

SSL Early Lessons Learned – Progress and Updates



DOE SSL Market Development Workshop

November 13, 2014

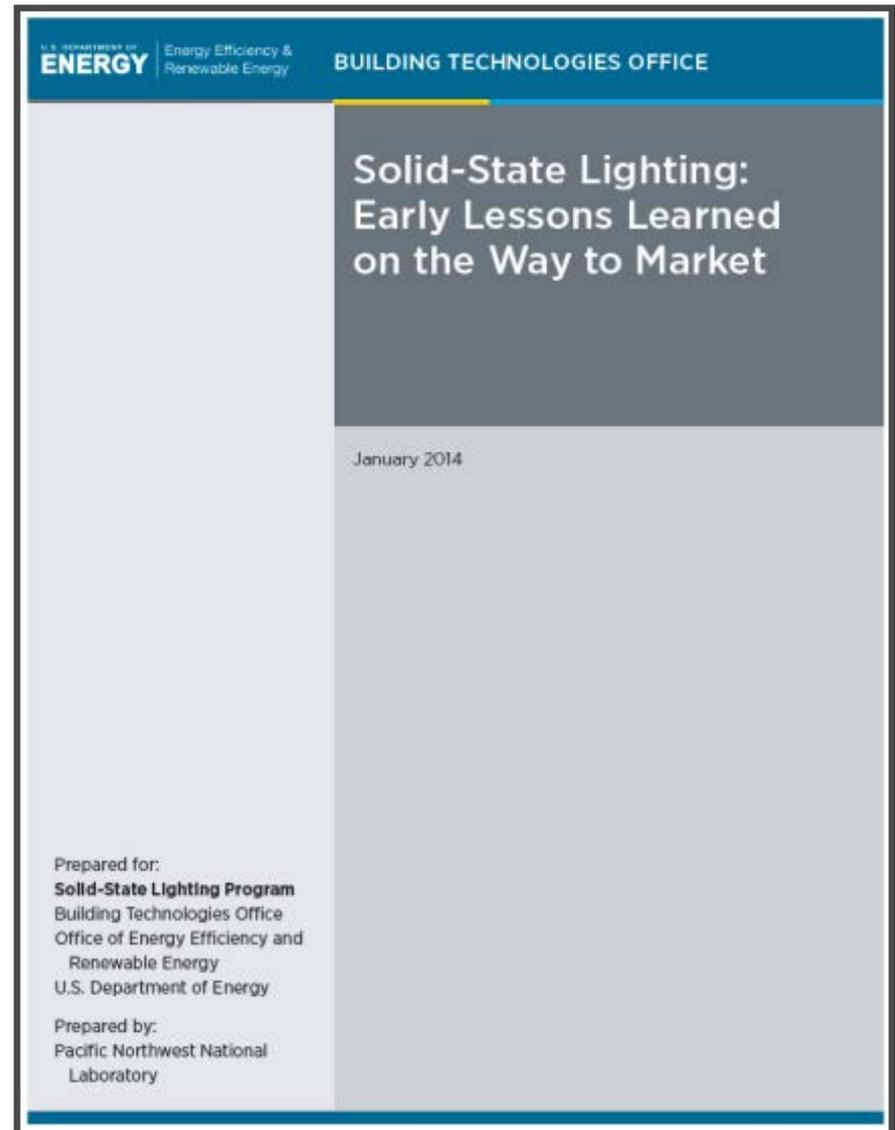
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Learning our lessons

1. Testing costs
2. Lifetime
3. Product families
4. Color quality
5. Color stability
6. Flicker
7. Glare
8. Dimming
9. Interoperability
10. Serviceability
11. Existing infrastructure
12. Qualification programs



Lesson 1: Testing Costs

Rigorous testing requirements adopted in the early days of SSL industry development were necessary to counter exaggerated claims of performance by some manufacturers, but they eventually led to unreasonably high testing costs



Lesson 1: Testing Costs - UPDATE

- Near 2,000 products qualified as family members to date
- Has already saved ~\$600k in testing costs

Family Grouping Summary

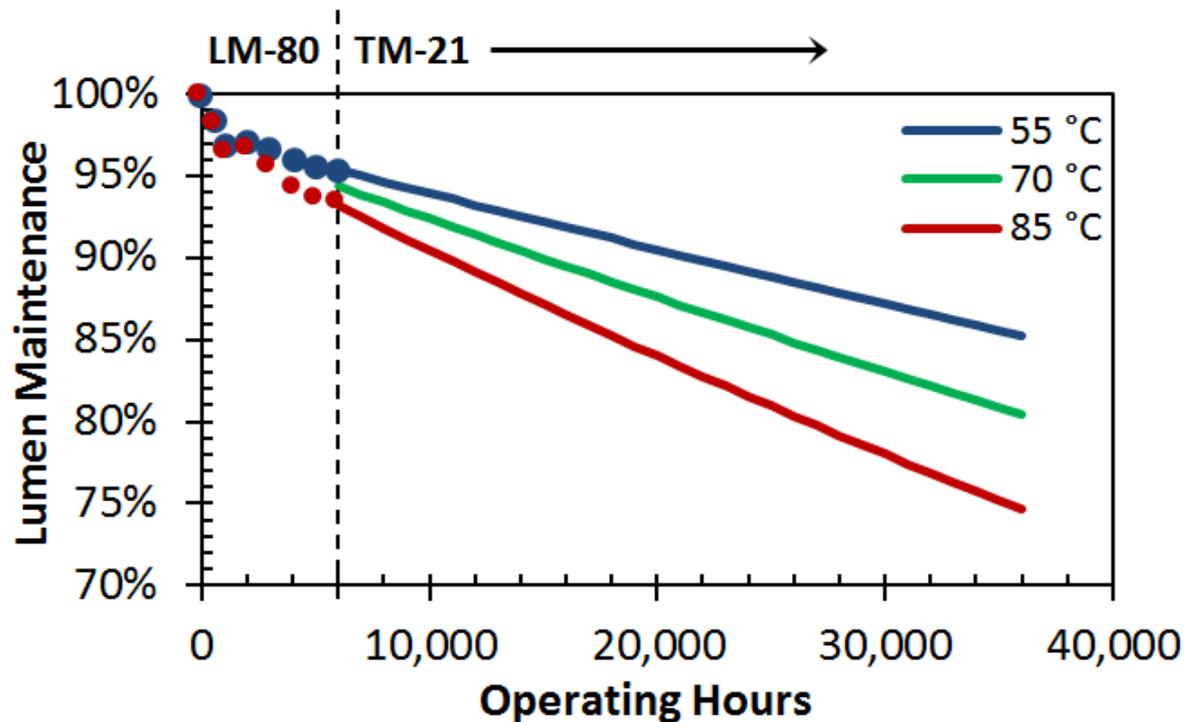
- Manufacturers will self-define family groupings
 - Definitions will be publicly available online with listings
 - At a minimum, the descriptions must include:
 - Characteristics shared by products in the family
 - Characteristics that vary among products in the family
- At least one product in each family must include a complete LM-79 report.
- Manufacturers will submit their method for deriving performance of related products in a family.

Manufacturer reactions:

- “...family grouping is fairly hassle free. We like and prefer your [...] grouping method [...]. Cost savings is huge.”
- “...allowed us to list configurations, mostly CCT, that we otherwise wouldn't have bothered to list.
- “As far as cost savings, I don't think we save any money because we would test our products to LM-79 regardless.”

Lesson 2: Lifetime

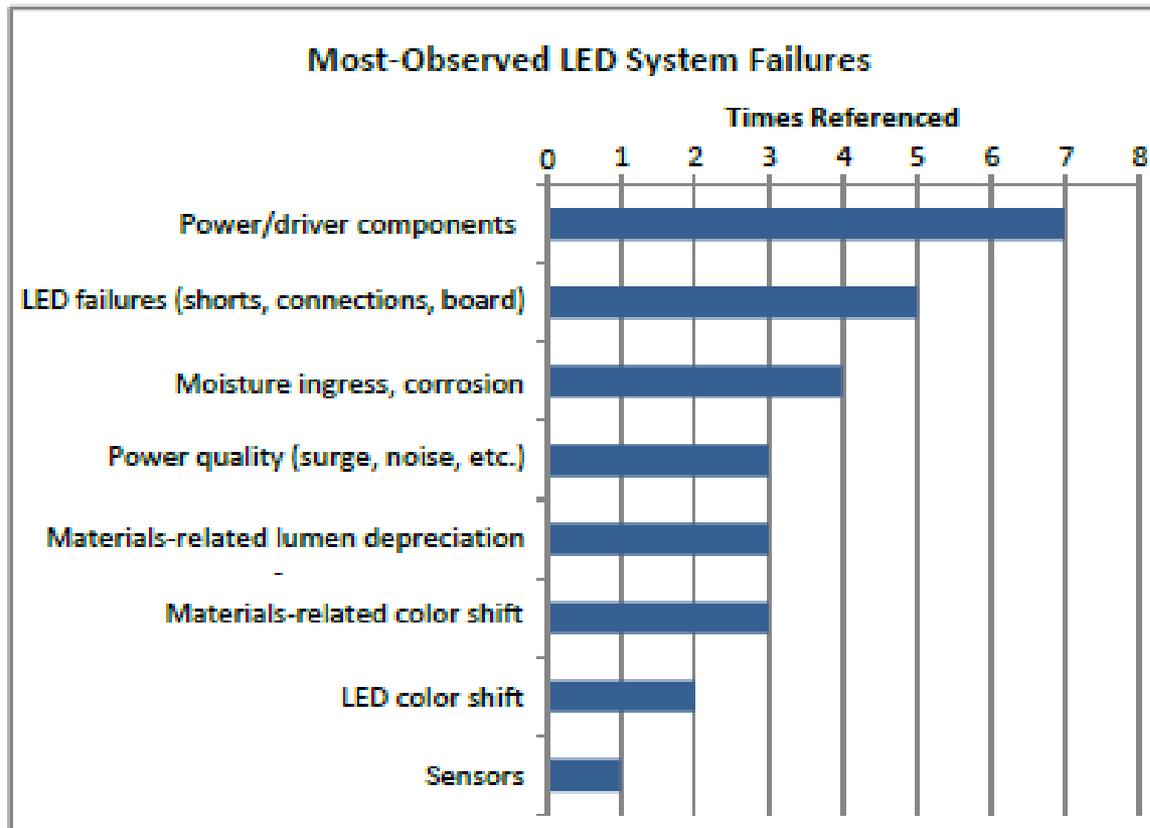
Despite the promise of long life, there is no standard way to rate the lifetime and reliability of LED products



www.ssl.energy.gov

Lesson 2: Lifetime - UPDATE

- LED Systems Reliability Consortium 3rd edition “LED Luminaire Lifetime: Recommendations for Testing and Reporting”
- ANSI C82 developing LED driver robustness test procedure



Lesson 3: Product families

Specifiers prefer complete families of products, but the rapid evolution of LED technology presents a challenge to manufacturers in creating and maintaining complete product lines

	16151	16135	16134
Image:			
Product Number:	16151	16135	16134
Name:	50PAR30HALIRSSP10TL 120 10/CS 1/SKU	39PAR30HALWFL50DL 120V 10/CS I/SKU	39PAR30HALNFL25DL 120V 10/CS 1/SKU
Select For New Comparison:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Details			
Abbrev. With Packaging Info.	50PAR30HALIRSSP10TL 120 10/CS 1/SKU	39PAR30HALWFL50DL 120V 10/CS I/SKU	39PAR30HALNFL25DL 120V 10/CS 1/SKU
Approx. Lumens	950	520	520
Average Rated Life (hr)	4500	3000	3000
Base	E26 Medium	E26 Medium	E26 Medium
Beam Angle (deg)	10	50	25
Beam Type	SP	WFL	FL
Bulb	PAR30	PAR30	PAR30
Centerbeam Candlepower (cp)	10600	600	1600

Lesson 3: Product families - UPDATE

- Families of specification-grade fixtures and lamps are becoming more available
- Still need better availability of families with different fixed output levels
 - e.g., 500, 1000, 2000 lumens

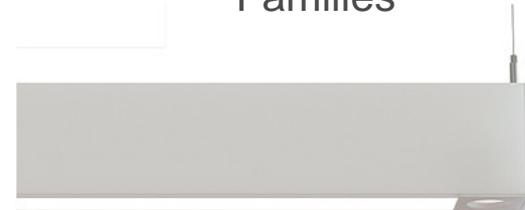


Beam Angle
15°
10°, 12°, 15°
10°, 25°
25°, 40°
40°



Finelite

NGL Indoor 2014 Families



Acuity Brands –
Mark Architectural Lighting

Lesson 4: Color quality

The range of color quality available with LED-based products and the limitations of existing color metrics may confuse users



Lesson 4: Color quality - UPDATE

- IES Color Metric Task Group
 - TM in balloting now
 - Will recommend metrics to use for more complete description of color rendering
- NGL judges say color “much improved” and “almost a non-issue”
- CA requires 90+ CRI for LED replacement lamps receiving utility rebates



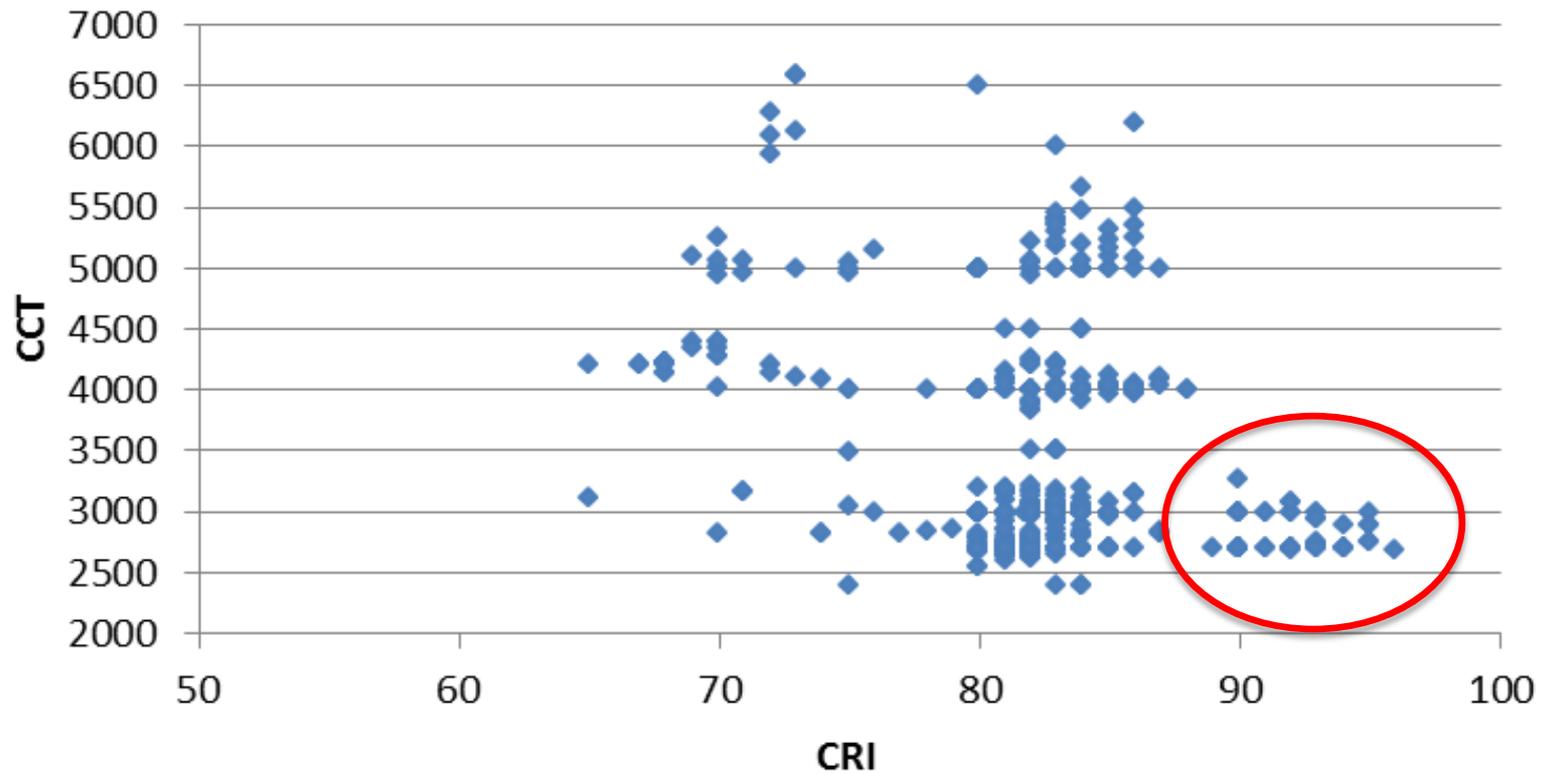
Finelite
Judges said:

“nice color rendition with clean field”



Lesson 4: Color quality - UPDATE

LED Lighting Facts Listed Medium Screw-Base Lamps



Nov 2014

Lesson 5: Color stability

The color delivered by some LEDs shifts over time, enough to negatively impact adoption in some applications



Lesson 5: Color stability - UPDATE

- A few manufacturers now offer warranties for color shift
- IES PIF on color stability
 - Should lead to a TM for projecting color shift over time

XICATO

FIVE YEAR COLOR CONSISTENCY AND LUMEN MAINTENANCE WARRANTY

1. VALIDITY

A "5 Year Color Consistency and Lumen Maintenance Warranty" shall only be confirmed in writing by Xicato according to the terms stated herein. This warranty, if effective, replaces the "Standard Warranty" as described in 8(a) of Xicato's Terms and Conditions of Sale (the "Terms of Sale") where such sale has occurred on or after January 1, 2013 and shall be incorporated into and governed by such Terms of Sale.

2. PRODUCT WARRANTY

Xicato warrants to Customer that under standard Xicato operating conditions as specified in Product datasheets and in use with the luminaire thermally validated by Xicato as provided below, the Product will, for a period of 5 years after installation but not more than 5 years and 3 months after the shipment date of the Product, conform to the following specifications:

- Flux output >70% as compared to the Product's performance as of the date of manufacture;
- Color consistency between Products in a population of Luminaires in a single contiguous visual space viewable from any location within that space that 1976 CIE Chromaticity Diagram.

ENVIRONMENT

Environment changes to the Luminaire other than temperature and trim are required to have been



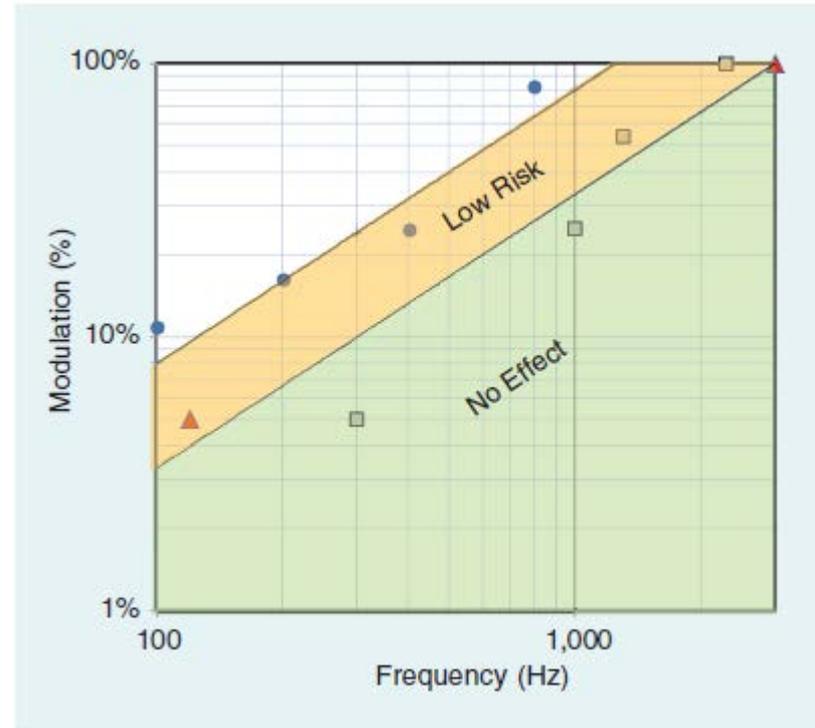
Lesson 6: Flicker

Some LEDs flicker noticeably, which may negatively impact adoption in some applications



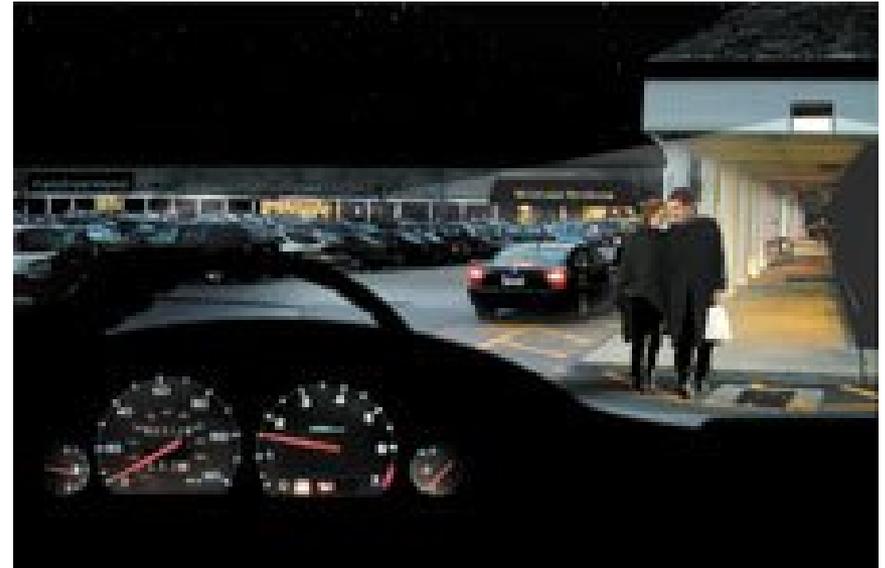
Lesson 6: Flicker - UPDATE

- IEEE PAR1789 committee Recommended Practice in balloting and review
- Article, “Designing to Mitigate the Effects of Flicker in LED Lighting”
 - Brad Lehman and Arnold Wilkins
 - IEEE Power Electronics Magazine, Sep 2014



Lesson 7: Glare

LEDs can cause glare, which may negatively impact adoption in some applications



Lesson 7: Glare - UPDATE

- NGL judges have noted improvements but glare remains their #1 complaint
- Industry is taking this seriously
 - Diffusing lenses
 - Edge lit designs
 - Other optics that reduce spot luminance and reduce contrast of LED to background



Focal Point

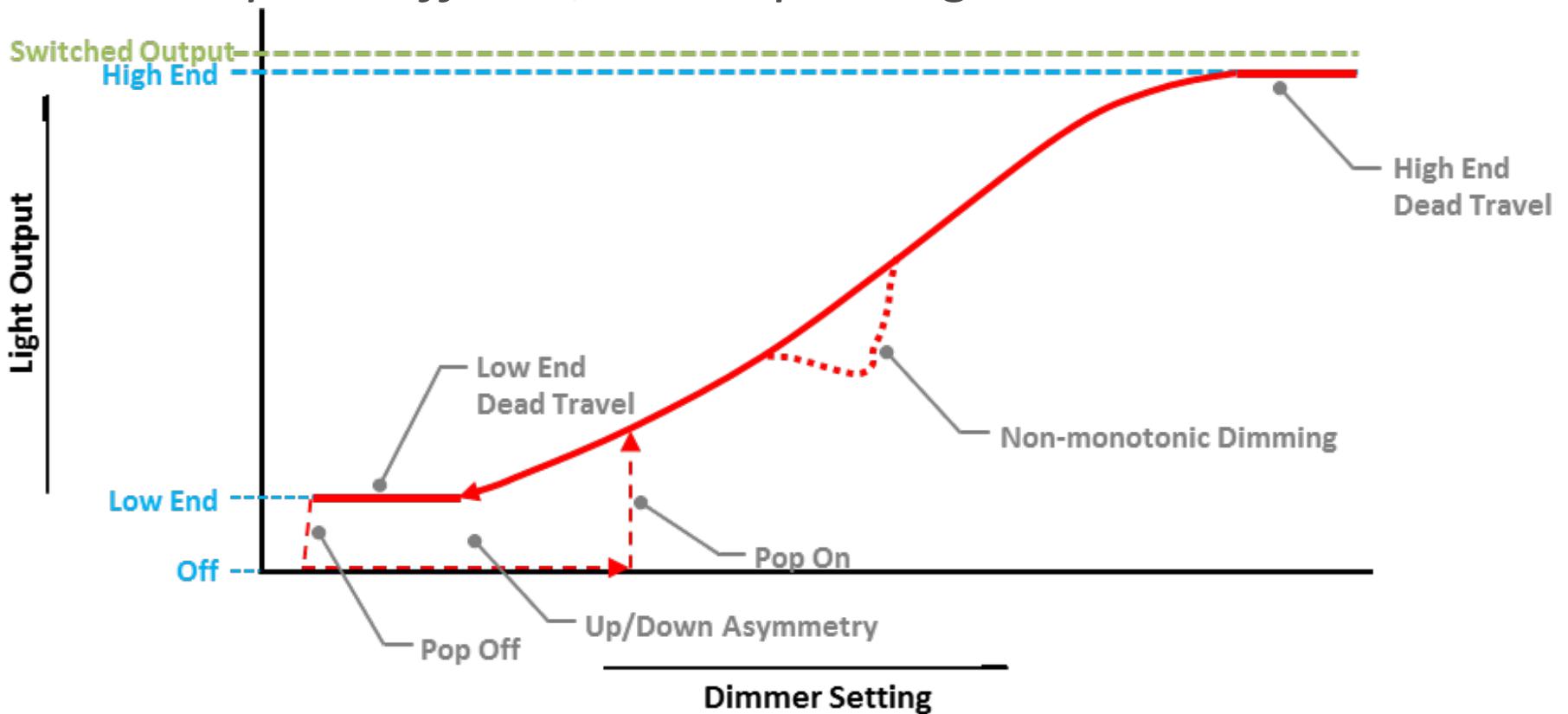
NGL Indoor 2014
Noted for glare control



Acuity Brands - Peerless

Lesson 8: Dimming

Achieving high-quality dimming performance with LED lamps is difficult, but improving



Source: Modified from NEMA SSL-6

Lesson 8: Dimming - UPDATE

- NEMA SSL-7A compliant products beginning to appear on market
- NEMA SSL-7B in progress
- CALiPER tested PAR38 LED lamps:
 - Some achieve high quality dimming, almost identical to incandescent

Diva® 250 W C•L® Dimmer Wallbox Controls

369810a 1 04.08.14

Diva® 250 W C•L® Dimmer

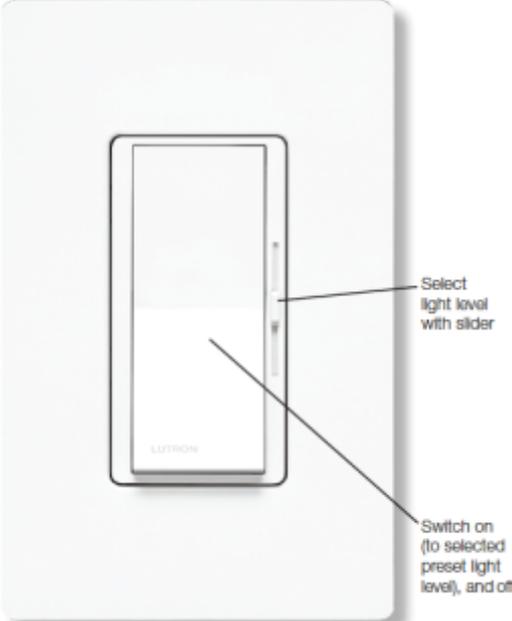
Dimmer for CFL, LED, Halogen, and Incandescent dimmable bulbs.

Features

- Large paddle switch with a captive linear-slide dimmer for a standard designer wallplate opening
- HED™ Technology: Advanced Lutron® dimming circuitry designed for compatibility with most high efficacy light bulbs
- UL® Listed to control:
 - Dimmable compact fluorescent (CFL) with integrated ballast
 - Dimmable LED with integrated driver
 - Lutron Hi-lume® A-Series LTE LED Driver
 - Halogen
 - Incandescent
- Low-end adjustment to accommodate a wide range of bulbs
- 100% factory tested
- **NEMA SSL-7A Type 2 Compliant**

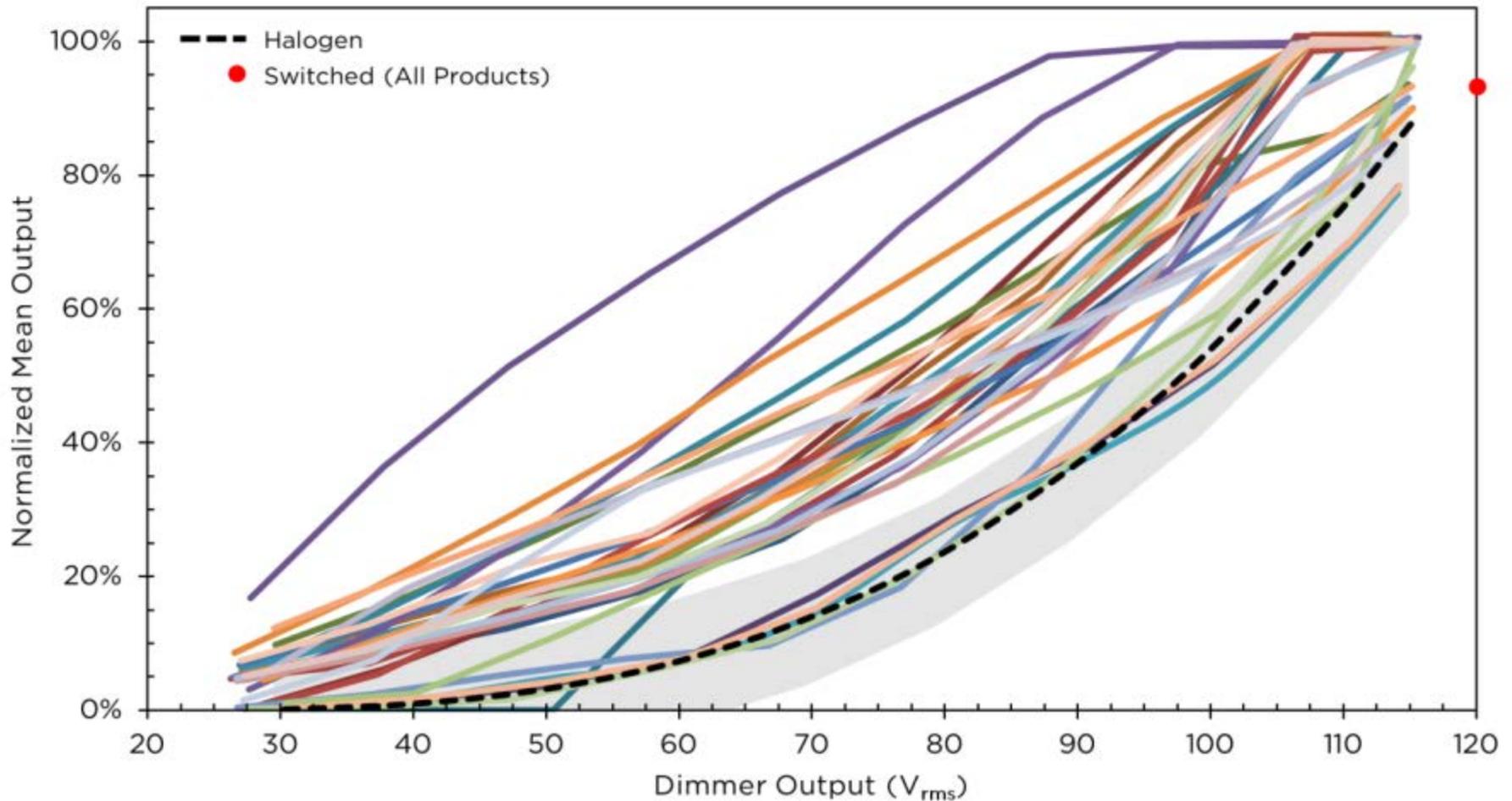
Application Requirements

- *When dimming CFLs or LEDs, only bulbs marked or rated as DIMMABLE may be used.*
- For a list of compatible DIMMABLE CFLs and LEDs please visit www.lutron.com/dimcflled. For questions call 1.800.523.9466.
- Some DIMMABLE CFLs and LEDs require a minimum number of bulbs for proper operation. For details and a list of bulbs, please visit www.lutron.com/dimcflled.



* Wallplate sold separately

Lesson 8: Dimming - UPDATE



CALiPER Report 20.2 Dimming, Flicker, and Power Quality Characteristics of LED PAR38 Lamps, March 2014

Lesson 9: Interoperability

Greater interoperability of lighting control components and more sensible specifications of lighting control systems are required to maximize the energy savings delivered by LED-based sources

Lighting Control on
Wi-Fi network



Example: ZigBee Light Link
to Ethernet
Gateway



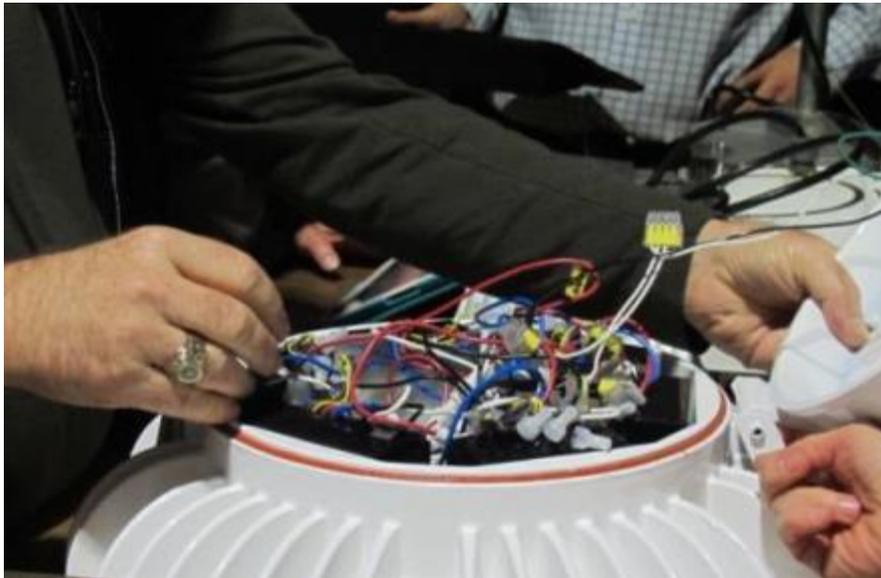
Lesson 9: Interoperability - UPDATE

- Industry consortia actively working on interoperability
 - TALQ - outdoor
 - TCLA – indoor
- ANSI C137 Lighting Systems committee recently launched by NEMA



Lesson 10: Serviceability

Lack of LED product serviceability and interchangeability has created market adoption barriers in certain sectors



Lesson 10: Serviceability - UPDATE

- NGL recognized several products for serviceability
- Zhaga standards for 7 different LED light engine form factors so far; 3 more in development
 - 174 products certified so far



GE Lighting

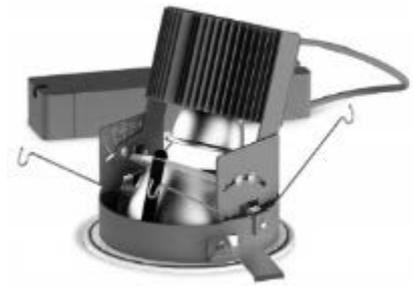
Examples of NGL
Indoor 2014
Products noted for
serviceability



H.E. Williams



Book 2 holder



Book 3 luminaire



Book 3 module



Book 4 module

Lesson 11: Existing infrastructure

Existing lighting infrastructure limits the full potential of SSL; more effort is needed to open the doors to new lighting systems and form factors



Lesson 11: Existing infrastructure - UPDATE

- New innovative form factors
- New controls approaches
 - Wireless
 - Networked
 - Luminaire integrated sensors
- New power distribution approaches
 - Low-voltage, DC power
 - Can be combined with control/communication
 - Power over Ethernet (PoE), other approaches

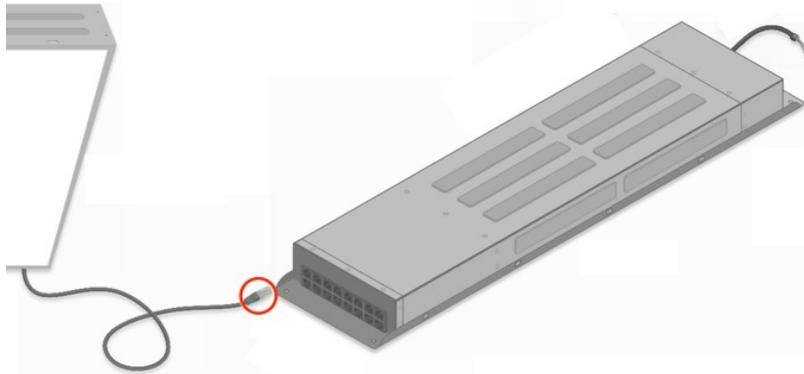


Blackjack Lighting



GE Lighting

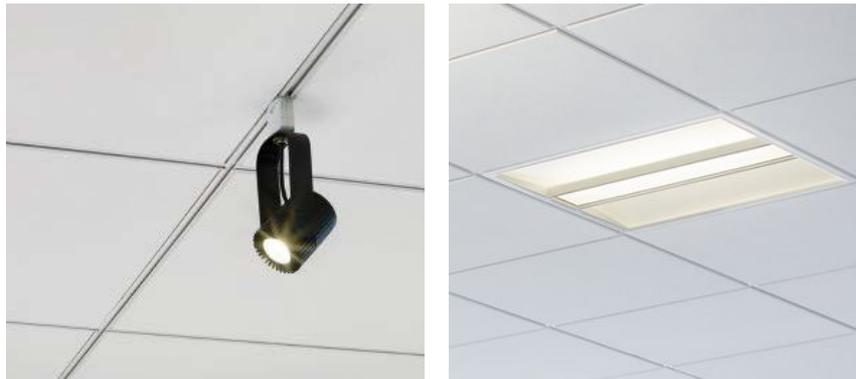
Lesson 11: Existing infrastructure - UPDATE



Example of low-voltage LED commercial lighting combined with control/communication



Example of IEEE 802.3at compliant PoE switch



Example of DC powered ceiling system



Example of outdoor wireless controller

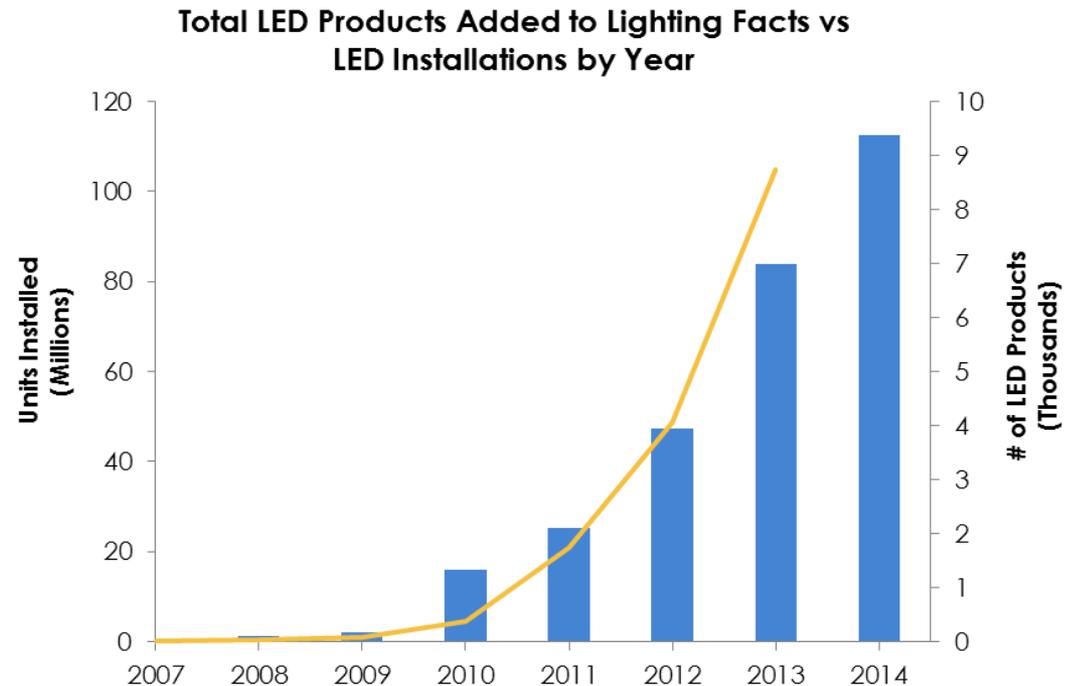
Lesson 12: Qualification programs

Programs that provide ways to identify quality LED products have helped support market adoption



Lesson 12: Qualification programs - UPDATE

- NGL: key resource for designers & specifiers
 - Nearly 400 luminaires evaluated to date
- DLC
 - more than 60,000 commercial lighting products listed
- LED Lighting Facts
 - more than 20,000 products listed
- Energy Star
 - nearly 2,000 LED lamps and more than 5,000 LED fixtures



Thank You

Kelly Gordon
PNNL

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Get the SSL Lessons Learned report at:

www.ssl.energy.gov