



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Update: ENERGY STAR[®] for SSL

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Activities to Date

- 1st Draft released December 20, 2006
- 1st Draft comments due: January 19, 2007
- Stakeholder meeting: February 8, 2007
- 2nd Draft released: April 9, 2007
- 2nd Draft comments due: May 4, 2007
- Effective date will be 270 days after the final criteria is released.



Transitional Two-Category Approach

- Approach recognizes rapidly changing technology
- Allows early participation of limited range of SSL products for directional lighting applications (Category A)
- At some point (3-5 years), Category A will be dropped entirely; Category B then becomes basis of criteria

Lighting industry is learning the unique issues of applying SSL to general illumination. Going slow allows industry and DOE to learn, and adjust



Understanding Terminology

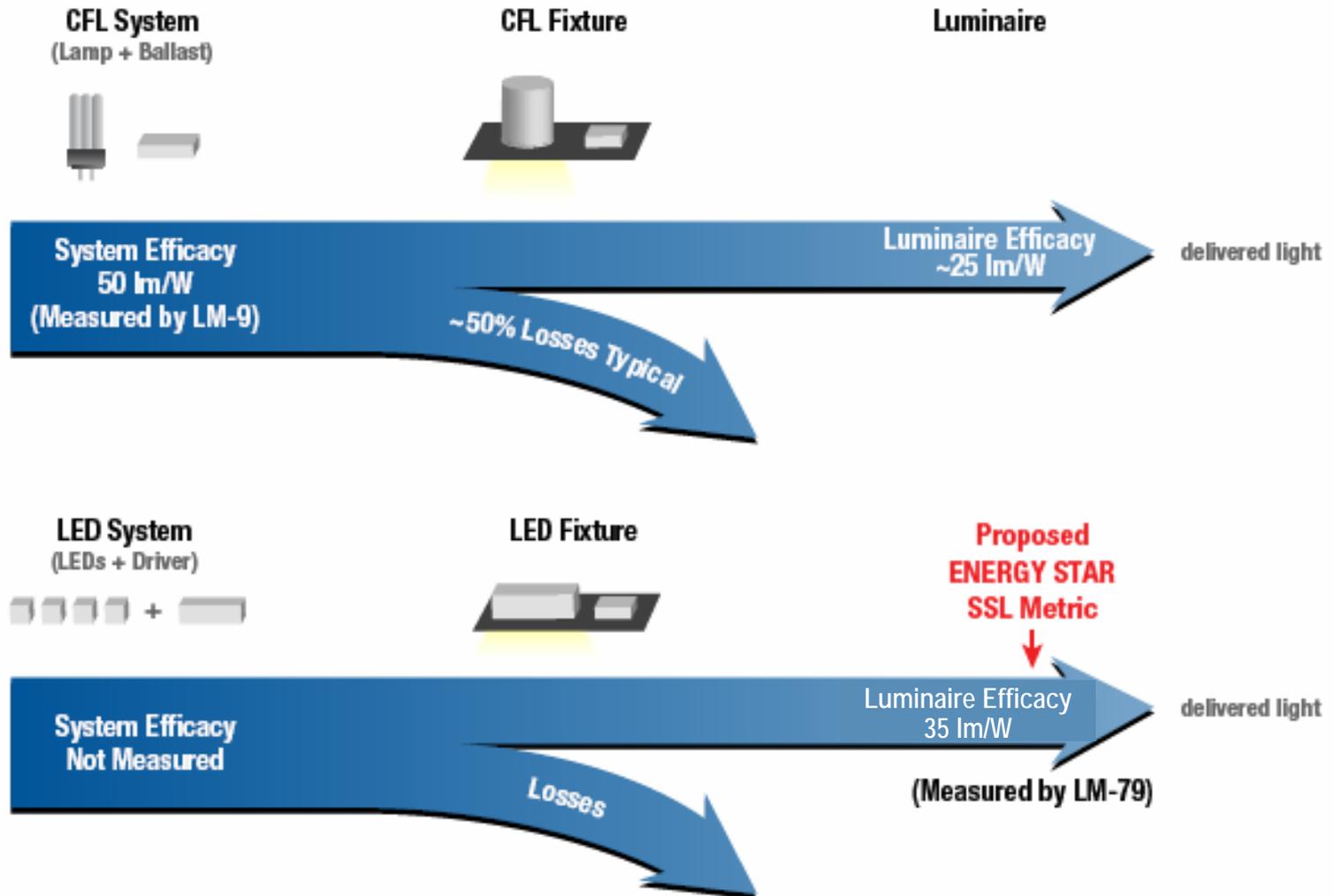
$$\text{Lamp Efficacy} = \frac{\text{Rated Lamp Lumens}}{\text{Lamp Input Power}}$$

$$\text{System Efficacy}_{\text{fluor}} = \frac{\text{Rated Lamp Lumens} \times \text{BF}}{\text{Ballast Input Power}}$$

$$\text{Luminaire Efficacy} = \frac{\text{Luminaire Light Output}}{\text{Ballast/Driver Input Power}}$$



System Efficacy Vs. Luminaire Efficacy (Recessed Downlights Example)





Luminaire Efficacy: Measurement

- **Photometric measurement of LED fixture**
 - Based on new ANSI/IESNA LM-79 standard in process
- **Measure total light output**
- **Measure input power**
- **Calculate luminaire efficacy as lm/W**



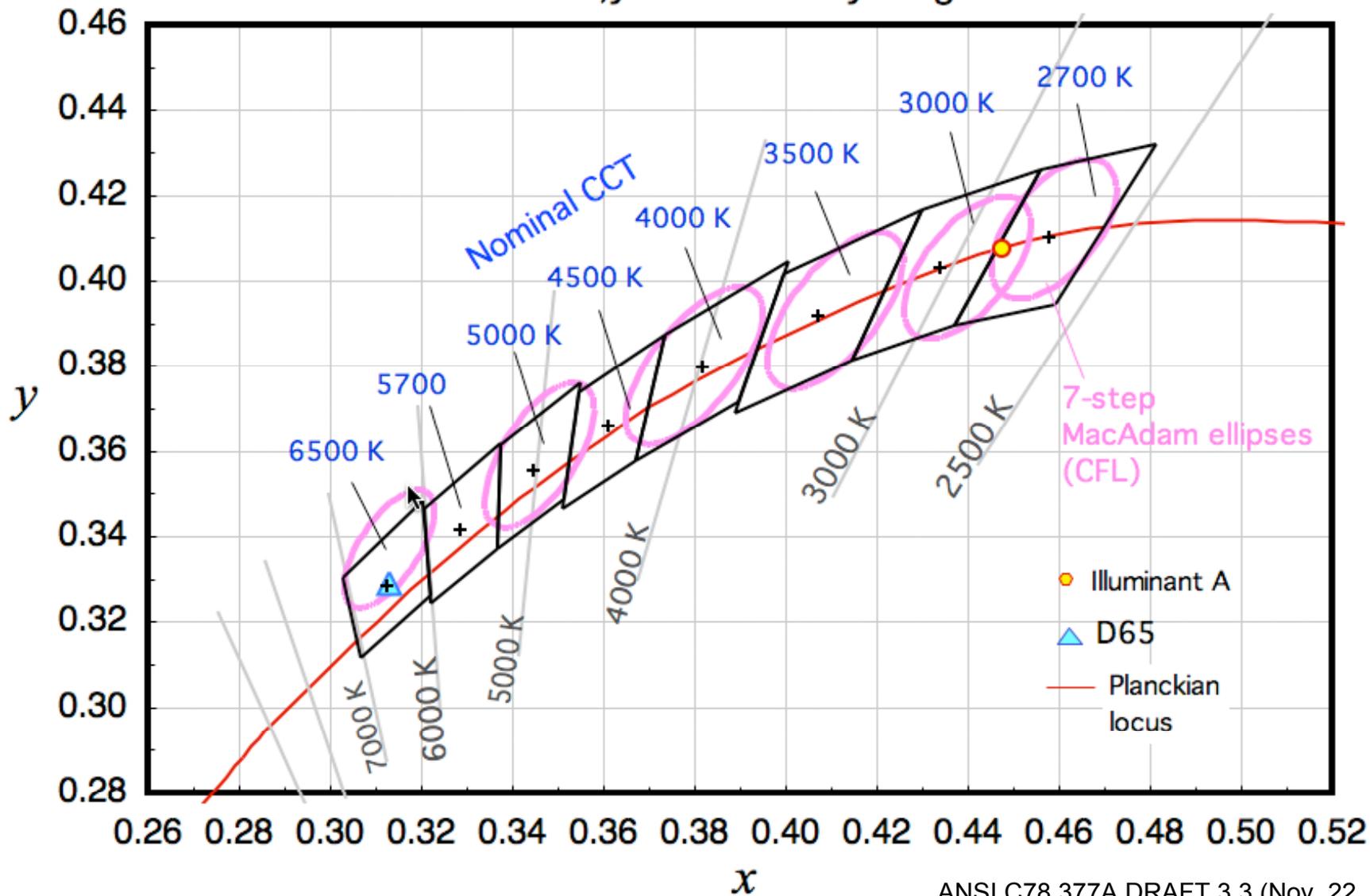


Overall Requirements

- **Luminaire**
 - **CCTs: 8 nominal CCTs**
 - **Color Spatial Uniformity: 4-step**
 - **Color Maintenance: 7-step**
 - **CRI: ≥ 75 for indoor, silent on outdoor**
 - **Off-state Power consumption prohibited except with integral controls**
 - **3 Year Warranty**
 - **Thermal Management**



CIE 1931 x,y Chromaticity Diagram





Color Rendering Index

- **A flawed metric, especially with respect to RGB LEDs**
- **ENERGY STAR will continue to use CRI until the lighting industry develops a new metric**
- **DOE is supporting NIST in standard and test procedure development**

1	2	3	4
5	6	7	8



Overall Requirements (cont.)

- **Modules/Arrays**
 - **Lumen depreciation (L_{70})**
 - Residential Indoor $\geq 25,000$ hours
 - Residential Outdoor $\geq 35,000$ hours
 - All Commercial $\geq 35,000$ hours
- **Residential Outdoor Automatic Daylight Control**
 - **Luminaires > 13 watts and designed for attachment to buildings must have photosensor**



Overall Requirements (cont.)

- **Power Supplies**
 - **Power Factor**
 - 0.70 residential
 - 0.90 commercial
 - **Minimum operating temperature: -20°C**
 - **In-situ power supply temperature measurement**
 - **Noise: Class A rating**



Overall Requirements (cont.)

- **Thermal Management**
 - **Follow device manufacturer guidelines**
 - **In-situ temperature measurement**



Category A: Niche Applications

- **Directed light applications**
 - Energy efficiency potential due to directional light source
 - minimize fixtures losses
- **Source relatively close to illuminated surface**
- **Relatively modest illuminance requirements**
- **Current fixtures $\leq 60\%$ fixture efficiency**



Category A: Niche Applications

- 1. Undercabinet Kitchen**
- 2. Undercabinet Shelf-mounted Task**
- 3. Portable Desk/Task**
- 4. Recessed Downlights (Res./Com.)**
- 5. Outdoor Wall-mounted Porch**
- 6. Outdoor Step**
- 7. Outdoor Pathway**



Category A: Overall Approach

- **Establish minimum luminaire efficacy**
 - **Benchmark to fluorescent**
 - **Consistent with current ENERGY STAR lighting criteria**
 - **Use IES recommendations wherever possible: Handbook, RP-33-99, etc.**
 - **Use ASHRAE/IESNA 90.1 Lighting sub-committee consensus system efficacy for CFL**
 - **58.8 lm/W**
 - **50 lm/W (lower wattage applications and E* min.)**



Category A: Overall Approach (cont.)

- **Surveyed existing products in the marketplace for:**
 - **Fixture efficiency**
 - **Light Output**
 - **Photometry**
 - **Lamp, lamp/ballast wattage**
- **Establish minimum net light output**
- **Establish zonal lumen density requirement**



Assumptions for Establishing Luminaire Efficacy

Niche Application	CFL System Efficacy	Typical Fixture Efficiency	Calculated Luminaire Efficacy
Under-cabinet Kitchen	58.8	40%	24
Under-cabinet Shelf-mounted Task	58.8	50%	29
Portable Task	58.8	50%	29
Recessed Downlight (residential)	58.8	60%	35
Recessed Downlight (commercial)	58.8	60%	35
Outdoor Wall-mounted Porch	58.8	40%	24
Outdoor Step	50	40%	20
Outdoor Pathway	50	50%	25



Category A: Under-cabinet Kitchen



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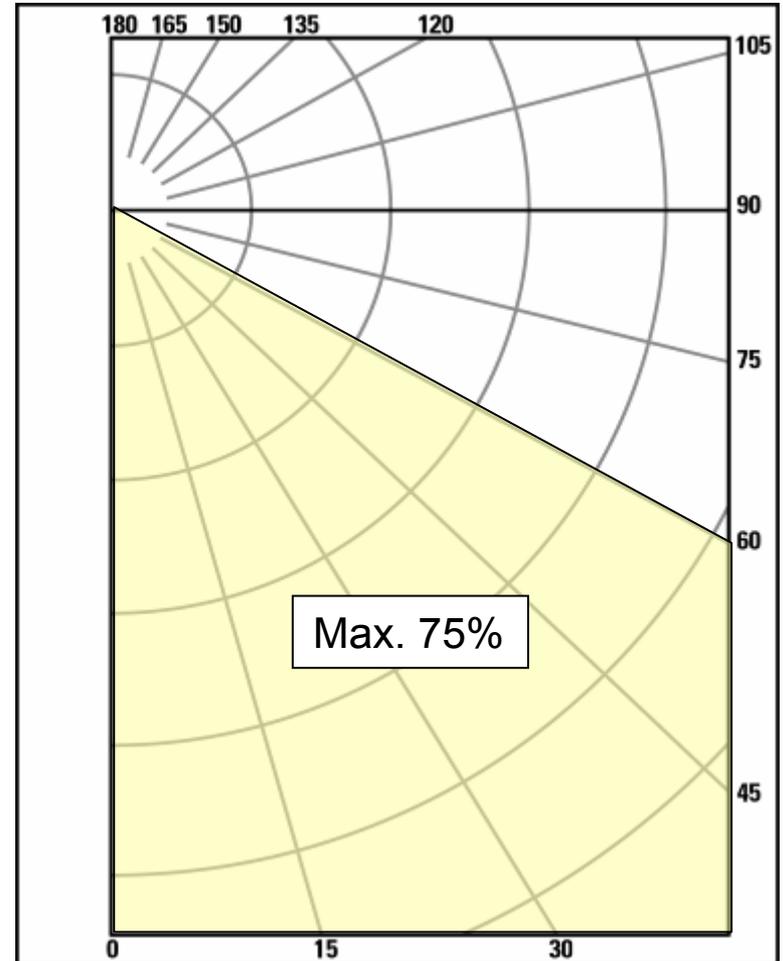


EnbrytenLED ENBU



Under-cabinet Kitchen

- **Minimum Light Output**
 - 125 lumens per lineal foot
- **Zonal Lumen Density**
 - No more than 75% of total light output within 0-60°
- **Luminaire Efficacy**
 - ≥ 24 lm/W
- **CRI: ≥ 75**
- **CCTs limited to: 2700, 3000, and 3500K**





Category B: Efficacy Based Performance

- Aggressive efficacy requirement: 70 lm/W
- Simpler; no total flux or zonal lumen requirements
- Allows for non-directional lighting applications
- Manufacturers able to qualify under Category B three (3) years after the effective date
- Serves as future target for manufacturers



Questions & Answers

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