

# Performance Insights on Solid State Lighting

#### USA DOE's CALIPER, NGL, and LED Lighting Facts Programs

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#### Outline

- The programs
- The trends
- Digging deeper
- Next steps







#### **The DOE Programs**

• NGLIA	SSL PARTNERSHIPS • IES • IEA • IALD • MUNICIPAL	CONSORTIUM	
RESEARCH & DEVELOPMENT	TESTING & PRODUCT DEVELOPMENT	MARKET DEVELOPMENT	
Core Technology Research Product Development Manufacturing	CALiPER LED Lighting Facts® Standards Development Support GATEWAY Demonstrations Next Generation Luminaires™ L Prize®	Utilities Energy Efficiency Programs Municipalities Manufacturers Designers Specifiers Retailers Distributors	Market-Ready Energy-Efficient Products
	COMMUNICATIONS & PLANNING	Distributors	-

#### **Understanding the Trends**

- CALiPER significantly dependent on products tested in a given year
  - 600 tested since 2006 (around 60-150 year)
- LED Lighting Facts best trend set
  - 7,000 products listed
- Next Generation Luminaire (NGL) only products meeting strict competition requirements
  - Started 2008 approximately 150 entries each year

#### **CALiPER – Efficacy, Lamps**



#### CALiPER – CRI, Lamps

**Color Rendering** 



#### **CALiPER – Efficacy, All Products**



#### **CALiPER – CRI, All Products**

8

Number of Products



#### **CALiPER 2012 Conclusions**

- Overall improvements in light output, efficacy, light distribution, power factor, color quality, etc.
- Manufacturer claims and equivalency claims are improving... but can still be a problem
- Suitability often depends on application
- Careful comparisons based on accurate performance data is an absolute necessity
- Be cognizant of "secondary" quality issues: glare, flicker, color tolerances, physical formats, reliability…

#### **LED Lighting Facts**



#### Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: ABC435TH4792023 Model Number: 18756CHT56428954RGHT1234H3 Type: 18756CHT56428954RGHT1234H3

9%		
	lighting facts:	1.5% Registered Users Login Forgot username or password?
14%	Information For:	LED Lighting Facts <sup>®</sup> Products
3.8%	Manufacturers	Welcome to the LED Lighting Facts Product list! This is a complete list of solid state  Product Breakdown
4.2%	Retailers & Distributors	lighting products that have received an LED Lighting Facts label. This list also includes the verified performance information for each product.
0.7%	Lighting Pros	There are several ways to search for specific products from this list: 2822 (36%)
1.3%	EE Sponsors	Use the drop down box to search by a specific product type.     Define specific criteria by adjusting the handles on the slider
4.6%	Testing Laboratories	bars or by entering information into the blank helps. 3. Enter text in the search box, such as a manufacturer or model number. S26 (12%)
6.6%	Consumers	Once you have narrowed your search criteria, click on the search button. You can further refine your search by clicking on the section headers.
6.2%	The Label	As of November 2012, manufacturers are required to annually designate if products
13%	The Partners	listed with LED Lighting Facts are commercially available. Products that are designated as unavailable are archived and no longer searchable from the Langer niting Facts
13%	The Products	Product List. Partners can access a list of archived products by clicking here. For more information on the annual product status update and how a product is archived, please
0.3%		see the Partner Participation Manual.
62%	Archive List	Reeldential and Commercial Product Performance Scales
2.8%	EE Programs	LED Lighting Facts has two tools for • the Residential (224 kg, PDF) comparing the performance values of LED and • the Commercial (122 kg, PDF)
1.9%	Approved Labs	standard lighting technologies for the five characteristics identified on the LED Lighting
3.8%	About	Facta (abel.
1.6%	Resources	LED Lighting Facts" Products Search Tool
	Contact Us	Show only fixture type: (All Fixture Types)
		13% 13% D and 81200 km
	Partner & Product Count	Light output between 13% 13% D and 800 w 7560
	Manufacturers 541	13% 13% 13%
	Retailers & 285 Distributors	Color Accuracy (CRI)
	Lighting Pro 261	between 13% 13% Vour Criteria
	EE Sponsor 87	12%
	Products 7560	Search Within Your Criteria: Search Reset
	Last updated 1/8/2013	

#### **LED Lighting Facts - Efficacy**



#### **LED Lighting Facts – Maximum Efficacy**



2009 Q32009 Q42010 Q12010 Q22010 Q32010 Q42011 Q12011 Q22011 Q32011 Q42012 Q12012 Q22012 Q32012 Q4

**Quarter of Initial Listing** 



#### **LED Lighting Facts – Maximum Efficacy**





Quarter of Initial Listing Seventh lites.asia workshop – Jakarta, Indonesia, 22-23 April 2013



#### Next Generation Luminaires Design Competition







#### **Best in Class Winners**



#### **NGL Trends**

- Efficacies continue to increase
- Significant documentation improvements
- Marked color improvements
- Increased dimming submissions
- Still waiting on emerging/innovative products
- Strong categories shift from year to year
  - Accent lighting always strong
  - Many downlight winners until 2013
  - Outdoor evaluation an issue until 2012
  - Troffers were prominent in 2012 along with high-bays
  - Linear pendants and track luminaires dominated 2013



#### **NGL Efficacy Advancements**

All recognized (avg. efficacy)

- 2008 37 lm/W
- 2009 52 lm/W
- 2010 45 lm/W
- 2012 65 lm/W
- <u>2013 75 lm/W (indoor)</u>

Remember, numbers are largely dependent on products recognized from year to year.



#### **CALiPER Shift in Focus**





# **CALiPER Digging Deeper**

- Snapshot Reports using data from LED Lighting Facts
- Application Reports focusing on specific product types and design scenarios, going beyond LM-79 testing
- Exploratory Studies that incorporate product installations and evaluations
- Standards Support for emerging areas such as flicker, dimming, power quality, long-term performance, etc.

#### **Recessed Troffer Exploratory Study**





- Install 24 pairs of similar performing recessed luminaires (2×2 and 2×4) and 0–10 V dimming controls in mock office space
- Show examples of fluorescent benchmarks, LED tubes, LED retrofit kits, and dedicated LED troffers
- Invite 18 designers/engineers to observe, brainstorm, and comment
- Get feedback from non-lighting experts as well



### **Energy efficiency – Luminaire efficacy**

#### All LED products did as well or better than the Fluorescent

	Min LPW	Max LPW	Average LPW	
FL benchmark troffers (28W lamps)	54	72	65.3	
Dedicated LED troffers	75	104	90.6	
LED tube retrofits	55	76	68.8	
LED retrofit kits	60	76	66.5	



#### **Energy consumption – Watts**

If you're not careful, LED retrofit tubes may not alter watts

	Min Watts	Max Watts	Average Watts
FL benchmark troffers (28W lamps)	49 (2x2)	83 (2x4)	63.5
Dedicated LED troffers (2x2 and 2x4)	34 (2x2)	58 (2x2)	43.6
LED tube retrofits	48 (2x4)	79 (2x4)	16 to 26W per tube
LED retrofit kits	35 (2x2)	51 (2x2) 🔨	41.2
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#### What did we learn?

- Wide range of quality in LED troffers
- LED tubes produce some funky luminaire appearance
- Be careful in choosing the beam angle on these tubes, LED tubes can change the distribution of light from the luminaire
- LED tubes may have unexpected installation problems, especially concerning sockets
- Luminaire efficacy is very high. Holds great promised. Look for LPW of 90+
- Dedicated LED troffers are a good option for new installations

# See it, mock it up before you buy a bunch of them!







#### What's Next?

- CALIPER focus on deeper dives
- LED Lighting Facts verification testing for QA
- NGL discussions on separate competition for cutting edge, emerging products

## Thanks!

# http://www1.eere.energy.gov/buildings/ssl/