DOE CALiPER Program The Latest Test Results and Analysis

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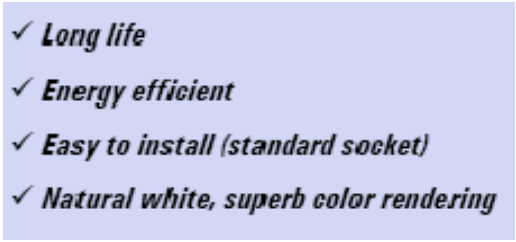
Purposes of CALiPER

- Provide objective, high quality performance information
- Know performance of market available products
  - To support R & D planning
  - To support ENERGY STAR
- Inform industry test procedures and standards development
- Discourage low quality products
- Reduce SSL market risk due to buyer dissatisfaction from products that do not perform as claimed



SSL Luminaire Testing

SSL energy efficiency is a function of:

LED device efficacy

+

Thermal management

+

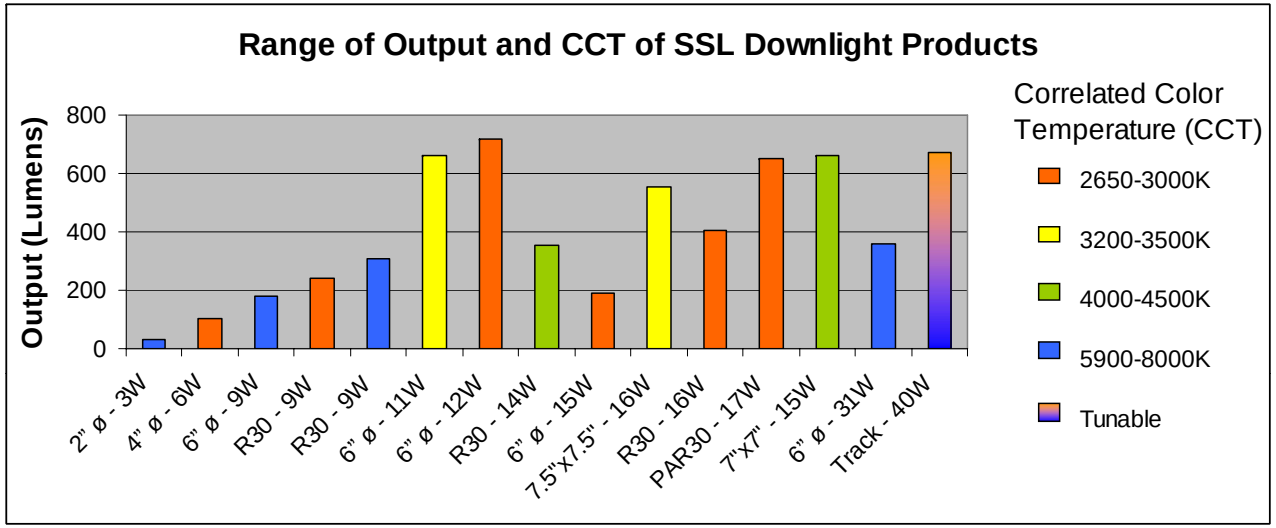
Driver/power supply efficiency

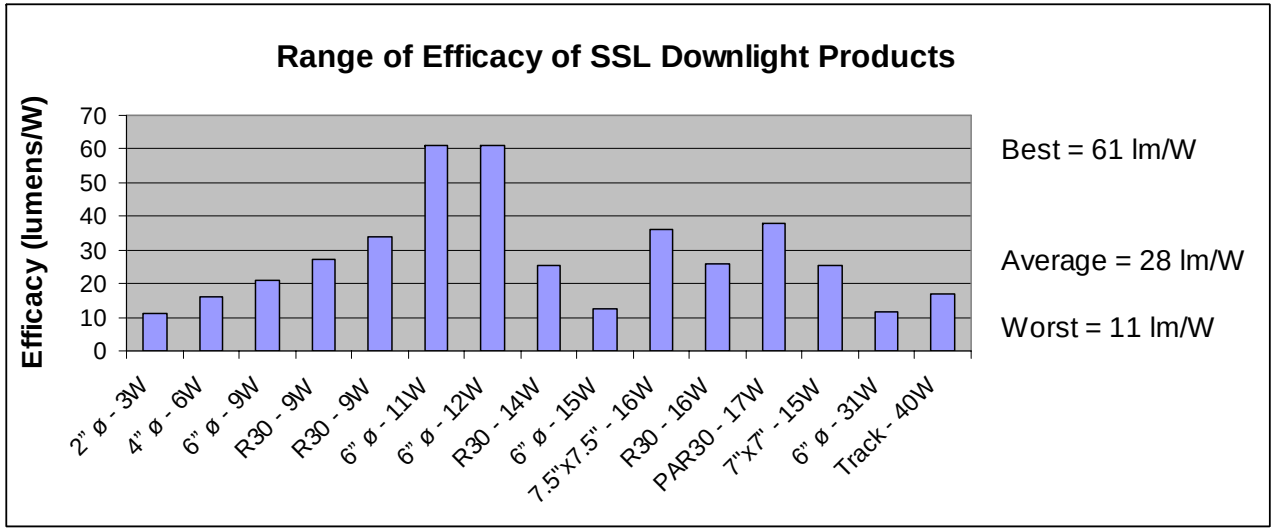
+

Luminaire design

- Must measure luminaire as a complete system
- Uses 'absolute photometry' rather than 'relative photometry'
- Based on IESNA *draft* standard LM-79
  - Photometric testing methods under development
- Stakeholders are not all familiar with these new testing paradigms

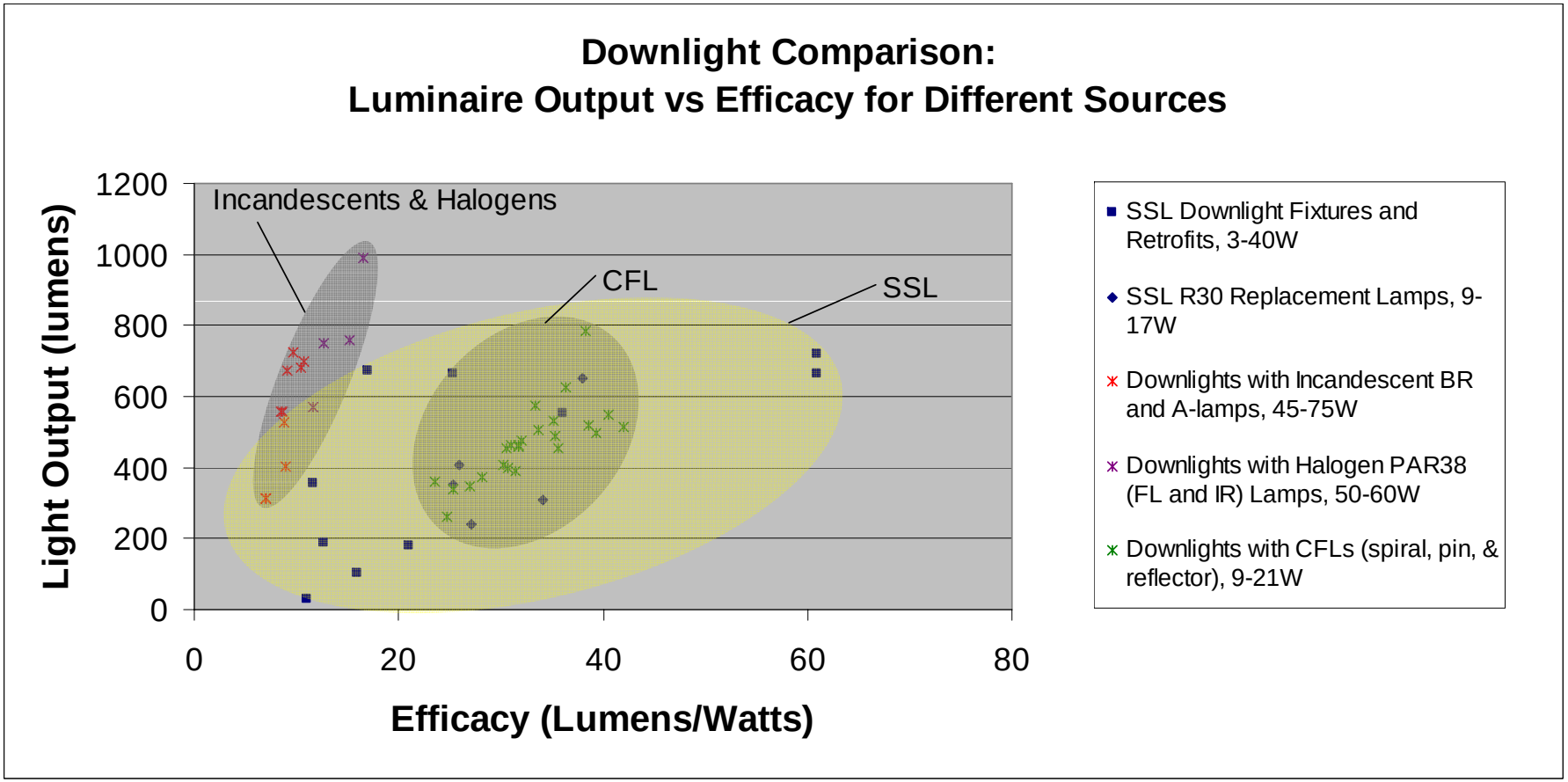
SSL Downlight Performance





- Different sizes and configurations
- Different color temperatures
- Outputs
  - From 29 to 719 lumens
  - 389 lumens on average
- Efficacies
  - From 11 to 61 lm/W
  - 28 lm/W on average
- CRI
  - Maximum = 95
  - Average = 76
  - 3 RGB products

Downlight Benchmarking



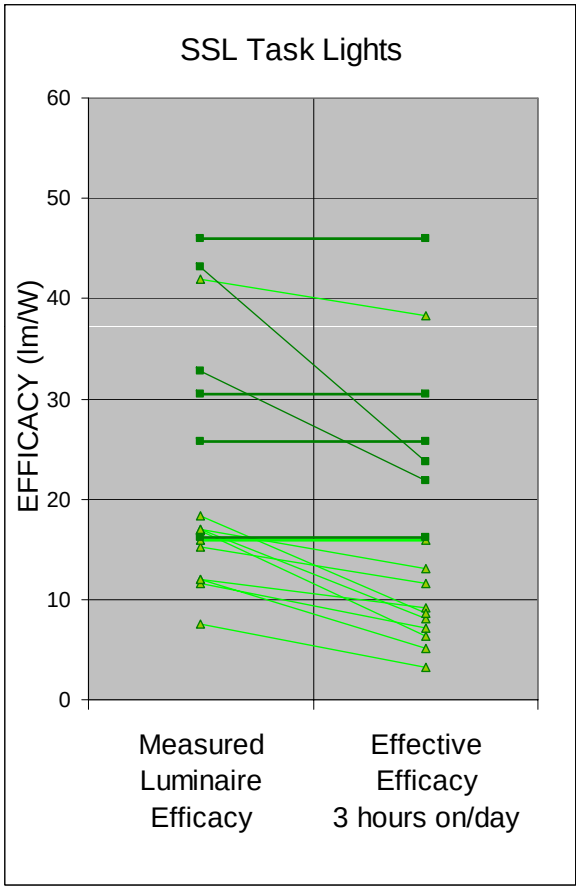
--Values for SSL downlight products are from CALiPER testing.
--Values for CFL and incandescents are assembled from CALiPER testing, earlier photometric testing and product catalogs.
--Fixture efficiencies are applied to replacement lamp values (factor depends on lamp type).

Round 4 Replacement Lamps

- T8: Look for direct comparisons with fluorescents in troffers in Round 5
  - Respectable performance (42 lm/W), but misleading manufacturer literature
- MR16: not quite competing with 20W Halogen MR16 Flood (40° beam angle)
  - ↑ Efficacy: SSL-MR16 @ 16-27 lm/W **>** 20W Halogen flood @ 9-19 lm/W
  - ↓ Output: SSL-MR16 @ 75-133 lm **<** 20W Halogen flood @ 200-450 lm
  - ↓ CBCP: SSL-MR16 @ 59-283 cd **<<** 20W Halogen flood @ ~500 cd
- Candelabra: Low wattage level, advantage or disadvantage?
  - No comparably small wattage incandescent products
  - CFL 5W candelabra rated at 200 lm (40 lm/W), Halogen 25W rated at 280 lm (11 lm/W)

Replacement Lamps		Power	Output	Efficacy	CCT	CRI
SSL T8	07-56	25	1058	42	3494	75
SSL MR16, *CBCP=283*	07-53	3	82	27	3007	74
SSL MR16, *CBCP=220*	07-59	9	133	16	3338	89
SSL MR16, *CBCP=59*	07-64	3	75	26	3458	74
SSL Candelabra	07-57	2.2	28	13	2855	71

SSL Task Lamp Performance



SSL Undercabinets

SSL Desk Lamps

Task lamps tested

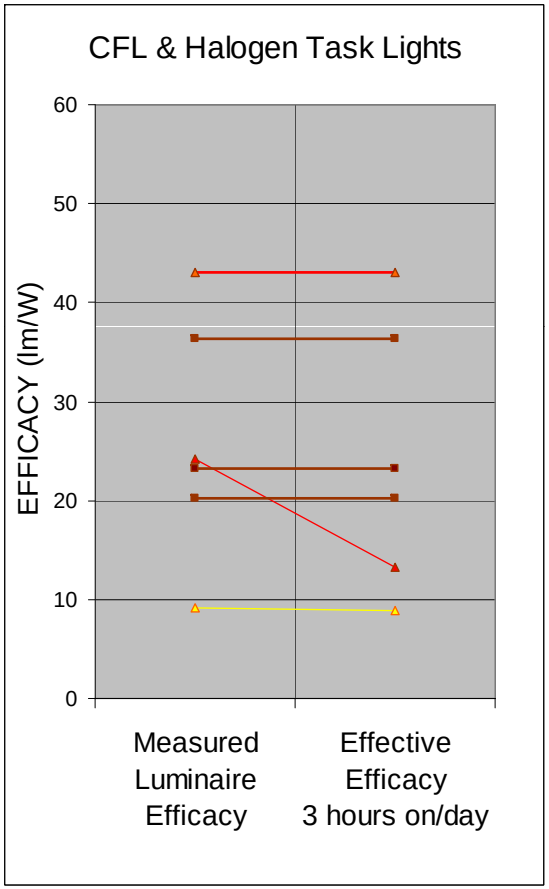
- 6 SSL undercabinets, 11 SSL desk lamps
- 3 fluorescent tube undercabinets, 2 CFL desk lamps
- 1 halogen desk lamp

SSL undercabinets

- Perform as well or better than fluorescent undercabinets

SSL desk lamps

- One SSL desk lamp rivals CFL energy star desk lamp
- Off-state power use ranges from 0 W to 2.6 W, reducing efficacy



Fluorescent Undercabinets

CFL Desk Lamps

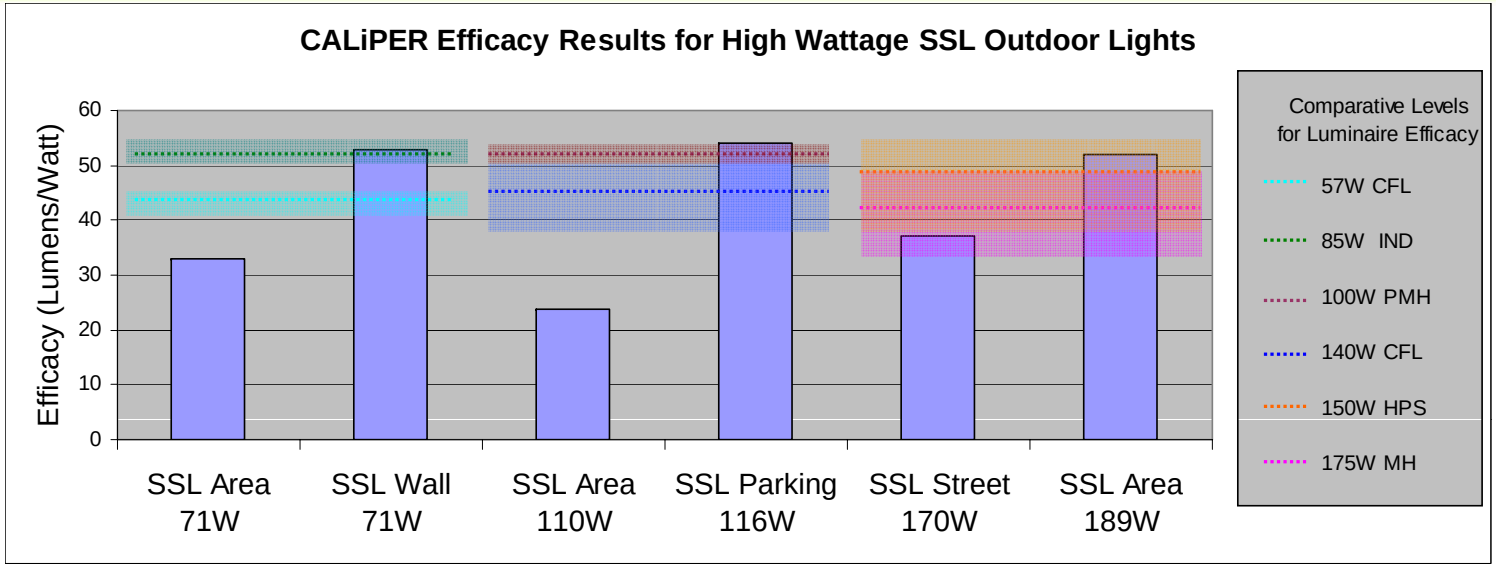
Halogen Desk Lamps

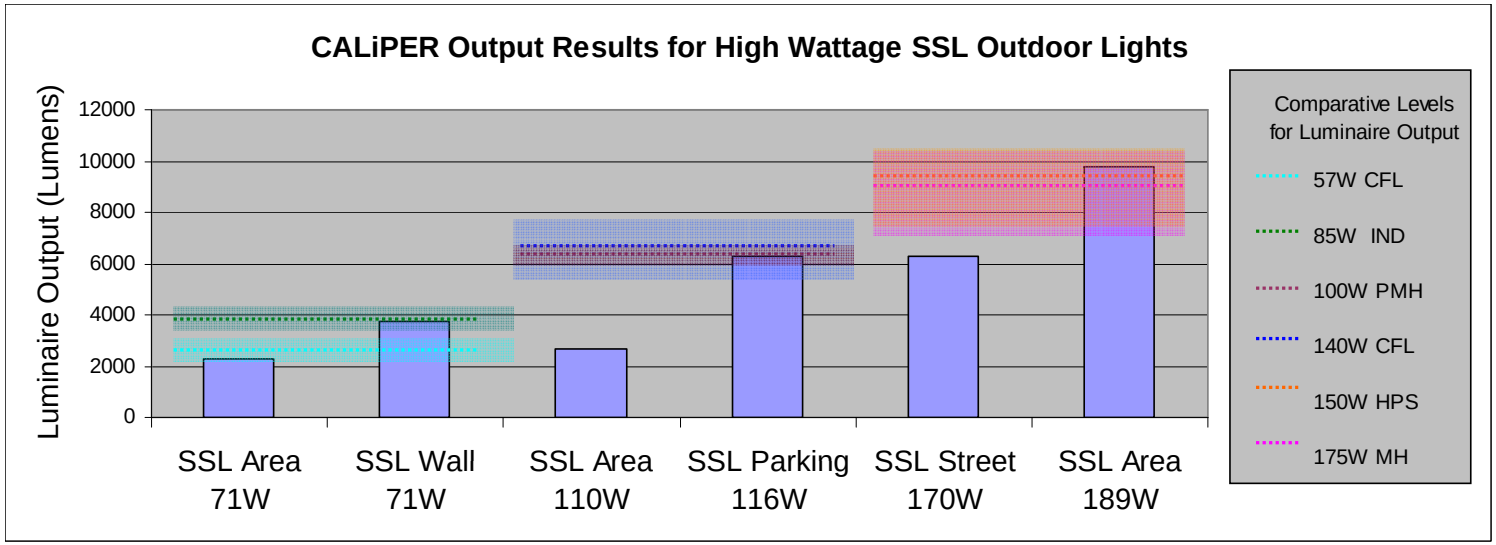
Round 4 Direct Comparisons

Same Recessed Wall Fixture, Different Sources			
	Halogen (20W)	CFL (13W)	LED (12W)
Luminaire Output (lm)	174	199	154
Luminaire Efficacy (lm/W)	8	16	10
CCT	3085	3956	5166
CRI	98	77	73
Power Factor	0.99	0.97	0.97

Manufacturer Published Values			
Recessed Wall Fixture	Manufacturer Brochure Output "Lumens"	Efficacy Calculated from Manufacturer IES files (lumens/W)	**CALiPER Measured Luminaire Efficacy (lumens/W)**
Halogen (20W)	350	8	**8**
CFL (13W)	900	19	**16**
LED (12W)	195	5	**10**

Outdoor Luminaires





Comparative levels are for initial luminaire efficacy and output, established using IES files and ballast factors for outdoor area lights, cobraheads, post-top, and pedestrian lights for CFL, induction, metal halide, pulse start metal halide, and high pressure sodium fixtures.

Rounds 1-4 Key Conclusions

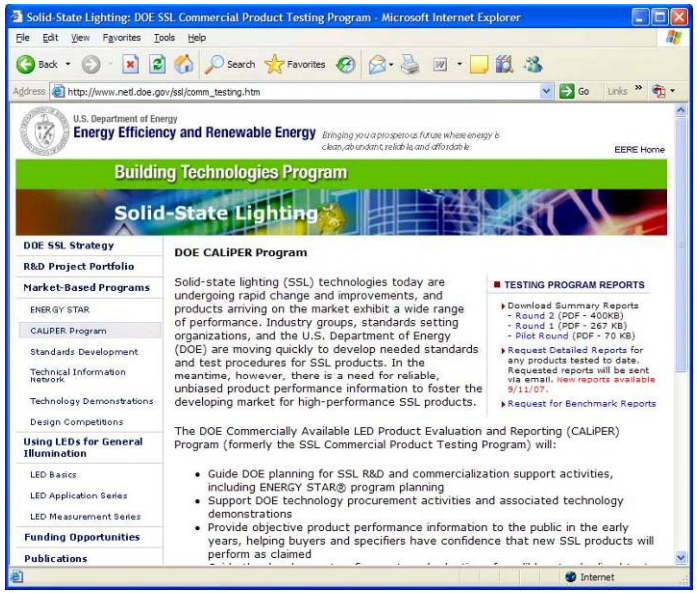
- Results include a wide range of products with a wide range of performance.
  - Be careful not to generalize.
- Product literature not always consistent, not always reliable
  - Be informed. Request luminaire testing results.

Round 1-4 products designed from 2005-2007, showing some now clearly rival traditional sources

Great promise for upcoming generation of SSL luminaires

More Info on CALiPER

- Via website
  - Summary reports
  - Detailed reports
    - Must be requested via web form
    - Requestor's contact information must be provided
    - Must agree to adhere to 'No Commercial Use Policy'



http://www.netl.doe.gov/ssl/comm_testing.htm

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