



October 24, 2014

California Energy Commission  
Dockets Office, MS-4  
Re: Docket No. 14-AAER-1  
1516 Ninth Street  
Sacramento, CA 95814-5512

California Energy Commission

**DOCKETED**

**14-AAER-01**

**TN 73901**

**OCT 28 2014**

Re: Docket No. 14-AAER-1

These comments related to Title 20 rulemaking for Small Diameter Directional Lamps and LED Lamps are provided by Soraa Inc., based in Fremont California. Soraa develops and manufactures LED lighting products based on newly developed GaN on GaN LED technology and was founded by Nobel Prize winner Shuji Nakamura and professors Steven DenBaars and James Speck from the University of California Santa Barbara. We support the California Energy Commission in its goal to promote efficiency and conservation, cutting-edge research, and support of development of renewable energy resources. We appreciate the opportunity to provide comments to Title 20 rulemaking.

Comments related to 1605.3 State Standards for Non-Federally Regulated Appliances  
(k) Lamps (6):

Based on analysis of efficacy of currently available LED Small Diameter Directional Lamps (LED SDDL) and expected improvements over the coming years, Soraa recommends that the luminous efficacy requirement be changed as per the following formula, derived from the proposed compliance score for LED Lamps (California Energy Commission, 2014).

$$3 \times CRI + Efficiency \geq 340$$
$$Efficiency \geq 55lm/W$$

For a sample size of 237 products submitted to Lighting Facts database (LED Lighting Facts Products) since 1/1/2013, the average efficacy of LED SDDL products in September 2014 between 80 and 90CRI was 61lm/W. LED SDDL between 90 and 100CRI had an average efficacy of 44lm/W.

## Efficacy of LED SSDL - Sep 2014

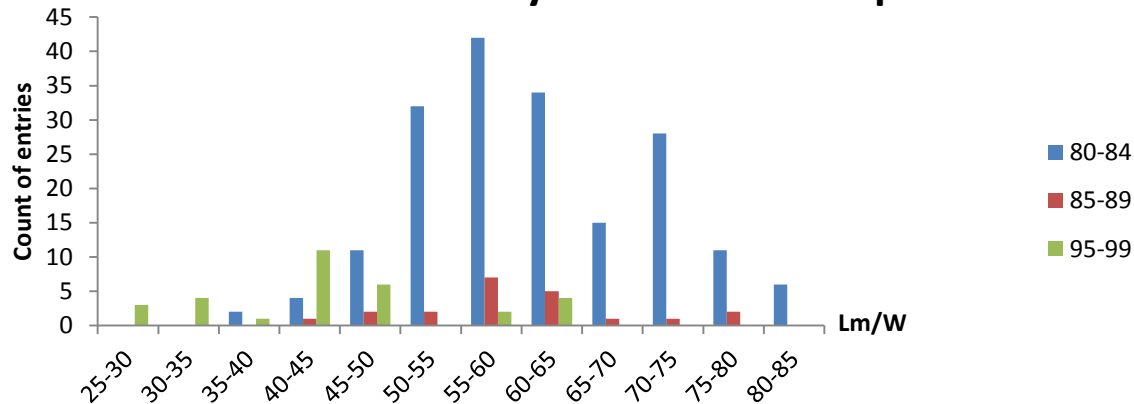


Figure 1. Efficacy distribution of Small Diameter Directional Lamps (SSDL) from Lighting Facts database. Included are lamps with CCT < 3,250K and submitted after 1/1/2013. Efficacy data is shown separately by CRI group, 80-84, 85-89 and 95-99 (no samples between 90 and 95). Total included 237 samples.

Assuming an average efficacy improvement of 10% per year, Soraa predicts that the average efficacy of LED SSDL between 80 and 85CRI will be 78lm/W in 2018. For 90-100CRI we predict 58lm/W in 2018. A proposed minimum requirement of 80lm/W (California Energy Commission, 2014) would make products with high color rendering index (90 or higher, for example 95 or 97CRI) too expensive to manufacture and would put high color rendering products at a severe disadvantage in the market place.

Color Rendering Group	Sep 2014 Efficacy	2018 Efficacy (forecasted based on 10% annual improvement)
80-85CRI	61lm/W <sub>ave</sub>	78lm/W <sub>ave</sub>
90-100CRI	44lm/W <sub>ave</sub>	58lm/W <sub>ave</sub>

Table 1. Current and forecasted average efficacies for SSDL based on analysis of Lighting Facts Database and assumed 10% annual improvement.

Soraa recommends efficacy requirements to be related to color rendering capability of lighting products (a well known tradeoff). This will enable the continuation of adoption of high color rendering LED lamps to replace halogen products that has already started.

LED SSDL lamps inherently have a lower efficacy than general LED lamps. Losses of a few percent points each are related to creating optical directionality, limited space for electronic driver resulting in a compact architecture, and higher operating temperature because less cooling surface is available. For these reasons Soraa recommends the compliance limit to be 340 instead of 350, the proposed 2<sup>nd</sup> tier for LED lamps in 2019.

### General Comments on proposed lamp regulations

It is forecasted that the lighting systems control market will see rapid growth (McKinsey, 2012), in part driven by new technologies to control light (for example wireless) as well as newly available parameters to control



such as color of light. Soraa recommends that the California Energy Commission take an open approach to appliance regulations to enable innovative solutions in this field that has great potential to reduce energy consumption. Examples where an open approach can be beneficial are requirements for

- Tunable white point - lamps with variable spectral power distribution and white point should be allowed
- Dimmability – lamps can be dimmed wirelessly, compatibility with phase-cut dimmers may be relevant in a reducing number of cases

Related to lamp durability, Soraa recommends that tests required to substantiate life time claims be limited to 2,000 hours or less. Requirements for long duration tests like Energy Star (Energy Star Product Specification for Lamps v1.1, 2014) delay the time to market for lower energy consumption innovative products and put emphasis on lumen maintenance to characterize the life of the product. Soraa recommends inclusion of color stability in the durability requirement because color shift is easily observable and negatively impacts consumer experience. On/off testing and elevated temperature tests are useful stress tests to characterize the durability of both the LED component and the electronic circuitry inside lamps.

Lastly, Soraa recommends that lighting products that meet Title 20 specifications, can be deployed within the Title 24 framework as well, without additional requirements to for example lamp base or color rendering.

Sincerely,

Willem Sillevs Smitt

Sr. Director Market Development  
Soraa Inc.

#### References:

California Energy Commission, C. (2014). *Analysis of Small Diameter Directional Lamp and Light Emitting Diode Lamp Efficiency Opportunities - 2014 Appliance Efficiency Pre-Rulemaking*. CEC-400-2014-020-SD.

Energy Star Product Specification for Lamps v1.1. (2014, August 28). EPA.

*LED Lighting Facts Products*. (n.d.). Retrieved September 22, 2014, from <http://www.lightingfacts.com/products#>

McKinsey. (2012). *Lighting the way: Perspectives on the global lighting market*.