

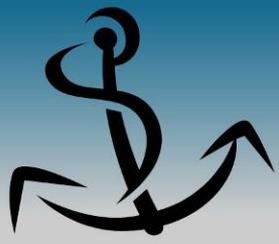
Charting a Course to Energy Independence

Providence, RI
August 9-12, 2009

DOE CALiPER *How LED Products Really Perform*

Mia Paget
Senior Research Engineer
Pacific Northwest National Laboratory



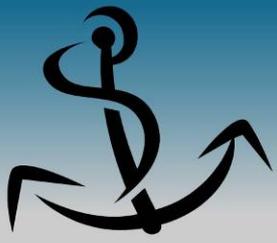


Key Messages



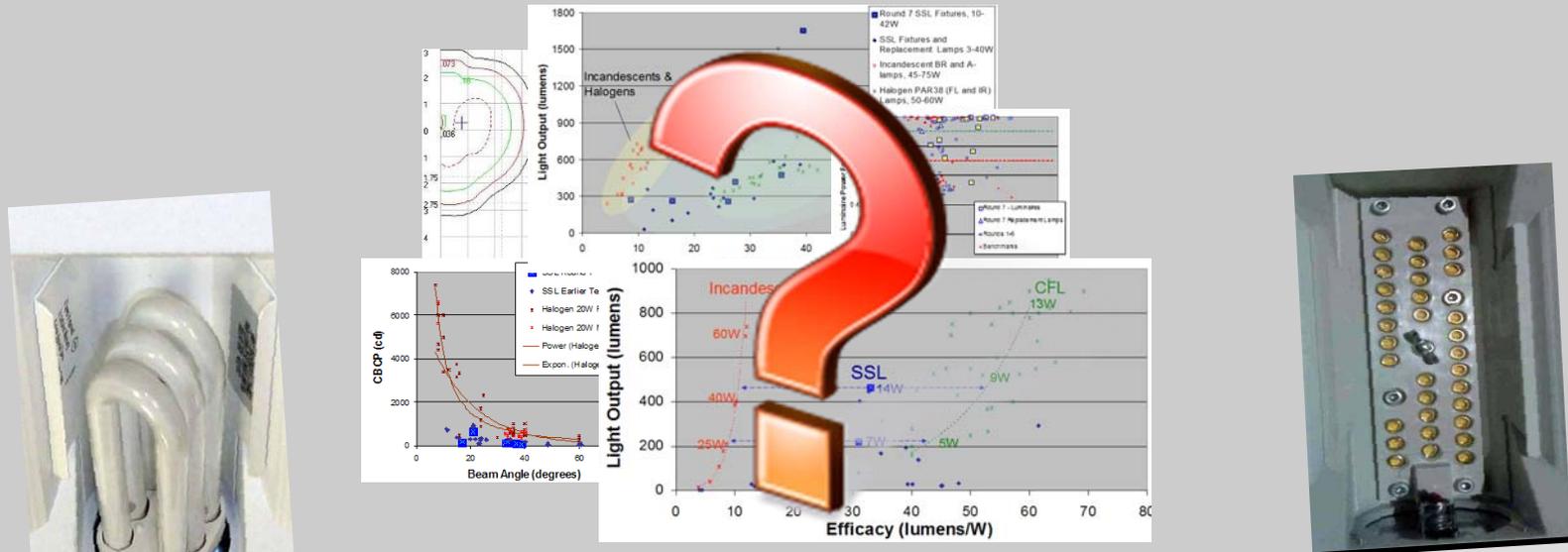
- LED technology continues to improve rapidly
 - New/revised/improved LEDs introduced regularly
- LEDs can save energy and provide high quality lighting in a growing number of applications
- Beware of generalizations
 - Few are good; many are not
 - Most LED products are new-to-market
 - Field experience is limited





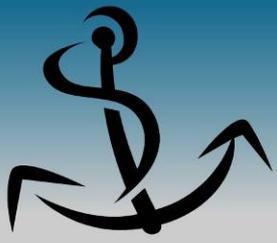
CALiPER Testing

Commercially Available LED Product Evaluation and Reporting)



SSL Luminaire and Replacement Lamp Performance





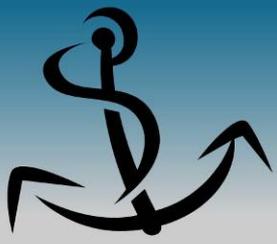
CALiPER Program Objectives

- Provide objective, high quality performance information of market available LED products
 - For DOE, to support R & D planning, and
 - Development of programs such as ENERGY STAR
- Provide independent testing data for use in industry test procedures and standards development
- Discourage low performance/quality products
- Reduce SSL market risk due to buyer dissatisfaction from products that do not perform as claimed:

“LEDs Produce
No Heat”

“LEDs last
forever”

“LEDs are VERY
efficient”



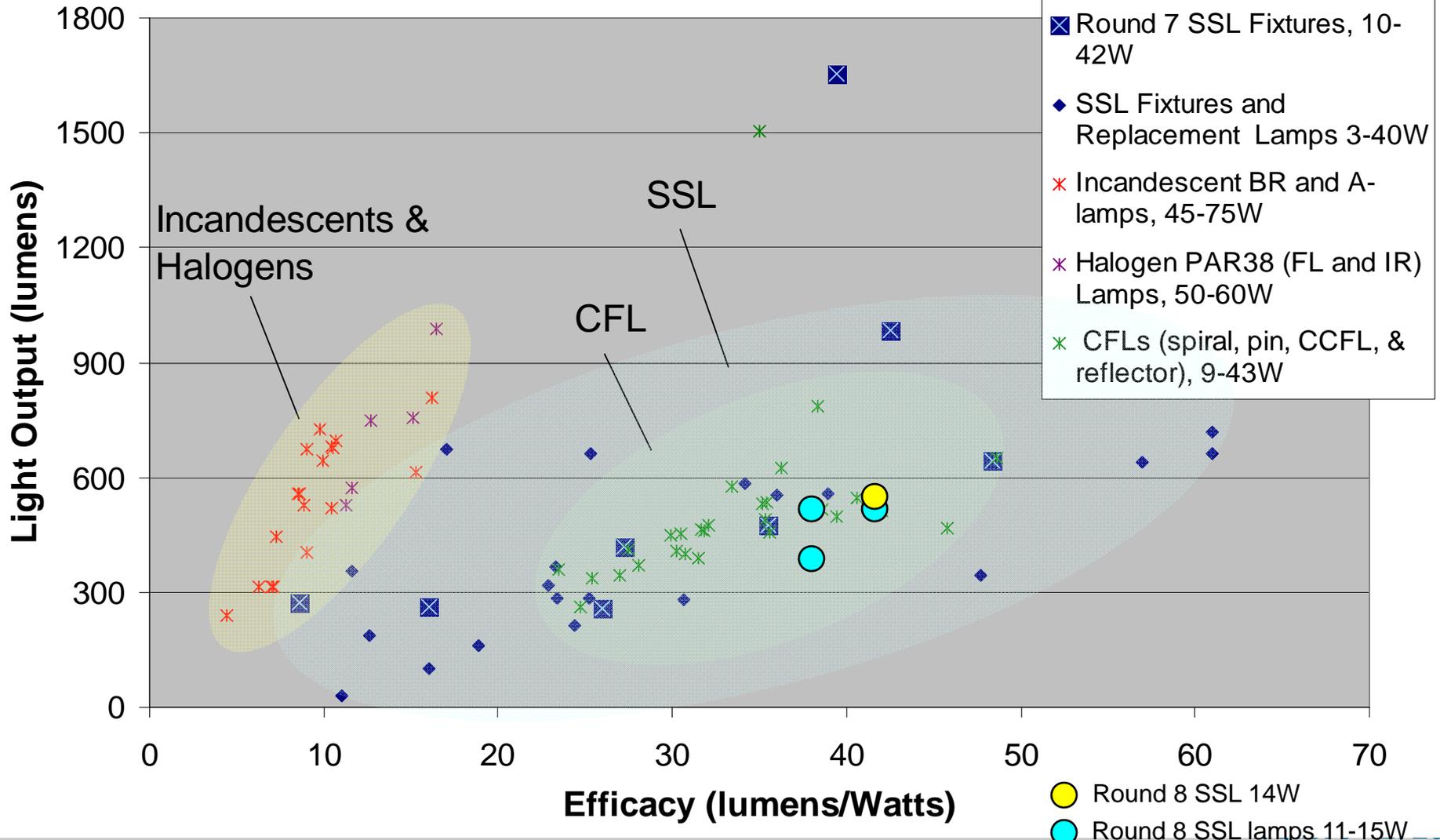
Downlights

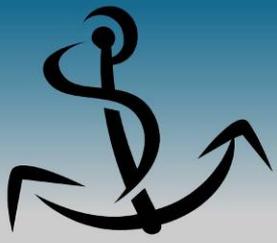
- ENERGY STAR® downlights now available
- Many meeting or exceeding CFL luminaire levels
- Keep in mind
 - Luminaire photometry: LM-79-08
 - Luminaire efficacy
 - Light output & distribution
 - CCT, CRI, D_{uv}
 - Glare, compatible dimmers...





SSL Downlight Performance





Undercabinet Fixtures

- ENERGY STAR qualified undercabinet available
- Can meet or exceed performance levels of fluorescent undercabinet
- Beware of wide range of performance characteristics:
 - Color characteristics
 - Efficacy levels
 - Light output & distribution
 - Geometries





Undercabinet – CALiPER Round 8

Undercabinet Fixtures	Test ID	Lm per lineal foot	Luminaire Efficacy (lm/W)	CCT (K)	CRI	PF	Energy Star?
SSL System-large	09-31	291	34	3030	74-93	0.83	Y
SSL System-small	09-31	274	29	2950	72-95	0.75	
SSL Strip	09-32	194	21	2973	96	0.96	
SSL Strip	09-38	200	41	5407	74	0.48	
Fluor 21W T5	07-20	230	36	3015	84	0.59	Y
Fluor 13W T5	07-41	135	20	5734	71	0.70	Y
Fluor 15W T8	07-60	235	23	3865	60	0.55	Y



Small Replacement Lamps

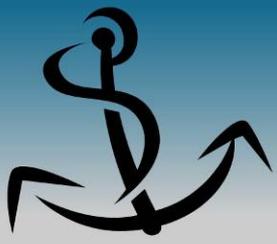
Directional

- MR-16, PAR
- Wide range of performance
- Some exceeding
 - Halogen output
 - Halogen CBCP
 - RCFL efficacy

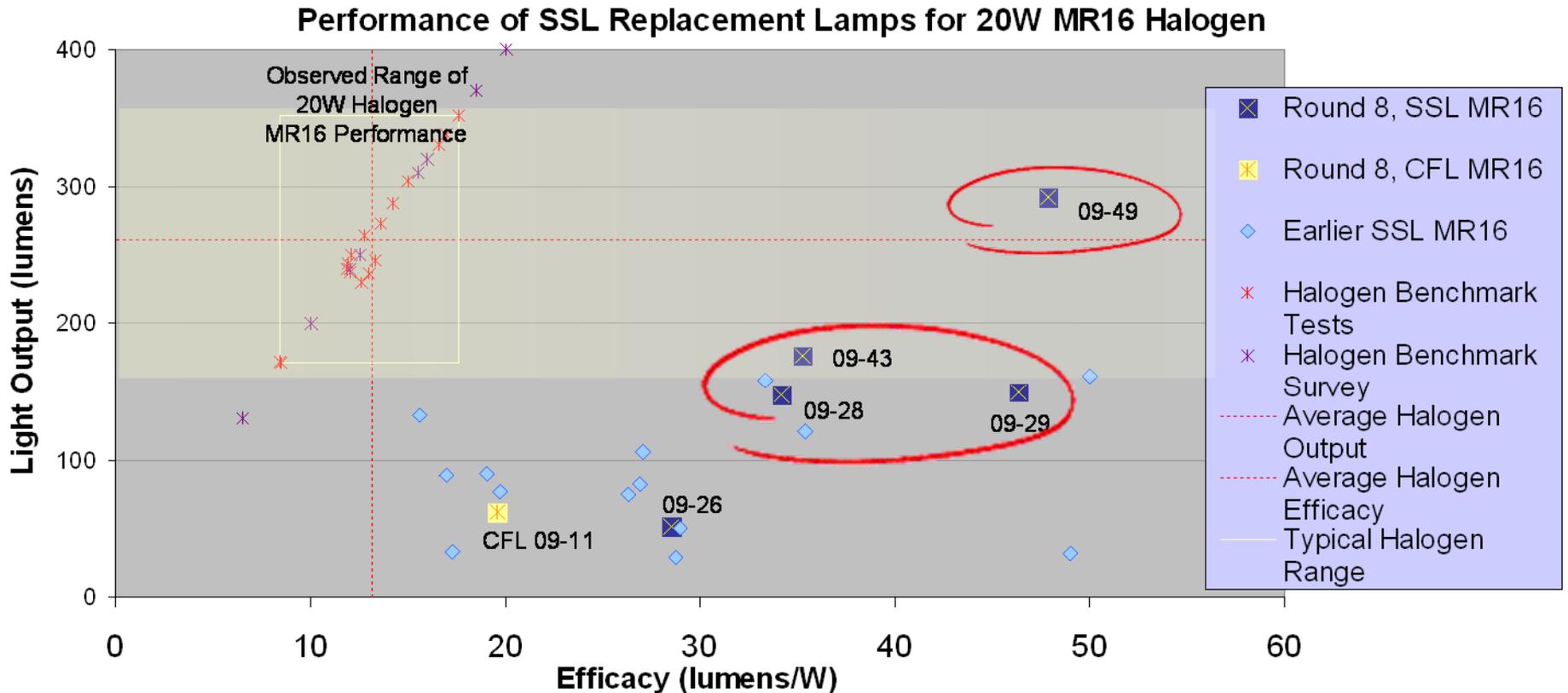
Omni-directional

- A-lamp, G-lamp, B10
- Wide range of performance
- Not meeting manufacturer claims
- Some viable for some applications

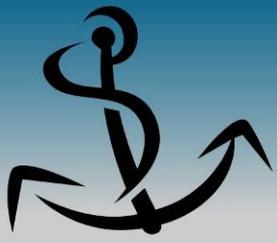




MR16 Lamps

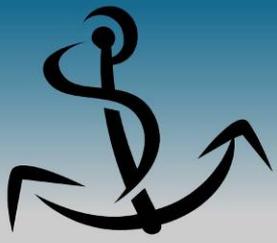


Benchmark values are based on CALiPER benchmark tests, surveyed ratings, and averaged manufacturer ratings for 20W MR16 halogen lamps. Values are based on initial output, not average life-time output.



Troffers

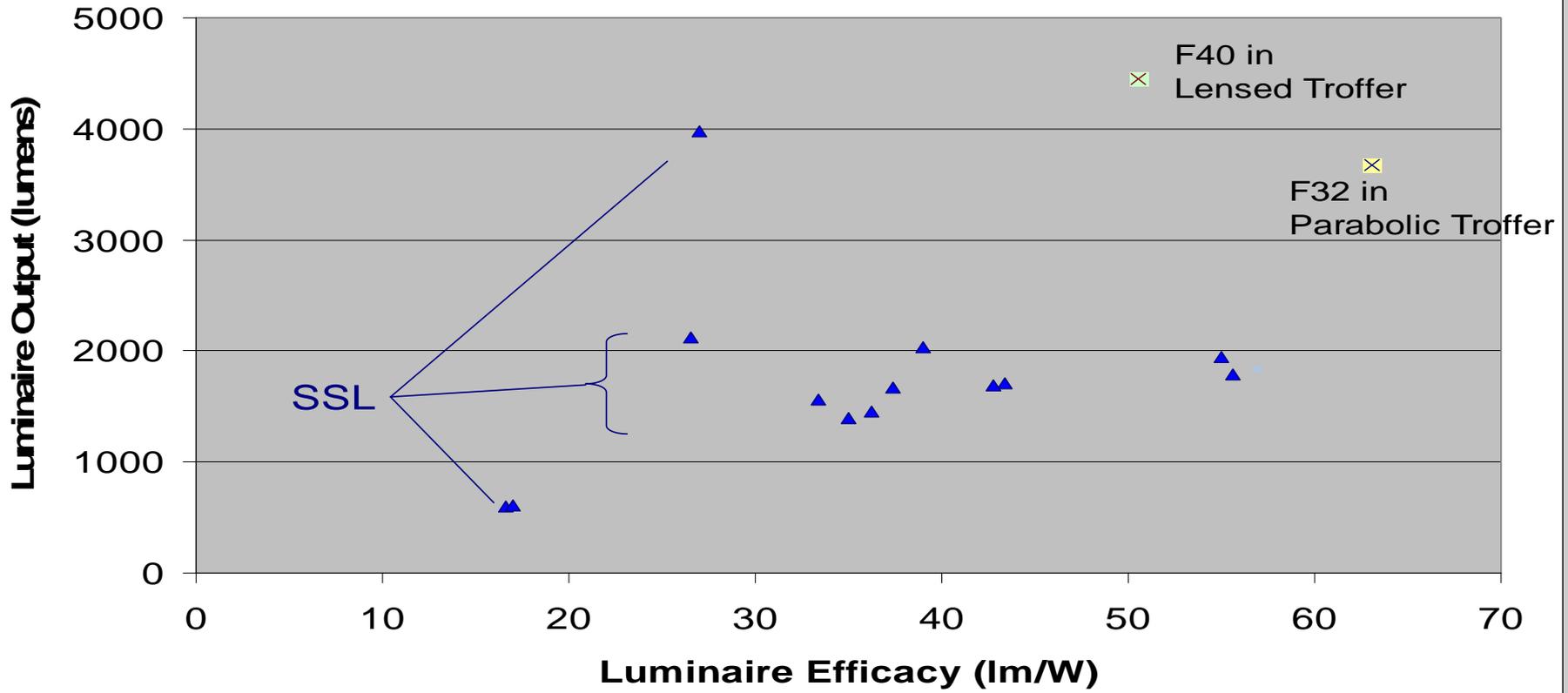
- Some 1'x1' and 2'x2' SSL products can meet or exceed some 1'x1' and 2'x2' fluorescent troffers
- 2' x 4' T8 linear lamp replacements are not yet competitive
 - ½ the light output or ½ the luminaire efficacy
- Look out for:
 - Efficacy, color, distribution & spacing, false claims, retrofits requiring rewiring



CALiPER-tested LED T-8s

½ The Light Output or ½ the Luminaire Efficacy

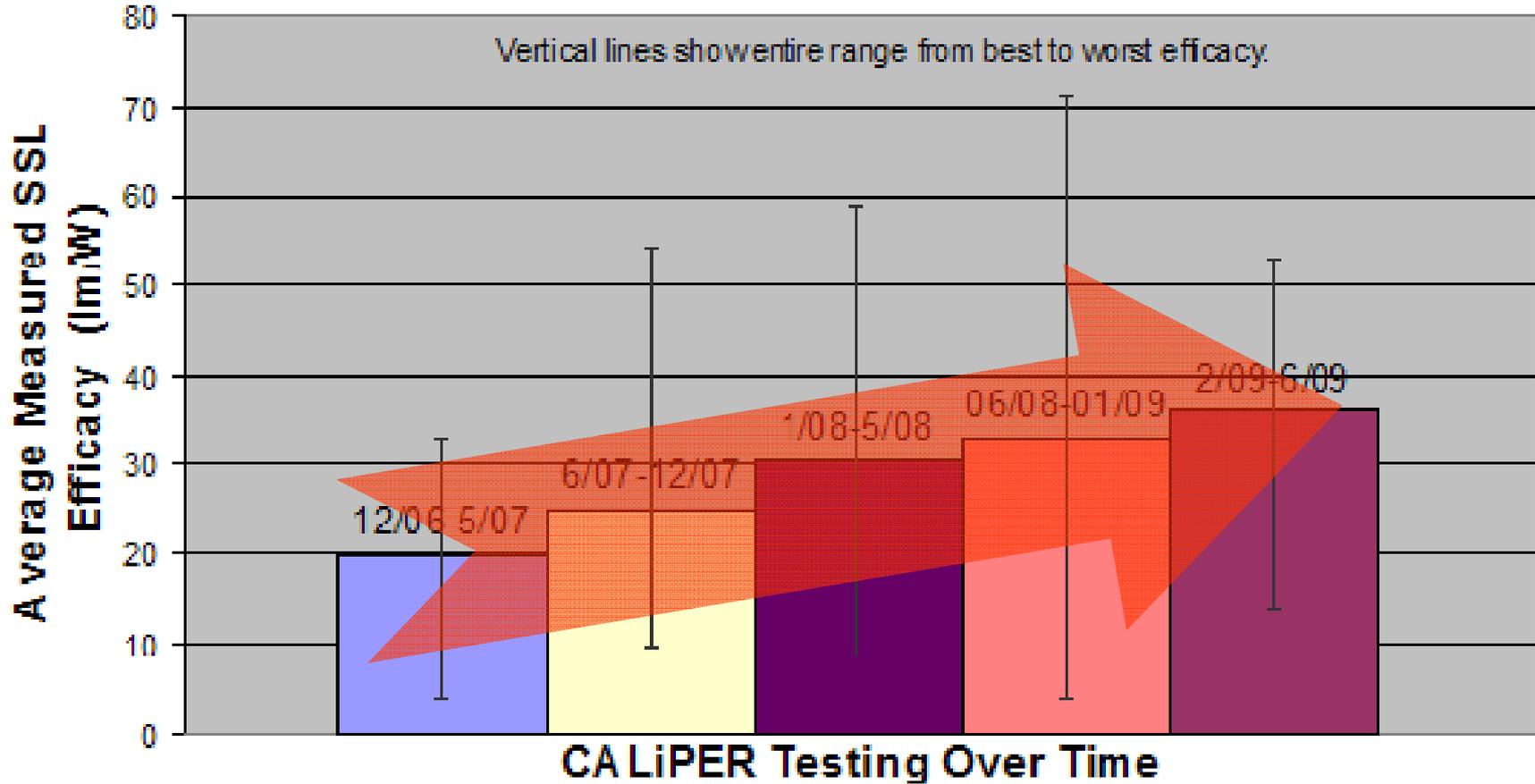
SSL vs Fluorescent in 2' x 4' Troffers





New Results Every 4 Months

Progressive Increase in Efficacy of SSL Luminaires and Replacement Lamps





Searchable Reports On-line

U.S. Department of Energy
Energy Efficiency and Renewable Energy *Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable*

Solid-State Lighting

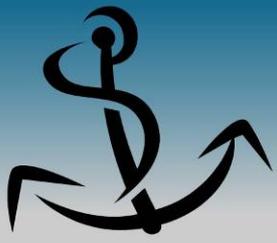
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Market-Based Programs

Advanced Search

Search using any or all data fields, for a comparative listing of information from CALiPER detailed reports. Multiple selections are allowed within round number and category fields.

Thumbnail	Light Source	Category	Round	Test Date	CALiPER Reference #	Power (W)	Initial Light Output (lm)	Initial Efficacy (lm/W)	CCT (K)	CRI	Power Factor	Report
	SSL	Downlight (6" recessed)	7	10/2008	08-118	13	476	36	3,119	52	0.84	(PDF 372 KB)
	SSL	Downlight (12"x12" recessed)	7	10/2008	08-119	42	1,654	39	3,262	82	0.99	(PDF 465 KB)
	SSL	Downlight (7.5"x7.5" surface mount)	7	11/2008	08-120	15	417	27	2,745	84	0.98	(PDF 591 KB)
	SSL	Downlight (6" recessed)	7	11/2008	08-123	13	644	48	3,073	79	0.98	(PDF 530 KB)
	SSL	Downlight (4" recessed)	7	11/2008	08-124	32	275	9	3,204	70	0.98	(PDF 496 KB)
	CFL	Downlight (12"x12" recessed)	7	12/2008	08-125	43	1,503	35	3,140	83	1.00	(PDF 598 KB)



CALiPER



Questions? Looking for More?

www.ssl.energy.gov/caliper.html

- Round by round summaries
- Detailed photometric reports
- Benchmark reports
- Exploratory reports
 - Dimming study
 - Long-term testing study
 - Variability and repeatability study