
Project Title: OLED Lighting Device Architecture

Agreement Number **FC26-06NT42933**

Performer: Eastman Kodak Company

Principal Investigator

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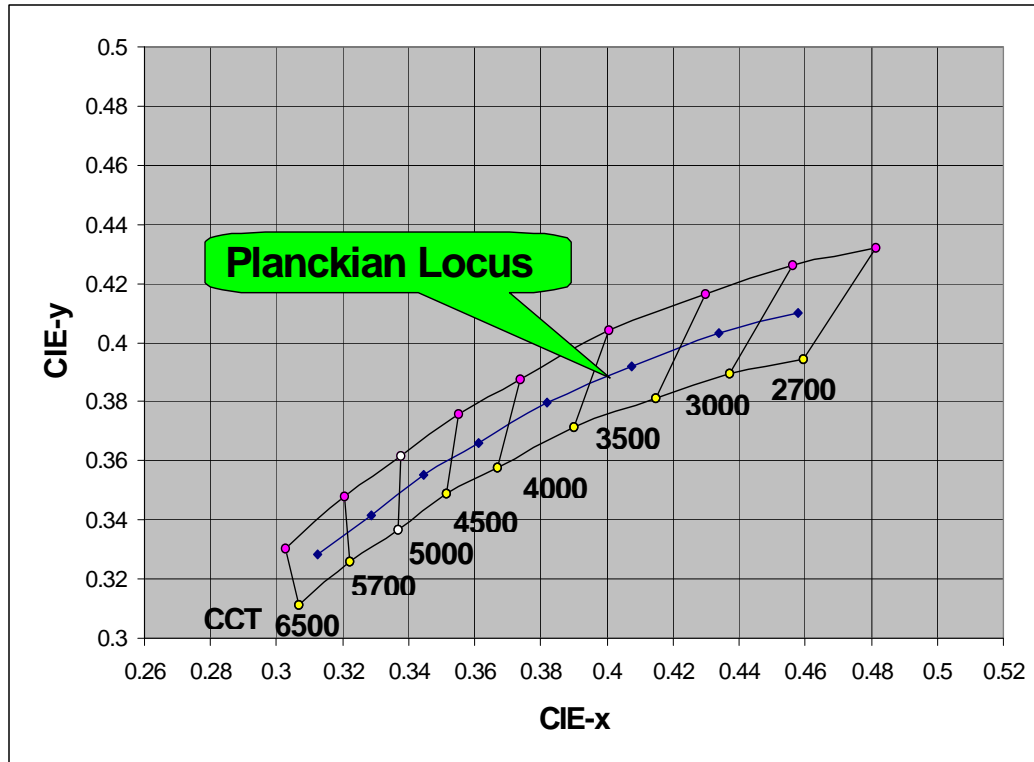
Technology Focus

Product

Project Goals

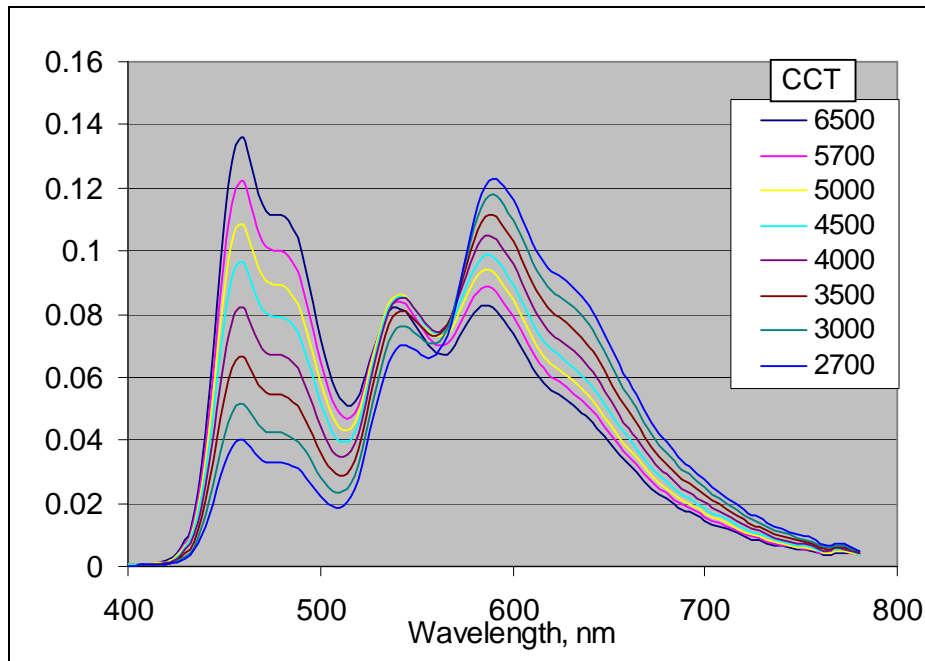
Demonstrate 50 lm/W power efficiency and 10,000 hours lifetime (T50) at 1,000 cd/m².

Meet DOE Energy Star color requirements.



CRI > 75

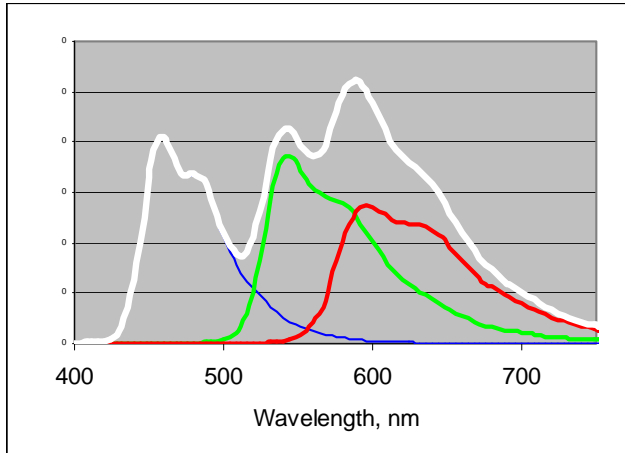
White OLED From Three Colored Emitters



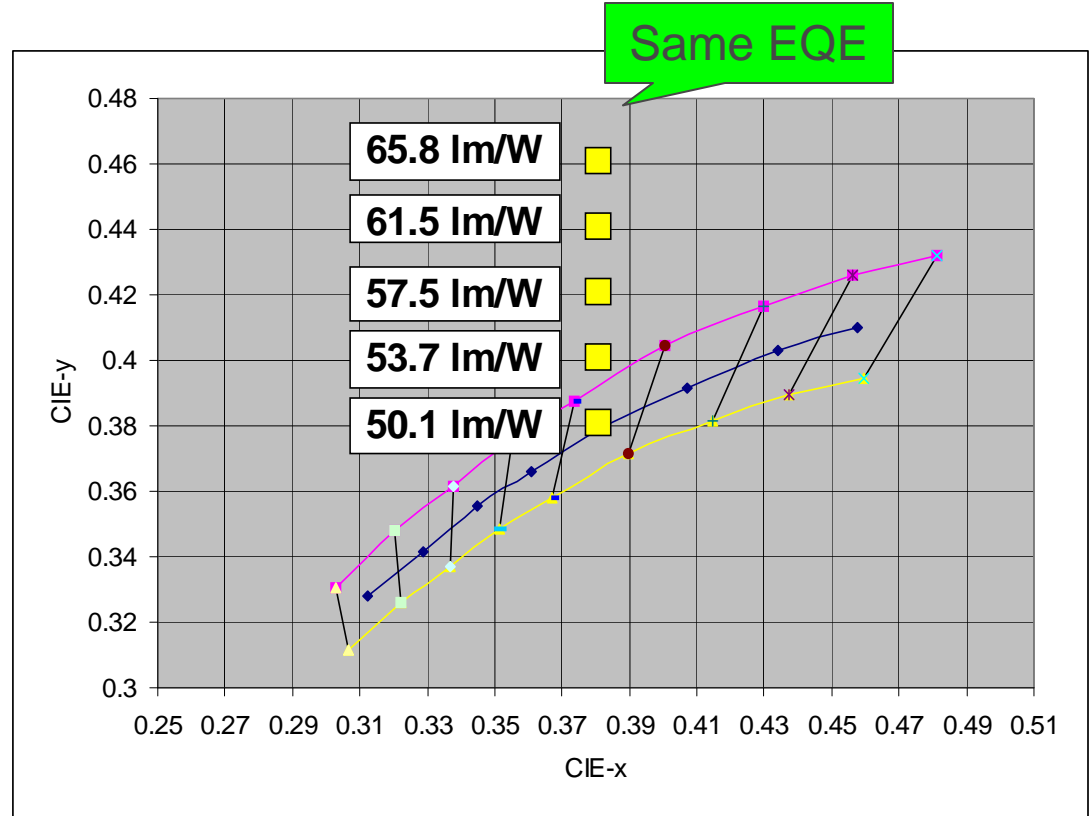
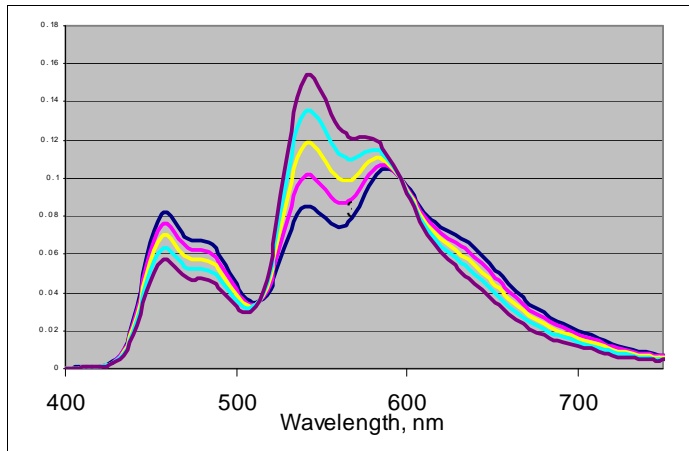
		% Photons		
		Blue	Green	Red
CCT	2700	12.2	32.2	55.6
	3000	15.7	34.8	49.5
	3500	20.2	36.5	43.2
	4000	25.0	37.8	37.2
	4500	29.5	37.1	33.3
	5000	33.3	36.8	30.0
	5700	37.3	34.9	27.8
	6500	41.6	33.1	25.3

- May not be possible with all device architectures
- May not be possible with all materials combinations

Color & Efficacy

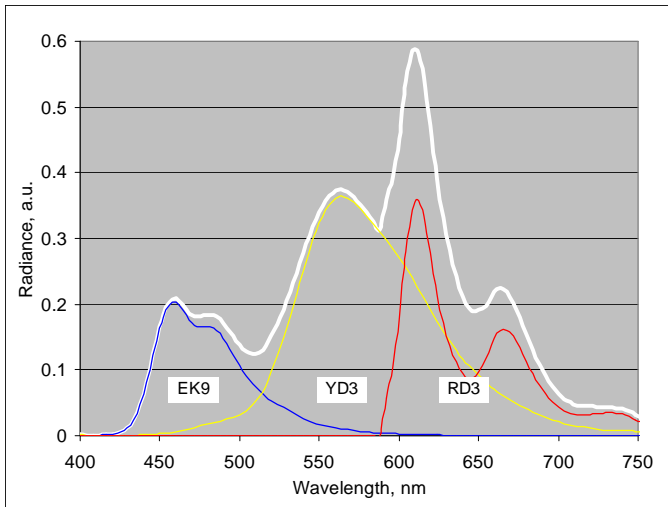


**4000K 683 lm/A;
EQE = 22%; Voltage = 3.0 V
Efficacy = 50.1 lm/W**



- Even if we can maintain the same EQE, we have to reduce efficacy to get the good color
- For some device architectures/materials, we have to reduce EQE to get the good color

Power Efficacy of White OLED

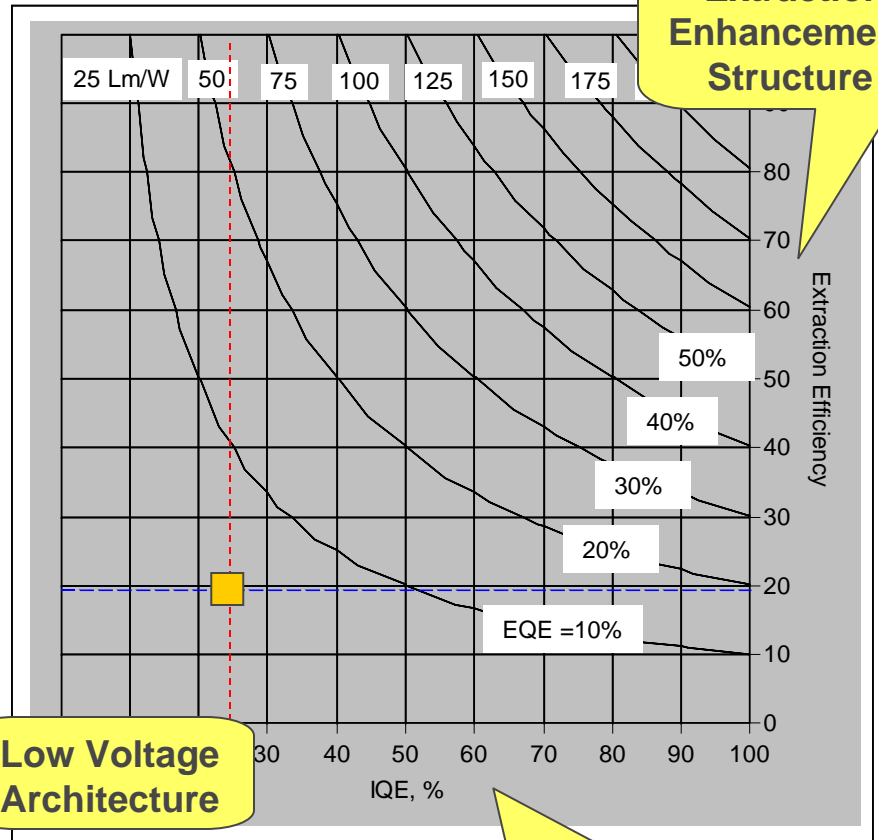


CCT = 3000 K CRI = 82.6

Total Available Light = 696 lm/A

= 174 lm/W @ 4.0 V

= 249 lm/W @ 2.8 V



Extraction Enhancement Structure

Low Voltage Architecture

Phosphorescent and Hybrid White Emitters

$$\text{Efficacy} = (\text{lm/A} / \text{V}) \times \underbrace{\text{IQE} \times \text{EFF}_{\text{extraction}}}_{\text{EQE}}$$

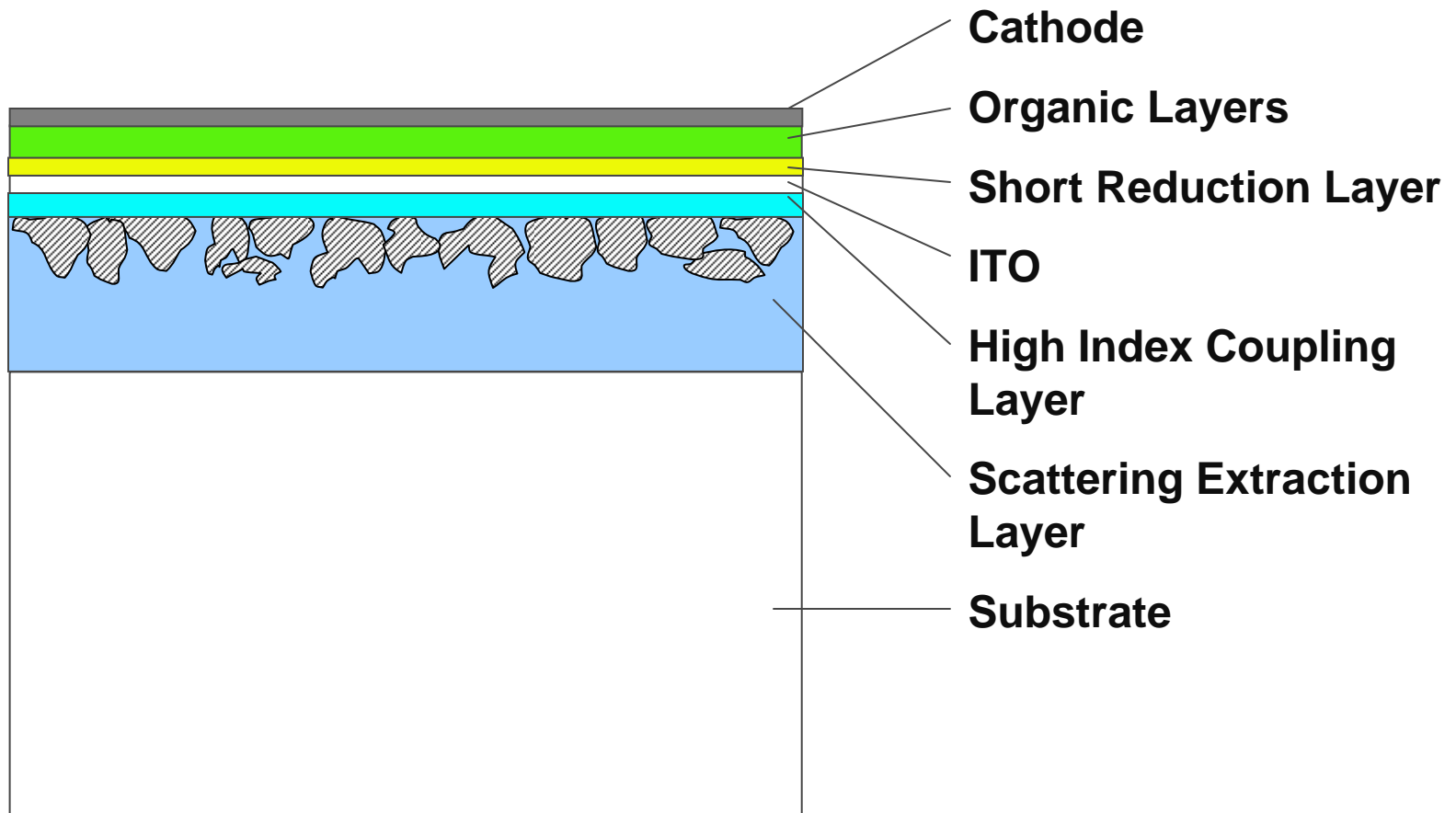
Technical Approach

- **Low-voltage materials and architecture**
- **Fluorescent and hybrid fluorescent/phosphorescent white-emitting layers**
- **Stacked structure**
- **Light extraction enhancement using extraction enhancement layers**

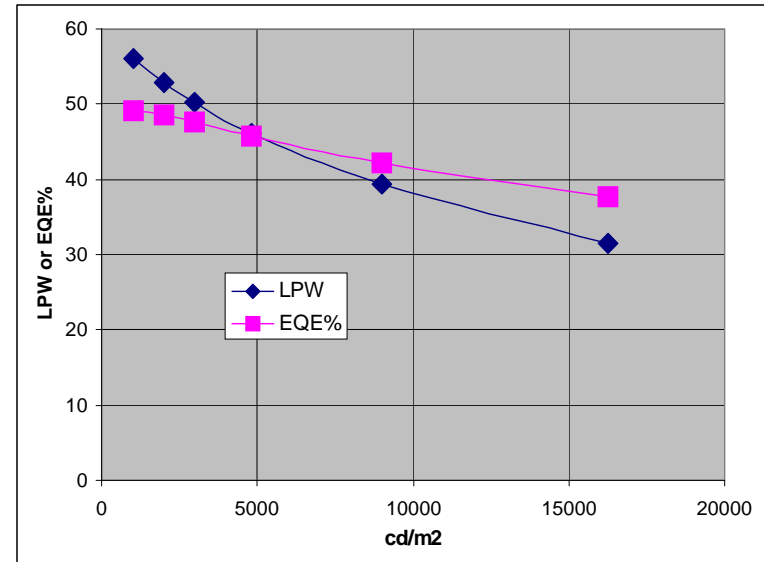
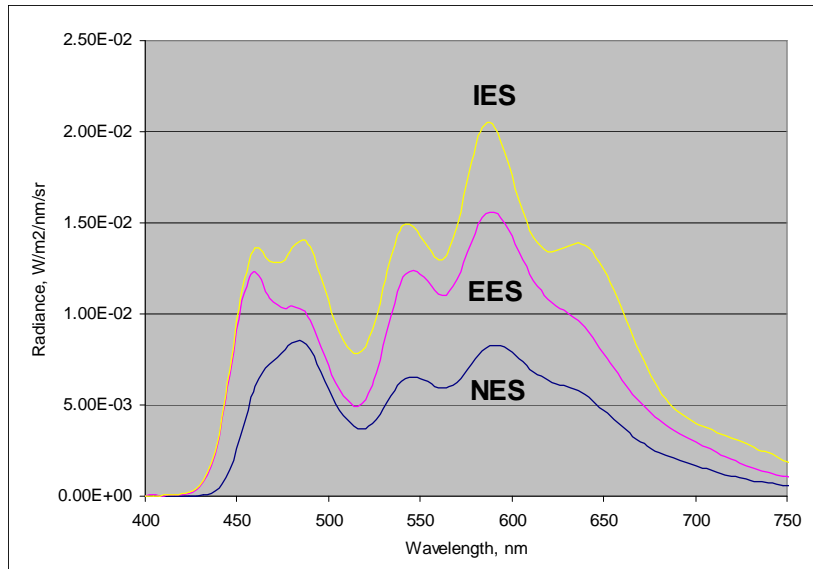
Device Structure



Internal Extraction Structure

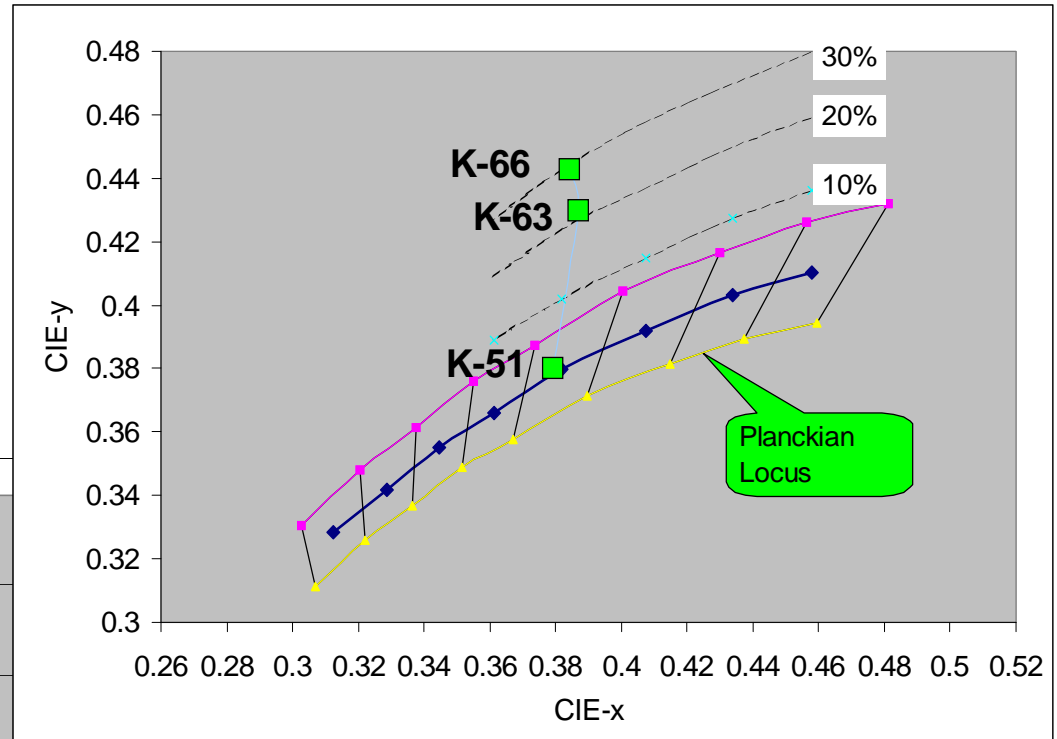
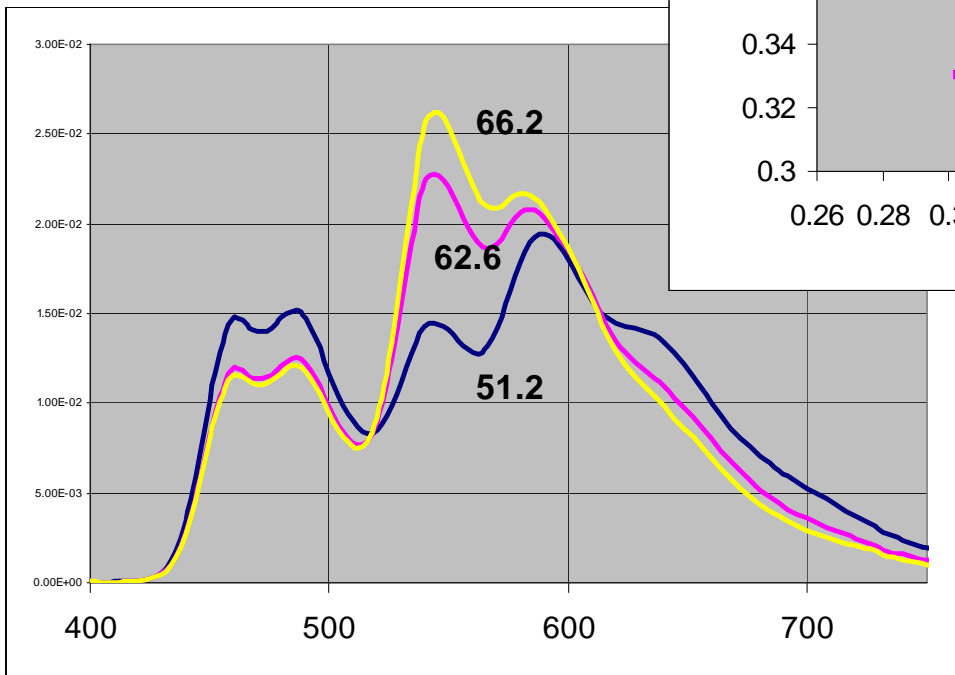


Effect of Extraction Enhancement Structures

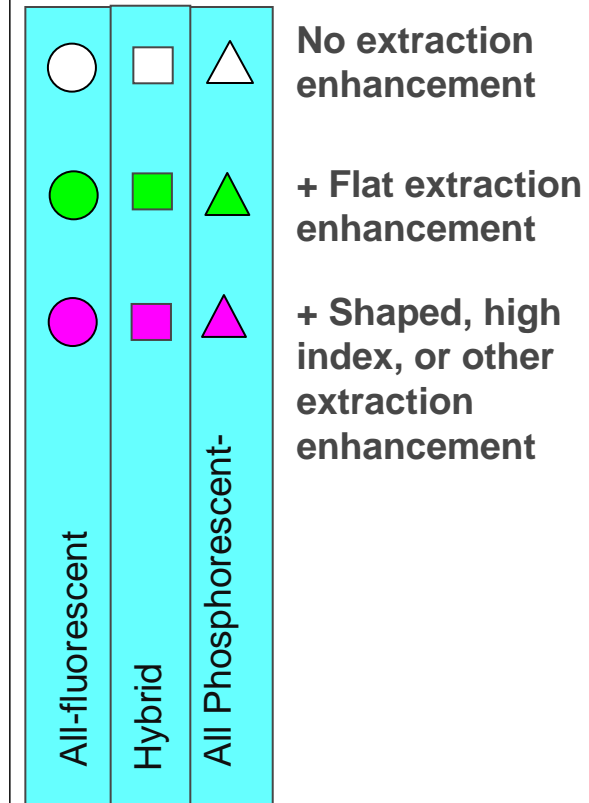
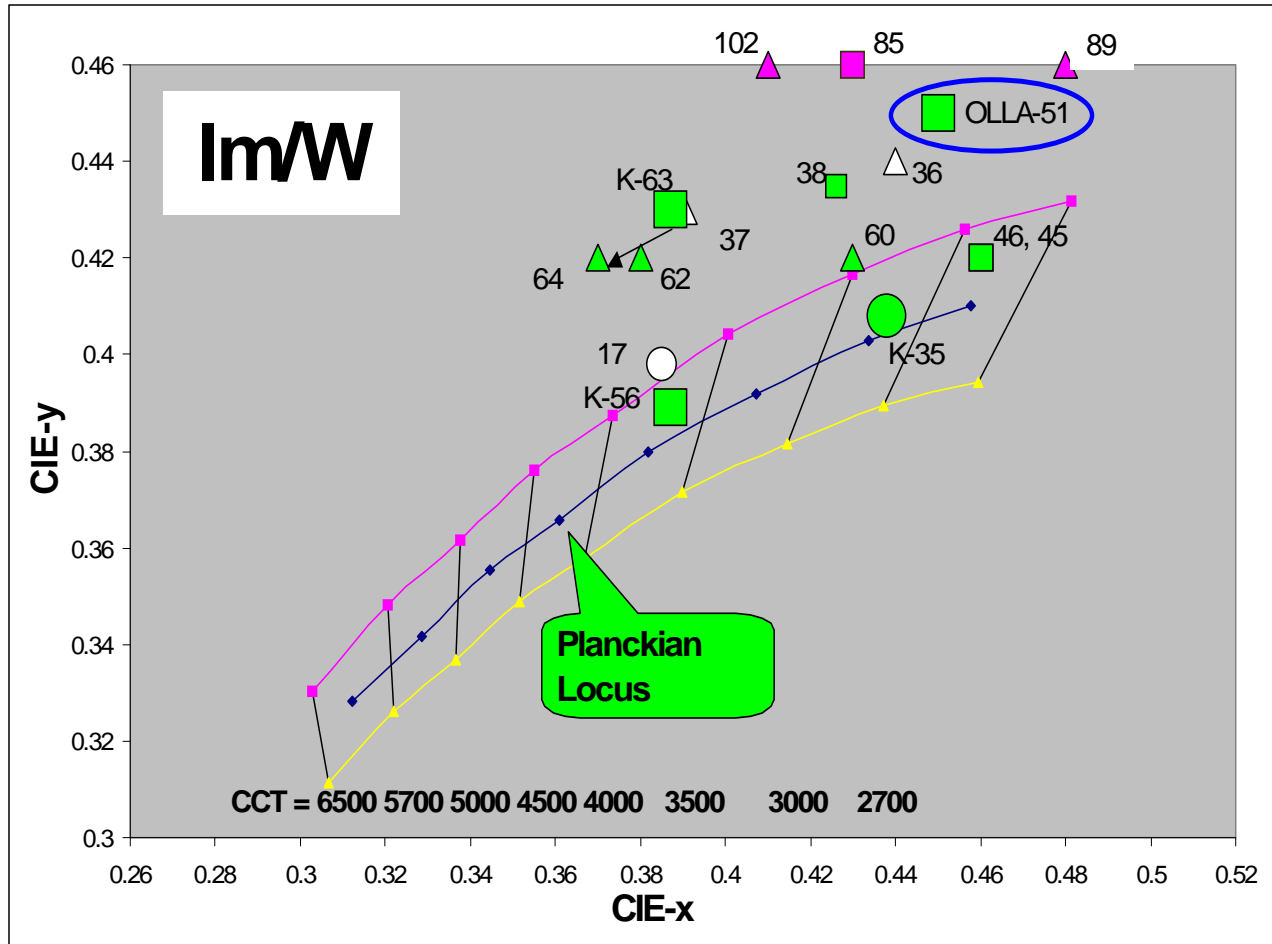


	mA/cm ²	cd/m ²	EQE%	cd/A	CIE-x	CIE-y	V	lm/W	CCT	CRI	EQE/NES
NES	1	453	21.5	45.3	0.380	0.392	5.7	24.8			
EES	1	795	37.0	79.5	0.383	0.378	5.7	43.9	3865	81.1	1.72
IES	1	1022	49.2	102.2	0.387	0.389	5.7	56.0	3836	83.6	2.29

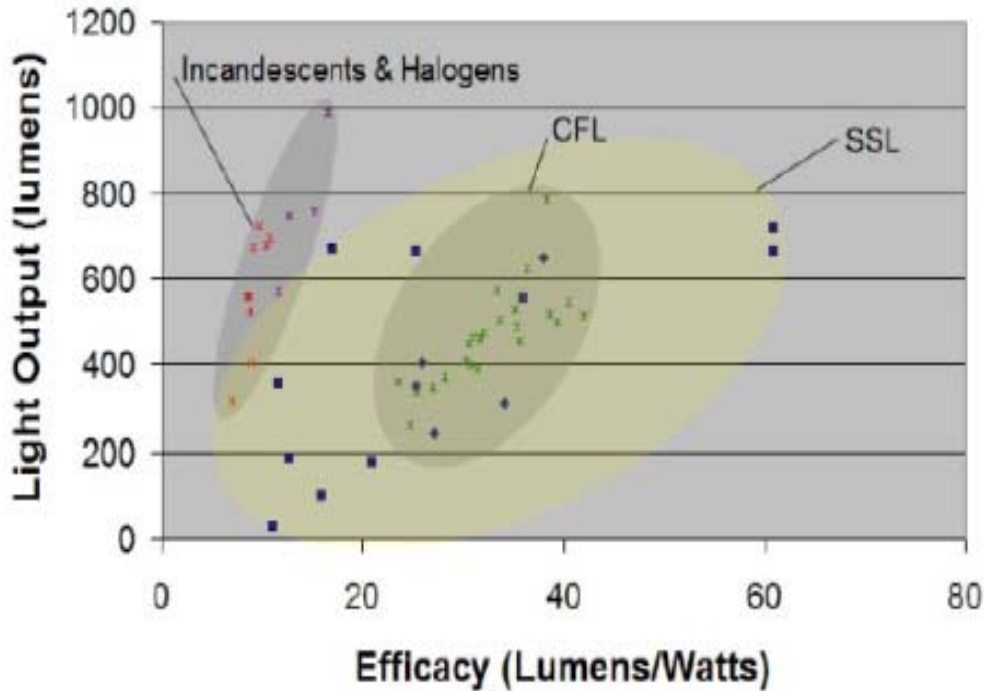
Color & Efficacy



High-Performance White OLED Devices



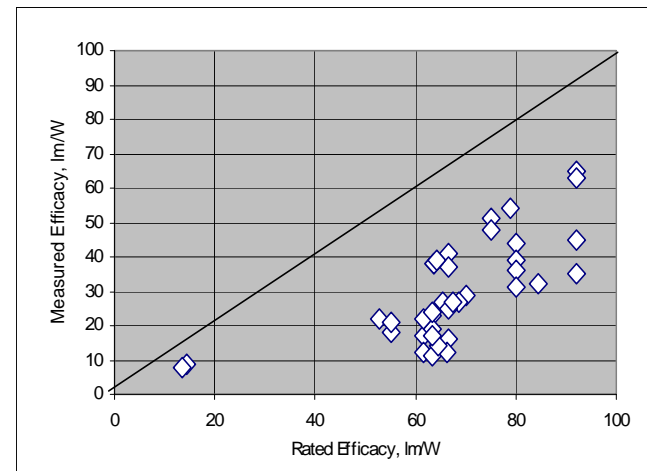
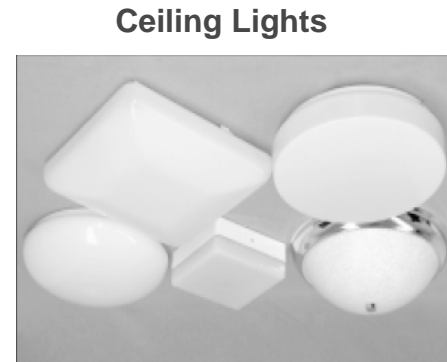
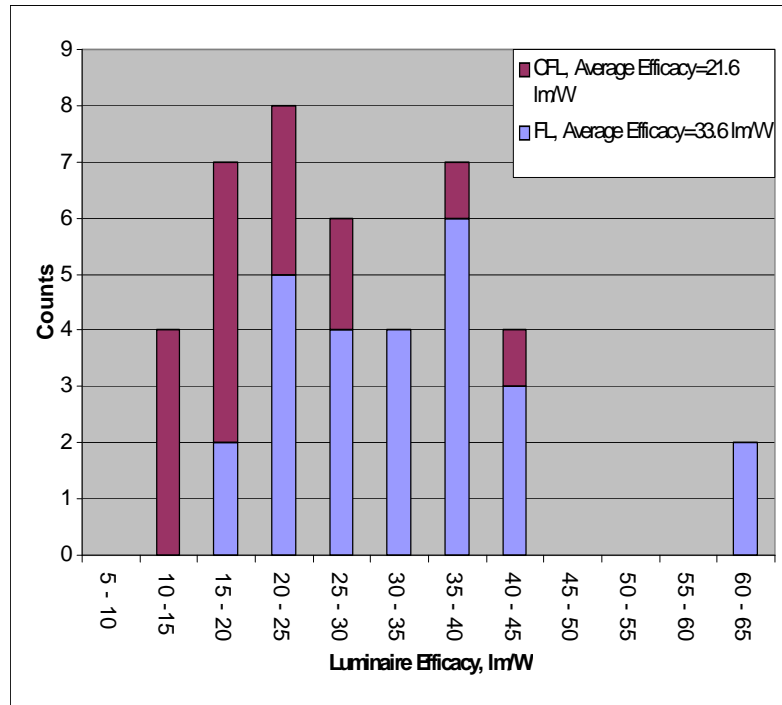
Efficacy of Competing Lighting Technologies -- downlight test results



Source: DOE
CALiPER Report

Efficacy of Competing Lighting Technologies

-- ceiling lights test results



Source:



Specifier Reports

Energy-Efficient Ceiling-Mounted Residential Luminaires

Volume 7 Number 2

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Summary

Project Goals

Demonstrate 50 lum/W power efficiency and 10,000 hours lifetime (T50) at 1,000 cd/m².
Meet Energy Star color requirements.

Project Status

Demonstrated 56 lum/W power efficiency and 10,000 hours lifetime (T50) at 1,000 cd/m²; color coordinates within 4,000K tolerance quadrangle, CRI = 83.6.