

Energy Efficiency & Renewable Energy

It's 2015: What's Next for SSL?

May 5–7, 2015 LIGHTFAIR[®]International James R. Brodrick, Ph.D.

U.S. Department of Energy



2005: The "Wild West"

- No real LED equivalents for incandescent or fluorescent
- No standards
- Exaggerated performance claims
- Steep learning curve

2006: Pilot round of DOE CALiPER testing None come close to matching performance of incumbent technologies

2008: CALIPER testing of LED replacement lamps Most are equivalent to 25–40W incandescent, with a wide variety of color quality, shapes, and sizes





A Decade of Rapid Growth

- Performance steadily improves
- Costs steadily come down
- Standards bring order to the Wild West









 ANSI C78.377-2008
 IES LM-82-2012

 IES LM-79-2008
 NEMA SSL 4-2012

 IES LM-80-2008
 NEMA SSL 7A-2013

 NEMA SSL 1-2010
 IES LM-84-2014

 NEMA SSL-6-2010
 IES LM-85-2014

 NEMA SSL-3-2011
 IES TM-28-2014

& MANY MORE IN DEVELOPMENT



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2015: The New Lighting Landscape

- Huge improvements in SSL performance
- Huge reductions in SSL price
- SSL is a viable option for most lighting applications
- Most lighting professionals have a basic understanding of SSL technology
- Industry standard test procedures now widely used







Remaining Challenges

- Still seeing technological challenges with today's products: lumen maintenance, color stability, flicker, dimming performance, and more
- Existing infrastructure limits full potential of SSL
- Interoperability issues
- DOE study details lessons learned and recommendations for a path forward





Remaining Challenges: Color Stability

CALIPER testing of various LED lamps shows color shift at 6,000 and 12,000 hours





Chromaticity Adrift: Understanding LED Color Stability Michael Royer, PNNL

8 Source: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2013_gateway_color-maintenance.pdf



Remaining Challenges: Color Rendering

New methods for evaluating color rendering will soon offer a more complete picture





How New Methods for **Evaluating Color Rendering** Will Affect You

Michael Royer, PNNL



Remaining Challenges: Flicker

Some LEDs flicker noticeably; a new recommended practice for limiting flicker in LED light sources is coming soon





Flicker: Understanding the New IEEE Recommended Practice

Naomi Miller, PNNL



Remaining Challenges: Existing Infrastructure

- Limitations of existing infrastructure present challenges related to compatibility, interoperability, interchangeability
- Controls offer added energy savings, but only work properly if specified, installed, and commissioned correctly





Outdoor Lighting Evaluations

- Long-term studies yield valuable insights on illuminance, dirt depreciation over time
- Yuma Border Patrol, I-35 Bridge installations





Baking LEDs in Yuma: A One-Year Update

Andrea Wilkerson, PNNL

LEDs at 5+ Years: The Scoop on Street Lighting Bruce Kinzey, PNNL





Specifying Today's LED Products

- Long lead times for projects + Rapid pace of technology improvements = Significant challenge for designers and specifiers
- Innovative new products pose additional challenges





Specifying Color Tunable Luminaires: What You Need to Know Naomi Miller, PNNL

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Opportunities for OLEDs

- OLED technology is 7–8 years behind LED; will soon face similar issues
- 2014: The Home Depot introduces first OLED products
- First OLED products recognized by Next Generation Luminaires[™] competition









- Increased sophistication of future lighting systems will present further challenges
- Intersection of lighting, communications networks, big data and advanced analytics will significantly alter today's lighting landscape
- New form factors, new players, new questions





Tomorrow's Lighting Systems





Intelligent and Adaptive Lighting Systems of the Future

Tess Perrin and Michael Poplawski, PNNL









Much Deeper Energy Savings Still Achievable





Lighting as a Platform

- Future lighting systems could become a platform for greater energy savings in buildings and cities
- Tradeoffs are not necessary; we can have energy savings as well as other benefits if we work together now to address key issues
- Key barriers limiting potential energy savings:
 - Complexity of installation, start-up, commissioning
 - Lack of interoperability between system components
 - Limited ability to measure and report performance



Future Lighting Systems: The Path to Optimized Energy Performance

Michael Poplawski, PNNL



Tons of Resources @ www.ssl.energy.gov



Ask the Experts!



Stick around, check the schedule, ask questions

