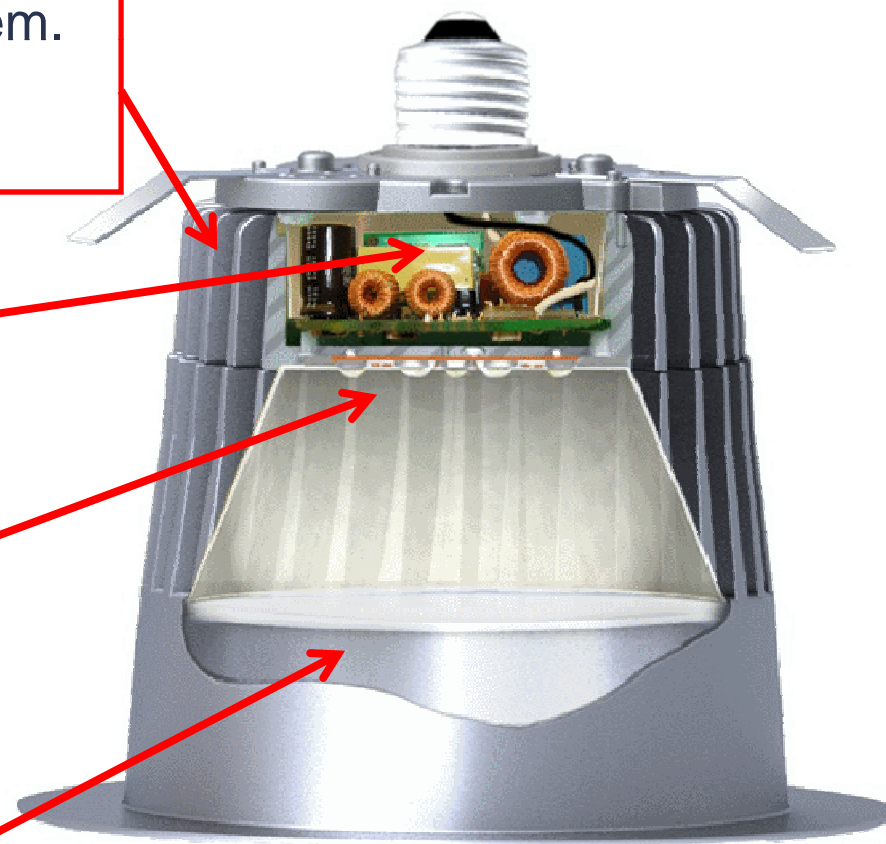
System Lifetime is What Creates Value

Heat Sink: Linchpin of the entire system. If this is poorly designed, all the other components can be compromised

Driver: Currently the weakest point of the system, but the big companies are working on this

LED Lamps: Practically never fail; depreciate very slowly in a well-designed system

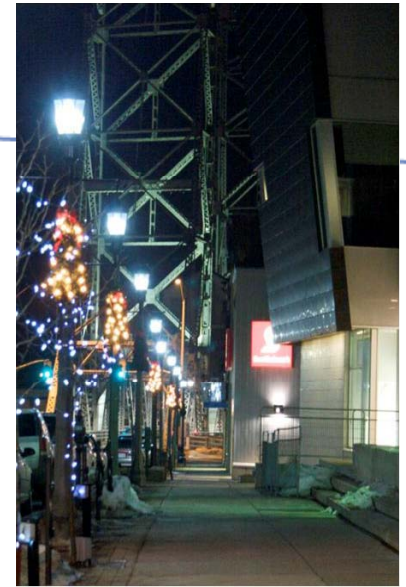
Optical Components: Can (rarely) yellow over time and lose light; system design choice



“Blue” Light Controversy



“...bluish light produces high levels of light pollution with significant environmental impact. Short wavelength light also increases sky glow disproportionately. In addition, blue light has a greater tendency to affect living organisms through disruption of their biological processes that rely upon natural cycles of daylight and darkness, such as the circadian rhythm. ...Developers of light sources should be required to refine their products to limit blue light at wavelengths shorter than 500 nm.”

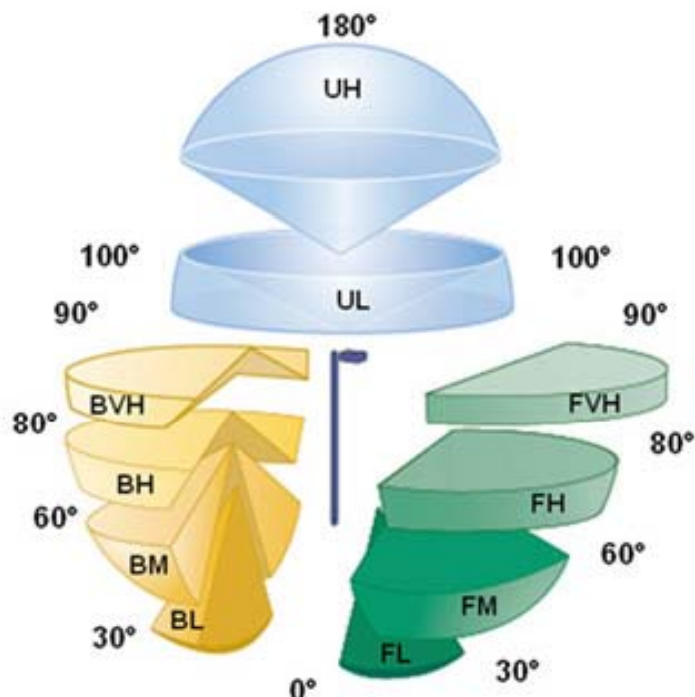


- IDA 10/7/2009

Important developments in the last 12 months

- Release of IDA's Model Lighting Ordinance
- Development of “Outdoor White” LEDs
- Better Understanding of reflectivity as a function of wavelength
- ...on the horizon: TM-12

Model Lighting Ordinance (MLO) and TM-15



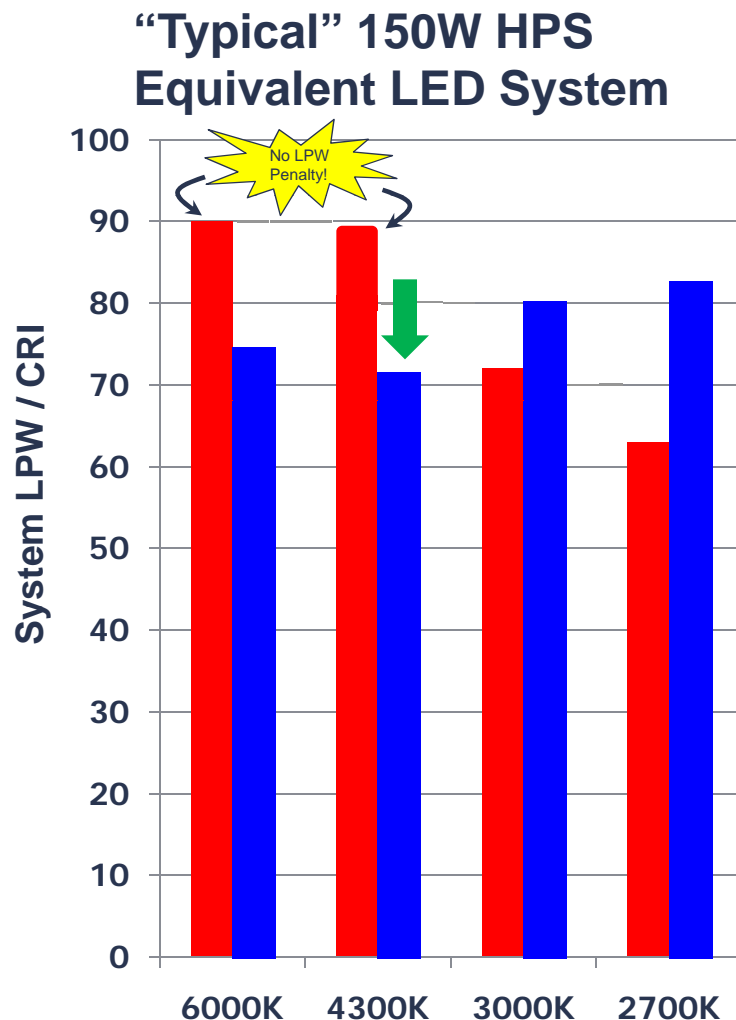
IESNA TM-15-07: Backlight, Uplight, and Glare (BUG) Ratings

		LZ0	LZ1	LZ2	LZ3	LZ4
Backlight	>2MH	B0	B1	B2	B3	B4
	1-2 MH	B0	B1	B2	B3	B3
	0.5-1 MH	B0	B0	B1	B2	B2
	<0.5 MH, adjacent to street	B0	B0	B1	B2	B2
	<0.5 MH	B0	B0	B0	B1	B2
Up-light		U0	U1	U2	U3	U4
Glare		G0	G1	G2	G3	G4

IDA Model Lighting Ordinance, p.22

- IDA's main concern is about the 2.5x "Rayleigh Scattering" effect short wavelength light has at the 80-110° ("BVH", "FVH", "UL") angles
- IDA's recently published MLO now addresses this
- LED fixture design to TM-15 and the MLO is straight-forward

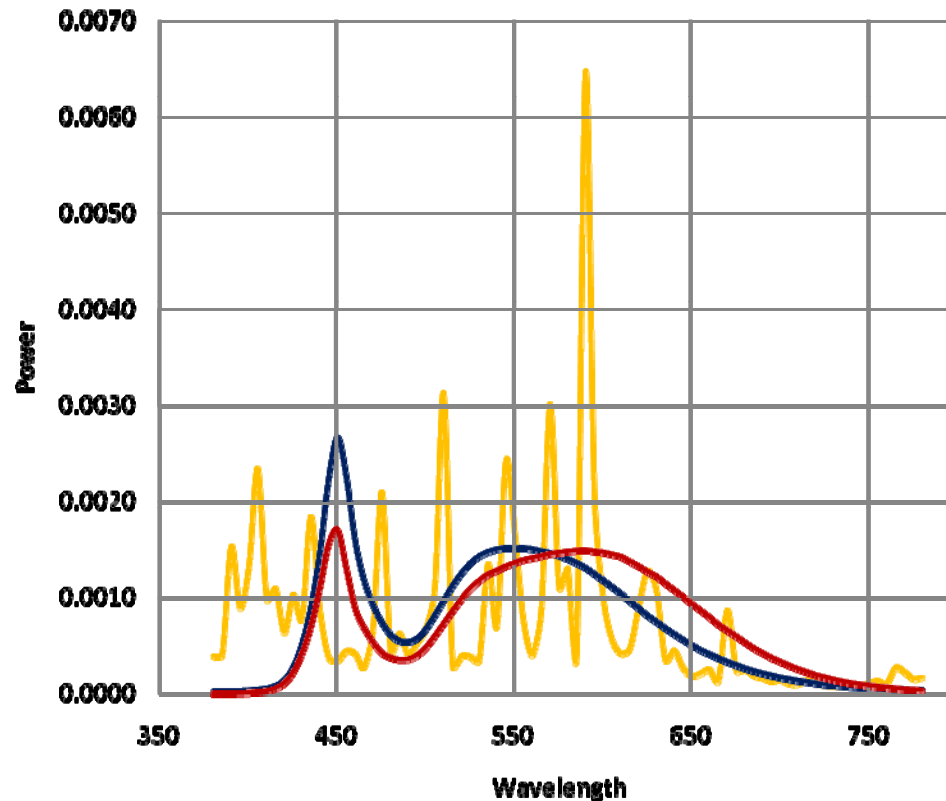
"Outdoor White" LEDs



- LEDs can be produced in literally ANY CCT
- Nothing magic about 6000K
- 6000K became popular because it was the most efficient CCT; made the business case/payback look better
 - Fewer LEDs, fewer optics, smaller, lighter systems...
- New innovations have eliminated the trade-off of efficacy for CCT
 - LED street lighting now has a high-efficacy option at 4300K: so-called "Outdoor White"
- The technical path to high-efficacy 3000K is not obvious

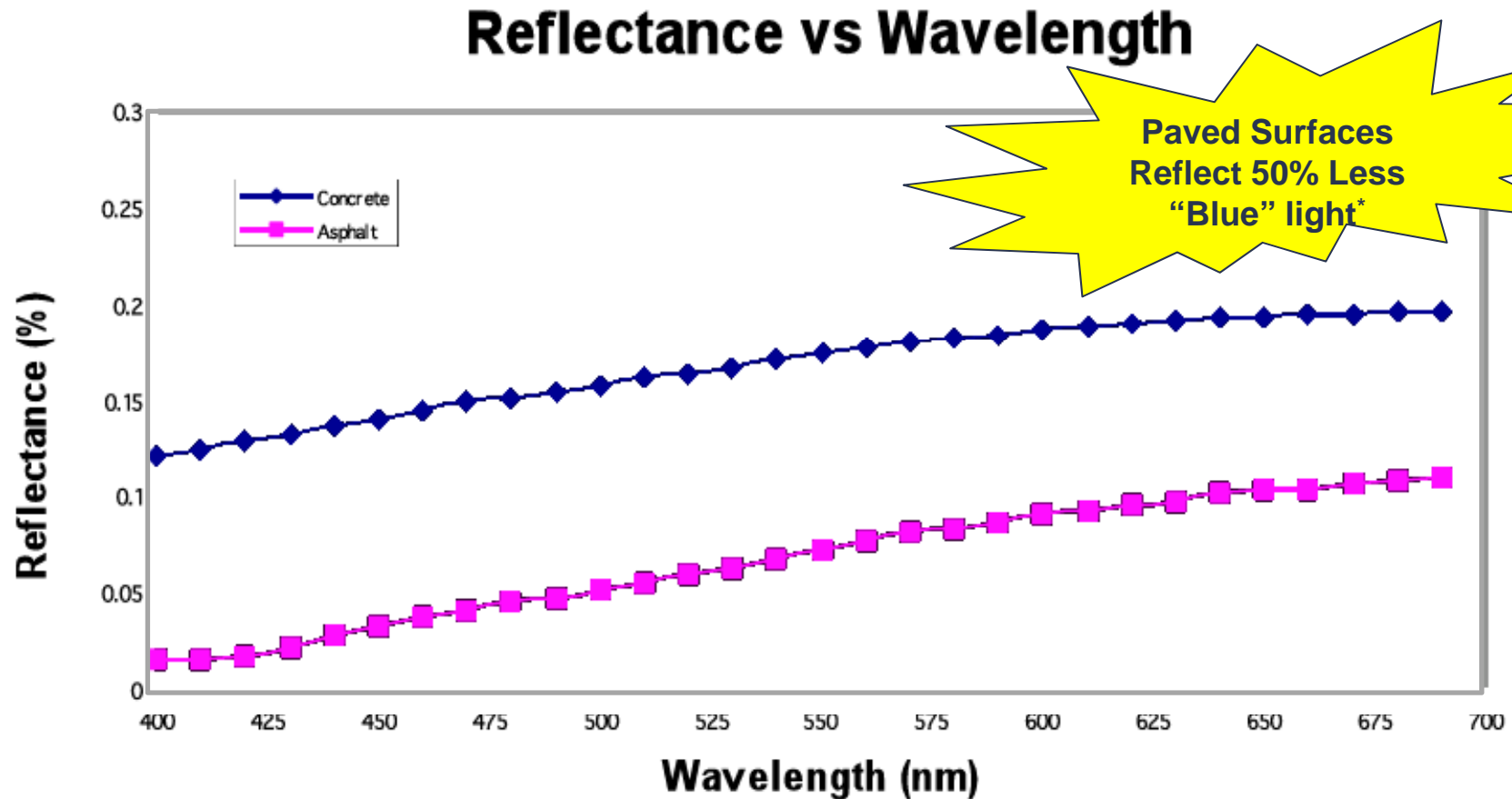
"Blue Light" Spectral Comparison

SPD Comparison at same Light level



Lamp Type	% Energy <500nm
Metal Halide	34%
Cool White LED	31%
Mercury Vapor	27%
T8 Fluorescent	22%
Outdoor White LED	20%

Paved Surfaces Reflect 50% Less "Blue"*

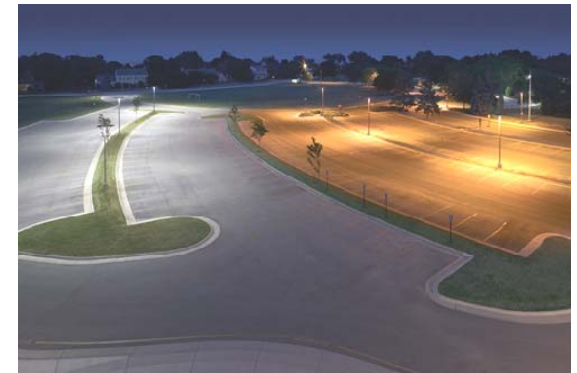
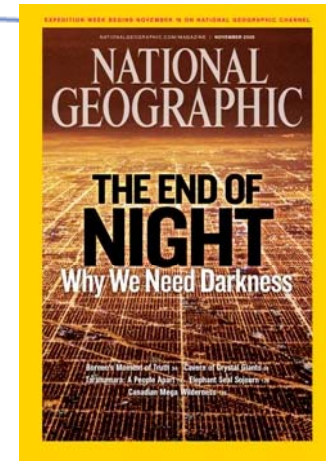


Glimpse of the Future for Dark Skies...



Working Together On The Top Priorities

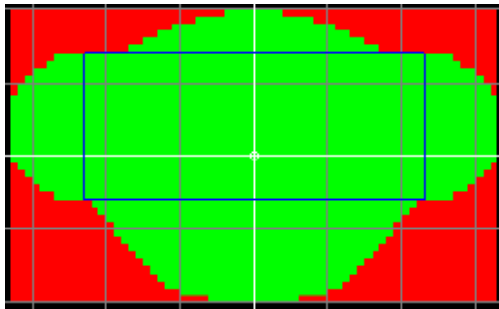
- Eliminate up-light with traditional or LED luminaires per TM-15 (“BUG” rating)
- Broad adoption of IDA’s Model Lighting Ordinance
- Reduce overall outdoor lighting levels by recognizing and standardizing some version of the unified system of photometry work led by the Lighting Research Center at RPI* (TM-12 working on this)
 - ~50% light and energy savings waiting on the table...



* <http://www.lrc.rpi.edu/programs/solidstate/assist/pdf/AR-VisualEfficacy-Jan2009.pdf>

Energy Star for Outdoor Luminaires

- It's a jungle out there
- Cities, commercial, and university buyers are bombarded with many confusing product claims from vendors they never heard of before
 - Some they will never hear from again...
- Energy Star stands to become a defacto "Good Housekeeping Seal" for the commercial space, but



DOE proposal on Fitted-Target Efficacy (FTE); currently being reworked...

1. EPA has to accelerate the efforts towards publication of the criteria for this program, and
2. EPA needs to forge relationships at the Municipal and University level

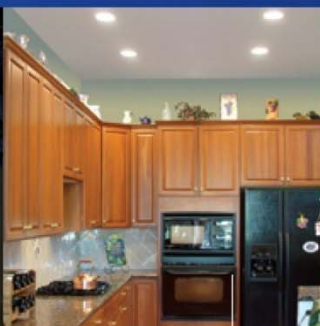
Summary

- Don't confuse LM-80 with LED lamp lifetime
- When TM-21 is complete we will have a tool to predict LED lamp lifetime, but
- Don't confuse LED lamp lifetime with luminaire lifetime
- "Blue" Light is not the controversy it once was, mitigated by:
 - Reduce the problem up-light via adoption of IDA's MLO & TM-15 ("BUG" rating)
 - **2x** reduction in sub-500nm SPD by new "Outdoor White" (4300K) LED lamps
 - **2x** reduction in reflected sub-500nm SPD
 - Potentially another ~**2x** reduction in overall light levels by TM-12
- Energy Star for Outdoor lighting can be a "Good Housekeeping Seal" for the Commercial and Industrial market

Rayleigh
Scattering
2.5x worse for
"blue" light



PORTABLE



RESIDENTIAL



OFFICE



RETAIL



ARCHITECTURAL



OUTDOOR

LED lighting: Energy efficient & planet friendly.

Cree. Leading the LED lighting revolution.

Join Cree's LED lighting revolution. We invite you to see how our high-performance, high-efficiency LEDs are lighting up the world.

