DOCKETED

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Small-Diameter Directional Lamps, General Service LED Lamps, and Portable Luminaires

Hearing on Proposed Negative Declaration & Express Terms

Art Rosenfeld Hearing Room
November 18, 2015

Harinder Singh & Gabriel Taylor
Appliances and Existing Buildings Office
Efficiency Division

INTRODUCTION

Agenda

- Opening remarks
- Staff Presentation: Proposed Negative Declaration
- Staff Presentation: Small Diameter Directional Lamps, Portable Luminaires, and General Service LED Lamps.
- Stakeholder comments
- Closing remarks/next steps

Purpose of Public Hearing

- Staff will present its analysis of the proposed standards and negative declaration for small-diameter directional lamps, general service LED lamps, and portable luminaires
- Staff will respond to clarifying questions
- Allow Staff and Commissioner McAllister to receive oral and written comments on the proposed Negative Declaration and standards

The California Energy Commission

- The state's primary energy policy and planning agency, created by the Legislature in 1974
- Responsibilities include promoting energy efficiency and conservation by setting minimum appliance and building efficiency standards, and other cost-effective measures
- The Commission's appliance and building energy efficiency standards have saved Californians more than $74 billion in reduced electricity bills since 1975

Appliance Efficiency – A Statutory Mandate

Warren-Alquist State Energy Resources Conservation and Development Act Public Resources Code Section 25402(c)

Requires the Commission to adopt minimum levels of operating efficiency, and other cost-effective measures, to promote the use of energy and water efficient appliances whose use requires a significant amount of energy or water on a statewide basis.

Appliance Efficiency – A Statutory Mandate

AB 1109

- Requires the Commission to adopt minimum energy efficiency standards to reduce average statewide electrical energy consumption from the 2007 levels.
- Reduce electric energy consumption by not less than 50 percent for indoor residential lighting by 2018
- Reduce electric energy consumption by not less than 25 percent for indoor commercial lighting by 2018
- Reduce electric energy consumption by not less than 25 percent for outdoor lighting by 2018

Document Availability

- Proposed Negative Declaration and Express Terms (45-Day Language) are available on the Energy Commission's website: http://energy.ca.gov/appliances/2015-AAER-06/rulemaking/

- Copies of rulemaking documents can also be obtained by contacting staff.

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Comment Period

- Comment period for the proposed regulations started on October 16, 2015 and will end on November 30, 2015.
- Comment period for negative declaration ended on November 14, 2015.
- Oral and written comments will also be accepted at the Commission adoption hearing scheduled for December 9, 2015

Next Steps

- Staff will evaluate all oral and written comments received and make recommendations to the Commission for the next step.
- Staff may propose 15-day language to make any necessary changes to the proposed regulations.
- An adoption hearing is scheduled for December 9, 2015.
- Staff will respond in writing to all oral or written comments in the Final Statement of Reasons (FSOR).

Public Assistance

If you need assistance commenting, please contact the Public Adviser's Office at

800-822-6228

PublicAdviser@energy.state.ca.us

Proposed Negative Declaration

Initial Study/Proposed Negative Declaration

- The proposed negative declaration discusses the environmental impacts of adopting the proposed standards for Small Diameter Directional Lamps, Portable Luminaires, and General Service LED Lamps.
- The study shows no adverse environmental impacts.
- Written comment period for negative declaration ended on November 14, 2015.
- Adoption hearing for proposed negative declaration is scheduled for December 9, 2015.

Small Diameter Directional Lamps (SDDLs)

Scope: SDDLs

(k) Lamps, which are federally-regulated general service fluorescent lamps, federally-regulated incandescent reflector lamps, state-regulated general service incandescent lamps, general service lamps, state-regulated light-emitting diode (LED) lamps, **state-regulated small-diameter directional lamps,** and includes GU-24 base lamps.

The proposed regulations intended to regulate lamps that are used for accent, task, and display lighting in museums, art galleries, retail stores, residential settings, and entertainment venues.

Definitions

- "Beam angle" means the angle within which the lamp produces 50% of the maximum luminous intensity.
- "Center beam candle power" means luminous intensity at the center of the beam of a reflector lamp, measured in candelas (cd).
- "Lumen output" means the brightness of the lamp at full output, measured in Lumens.
- "Power" means the total amount of electric power required, measured in Watts, to operate the lamp, as measured at the base of the lamp.

Definitions

- "State-regulated small diameter directional lamp" means a directional lamp with a diameter of less than or equal to 2.25 inches and a GU10, GU11, GU5.3, GUX5.3, GU8, GU4, or E26 base.
  - Small diameter directional lamp includes incandescent filament, LED, and any other lighting technology that falls within this definition.
  - State-regulated small diameter directional lamp does not include products that use LEDs and have an E26 base, which are state-regulated light emitting diode lamps.

Test Method

- Incandescent filament SDDLs (in case they are able to meet the proposed standard): 10 CFR section 430.23(r) (Appendix R to Subpart B of part 430)

- LED SDDLs:

Measurement	Test Procedure
Input power, Lumen output, Lumens per Watt, Correlated Color Temperature, Color Rendering Index	IES LM-79 (2008) with additional guidance provided in 80 Fed. Reg. 39665-39666 (July 9, 2015), §430.23(dd) and Appendix BB to Subpart B of Part 430.
Lumen Maintenance and Time to Failure	IES LM-84 (2014) and TM-28 (2014) with additional guidance provided in 80 Fed. Reg. 39665-39667 (July 9, 2015), §430.23(dd) and Appendix BB to Subpart B of Part 430.

Regulation

Sections 1605.3 (k)

- Effective January 1, 2018
- Minimum rated life: 25,000 hours based on lumen maintenance and time to failure test procedure
- Meet one of the following requirements:
  - Luminous efficacy of ≥ 80 lumens per watt.
  - Luminous efficacy ≥ 70 lumens per watt *and* CRI + Efficacy ≥ 165

Certification Requirements

Appliance	Required Information	Permissible Answers
State-regulated small diameter directional lamps	Base Type	GU 11, GU 5.3, GUX 5.3, GU8, GU 4 and medium screw base
	Lamp Type (examples PAR-16, MR-11, MR-16, or R)	
	Lamp Power (Watts)	
	Lamp Output (Lumens)	
	Beam Angle	
	Center Beam Candle Power (CBCP)	
	Lumens Per Watt	
	Minimum lamp efficacy (LPW)	
	Color Rendering Index (CRI)	
	Combined CRI + Efficacy	
	Correlated Color Temperature	
	Rated Life (hours)	

Necessity of Standards

- Currently there are no Federal or State Standards for small diameter directional lamps.
- There are about 15 million SDDLs installed in the residential and commercial building and consume more than 2500 GWh/year.
- More than 90% of the installed SDDL stock is comprised of inefficient incandescent, halogen and halogen infrared (HIR) lamps; about 10% are LED lamps.
- 65% of the stock is commercial and 35% of the stock is residential.
- Commercial duty cycle of SDDLs is 3720 hours a year whereas residential duty cycle is about 840 hours a year.

Baseline Energy Consumption & Energy Consumption with Standards

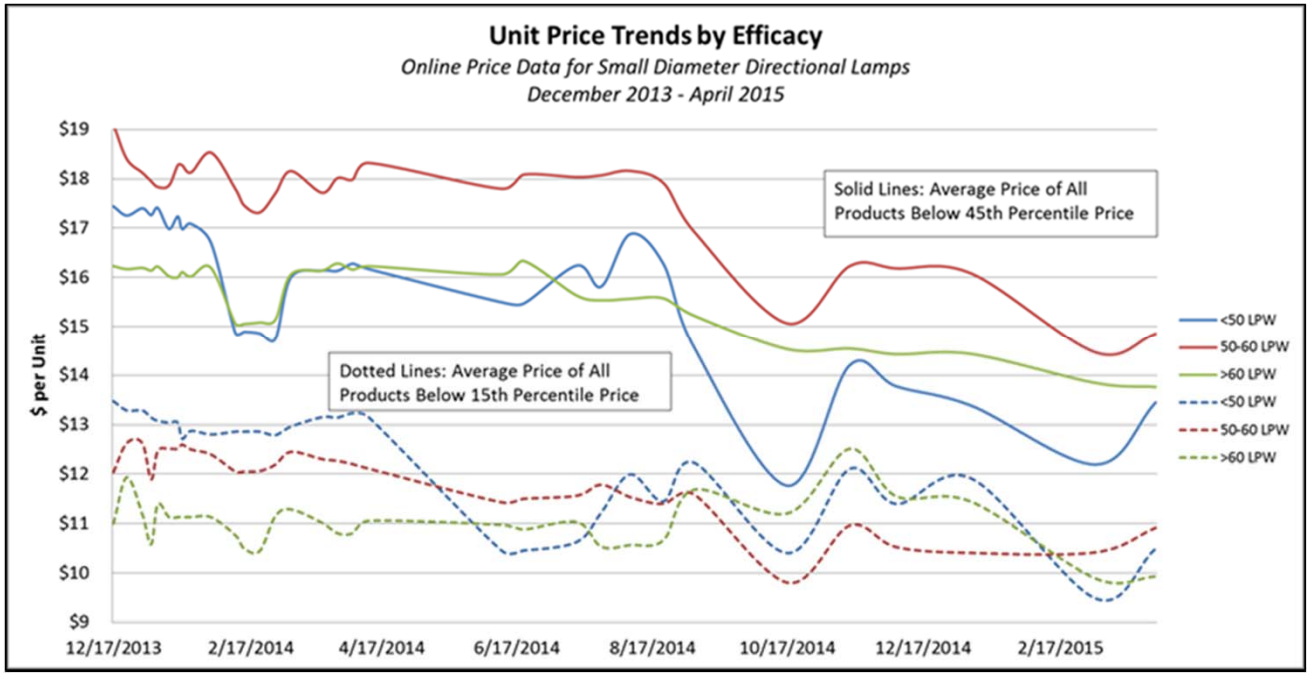
Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Energy Consumption Without Standards (GWh/Year)	2528	2561	2594	2628	2662	2697	2732	2767	2803	2840	2877	2914
Annual Energy Consumption After the Proposed Standards take effect (GWh/Year)	371	376	381	386	391	396	401	406	412	417	422	428

Cost-Effectiveness

Annual Energy Consumption Per Lamp		
Energy Consumption without Standards	**≥ 80 lumens per watt or a CRI +Efficiency ≥ 165 and a minimum required Efficiency ≥ 70 LPW**	**Savings per year from proposed standards**
158.43 KWh/year	**25.04KWh/year**	**133.39 KWh/year**
Annual Operating Cost		**$ Savings/year**
No Standards	**80 lumens/watt**	
$25.94	**$3.81**	**$22.14**

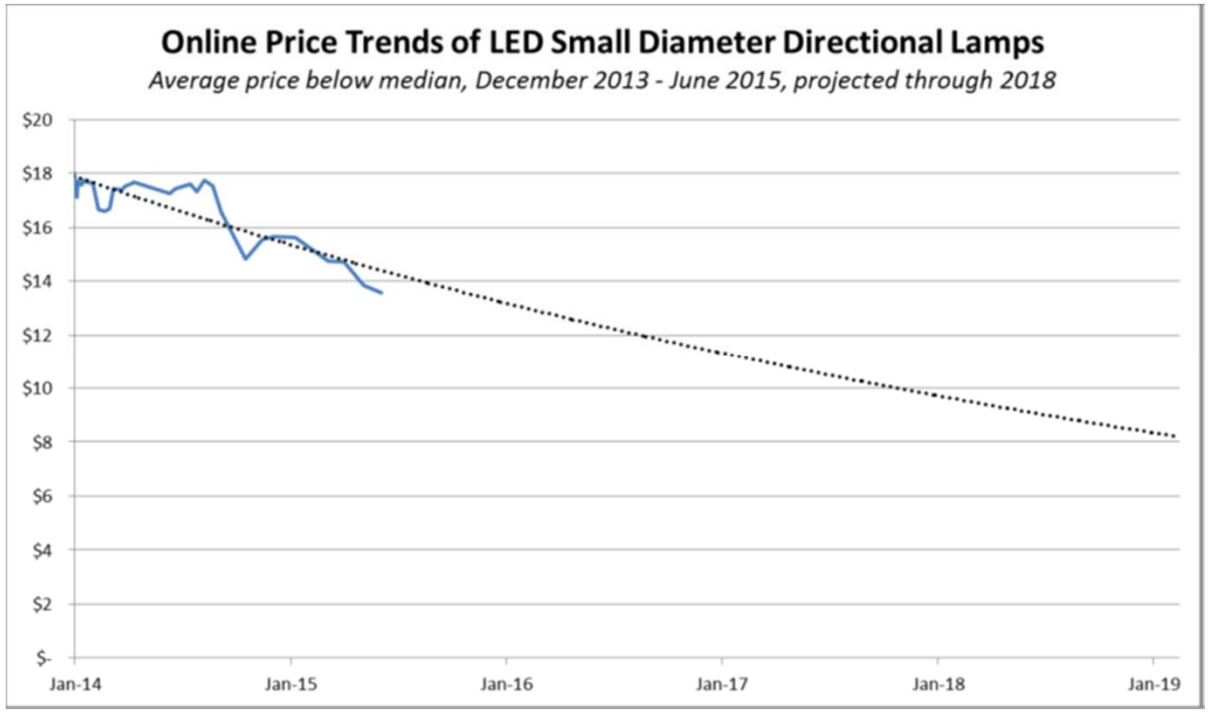
Cost-Effectiveness

Product Price Trend by Efficacy



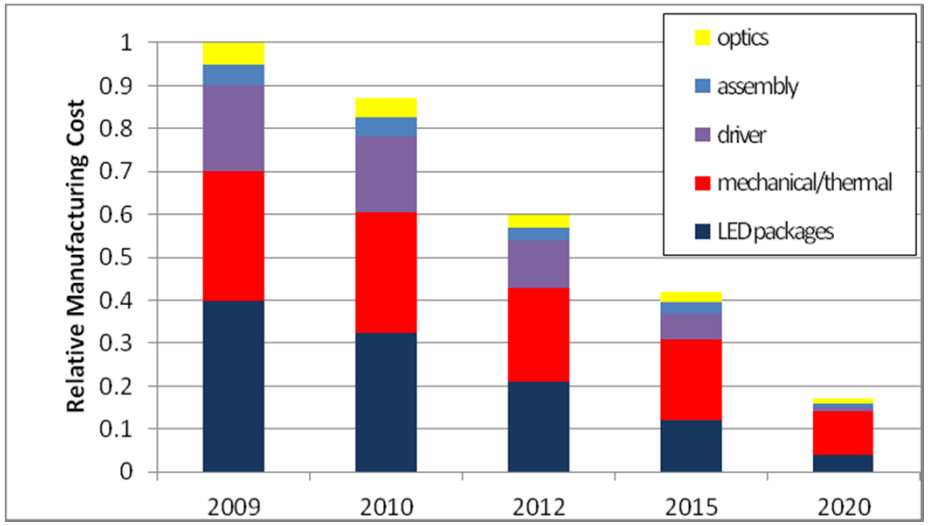
Cost-Effectiveness

Unit Price Trends Projected Through 2018



Incremental Cost Decrease

Relative Manufacturing Cost Per Year

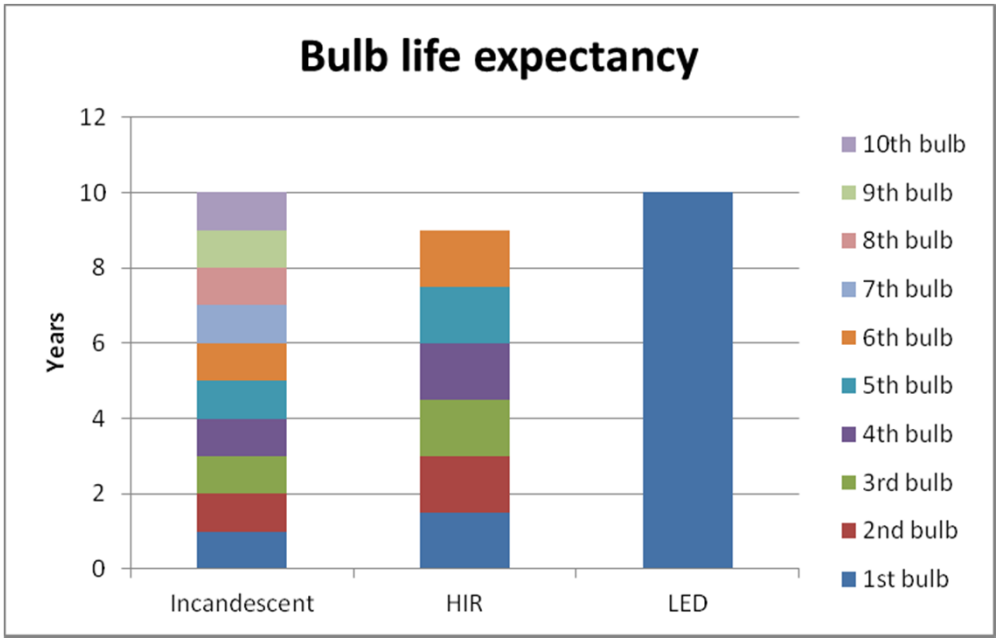


Cost-Effectiveness

- Based on the market trend and data staff has found that the price of SDDLs is dropping while the efficiency and quality of lamps are increasing.
- From the current market SDDL price data, the exact incremental cost to improve efficiency is unclear. However, learning curves show steep drop in costs to improve efficiency.
- Staff assumes incremental cost to improve efficiency is minimal or zero.

Lamp Replacement Cost

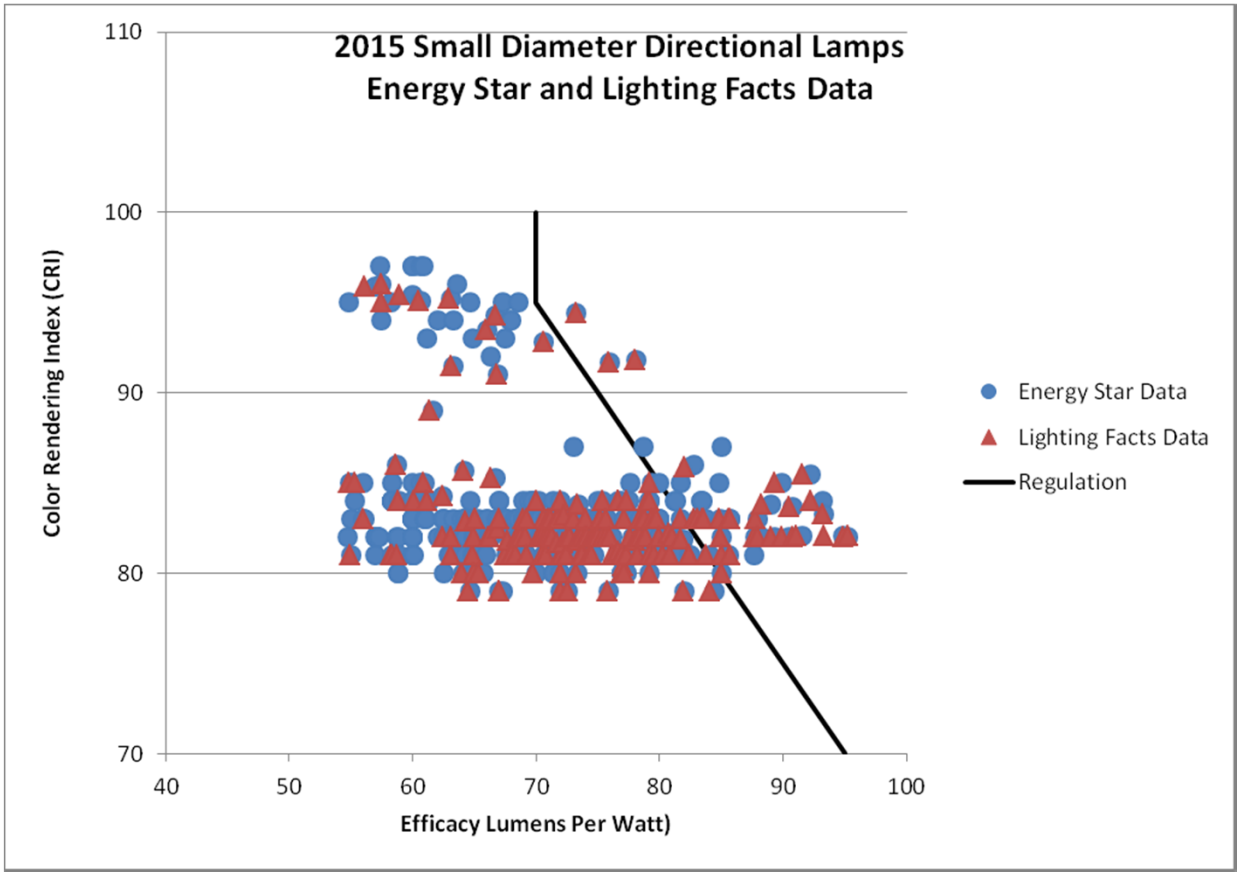
Bulb Life Expectancy Comparison and Price Over Time



Technical Feasibility

Efficacy vs. CRI

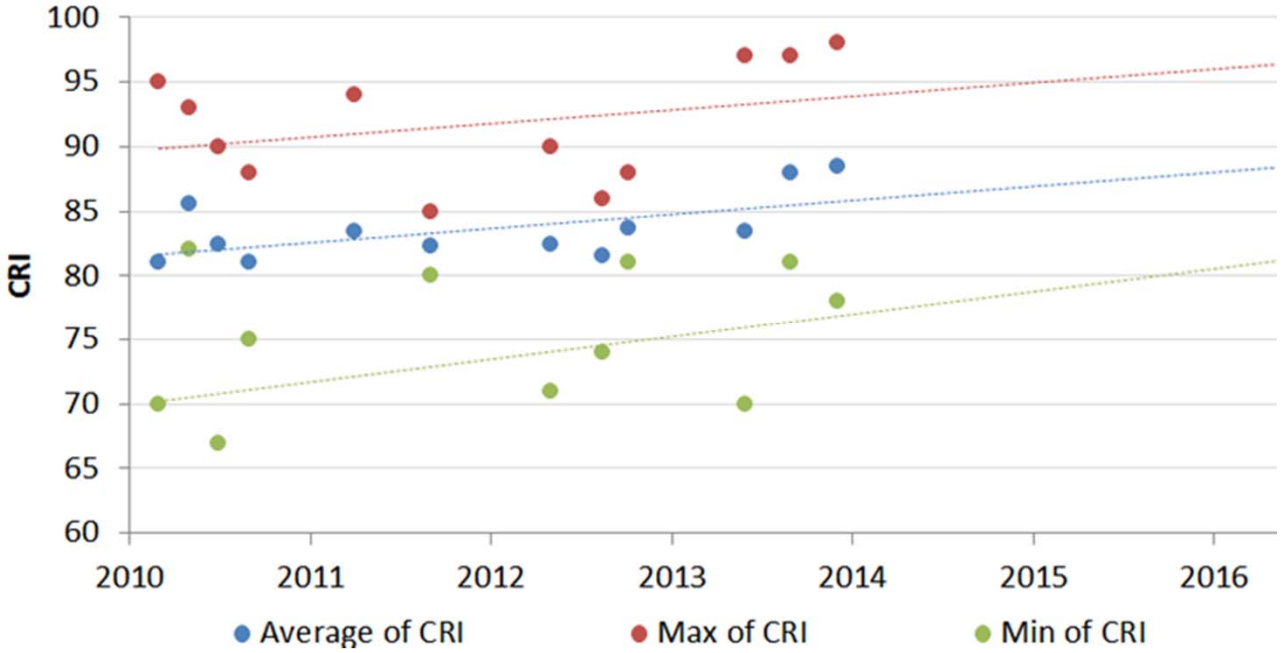
Significant number of SDDLs at high CRI and high efficacy are available.



Technical Feasibility

CRI improvements over time

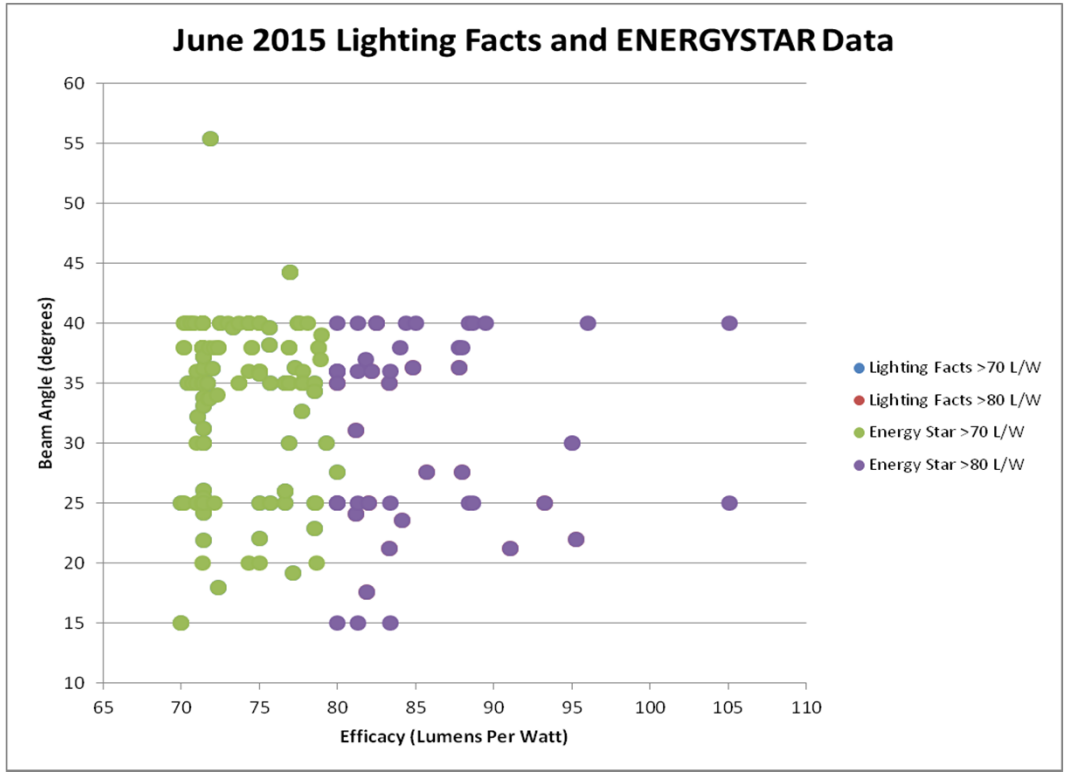
Significant improvements in SDDLs' CRI have been made. CRI is trending upwards over time.



Technical Feasibility

Efficacy vs. Beam Angle

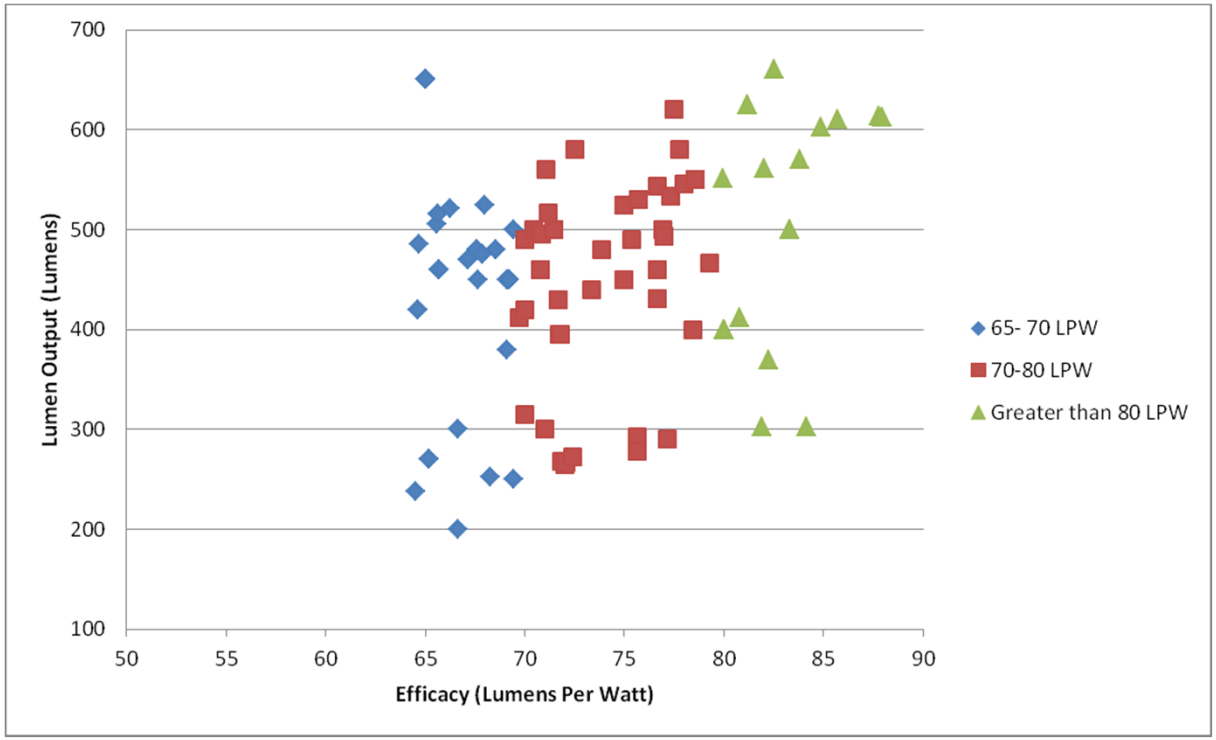
LED SDDLs of beam angle of 15° of efficacy 80 or greater are available.



Technical Feasibility

Efficacy vs. Lumen Output

Many lamps of total lumen output > 600 lumens and LPW ≥ 80 are available in the market.



Statewide Energy Savings & Cost Impacts

Design Life	Annual Energy Savings/Unit	Incremental Cost of LED Improvement/Unit + Replacement Cost	2018 Stock	First year Unit Energy Savings	Total unit savings over the design life	Simple payback period	Annual sales in millions	1st year statewide energy savings
11 years	133.39 KWh/year	$0.00+$4.00	15.8 Million	$22	$221.301	<1 year	15.8	1978 GWH

Annual Utility Bill Savings to Consumers

Annual $ savings												
Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Savings (in Millions)	$310	$318	$326	$333	$341	$349	$357	$389	$399	$409	$419	$430

Environmental Benefits in Numbers

Year	Avoided Emissions (tons)			
Emissions	Oxides of Nitrogen (NO_x)	Sulfur Dioxide (SO_x)	Particulate Matter ($PM_{2.5}$)	Greenhouse Gas (eCO_2)
Cumulative 2017- 2029	6558	116	1148	10.3 Million Metric Tons

Portable Luminaires

- **1605.3 (n) Luminaires and Torchieres.**
- Currently requires that portable luminaires be sold either with a CFL or with an LED that meets specified requirements.
- Propose to amend the language for LEDs to require state-regulated LEDs.

Questions and Comments will be received at the end of staff presentations.

Thank You

Contact

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Docket #15-AAER-06

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General Service Light Emitting Diode (LED) Lamps

LEDs: Scope

(k) Lamps, which are federally-regulated general service fluorescent lamps, federally-regulated incandescent reflector lamps, state-regulated general service incandescent lamps, general service lamps, state-regulated light-emitting diode (LED) lamps, state-regulated small-diameter directional lamps, and includes GU-24 base lamps.

The proposed regulations intended to regulate lamps that are used for general service lighting in both residential and commercial spaces, including omnidirectional, directional, and decorative lamps.

Definitions

"**Connected LED lamp**" means an LED lamp capable of changing its lumen output or spectral power distribution in response to an external control signal other than a change in RMS AC supply voltage or a 0-10 volt DC control signal. Connected LED lamp includes lamps that can be controlled wirelessly and through power line carrier digital communication.

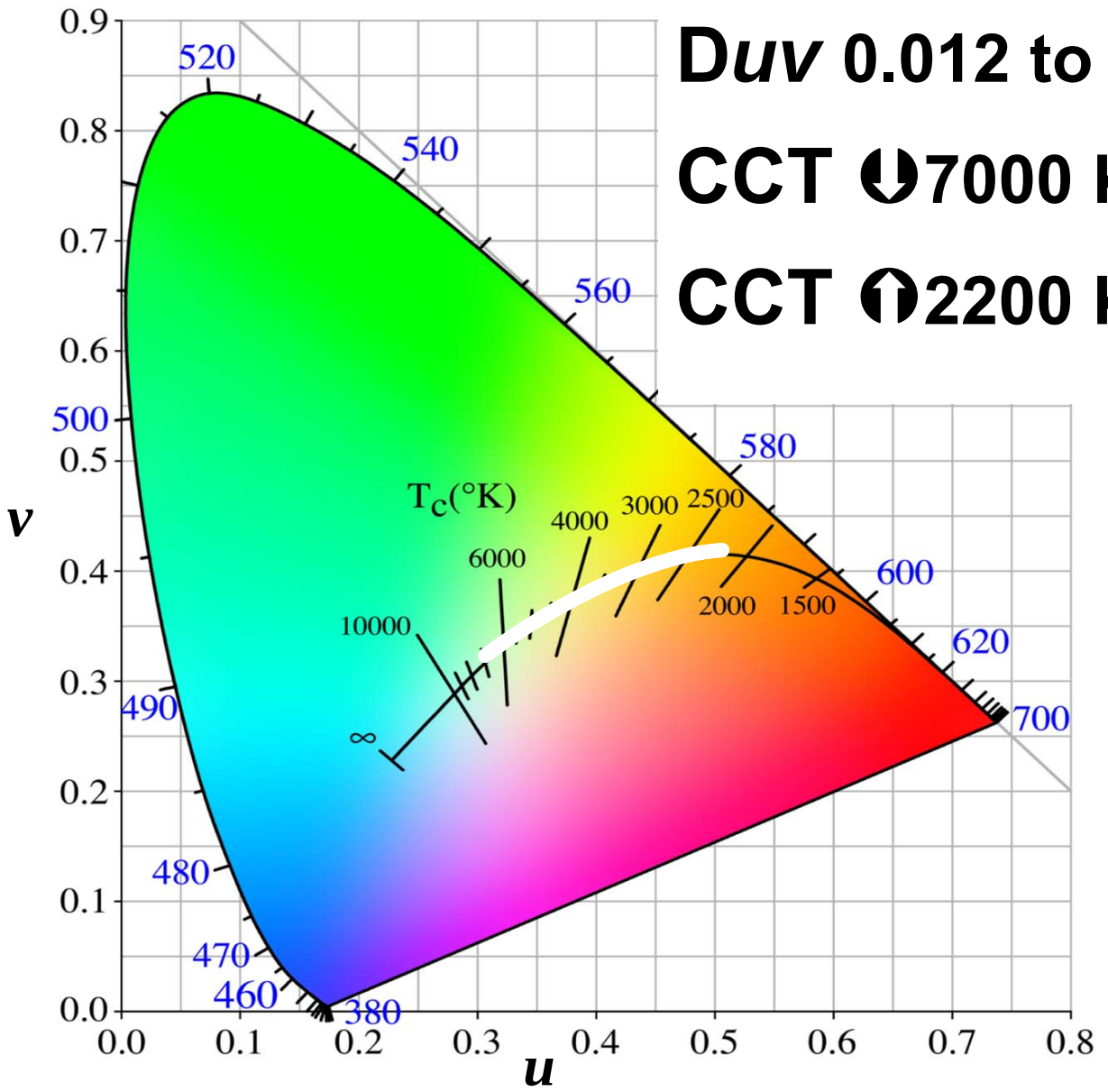
"**Duv**" means the closest distance from the chromaticity coordinate of the light source to the Planckian locus on the International Commission on Illumination (CIE) (u', 2/3 v') coordinates with "+" sign for above and "-" sign for below the Planckian locus.

Definitions

"**State-regulated Light Emitting Diode (LED) lamp**" means a lamp capable of producing light with Duv between -0.012 and 0.012, and that has an E12, E17, E26, or GU-24 base, including LED lamps that are designed for retrofit within existing recessed can housings that contain one of the preceding bases. State-regulated LED lamp does not include a lamp with a brightness of more than 2,600 lumens or a lamp that cannot produce light with a correlated color temperature between 2200 K and 7000 K.

State-regulated Light Emitting Diode (LED) lamp

- **Base**: E12, E17, E26, or GU-24
- **Brightness**: less than 2,600 lumens
- **CCT**: between 2200 K and 7000 K
- **Duv**: between -0.012 and 0.012



D*uv* 0.012 to -0.012

CCT 7000 K

CCT 2200 K

Regulations

1605.3(k)(2):
All state-regulated LED lamps shall meet the following:

Effective Date	Minimum Compliance Score	Minimum Efficacy Lumens per Watt
January 1, 2017 (Tier 1)	277	65
January 1, 2019 (Tier 2)	297	80
The compliance score shall be calculated as the sum of the efficacy and 2.3 times the CRI of a lamp.		

Regulations

(C) State-regulated LED lamps with lumen output of **150 lumens or greater** and manufactured on or after January 1, 2017 shall have:

(i) a **color point** with a Duv that is:

(1) No less than -0.0033

(2) No greater than

$$\mathbf{57,700}\left(\frac{\mathbf{1}}{\boldsymbol{T}}\right)^{\mathbf{2}} - \mathbf{44.6}\left(\frac{\mathbf{1}}{\boldsymbol{T}}\right) + \mathbf{0.01184}$$

where T means the measured correlated color temperature.

(ii) A **CRI (Ra) of 82** or greater

Regulations

(iii) **Individual color scores** of R1, R2, R3, R4, R5, R6, R7, and R8 of **72 or greater**

(iv) A **power factor of 0.7** or greater

(v) A **rated life of 10,000 hours** or greater as determined by the lumen maintenance and time to failure test procedure.

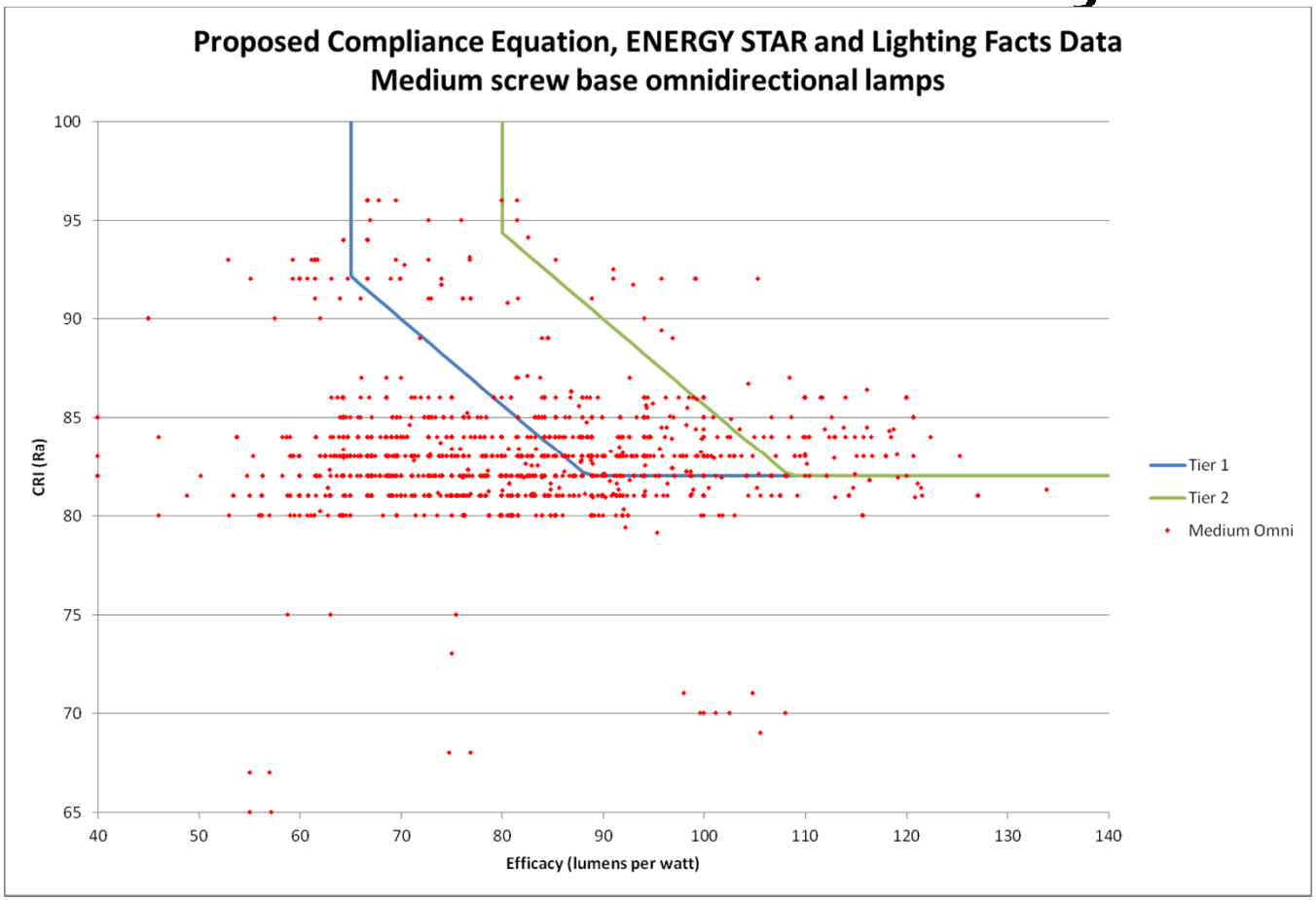
Regulations

(vi) State-regulated LED lamps that have an ANSI **standard lamp shape of A** shall meet the **omnidirectional light distribution** requirements of ENERGY STAR's Product Specification for Lamps Version 1.1. State-regulated LED lamps that have an ANSI **standard lamp shape of B, BA, C, CA, F, or G** shall meet the **decorative light distribution** requirements of ENERGY STAR's Product Specification for Lamps Version 1.1

Regulations

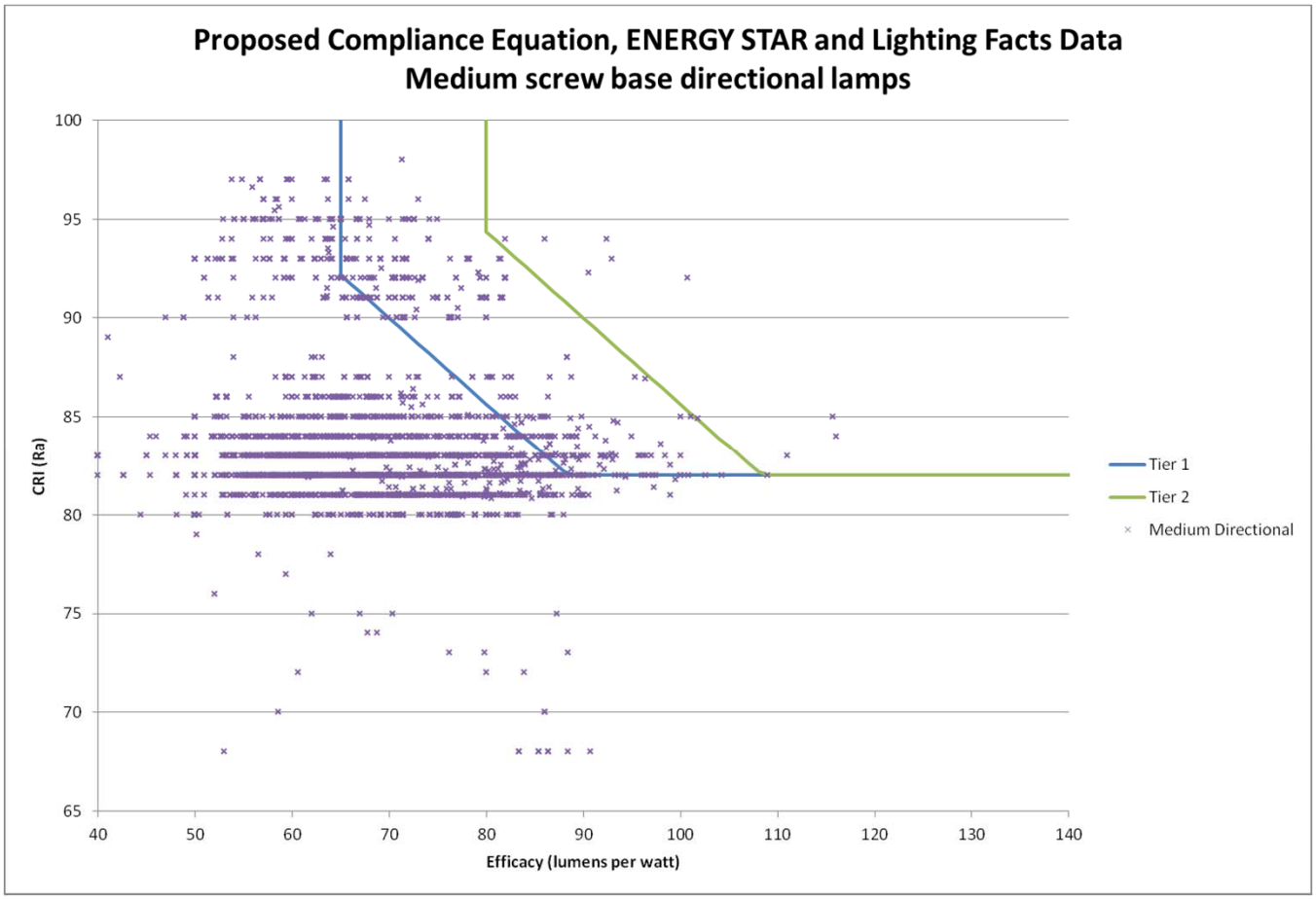
(D) In addition to the requirements in 1605.3(k)(2)(C), state-regulated LED lamps manufactured on or after January 1, 2019 shall have a **standby mode power of 0.2 watts or less**.

Technical Feasibility



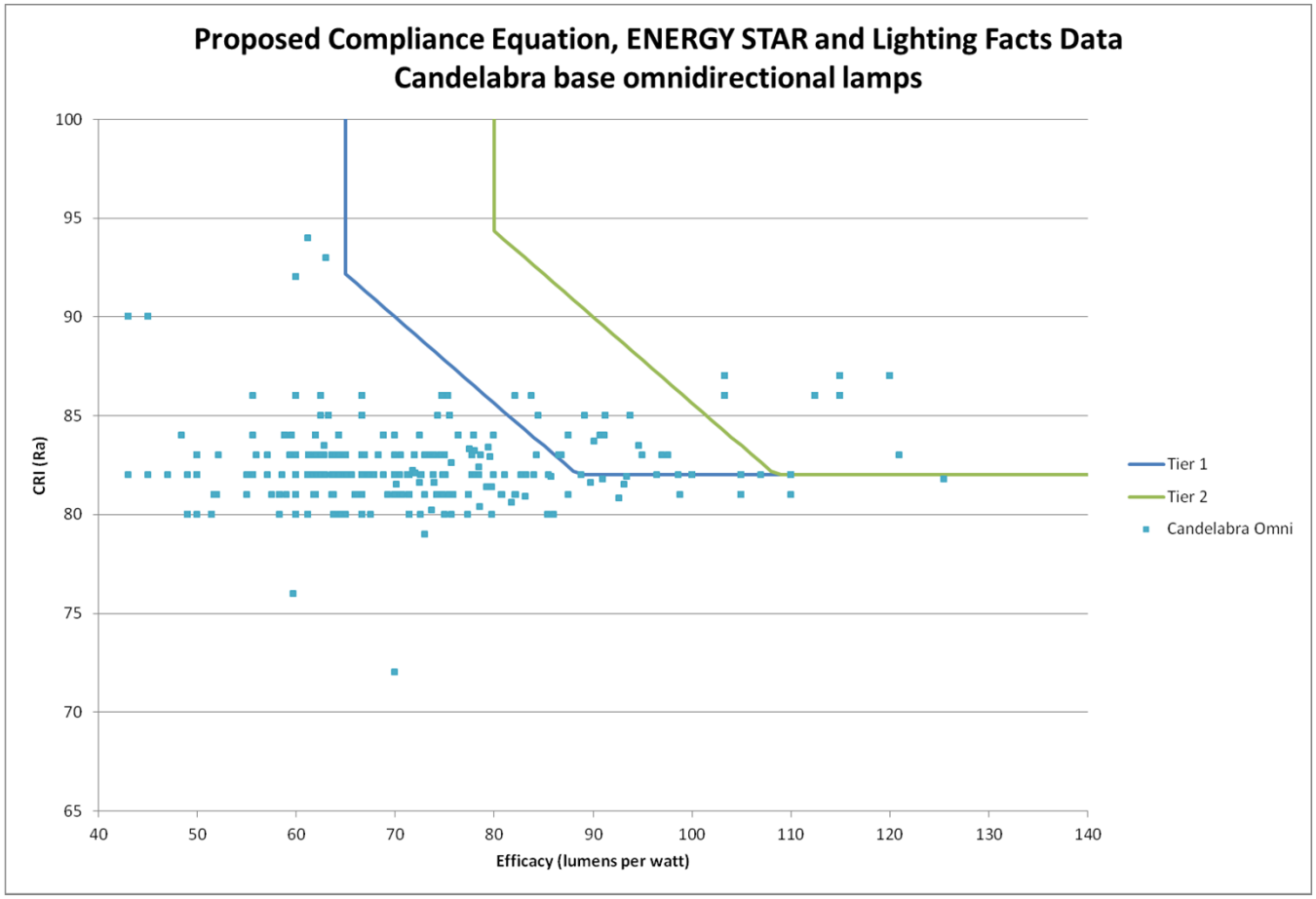
- 573 models of medium screw base omnidirectional lamps currently meet the Tier 1 efficacy/CRI requirements; 113 meet Tier 2.

Technical Feasibility



- 658 models of medium screw base directional lamps currently meet Tier 1; 18 meet Tier 2.

Technical Feasibility



- 85 models of candelabra-base lamps currently meet Tier 1; 42 meet Tier 2.

Cost Effectiveness

Lamp Type	Incremental Cost per Lamp	Lifetime Savings per Unit	Cost-to-Benefit Ratio	Payback Period (years)
Omni-directional	$0.50	$7.80	15.6	1
Directional	$1.50	$11.57	7.7	2
Candelabra	$1.00	$4.47	4.5	3.5

Statewide Energy Savings

Scenario	Statewide Energy Savings (GWh/yr)	Statewide Utility Bill Savings
First Year of Tier 1	28	$4,800,000
First Year of Tier 2	185	$31,500,000
Projected Savings 2029	859	$146,000,000

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Docket #15-AAER-06

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QUESTIONS
&
STAKEHOLDER COMMENTS