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Response to Comments: General Services LED Lamps and Small Diameter Directional Lamps Rulemaking

DOCKET #15-AAER-6

TABLE OF CONTENTS

Core Comments & Responses

During the rulemaking the Commission received several thousand comments on the proposed language and rulemaking process. The comments and staff responses are set forth below. While thousands of individual comments were submitted, the subject matter of the comments related to a few common areas. For ease of public review and quick reference, the following is a consolidation of the core comment topics with a comprehensive response for each topic labeled RESPONSE 1-13. These responses should be considered incorporated into the individual responses found in the chart.

Comments: For general service LED lamps, the CRI should be set at 80 as opposed to staff's proposed 82. Requiring a minimum 82 CRI means in practice, based on how LED packages are binned and based on phosphor conversion technology, manufacturers will have to produce 90 CRI products, resulting in more expensive and less efficient lamps in the California market. (NEMA, GE, Lumileds, Cree, Maxlite, Phillips) Standards should focus on efficiency not CRI. (Robert Clear, NEMA, IESNA, Sony) Staff incorrectly describes the meaning of CRI in its Staff Report or has other errors which demonstrate fundamental misunderstandings of the science of light. (Robert Clear, Francis Rubinstein, NEMA, GE, ALA) The only less than 90 CRI products with high R8 are high color temperature, 5000K products. (NEMA, GE, Phillips) In suggesting a minimum CRI of 82, staff has reached a conclusion that no reasonable person could have reached, by implying that a CRI 82 lamp can meet the additional R1-R8 72 requirement. (NEMA, Phillips, Osram)

RESPONSE 1: The color rendering requirements (in terms of CRI, and individual color scores) were determined based on technical input during the rulemaking proceeding from a number of stakeholders. The purpose of minimum color rendering requirements is to establish a minimum performance threshold for a light bulb's ability to light a room with accurate color fidelity. The exact levels for CRI and R1-R8 were chosen to balance the cost of these requirements and the benefits of the proposed standard, to ensure that the standard was still cost-effective to the consumer while being technologically feasible as required by Public Resources Code section 25402(c)(1). Detailed discussion of the color rendering requirements and the technical background regarding CRI can be found in the Staff Report at pages 38-40, 52-

53, 57-58, and 76-77: Harinder Singh, Ken Rider, 2015. *Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034.

Staff agrees with the general assertion that higher CRI lamps tend to be less efficacious in terms of lumens per watt than lower CRI lamps. This is why a minimum of 82 CRI was chosen and not a higher CRI.

Staff also did not choose a lower CRI option than 82 CRI. Higher CRI lamps are not necessarily less efficient – when one considers human perception of brightness in addition to lumens – than lower CRI lamps. Human perception of the brightness of a higher CRI lamp can be as bright as a lower CRI lamp even if the lower CRI lamp actually emits greater lumens. Thus, one could install a lower lumen, higher CRI lamp and save the same amount of energy as a higher lumen, lower CRI lamp. (See pages 38-40, 52-53 Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034.) In choosing between the two, however, higher CRI lamps provide a quality more like what consumers have come to expect from incandescent lamps, making it more likely that consumers will continue to choose LEDs over incandescent or CFL options, thereby achieving higher market penetration to save energy. Standards that did not consider CRI and only focused on lumens per watt (efficacy) could result in lower quality lamps with less market penetration. LEDs are competing with CFL and halogen/incandescent technologies. While CFLs do not have high CRI levels, they also do not have as significant market adoption as halogen/incandescent technologies, and thus have not achieved a large portion of the potential energy savings in replacing incandescent lamps. The majority of light bulbs currently installed in California homes are 100 CRI halogen/incandescent light bulbs.

A CRI of 82 was specifically chosen because it was closest to the level met by lamps that had demonstrated individual color scores in R1-R8 of 72, based on the study conducted by the California Lighting Technology Center.

Some commenters have argued that a requirement to have CRI at 82 with an R1-R8 of 72 is a “de facto CRI of 90.” The Energy Commission does not find this to be true, as there are lamps that perform at a CRI lower than 90 that also have an R1-R8 of at least 72 (see RESPONSE 3). Nonetheless, even if the standard were set with a CRI of 90, the standard

would still be cost-effective and result in significant energy savings to consumers, as explained in *Supplemental Staff Analysis for General Service Light-Emitting Diodes (LEDs)* (Dec. 23, 2015).

Adopting the language as suggested by some stakeholders, either to lower the average color score (CRI) to 80 or to lower the individual color scores (R1-R8) to some other level, would allow inclusion of poorly performing individual color rendition in a larger average. As the Staff Report evidences, eight color samples are measured to derive CRI, meant to cover much of the visible spectrum, like reds, and blues and greens. The scores of each of these samples are averaged and the result is the CRI score. However, much as a student can get all A's and one F, and still achieve a B average, a good average CRI score can still be achieved when having most of the error in a single color.

This is, in fact, the characteristic in many LED lamps, today, with error concentrated in sample 8, referred to as R8, and which is a pinkish, purple color strongly linked with red. Lamps that would not comply with the proposed regulation generally meet a minimum of 72 for each color sample except for R8. These lamps are generally blue LEDs with white phosphor. One lamp scoring more than 81 average CRI has individual color scores as low as 55, which amounts to 12 "delta errors" versus the 6 allowed by the proposal. Setting a minimum CRI average of 80 or 82 alone does not resolve this error – instead, the Commission must either set a high average CRI (e.g., 90) or it must set minimum individual color scores. The Commission decided to set individual color scores with a lower average CRI to maximize the flexibility of LED manufacturers to find ways to meet the standard. Technological solutions for doing this typically require adding red to the associated spectral power distribution – either by adding red phosphors or red LEDs. The cost to do this is roughly $0.15 per lamp for red phosphors, or $1.04 to add red LEDs, or $1.84 to improve the CRI to 90. The Energy Commission chose to analyze the lowest incremental cost solution, as it is the one most likely to be chosen by manufacturers, but all of the assumed incremental costs are well within the level necessary for the standard to still be cost-effective.

To provide additional time for manufacturers to source components and design light bulbs meeting the standard at low cost, the Tier 1 and 2 compliance dates were extended. No additional changes are necessary.

Comment: The standby power limit of 0.2 watt is too stringent and will negatively impact new products from entering the market. (Acuity Brands, Kent Whiting, Sony, NEMA, GE, Maxlite, Phillips)

RESPONSE 2: Staff disagrees with the proposal to increase the standby allowance from 0.2 watt. A 0.2 watt standby standard is cost effective and feasible and would save significant energy statewide. A higher proposal, such as in ENERGY STAR or in some international standards, would result in significant energy losses without any added utility or benefit to the consumer.

Standby power is an emerging area of energy consumption that occurs in lamps that can be connected to a network (e.g., the internet) and can be remotely controlled. An otherwise efficient LED lamp can consume considerable energy over the years even if not turned on due to the standby power which is being consumed 24 hours a day. Therefore it is critical to ensure that standby power is as low as feasible; otherwise the efficiency benefits of LEDs may be compromised.

A non-connected LED lamp that uses 8.5 watts while on and 0 watt while off consumes 7.8 kWh per year if used 2.5 hours per day. If a network standby circuit were added that used an additional 1 watt all day long, this energy consumption would more than double to 16.5 kWh per year. This means that the majority of the energy use of the connected lamp would no longer be from producing light, but rather from waiting for network commands. However, if a more energy conserving network circuit were added that consumed 0.2 watt, the energy consumption would increase only to 9.5 kWh per year.

As noted in the Staff Report, the International Energy Agency conducted research under their Electronic Devices and Networks Annex on smart-connected lamps and the current levels of standby mode power in 2014. The models tested were all commercially available in the United States. The network standby mode power of lamps in the market varied from 0.17 watt up to 2.7 watts. In addition, the study measured further energy consumption in some devices where a gateway device was required for functionality. This regulation does not cover gateway devices. For a detailed discussion on standby power of connected lamps see pages 54, 60 and 66 of Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034.

The standby mode requirement that a connected lamp use 0.2 watt or less is feasible as there are products for sale today that would comply. While products on the market today have a wide variety of functionality and use different

communication protocols, most spend the majority of the time waiting for commands in standby mode. Achieving lower standby mode power is a matter of both hardware and firmware design. The communication in standby mode requires only very small amounts of information to be passed and, therefore, only a low average bitrate and bandwidth. Staff found implementations in the market claiming as low as 0.1 watt and measured as low as 0.17 watt. In addition, staff found feasibility white papers discussing connected standby power levels as low as 0.05 watt. The proposed standard levels are consistent with technologies available today and as discussed in the Staff Report.

Comment: There is no data or it has not been provided that shows compliant products in ENERGY STAR database that would meet all of the regulatory requirements for general service LED lamps. (NEMA, Soraa, Osram, Westinghouse) In many cases the qualifying products in the Energy Star and Lighting Facts Database do not seem to actually exist. (NEMA, Soraa, Osram)

RESPONSE 3: Compliance with the proposed Tier 1 and Tier 2 efficacy-CRI equations for LEDs is feasible and attainable as many commercially available products already comply. In examining active models in the lighting facts and ENERGY STAR databases as of June 15, 2015, there were 573 models of medium screw base omnidirectional lamps, 658 models of medium screw base directional lamps, and 85 models of candelabra-base omnidirectional lamps that meet the Tier 1 equation standards for lumens per watt and the 82 CRI minimum. Generally, lamp models exceed the 10,000 hour life expectancy and 0.7 power factor standards.

List of lamps and data used in the staff report is publically available on the ENERGY STAR and Lighting Facts websites. The ENERGY STAR database is very detailed and contains the following information relevant to the standards on each lamp:

- Base type
- Light distribution (omnidirectional or directional)
- Energy used (watts)
- Efficacy (lumens/watt)
- Wattage equivalency (watts)
- Lifetime (hours)
- Brightness (lumens)

- Power factor
- Correlated color temperature
- Color rendering (CRI)
- R9
- Dimmability and level of dimming
- Date and where available

See, e.g., https://www.energystar.gov/productfinder/product/certified-light-bulbs/details/2238759.

Information not specifically reported in the ENERGY STAR database but that is yielded as part of product testing is the individual color scores for R1-R8, the standby power consumption, and the Duv. Staff approximated the R1-R8 values by searching for lamps with a CRI of 90 or higher, as such lamps would have to meet the minimum 72 for each color score. The search showed lamps available that meet all of the regulatory requirements with a CRI of at least 90. Moreover, staff's review of the current LED technology, as set forth in pages of 38-40, 52-53, 57-58, and 76-77 and table 18 of the staff report, supports a conclusion that products exist that have a CRI from 82-89 with individual color scores of 72 for R1-R8, making it a technologically feasible standard.

Staff also reviewed product testing completed by the California Lighting Technology Center (CLTC). The CLTC test reports provided performance data for all of the required metrics for approximately 50 A-lamps and directional lamps. Both of these analyses show that there are products available that meet all of the Commission's proposed mandatory requirements, including chromaticity, CRI of at least 82, R1-R8 of at least 72, minimum efficacy, CRI/efficacy compliance score at both Tier 1 and Tier 2, lifetime, power factor, light distribution, and standby power.

Staff looked at separate studies to identify standby power consumption, and found no technical barriers that would prevent a lamp from meeting both the standby power requirements (if applicable) and all of the other requirements in the regulation. In other words, there is no relationship between standby efficiency and other efficacy or quality metrics in the lamp.

Compliant products are available from multiple manufacturers, showing that there are not intellectual property or feasibility issues. These products are available in a wide variety of shapes and sizes, including A19, A21, BR30, BR40,

PAR20, PAR30, PAR38, PAR38L, R20, Globe, Candle, and others. These products are available in a range of color temperatures from 2700K to 6500K, and range in light output from 200 lumens up to 1,650. There are also already products available that meet the Tier 2 requirements, across all lamp type categories, from multiple manufacturers, despite the standards not taking effect for almost another three years (July 1, 2019). (See pp. 7-19 at http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206868_20151207T161702_Michael_McGaraghan_Comments_CA_IOU_Comments_on_LED_Lamps.pdf). This is more than sufficient data to demonstrate the technical feasibility of the standards as a whole, as well as piece-by-piece.

Comment: The proposed regulations will inhibit consumer choice, raise operating costs, and raise the price of LED lamps. (Francis Rubinstein, NEMA, GE, Phillips)

RESPONSE 4: The standards for general service LEDs and small-diameter directional lamps are designed to save energy while ensuring that manufacturers do not diminish the quality of the lamp in order to achieve higher efficiencies. The standards do not choose between consumer preferences, nor are they based on those preferences. In some sense, the standards will reduce consumer choice, to the extent that the efficiency regulations will prohibit inefficient products from being sold or offered for sale in California. However, the Commission's mandate under Public Resources Code section 25402 is to develop standards that reduce the wasteful, uneconomic or unnecessary consumption of energy. In developing regulations, the Energy Commission considers whether the regulation would diminish some *utility* of the product. As discussed in the staff report, these standards will save significant energy for California citizens, and the standards are set to ensure that the efficiency regulations do not unintentionally result in decreased utility of the product for consumers. Also as discussed in the staff report and supported by the CASE reports and comments from manufacturers, there are currently, and will be by 2018, many types of compliant products, which from an objective analysis would provide consumers many choices. See Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034; See also McGaraghan, Michael, 2015. *LED Lamps, Response to CEC's Express Terms 45-Day Language Proposals*, Codes and Standards Enhancement (CASE) Initiative, available at http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206868_20151207T161702_Michael_McGaraghan_Comments_CA_IOU_Comments_on_LED_Lamps.pdf; McGaraghan, Michael, 2015. *Small Diameter Directional Lamps, Response to CEC's Express Terms 45-Day Language*

Proposals, Codes and Standards Enhancement (CASE) Initiative, available at http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER06/TN206867_20151207T161554_Michael_McGaraghan_Comments_CA_IOU_Comments_on_Small_Diameter_D.pdf

The proposed regulations reduce, and do not increase, operating costs compared to many LEDs today, and they greatly reduce, and do not increase, operating costs compared to incandescent lamps that are still a significant part of the market. It is factually incorrect that the standards will raise operating costs.

Generally speaking, efficiency improvements have an incremental cost. The Energy Commission is required to ensure that this incremental cost is recovered by the consumer through the operating savings of the efficient appliance. As the staff report demonstrates, the LED standards do have a small incremental cost, but this cost is more than paid back in savings over the lifetime of the lamp, making the standard cost-effective to the consumer as required under Public Resources Code section 25402(c). As a result, no changes to the standard are necessary in response to this comment.

Importantly, the standards do not regulate every aspect of an LED light bulb. For example, the standards do not limit the range of correlated color temperature (CCT) that an LED may have, allowing consumers to choose between more traditional yellow light bulbs and high temperature, almost blue light bulbs. Similarly, the standards do not require LED lamps to dim or be of a certain shape or size.

Comment: The Energy Commission did not sufficiently engage industry in developing the standards. (NEMA, Phillips)

RESPONSE 5: Considerable engagement with stakeholders occurred since the rulemaking began in earnest in 2012. Starting with the development of the 2012 Order Instituting Rulemaking Proceeding, staff solicited stakeholder input with an invitation to participate in March 2013 that requested data and information about the products, followed by a request for proposals in June 2013. Staff held workshops to vet information received in both of these activities. In September 2014, staff released a draft staff report and held a public workshop to solicit comments on proposed standards for general service LEDs and small-diameter directional lamps. Staff then solicited stakeholder input through the formal rulemaking proceeding, through publication of the revised staff report, Notice of Proposed Action, Initial

State of Reasons, and Express Terms in October 2015, through the 45-day and 15-day public comment periods, the December 2015 workshop, the January adoption hearing, and in numerous one-on-one discussions. (For pre-rulemaking information, see: http://www.energy.ca.gov/appliances/2014-AAER-01/prerulemaking/documents/index.html. For rulemaking documents, see: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=15-AAER-06). This engagement exceeds what is required by the Administrative Procedure Act and resulted in many beneficial changes to the proposed regulations to achieve the Energy Commission's mandate of cost-effective and technically feasible energy efficiency.

Comment: The standards lack factual support and were rushed through the rulemaking. (Robert Clear, Francis Rubinstein, NEMA)

RESPONSE 6: The development of proposed regulatory language was a multi-year effort that consisted of engagement with industry, manufacturers, utilities, environmental groups, academic institutions and others. Workshops and information exchanges with these stakeholders and independent research resulted in the publication of two staff reports, a supplemental staff analysis, and a detailed Standardized Regulatory Impact Assessment. Therefore, it is factually incorrect to say that the standards were "rushed."

Specifically, the Energy Commission began this rulemaking on March 14, 2012 with an Order Instituting Rulemaking (OIR). Staff followed this up with an "invitation to participate" released on March 25, 2013 to provide interested parties an opportunity to provide data and information about the appliances identified for potential standards in the OIR. In May 2013, staff publically vetted information received in response to this invitation to participate. In June, staff requested proposals for regulating the appliances. Based on the proposals it received, staff developed a draft staff report proposing efficiency standards for general service LEDs and small-diameter directional lamps, which report was published on September 19, 2014. Staff held a workshop and solicited comments on the information and proposal in the staff report. Staff then prepared a Standardized Regulatory Impact Assessment analyzing the macroeconomic effects of the regulation. This document was available on the Department of Finance's website for review and comment in August 2015. Staff followed this with a revised Standardized Regulatory Impact Assessment, a final staff report, Express Terms, Notice of Proposed Action, and Initial Statement of Reasons in October 2015 that began a 45-day comment period on the proposed standards. Each of these documents referenced and cited publically available data that was used in developing

the proposed standards. Staff held a workshop during the comment period to solicit oral feedback on the regulations. In response to comments it received, staff prepared and published 15-day language as well as a supplemental analysis of the proposed efficiency standards. This was followed by revised 15-day language to correct a couple of errors in the original document. Finally, the Commission held a hearing in January 2016 and voted to adopt the revised 15-day language, setting the nation's first efficiency standards for general service LED lamps and small-diameter directional lamps.

This is a lengthy rulemaking proceeding, and there is a robust factual record constituting substantial evidence to support the standards for both general service LEDs and small-diameter directional lamps. No additional time or changes are needed.

Comment: LED downlight retrofit kits are luminaires, not lamps, and therefore should not be included in this rulemaking or have a separate set of standards to accommodate this product type. Screw-based downlight retrofit is not an omnidirectional lamp and provides radically different optical performance from other LED lamps evaluated by staff. (Acuity Brands, NEMA)

RESPONSE 7: Staff finds that the data of available lamps show that the proposed standard is cost-effective, technically feasible, and will result in significant energy savings for all lamp types, including downlight retrofit kits. The definition of state-regulated LED lamp is set forth in section 1602 and includes downlight retrofit kits. This definition is deliberately different from ENERGY STAR, which covers downlight retrofit kits as a "luminaire" instead of a "light bulb." However, ENERGY STAR regulates aspects of the luminaire that relate to the fixture, whereas the Energy Commission's standards only regulate the LED technology, not the fixture. As a result, it is appropriate to include these lighting products as a "lamp" covered under these regulations.

In addition, staff's analysis does consider downlight retrofit kits, as these are white light LED replacement lamps like any other LED with the same base. Therefore, staff's analysis covering LEDs also is applicable to LED downlight retrofit kits. The standards do not dictate glare or trim styles but relate to the internal LED components which are similar to most other LED lamps. Since the underlying LED technology is the same, it is not necessary to specifically assess LED downlight retrofit kits as a separate type of product. Downlights, including downlight retrofit kits, are essentially large-

diameter reflector lamps, and were included in the analysis of all other large diameter reflector lamps (not omnidirectional lamps), as they do not have a unique technology or unique utility. Moreover, the CASE analysis found that products are available across all lamp type categories; there are omnidirectional, directional, downlight, and decorative lamps that meet the requirements. (See pp. 7-11, 17-18 at http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206868_20151207T161702_Michael_McGaraghan_Comments_CA_IOU_Comments_on_LED_Lamps.pdf)

Comment: The early adoption of LEDs through market forces of supply and demand has far exceeded the historical experience with CFLs. There is no parallel here and no reasonable person could reach the conclusion that the history of CFL market adoption is relevant to LEDs. (NEMA, GE)

RESPONSE 8: The commenters show a false comparison of the uptake of CFLs versus LEDs, rather than the uptake of LEDs compared with the total number of screw-base lamp sockets in the state. While 80 million LED lamps were sold in the United States in 2014 – and approximately 10 million in California (based on 12 percent share of sales for California) – it is important to note that there are more than 622 million medium screw base lamps in California. A sale of 10 million lamps in California amounts to about 0.16 percent. Staff finds that these sale numbers are too small to conclude that LED lamps have achieved widespread adoption. In 2000, there were few CFL manufacturers compared to the number of LED lamp manufacturers in 2013. This may be one of the reasons for an increase in the LED lamp shipments, rather than simply consumer satisfaction with LEDs. Commenter ignored the fact that there are more than 622 million sockets in California and 99.8 percent of the lamps in those sockets are non-LED lamps. Staff disagrees with the comment because data is insufficient to conclude that LED lamps are successfully adopted by the consumers.

The historical CFL experience highlighted important factors that consumers consider in choosing lighting. Consumers do not look only at how many watts the light bulb will consume, but also how bright it is (lumens), what color temperature it is (CCT), whether it differentiates well between different colors (CRI), lifetime (hours), whether it contains hazardous materials, and cost. These factors dictated whether a consumer would replace their incandescent lamp with a CFL. These same factors are relevant for whether a consumer would replace their incandescent or CFL with an LED. Unfortunately, as occurred with CFLs, performance of the lamp can be sacrificed either to increase the efficacy or to reduce the cost. Standards are necessary to ensure that LEDs meet certain minimum performance requirements while pushing higher

efficacy levels: so that consumers reap operational savings not only compared to incandescent lamps, but also compared to many of today's LED technologies.

Comment: Decorative LED lamps typically have lower efficacy level than omnidirectional lamps that give off the same amount of light and may need to be included in a separate category with a different efficiency equation. (NRDC, NEMA, GE)

RESPONSE 9: Setting a less stringent standard for decorative lamps is not necessary because there are several products that already meet the Tier 2 levels that are commercially available today, almost three years in advance of the standard. There are 85 candelabra base LED lamps available in the market that meet Tier 1 and 42 candelabra base lamps that meet the Tier 2 requirements.1 The Tier 1 standard will take effect in January 1, 2018 and the Tier 2 standard will take effect in July 2019.2 These products are available at a cost that yields energy savings to the consumer, and are technically feasible as there are products that exist today that meet the standards.

Moreover, the lighting technology improvements necessary for decorative lamps to meet the standard are not restricted by their smaller form factor. The same technology improvements that the standards require for omnidirectional and directional lamps would apply to decorative (candelabra) lamps. These technology improvements have been demonstrated in the staff report and in the Supplemental Staff Analysis for General Service Light-Emitting Diodes (LEDs) to be both cost effective and technically feasible.

The regulation only covers LED technologies for decorative lamps; halogen and incandescent technologies are outside the scope of the general service LED regulation. Nonetheless, there is no evidence in the record to support the assertion that the standard will result in a rise of incandescent and halogen decorative lamp sales. Market data trends show a

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1 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 64

2 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN207130_20151228T085859_Supplemental_Staff_Analysis_for_General_Service_LightEmitting_D.pdf

rapid increase in the availability of LED candelabra base lamps. The proposed standard for candelabra base lamps will result in significant energy savings.

To provide additional time for manufacturers to source components and design light bulbs meeting the standard at low cost, the Tier 1 and 2 compliance dates were extended for decorative as well as omnidirectional and directional LED lamps. No additional changes are necessary.

Comment: There is no data or it has not been provided that shows compliant products in ENERGY STAR database that would meet all of the regulatory requirements for small-diameter directional lamps. (NEMA, Soraa)

RESPONSE 10: The Commission's efficiency standards for small-diameter directional lamps (SDDLs) set fewer performance-related requirements than general service LED lamps because the market for SDDLs is more sophisticated and able to specify the performance metrics necessary, as it is mostly a commercial market. The Energy Commission looked at only two requirements for SDDLs in its analysis: CRI-efficacy equation and lifetime. ENERGY STAR and Lighting Facts data shows there are more than 70 lamps in the market that already meet the standards,3 demonstrating that they are technically feasible. The standards are also cost-effective to the consumer, as described on pages 21-35 of Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034. Staff also considered whether efficient LED technologies were able to provide certain characteristics of small-diameter directional lamps, such as beam angle, center beam candle power, and high CRI. Staff found that LED technologies were not a barrier to providing these additional characteristics, although it did acknowledge the need to invest in further development to ensure that these products could be available at low cost.

The SDDL regulation covers all technology types. Staff did not find any halogen or incandescent SDDLs that would meet the efficacy standards in the regulation. However, staff did find that there were LED replacements for each of these lamp

3 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 36.

types, or that the technology for making an energy-efficient replacement existed and was not restricted by the specific application or form factor of the bulb in question.

Staff did modify, in 15-day language, the proposed regulations to limit the scope of the SDDL regulation to those lamps that had a larger marketshare and for which staff expected there to be an adequate energy-efficient replacement lamp, based on either a compliant product existing today or the technology being available to make a compliant product by the effective date. Additional changes to the standard were not necessary, as it was cost-effective, technically feasible, and would result in significant energy savings.

Comment: The scope of the regulation as applied to small-diameter directional lamps should be limited to directional lamps of any technology type (halogen, incandescent, or LED) with a diameter less than or equal to 2.25 inches and a GU-10, GU5.3, GUX5.3, GU8, GU4, or E26 base that is capable of meeting performance specifications when operated within a voltage range of 11 to 13 volts, or, 110 to 130 volts, has a rated life of more than 2000 hours, and has a lumen output greater than 150 lumens and less than 825 lumens. (NEMA, GE, Philips)

RESPONSE 11: In the 15-day language, staff modified the proposed language defining a state-regulated small-diameter directional lamp to remove certain products from the scope of the regulation. The products removed were those that were used in specialty applications and for which staff was unable to identify either an existing LED replacement lamp or for which staff did not find existing LED technologies could be used in the application identified.

Specifically, staff found that for higher lumen lamps, thermal dissipation may be an issue due to the small form factor of these lamps and the large number of lumens produced. In addition, a number of small-diameter directional lamps are designed for unique voltages or limited lifetime. These products are extremely low-volume, and staff does not expect that manufacturers have or will invest in LED technologies for these very niche applications.

The 15-day language excludes these various lamp types based on the physical features and electrical characteristics of the lamp so that they can be easily identified on the shelf. An application-based exclusion would be extremely difficult to enforce at the point of sale, so staff carefully drafted the regulations to avoid describing these niche-lamps by their intended use.

Staff did not exclude low-lumen lamps (under 150 lumens) because there are efficient LED replacements for those lamps. Similarly, there are LED replacements available for lamps up to 850 lumens (not 825), so the higher bound was adjusted to 850 lumens. The voltage ranges were modified slightly for clarity, but are essentially the same as proposed by stakeholders. Staff used a lower rated-life (300 hours) than proposed because there were efficient LED replacements available for applications that typically use lower rated-life lamps, and because too high a number would essentially exempt most halogen lamps, which have a short lifetime. Staff also clarified the base-types to encompass all bases intended to be in the scope of the rulemaking.

The scope, as modified, covers products for which staff has found cost-effective and technically feasible solutions for achieving the standards. No further changes are necessary.

Comment: The proposed standards for SDDLs will cause compatibility issues for SDDLs used on dimming systems due to the low wattage of the efficient SDDLs. (NEMA, GE) Low wattage LEDs may not be compatible with existing transformers. (GE, Baty)

RESPONSE 12: Staff used the data reported to ENERGY STAR and CALiPER by manufacturers. Data reported in the 2015 CALiPER did not include new information related to dimming capability, so older version of the CALiPER, also reviewed by the Commission, were included in the analysis. Older transformers typically require a higher minimum load for the LED lamps to maintain dimming abilities, which is often higher than the minimum required load for a transformer to run. This minimum load can vary from as low as 2.5 W (low-wattage start) to as high as 20 W (for dimming capabilities). Transformer compatibility is occasionally an issue for LED lamps that are installed on high-wattage transformers. These issues are increasingly less prevalent based on evidence from utility rebate programs that suggest the incidence of compatibility issues is decreasing. LED dimming problems can be resolved by the use of LED drivers that are compatible with electronic transformers.4 Most lamps have built in mechanisms to account for the transformer frequency and adjust driver frequency to avoid flicker while dimming. Thus, there are many existing technical pathways available to the

4 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 11 and 12.

manufacturers to identify and resolve dimming issue in a way that is cost-effective to their consumers. Therefore, no change was made to the standard.

In a worst case scenario, as suggested by NEMA, switching to an LED-compatible transformer will eliminate LED flickering and dimming problems.5 This approach is still cost-effective to the consumer. A standard 12 V, 60 W transformer can be found in the market for less than $20, although staff found products up to $80. An LED lamp will save about $200 over the entire life cycle of the product compared to a halogen lamp. Further, most SDDL systems have multiple lamps (3-5) installed, all of which rely on a single transformer, resulting in $600-$1000 in savings. Thus, even if the cost to replace the transformer were included in the incremental cost of the lamp, the savings would still vastly6 outweigh the cost. Therefore, no change was made to the standard.

Even though upgrading equipment is cost effective it is important to note that the Commission is not requiring the use of a dimmer with small-diameter directional LED lamps, so there is no requirement to upgrade the transformer to accommodate dimmable LEDs.

Public Resources Code 25402(c)(1) requires appliance efficiency standards to not result in any added total costs for consumers over the designed life of the lamp. When determining cost-effectiveness the Commission shall consider the value of the energy saved, impact on product efficacy for the consumer, and life cycle cost to the consumer of complying with the standard, impact on housing costs, total statewide costs and benefits of the standard over its lifetime, economic impact on California businesses and alternative approaches. The potential need to upgrade equipment to fully utilize an efficient lamp is just one consideration in a comprehensive analysis. Therefore, no change was made to the standard.

Comment: The Energy Commission should modify its power factor requirement from 0.7 (GE, IOUs, Sony, Exar)

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5 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf

6 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 30

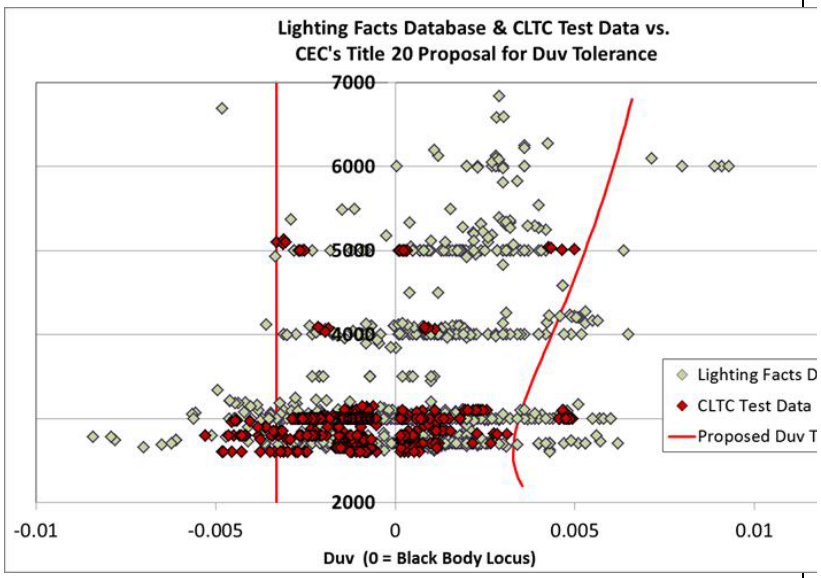
RESPONSE 13: The Energy Commission developed its power factor requirement of 0.7 for general service LED lamps by beginning with the ENERGY STAR specification version 1.1, which at the time had a 0.7 power factor requirement for these products. The purpose of a minimum power factor is to ensure against harmonics in the grid that can cause power quality to be reduced. A power factor of 1 is ideal, although lesser levels have proven to be acceptable. A power factor of 0.7 was chosen to balance the cost of improving power factor against the benefits of the proposed standard to ensure that the standard remains cost-effective to the consumer. Detailed discussion of the power factor requirement can be found in the following report on pages 40-41: Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034. This discussion demonstrates that a 0.7 power factor is technically feasible (most LED lamps have a power factor of at least 0.8) and cost-effective, as there is almost no incremental cost to achieve a power factor of 0.7.

A higher power factor, such as 0.9, is technically feasible for general service LED lamps, but it comes at a significantly higher cost that would reduce the total amount of energy savings that a consumer would receive. In contrast, a lower power factor would reduce the cost to make the lamp, but the level was identified as too low to avoid power quality issues, especially in lighting systems with a significant number of low power factor bulbs. Because raising or lowering the power factor would not be as effective at achieving the Commission's goals and would not necessarily reduce burden on manufacturers, the Energy Commission kept the power factor standard at 0.7 for general service LED lamps.

For small-diameter directional lamps, the Energy Commission did not adopt a power factor requirement because it was deemed unnecessary. Unlike general service LED lamps, SDDLs are primarily used in commercial settings. Commercial users are more sophisticated and able to specify a power factor level appropriate for their systems. Residential consumers will benefit from this, as manufacturers are unlikely to make products with different power factors just for residential consumers. Therefore, a power factor requirement for SDDLs was not needed to address any identifiable problem.

45-day Written Comments

Commenter	Comment	Response
Chromaticity and Color Consistency		
California IOUs	Color Appearance (Duv): We support CEC's proposal to require lamps to provide white light within a 4 MacAdam step tolerance (i.e. +/-0.0033) from either the black body locus or the ANSI white curve defined in ANSI C78.377. The 4 step tolerance was introduced to the ANSI specification in 2011 as LEDs were introduced to the market with much tighter color binning than had historically been provided with by fluorescent sources. The Duv standard will help ensure that products provide a true white light with better color consistency between products (tightening the tolerances helps to prevent the wide variation of different shades of white among different lamps installed in the same space).	This comment supports the standards and does not request changes to the standards.
California IOUs	Color Appearance (Duv): The vast majority of LED products available today already meet this specification. Our analysis of the thousands of products reporting Duv in the Lighting Facts Database, shown in the Figure 4 below, found that 89% of covered products fall within this range. Testing completed by California Lighting Technology Center for PG&E, incidentally also found that 89% of products meet this specification. In fact, most products pass this requirement	The comment supports the standards and does not ask for changes to the standards. In 15 day language issued on January 9, 2016 change to Duv was made to align with the Duv limits in Table 1 of Annex B of ANSI C78.377- 2015 for color targets and color consistency. No change is needed.

	by a significant margin. Even if the requirement were tightened by 33% (to Duv +/- 0.0022), ~75% of products would still meet the proposal. Notably, among products with a CRI listed above 82 in the Lighting Facts Database, the passing rate for Duv is even higher at 91%. Market Analysis of CEC's proposed Duv Tolerance Requirements  	
California IOUs	Specific Comments in Support of the CEC's 45-day Language: There is a wide variety of products available today that meet all of the proposed standards, at reasonable prices. Products are available from Philips, Feit, Osram, Cree, Cooper, Green Creative, and many others. We support the CEC's proposal to require lamps to provide white light	The comment supports the standards and does not ask for changes to the standards.

	within a 4 MacAdam step tolerance from either the black body locus or the ANSI white curve defined in ANSI C78.377. The vast majority of LED products available today (about 90 %) already meet this specification, and this will ensure that products with a noticeably pink or greenish hue will not be sold as white lights.	
American Lighting Association	Section 1605.3 after table K-13, (C)(i) - Duv Requirements. The ALA has supported the "Voluntary California Quality" LED lamp requirements. We agree 90 CRI products should be an option for consumers who need exceptional color rendering for specfic applications. However, 90 CRI is not necessary to incorporate into a minimum efficiency standard.We do not understand the need for the proposed, more stringent and more complicated, Duv requirements considering the absence of consumer complaints about lamp color variation and the success that Energy Star continues to have using simpler and broader Duv values.	See RESPONSES 1, 3, and 4. The Duv requirement has been changed in the 15 day language to require general service LEDs to meet Table 1 of Annex B of ANSI C78.377-2015 for color targets and color consistency. ANSI C78.377-2015 is an industry standard that is similar in many ways to Duv but provides more specificity. While this standard is more stringent than the approach used by ENERGY STAR, the Energy Commission found that it is technically feasible, cost-effective, and is important for market uptake by consumers. Therefore, no additional change was made.
	"Modfied Spectrum" Lamps. A related issue is that the proposed CRI, chromaticity and Duv limits will eliminate the so-called "enhanced spectrum" or "modified spectrum lamps" from the market. Is that the CEC's intent? Such products are carefully designed to appeal to a growing segment of residential lighting consumers. They continue to be successful in the market and are now available in LED versions.The ALA believes it would	Modified spectrum lamps would be required to meet the chromaticity and color consistency requirements of the regulations if they fall within the Duv range of the definition of “state-regulated LED lamp”. This avoids unintended loopholes that would otherwise allow modified spectrum LEDs to avoid the requirements of the regulation despite

	be a mistake to regulate these lamps out of existence. Rather, as other regulatory programs have done, an exemption for this class of products should be implemented.	serving the same market. The adopted chromaticity and color consistency requirement is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). Significantly deviating from the adopted requirements, such as by adopting a 7-step approach, as suggested by some manufacturers, would allow a noticeable variation in the color consistency while simultaneously allowing significant deviations from "white" light. Alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.
American Lighting Association	No provision has been made in the proposed language for "warm dim" or LED lamps which emit light of a warmer tone (lower chromaticity) when dimmed although such lamp products are growing in popularity and have been judged as lighting award winners in competitions such as Lighting for Tomorrow. An exemption for this class of products should be implemented	The regulations do not prohibit "warm dim" LED products. Products that fall within the range of "white" light should be tested at full output and must meet the chromaticity requirements when it is in the covered Duv range.
Brian Liebel, IESNA	The use of CRI in energy regulations: The Illuminating Engineering Society has recently published a Position Statement, PS-8-15, Color Rendering Index	See RESPONSES 1. While IES is not endorsing any mandatory color rendering measure, the need to include CRI in the efficiency regulations was

	(see http://www.ies.org/PDF/PositionStatements/PS-8-15.pdf, attached). The statement reads, in part, "The IES recognizes that while color rendering is important for consideration in energy regulations on the basis of maintaining lighting quality, the IES does not endorse any mandatory color rendering measures in energy regulations until there is a national or international consensus regarding an appropriate metric and range of values." This position is pertinent to this Docket and represents the view of the IES on issues of lighting color and energy efficiency regulations.	determined to be the best means of ensuring an adequate energy efficient product.
NEMA	Executive Summary of Proposals and Requests List of NEMA Proposals Use the well-established 7-step ANSI quadrangle for allowable Duv chromaticity and normatively reference ANSI C78.377-2015 as the guidance for calculations. 1602(k) Definitions (C) State-regulated LED lamps with lumen output of 150 310 lumens or greater and manufactured on or after January 1, 2017 shall have a color point as described in ANSI C78.377-2015 Table 1.: a color point with a Duv that is: (1) No less than -0.0033 (2) No greater than 57700 x (1/T)2 – 44.6 x (1/T)+0.00854	Staff disagrees with the NEMAs comment to set a lower limit of 310 lumens. Proposed lower limit will close the loop holes and will result in greater energy savings to the state. LEDs lamp are a good replacement for appliance lamps. Proposed standards will not create disharmony or disruption. Staff recommends no change. Based on comments from NEMA on the 45-day language changes were made in the 15-day text to align the chromaticity requirement with the ANSI C78.377-2015. Proposed requirements are a color point that meets the requirements in Table 1 of Annex B of ANSI C78.377-2015 for color targets and color consistency. The color point (chromaticity) requirement was determined based on technical input during the

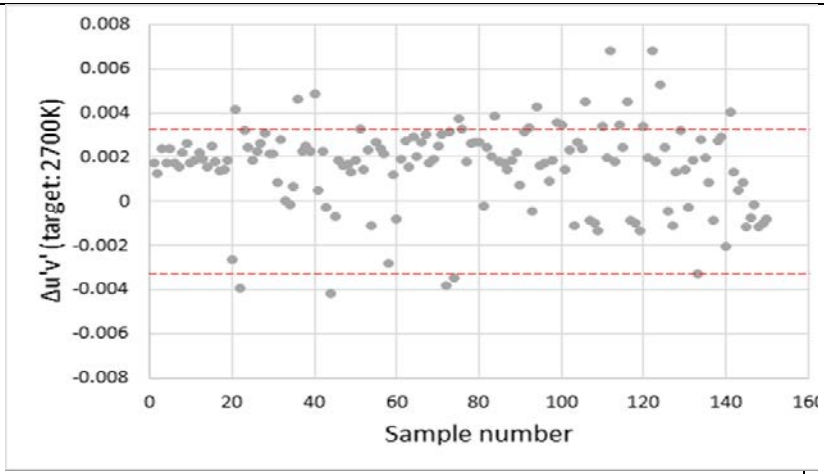
	where T means the measured correlated color temperature.	rulemaking proceeding from a number of stakeholders on desirable lamp chromaticity, to ensure that two lamps, held side by side, look similar in color. The exact levels are designed to balance cost and benefit of the proposed standard, ensuring that the standard is cost-effective to the consumer while being technologically feasible as required by Public Resources Code section 25402(c)(1). Detailed discussion of the chromaticity requirements (also called "MacAdam steps") can be found in the following report at pages 58-59: Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034. The 7-step ANSI quadrangle approach as suggested by NEMA was rejected because the 4-step approach provides superior color consistency, is cost effective and feasible.
NEMA	Chromaticity: The CEC's proposed chromaticity requirements create a 2-step band of acceptability which is too restrictive: it imposes tighter binning requirements in order to meet the narrow 2-step band, and this will eliminate more than 70% of LED packages falling within the applicable ANSI standard range for LED chromaticity used	Staff has reviewed the NEMA comment and in the 15-day language made the suggested change to align the chromaticity requirement with the ANSI C78.377-2015, Annex B, Table 1. This approach is essentially identical to the Commission's original Duv requirement, but is a more nationally

	today. We appreciate the spirit of the proposed correction to the upper bound, widening the band to 4-steps as articulated in the CEC's presentation during the November 18, 2015 public hearing, but we still urge the CEC to stick with the well-established 7-step ANSI quadrangle approach. There are ANSI specification standards and regulatory certifications (ENERGY STAR and LED Lighting Facts) that specify 7 steps from the Planckian locus, as represented by the quadrangle in the ANSI standards, and this approach enjoys strong consumer satisfaction, as reflected by the 80 million unit sales in the ENERGY STAR LED lamps program. The ANSI standard dates back to 2008, has been in use in ENERGY STAR specifications with the EPA spec since 2009, and it has not changed from +/-7 steps (Duv ±0.006). ENERGY STAR regularly looks at making changes to this spec and none have been made so far because it is not desirable to do so. The constriction of the Duv spec from 7 to 4 steps has consequences related to economy of scale and the higher cost of manufacturing. A 4-steps approach will result in smaller economies of scale, and the resulting higher costs will be passed along to the consumer. This added cost implied by the staff analysis and 45-day express terms is in direct conflict with the number #1 factor influencing consumer adoption: acquisition cost. With respect to the feasibility of tighter binning, we note that using data from sites sources like DOE LED Lighting Facts and EPA ENERGY STAR will only show individual data points and not typical manufacturing variations.	recognized standard that manufacturers expressed more comfort with. The Commission declined to adopt a 7-step ANSI quadrangle approach because it would allow too great a deviation from the black body locus (white light) and too great an inconsistency between two light bulbs, issues that were of concern in CFL adoption. The 4-step ANSI quadrangle approach provides addresses these issues, is cost effective, and is technically feasible.

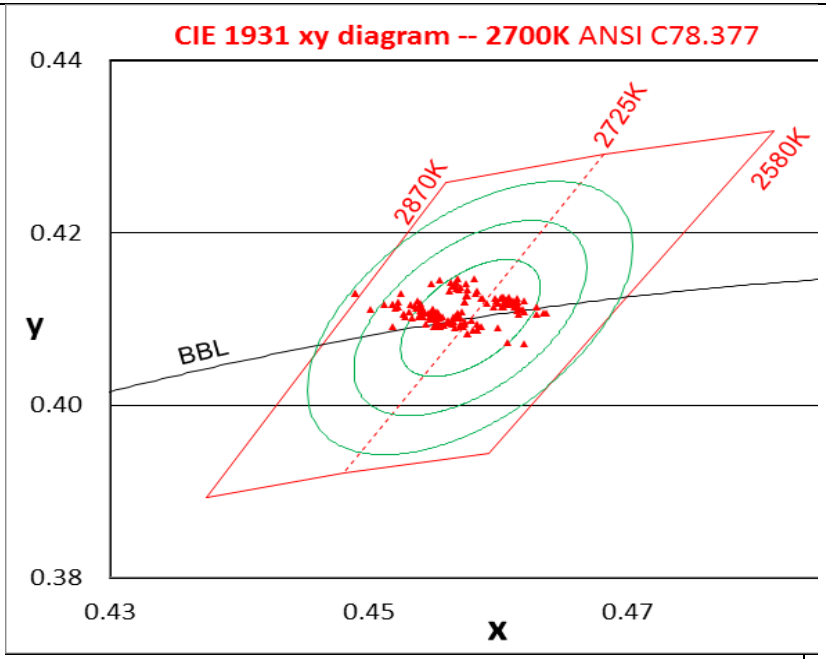
	Importantly, the proposed rule's 2- step requirement, even if amended for a 4-step requirement would violate the necessity and consistency requirements of California Government Code §11349.1(a). NEMA proposes the CEC allow a 7-step ANSI quadrangle for allowable Duv chromaticity and normatively reference ANSI C78.377-2015 as the guidance for calculations. Still, we strongly urge the CEC not to adopt a 4-step requirement. In some ways, the unnecessarily tight 4-step tolerance seems to be the result of confusing the ability to measure a performance aspect to a high degree of detail with needing to regulate that aspect to a higher degree. The former does not justify the latter in this case and yields no incremental benefit to California lighting consumers. We ask the Commissioner to reconsider this decision and ask if it is truly necessary. NEMA submits it is absolutely not necessary. The strong sales evidence in the ENERGY STAR program in the rest of the Unites States indicates the answer is "no" With our preceding comments #2 and #4 in mind, NEMA recommends changes to the 45-day language as follows: 1602.3(k)(C) (C) State-regulated LED lamps with lumen output of 150 310 lumens or greater and manufactured on or after January 1, 2017 shall have a color point as described in ANSI C78.377-2015 Table 1.:	

	a color point with a Duv that is: (1) No less than -0.0033 (2) No greater than 57700 x (1/T)2 – 44.6 x (1/T)+0.00854 where T means the measured correlated color temperature.	
NEMA	"White" color space: The transition from the CEC staff report to the 45-day express terms completely eliminated a class of products known for being off the black body locus, known in the DOE regulation as "modified spectrum" lamps. These are products for which there is a very strong consumer preference as demonstrated by the popularity of modified spectrum products on the market and research studies undertaken by the Lighting Research Center dating back to 2012, as well as others. The elimination of this type of high efficacy LED Lamp that the consumer prefers from the marketplace is inconsistent with CEC stated goals of combined consumer satisfaction and energy savings. Either the Duv requirement must be removed entirely or a full 7-step ANSI quadrangle allowed, permitting these in-demand products to continue to be sold. Our proposed change in the preceding comment rectifies this and meets the consistency requirements of the California Government Code §11349.1(a).	The Energy Commission modified its regulations related to chromaticity and color consistency in 15-day language to allow use of the ANSI C78.377-2015, Annex B, Table 1 (4-step ANSI quadrangle), as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). A 7-step ANSI quadrangle would not be as effective at achieving this goal, although it costs manufacturers less to make a lamp that complies with 7-steps instead of 4 steps. Other alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.
Philips	In addition to limits on R1 – R8 and CRI, the Commission has proposed limits on Duv, which is a seldom used metric that describes how far the light source color is from the black body locus. The proposal that appears in the 45 day	Staff modified the color consistency and chromaticity requirements in 15-day language to state "A color point that meets the requirements in Table 1 of Annex B of ANSI C78.377- 2015 for

	language is as follows: -0.0033 ≤ Duv ≤ 57700 x (1/T)2 – 44.6 x (1/T) + 0.00854, where T means the measured correlated color temperature. At the public hearing, this was replaced with: -0.0033 ≤ Duv ≤ 57700 x (1/T)2 – 44.6 x (1/T) + 0.01184, the difference being the quantity at the far right of the equation. These are rather tight limits for any SSL lamp to meet. As the Commission might be aware, in 2011 Philips Lighting was awarded the L-Prize by the DOE for our design of an SSL 60W replacement lamp. This lamp is one of the most highly designed and tested lamps in the history of lighting with extremely challenging performance characteristics. The following graph shows Duv data from 150 lamps sampled over 10 weeks of production for the commercial version of the L Prize design. Superimposed on the data are the Duv limits from the equation presented at the public hearing. These data show that not even this award winning design will meet the Duv limits in the 45 day language. Duv Data from Production for L-Prize Design	color targets and color consistency." This approach is essentially identical to the Commission's original Duv requirement, but is a more nationally recognized standard that manufacturers expressed more comfort with. The Commission declined to adopt a 7-step ANSI quadrangle approach because it would allow too great a deviation from the black body locus (white light) and too great an inconsistency between two light bulbs, issues that were of concern in CFL adoption. The 4-step ANSI quadrangle approach provides addresses these issues, is cost effective, and is technically feasible.



These same data are replotted below with MacAdam ellipses of 3, 5, and 7 steps. All of the 267points are within 7 steps and 90% are within 4 steps.

	 Based on these data, from a product with an extremely tightly controlled design, we believe that we have demonstrated that the proposed Duv limits are too restrictive. We recommend instead that the Commission adopt ANSI 7-step quadrangles for the color limits.	
GE	Indeed, the color space proposed by the staff (- 0.0033 on and slightly below the black body curve) is not a color space that suits consumers in many applications. Lamps producing light in the preferred "white" color space, such as GE's Reveal lamps, would be prohibited in California under this specification, even though the Staff report states on	The Energy Commission established standards for lamps that were blind to specific models or technologies. The Energy Commission modified its regulations related to chromaticity and color consistency in 15-day language to allow use of national standards, such as ANSI C78.377-2015,

	pages 58 and 59 (CCT) that such products would be allowed to be sold using an alternative approach. This is a contradiction that is just one example of the extreme complexity of the proposed regulations, which could lead to misinterpretation and unintended consequences that are not in the best interest of consumers or the Commission's energy efficiency objectives.	Annex B, Table 1, as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). Alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.
GE	To achieve simplification, first, the commission should remove the proposed complex Duv requirement and replace it with a requirement to meet the ANSI C78.377 color standard. In proposing the Duv requirement, the Commission is will be creating a brand new de-facto industry standard without any manufacturer input or external peer review. As a result of this development approach, the staff proposal is fraught with technical and practical problems, such as the requirement to consistently place all lamps in an overly narrow color space.	Staff made the requested change in 15-day language.
GE	The Duv specification should also be removed because Duv information is not commonly available or commonly understood in the marketplace. If the Commission wants to ensure that manufacturers maintain color consistency in their manufacturing process, it should use the current consensus-based standard. The ANSI color standard, ANSI C78.377 is well understood by industry as a method to	Staff made the requested change in 15-day language.

	consistently meet standardized color points. This approach would ensure that consumers have a uniform and favorable color experience when buying the same color temperature lamp regardless of the manufacturer. This standard has been in place since white LED consumer lamps appeared on the market. There is no evidence to suggest anything further is needed to ensure color consistency for LED technology.	
GE	Recommended Standards Change for E26 or GU-24 A-line LED lamps Per the discussion above, GE recommends the following changes in the proposed LED Lamp standard to greatly simplify the requirements while achieving greater consumer adoption and energy savings: State –regulated LED lamps with lumen output of 310 lumens or greater and manufactured on or after January 1, 2017 shall have: (i) A color point that meets the ANSI C78.377 Standard for Color Targets and Color Consistency A color point with a Duv that is: 1. No less than -.0033 (Alternatively change to a Duv that is no less than -.006 and no greater than .006 from 57700 x (1/T)2- 44.6 x (1/T)+0.00854 where T means the measured correlated color temperature) 2. No greater than 57700 x (1/T)2- 44.6 x (1/T)+0.00854 where T means the measured correlated color temperature. i. Lamps that are rated with a color temperature of 3000K or less and have a color point that is more than 4 McAdam steps below the black body curve do not have to meet this requirement	The Energy Commission modified its regulations related to chromaticity and color consistency in 15-day language to allow use of national standards, such as ANSI C78.377-2015, Annex B, Table 1, as recommended by manufacturers. Although GE's Reveal lamp would not, as currently designed, meet these requirements, this standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). Alternatives proposed would allow for significantly more variation without a correlated energy or performance benefit. Therefore further changes were not made.

	(This is to allow lamps to be designed in a color space around the "ANSI White Curve" such as GE Reveal lamps.)	
LumiLEDs	First, regarding chromaticity, we urge the CEC to make normative reference to American National Standard ANSI C78.377- 2015, rather than attempting to reproduce such technical requirements in the regulation itself. Standards exist to enable consistency and clarity in the market, and this standard – in addition to being widely referenced across the lighting industry – is well suited to help the CEC achieve its stated goals. ANSI standard C78.377, with its scope for LED lamps and luminaires, has also become the de facto LED binning standard used by all major LED device manufacturers worldwide, including Lumileds and its competitors (note: this de facto status has held since the original version was published in 2008). If the CEC feels that 4-step instead of the standardized 7-step quadrangles are necessary, please reference Annex B, which was created specifically in reaction to the CEC's publication of the aforementioned "Voluntary" specification.	Staff has made the change in 15 day language.
LumiLEDs	Compared to the ANSI standard, the CEC's proposed requirements create a band of acceptable chromaticity's which would eliminate more than 70% of LED package color binning space. The proposed 2-step band of acceptability detailed in the 45 day language is too restrictive and would unnecessarily and dramatically limit consumer choice while driving up costs. With the understanding that initial cost is the primary consumer consideration when purchasing	Staff has made the change in 15 day language.

	lighting products, and knowing that consumers have myriad ways to obtain LED lamps from outside of California (e.g. via online retailers), we believe this proposal is in conflict with and will work against the CEC's LED lamp adoption goals.	
MaxLite	Table K-13. (C) Color Point: We support the American Lighting Association stance in not feeling a need for more stringent and more complicated, Duv requirements considering the absence of consumer complaints about lamp color variation and the success that Energy Star continues to have using simpler and broader Duv values.	Changes were made in the 15-day text to align the chromaticity requirement with the ANSI C78.377-2015. Requirements are a color point that meets the requirements in Table 1 of Annex B of ANSI C78.377-2015 for color targets and color consistency. The color point (chromaticity) requirement was determined based on technical input during the rulemaking proceeding from a number of stakeholders on desirable lamp chromaticity, to ensure that two lamps, held side by side, look similar in color and are, in fact, producing a white light. The exact levels are designed to balance cost and benefit of the proposed standard, ensuring that the standard is cost-effective to the consumer while being technologically feasible as required by Public Resources Code section 25402(c)(1). Detailed discussion of the chromaticity requirements (also called "MacAdam steps") can be found in the following report at pages 58-59: Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service

		Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034. The 7-step ANSI quadrangle approach suggested here was rejected because the 4-step approach provides superior color consistency, and is cost effective and feasible.
Consumer Choice/Preference		
Francis Rubenstein	In summary, I strongly recommend that Staff abandon their proposal to legislate high color fidelity at the expense of energy efficiency, consumer choice and cost and use instead the alternative proposed by the NRDC. The NRDC recommendations would encourage the use of the most energy-efficient LEDs while allowing consumers to purchase more expensive, higher CRI lamps if they so desire.	See RESPONSES 1 and 4.
Francis Rubenstein	The purpose of the regulations in Title 20 is to encourage the use of appropriate energy-efficient products in the residential and commercial markets. I submit the proposed revisions will have the opposite effect. By limiting customer choice, raising operating costs, and raising the price of LED lamps to the consumer, the proposed actions may cause many consumers to avoid LEDs altogether and fall back on poorer, less efficient products for most of their home lighting needs.	See RESPONSES 1 and 4.
Francis	I object specifically to two major portions of the Proposed	See RESPONSES 1 and 4.

Rubenstein	Amendments: Excessively high requirements for the allowable Color Rendering Index (CRI), which will severely limit the availability of more efficient and less costly LED lamps that would be adequate to the purpose. The requirement for an omni-directional distribution for general service LED lamps.	
Francis Rubenstein	Although the above could be re-formulated to be technically correct (similar to the NRDC's proposed Table 2, which I do support both in formulation and value), I object to the high bar on CRI and efficacy that Staff's "formulation" selectively imposes on lamps of modest CRI (80-85). To illustrate this, I take two LED lamps: one with a higher CRI (92) that just passes the CEC proposed efficacy limit and a second LED lamp of modest CRI that passes the efficacy limit but just fails the CRI minimum. As shown in the below hypothetical example, the consumer might be obliged to purchase a high CRI that would use 35% MORE energy and cost 35% more to operate than a medium CRI lamp that would be adequate to the consumer's purposes.	See RESPONSES 1 and 4.

	<table><tr><th>Lamp</th><th>Efficacy (l/w)</th><th>Light Output (lumens)</th><th>Power (watts)</th><th>CRI</th><th>kWh consumed over life</th><th>Lamp operating cost ($/lamp)</th><th>Initial Lamp Cost ($/lamp)</th></tr><tr><td>High CRI lamp (pass)</td><td>65</td><td>800</td><td>12.3</td><td>92</td><td>123</td><td>$16</td><td>$12</td></tr><tr><td>Medium CRI lamp (fail)</td><td>88</td><td>800</td><td>9.1</td><td>81</td><td>91</td><td>$12</td><td>$10</td></tr></table>	
Francis Rubenstein	The Staff has not presented any persuasive evidence that a modest increase in CRI is worth the added cost of the lamp, the increased operating costs to the consumer or the increased energy footprint for the State. Given the imperatives of California's carbon and energy reduction targets, it is not in the interest of the State to steer consumers to premium CRI lamps, when a cheaper and more efficient lamp that is adequate to the consumer's needs is available.	See RESPONSES 1 and 4.
Francis Rubenstein	In attempting to justify the requirement for high CRI, Staff asserts that: "The vast majority of lamps covered under the proposed color score regulation are used in residential buildings. Several residential room types demand color accuracy, including the kitchen and bathroom, where grooming and food preparation/consumption occur". Even if one accepts Staff's debatable assertion that grooming in bathrooms and food preparation in kitchens REQUIRES high CRI lighting, kitchens and bathrooms account for less than 30% of the bulbs in a typical home. According to Navigant's	See RESPONSE 1.

	Lighting Market Characterization Report 2010, more than 70% of the light bulbs in a typical house are not in the kitchen or bathrooms. Staff has not presented any evidence that high CRI lighting is necessary for the majority of light bulbs in a typical residence.	
Francis Rubenstein	Simply put, high color rendering is not required in most applications and should not be imposed as a restriction by the State. Since modest CRI lamps are more energy-efficient and less expensive to operate, the consumer's choice of this type of lamp should not be arbitrarily restricted.	Staff agrees with the comment and believes the proposed regulations are consistent with it.
Francis Rubenstein	The Staff's additional requirements on CRI, which not only requires CRI >= 82, but also requires all the individual CRI components to each be greater than 72%, will greatly reduce the number of lamps available to the consumer all in the name of increased color fidelity. Staff's actions will reduce consumer's choice of less expensive LED lamps and as a result will force consumers to consider premium lamps that they cannot afford. Furthermore, the additional CRI component requirements represent an additional cost burden to the manufacturers with regards to compliance. Manufacturers already have test requirements to comply with existing Energy Star requirements. Staff has not presented convincing evidence that the additional cost burden to the manufacturers is justified. If the testing requirements are unnecessarily burdensome, manufacturers will simply not market their products in California. Consumers will be forced to choose cheaper options such as	See RESPONSES 1 and 4.

	CFLs, which do not perform nearly as well as LEDs but will not be regulated by T20, or energy-wasteful appliance lamps, which are allowed as exceptions to Federal rules. Alternatively, consumers will simply skirt the California retail market altogether and buy their light bulbs on Amazon	
Acuity Brands	Color requirements: We thank the CEC for considering a relaxation of the CRI value since color quality and consumer preference are not well correlated to the CRI metric. Consumers may prefer a light source that is more saturated in a specific hue to match their interior design or skin color. But any product that deviates from the referent illuminant and samples upon which the CRI metric is based will result in a lower CRI. We do agree that the CEC should help prevent the situation where color quality is compromised solely to game higher energy efficacy. However this should be evaluated with a perspective of a breadth of quality attributes and based on "acceptability" rather than "preference" so that unintended consequences do not result from gaming a regulated color metric that results in penalizing other aspects of consumer preference. Because "preference" is very subjective among consumers and intended application, focusing on a minimum level of acceptable performance along with availability of information allowing consumers and designers to easily evaluate color and tradeoffs should be the focus for future CEC standards.	See RESPONSE 1.

Philips	We do not see any statistically based evidence in the rulemaking file that consumers actually want or prefer lamps with CRI ≥ 90. The staff report references the IES Handbook and suggests that certain residential room types demand color accuracy. The suggestion that high CRI is needed for limited residential applications should not be the determining factor in setting state minimum performance requirements.	See RESPONSE 1 and 6. The cost-effectiveness and technical feasibility of the standards, based on the incremental cost of a compliant product and the energy savings resulting from compliance, must be supported by substantial evidence in light of the whole record. (Pub. Resources Code section 25901.) The data and analysis includes two staff reports, a supplemental staff analysis, and the Standardized Regulatory Impact Assessment, as well as the comments received from the IOU CASE Team during the rulemaking process. These reports and comments included references and citations to publically available data that supported the Commission's proposed standards.
Philips	If the proposed language becomes the minimum requirement to sell LED lamps in the state, California consumers will be forced to pay more for a high CRI product which is typically 15-20% less efficient and 15-20% more expensive than lamps available to consumers in the other 49 states.	See RESPONSE 4.
NEMA	We reiterate our comment made at the November 18, 2015 CEC hearing that the California Lighting Technology Center is well-suited to conduct some of the consumer studies that have yet to be pursued by the CEC in effort to better understand consumer preferences towards lamps. The CEC should fund the CLTC to conduct these studies	See RESPONSE 4.

	and put to rest speculations about consumer preferences and practices.	
NEMA	We perceive the intent of the rulemaking to be twofold: (1) set minimum requirements both for existing LED product offerings, and (2) establish minimum requirements for lamps which are not yet offered in LED technology options. The 45 day language proposes very tight requirements on chromaticity and CRI that set the minimum bar for sale in California too high. This will have substantial unintended consequences. These requirements will effectively mandate SSL lamps with a CRI close to 90, which are significantly more expensive than the CRI 80 lamps that are currently on the market and experiencing good sales results (nearly 80 million units in 2014). This outcome reduces consumer choice, competition, and increases cost for these lamps to the average Californian.	See RESPONSES 1 and 4.
NEMA	Also evidenced in the strong sales of the ENERGY STAR program's strong sales is the apparent consumer satisfaction with a product offering of lamps mostly landing at the 80 CRI level. Given that there is no credible consumer survey or human factors analysis which attributes increased acceptance of 90 CRI products over 80 CRI products, we propose the CEC should not make high-CRI mandatory in California. This will not prevent high-CRI products from being offered or sold, and will allow for greater consumer choice. As the CEC staff analysis	See RESPONSES 1 and 4.

	notes, the addition of red LEDs or the inclusion of more expensive Red Green Blue White (RGBW) color-tunable LED chips comes with added cost. We again refute the conclusion in the staff analysis that contends, with no justification, that prices will continue to go down despite increased material costs and design complexity demanded by the proposal. The products whose prices are going down in the national market are 80 CRI products whose performance has been engineered to deliver satisfying performance alongside acceptable initial purchase prices. While consumers have been educated on the benefits of energy efficiency, national sales trends back up the long-standing economic conclusion that cost remains the highest barrier for adoption. While California has strong rebate programs, they cannot be counted on to remain in place forever, and there are still millions of sockets carrying incandescent and compact fluorescent lamps that might find an LED substitute.	
American Lighting Association	The two factors that drive consumer acceptance with respect to residential lamps are (1) price and (2) quality of light. Both continue to improve with LED products so that consumers everywhere are responding enthusiastically and ever more rapidly changing to LED lighting. The ALA believes that, for maximum energy savings, new regulations should build upon this success - not by setting efficacy and performance standards which stretch technology limits and result in a limited range of approved products;but rather by standards which result	See RESPONSE 4.

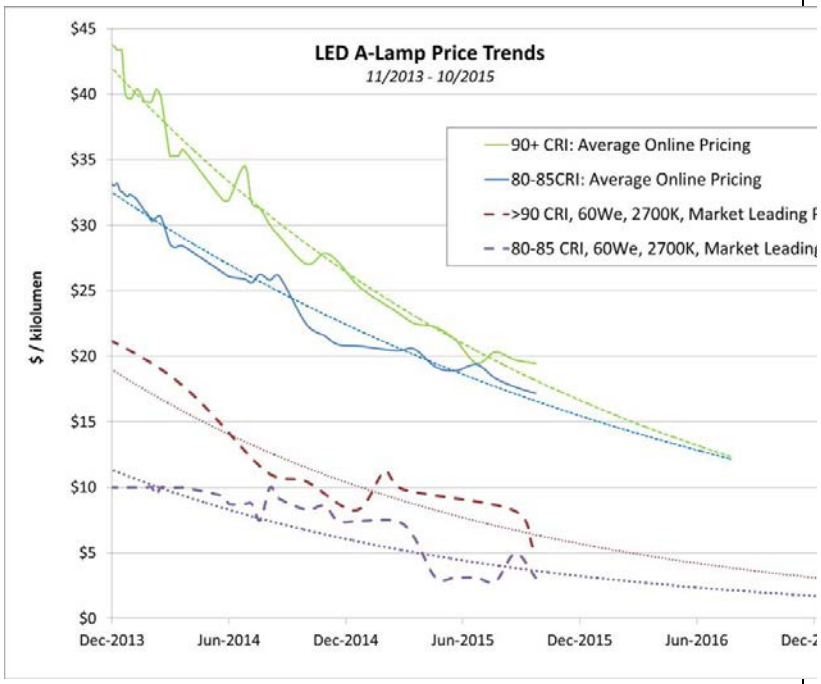
	in filling the many unconverted sockets with more energy efficient products that result in substantial overall energy savings. The Table K-14 efficacy requirements, we believe, are so broad and yet so tightly focused on lamp efficacy and color that the number of lamp types which will comply and be available in quantity and at acceptable price points will be very limited. From our experience, that will seriously reduce consumer choice, limit sales volume and consumer acceptance. We urge the California Energy Commission (CEC) to cast a "broader net" with respect to these two critical performance factors of efficacy and color.	
GE	GE Lighting also believes CEC's proposals introduce serious concerns that, if enacted without further modification, will greatly limit the number and types of LED lighting products available to California consumers and result will slow the adoption of LED lamps in California. While other states benefit from a far greater selection of consumer-preferred LED products, California would be limited to a smaller selection of higher priced premium products designed for specialty applications. This slower adoption will also inhibit the energy savings potential that a more widespread adoption of LED products can deliver.	See RESPONSES 1, 3, and 10.
GE	There is no evidence in the staff report that specifications, such as the extensive color quality metrics in the proposed regulations are necessary or even desired by consumers. Premium specialty products that could potentially meet	See RESPONSES 1 and 4.

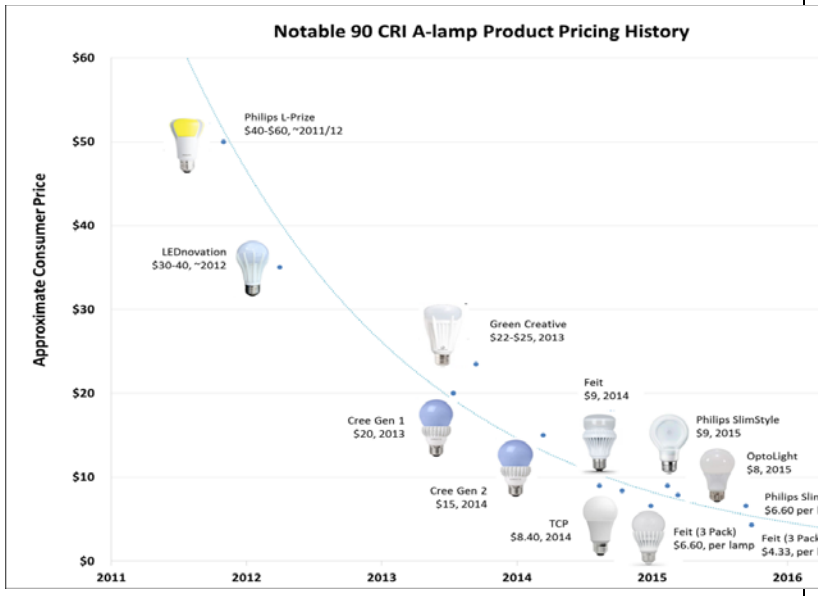
	these proposals may be appropriate for limited niche applications, but they will not enhance the consumer experience in the vast majority of general service lighting applications.	
GE	The intense focus on color quality seems to be driven by an attempt to make LEDs more attractive than CFLs as replacements for incandescent lamps in certain applications such as bathrooms and kitchens. However, a focus on mimicking incandescent lamp color is misguided. CEC seems to have made an assumption that lack of acceptance in particular applications is due predominantly to lamp color properties. However, such an assumption is unsupported. There is research suggesting that consumers actually prefer white light (compared to the yellow-tinted light of incandescent sources), which is perceived by the human eye as an area below the black body curve at low color temperatures. Furthermore, we assert that the lack of CFL use in certain applications is not color related. Rather, the primary reason CFLs were not as well accepted in bathrooms is due to frequent, short duration use and consumer frustration with slow warm-up time and, the significant reduction in CFL life resulting from the frequent on-off daily duty cycle.	See RESPONSES 1 and 8. The Energy Commission modified its regulations related to chromaticity and color consistency in 15-day language to allow use of national standards, such as ANSI C78.377-2015, Annex B, Table 1, as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). Alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.
GE	The proposed complex specifications for LED color are entirely unrelated to actual consumer complaints and therefore are not necessary to ensure consumer satisfaction. Previous studies on CFL use have indicated:	See RESPONSES 1, 4, and 8. The LED lamp standards were based on previous issues from CFL adoption, but were also based on issues specific to LEDs, such as a range of correlated

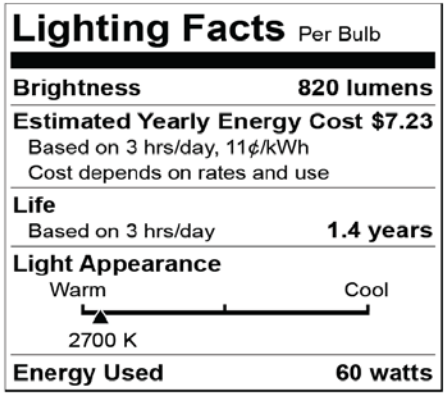
	1. Users report the most important characteristics of light bulbs include brightness, equivalent light output, and warm color. They expect color consistency and predictability from CFLs (Rensselaer, 2003). 2. Eighty percent of CFL purchasers reported they were at least as satisfied with the CFLs they purchased as with purchases of incandescents (NEEA 2004 [14]). More than one-third said they were more satisfied. 3. The main reasons for dissatisfaction were: · the lamps were not as bright as they were led to expect, or · they didn't like the lighting 4. CFL purchasers are becoming more satisfied over time. One study (KEMA 2005 [8]) noted that 28% of purchasers are more satisfied with newer CFLs than earlier purchases, and only 5% were less satisfied. Reasons for higher satisfaction were related to the shape and size of the CFL; reasons for remaining dissatisfaction included early burnout, cost, and product style.	color temperatures.
GE	If the state wishes to have many manufacturers competing with quality products widely available for consumers, CEC should lower the proposed levels by at least 15 LPW, which would still eliminate over 75% of today's products from the market. 1) >=65 LPW minimum (current ENERGY STAR Standard), or	See RESPONSE 4. The record shows that there are many compliant lamps available in the market that meet the adopted standard, and that the standard is cost-effective and technologically feasible. The proposed alternative here would reduce the potential energy savings from the standard.

	2) >= 55 LPW if the CRI is 90 greater	
California IOUs	Price Trends for high CRI products: Prices are falling quickly for all LEDs, but they are falling more rapidly for higher CRI products. The CASE team has been monitoring LED pricing, regularly obtaining thousands of price points from online retailers, as well as tracking individual price points of high CRI products, including those that meet the CEC Voluntary Specification. Figure 2 below shows average online pricing per kilo lumen based on A-lamp prices collected from nine online retailers between late 2013 and fall 2015. In less than two years, average pricing of low CRI products came down by about 47%, but the average pricing of high CRI A-lamps came down by about 58%. The graph also shows market-leading price trends for low and high CRI products. Again, the best high CRI prices have come down more quickly and continue to catch up to the best lower CRI prices. Exponential trend lines (dotted lines) provide a possible forecast. These macro-level results are corroborated by specific product launches from the past several years. Figure 3 (In the IOUs comment letter) below highlights many of the notable high CRI A-lamp product releases and new price point offerings. Since late 2014, a number of products have been released from multiple manufacturers below $10. The latest pricing as of late 2015 includes multiple products	This comment supports the staff report analysis.[7] No change is needed.

7 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf, page 70.

	below $7, including one as low as $4.33. Average Online per Kilolumen Price Trends for A-lamps  	

	High CRI A-lamp Price History  	
Correlated Color Temperature		
MaxLite	Correlated color temperature: Should allow for the use of warmer CCTs, such as the new ANSI standard 2200K and 2500K	The standards do not specify what CCT is required for a lamp. Manufacturers may produce 2200K and 2500K lamps as long as they comply with the remainder of the standards. No additional change is needed.
NRDC	CEC shall not restrict the allowable CCT of lamps offered for sale in CA. CEC is encouraged to work with utilities, retailers and manufacturers to educate consumers about the "light	The proposed standard does not restrict the correlated color temperature (CCT) of the lamps offered, unless the lamp claims to be equivalent to

	appearance" information that is required by the Federal Trade Commission to be shown on light bulb packages. See example below:  	an incandescent. Incandescent lamps typically have a CCT between 2700K and 3000K, so staff has included a requirement that any lamp claiming to be equivalent to an incandescent have performance that is equivalent to an incandescent, including for CCT. The Commission agrees that we should work with stakeholders to educate consumers about LED products. No change was made in response to this comment.
Cost/Cost-effectiveness		
NEMA	Cost Analysis: With respect to the conclusions of the Staff Analysis regarding cost, one does not need a financial feasibility analysis to conclude that raising baseline lamp performance requirements will logically raise baseline cost. By raising the cost of the baseline product available in CA today, the proposed rule will effectively reverse the market's progress in substantially driving lamp prices and costs down and making LED products affordable for consumers. Manufacturers of LED lamps have been successfully innovating and competing aggressively to develop high quality LED lamps at lower prices to advance customer acceptance and demand for the more efficient	See RESPONSE 4. The standards will not interfere with manufacturer's innovation in the development of efficient quality lamps at low cost. The standards are performance standards, not design standards. Manufacturers are free to meet the performance standards for quality and efficacy in LED lamps in the least-cost manner that they deem appropriate. Based on existing trends in LED technology, as highlighted by the commenter, staff expects that manufacturers will continue to improve efficacy and quality while decreasing the cost. These

	light sources. The CEC's proposed rule as expressed in the 45-day express terms will unreasonably interfere with the success that the market alone has achieved.	standards encourage manufacturers to continue along that trend, and only prevent manufacturers from selling low quality, low efficacy products in the state.
NEMA	There are other equally effective and less burdensome ways of avoiding this outcome. California Government Code §11346.2(4)(a) The staff analysis on pages 91-92/107 concludes that additional components or redesigns will be necessary for many products to remain in the market, and that there will be an associated cost with those measures. Rather than allow the market to continue its steady excellent progress on providing affordable and acceptable products to consumers, the CEC proposal will cause a rise in the prices of baseline lamps in the market along with reduced selection and availability compared to today's offerings. or, having been told again and again they should no longer buy incandescent lamp products, are left with a choice between several-dollar LED options and < $1 CFL prices. A cost-constrained consumer will obviously gravitate toward slightly less-efficient compact fluorescent lamps (CFLs), no matter how nice or superior the LED options appear to be or how many performance parameters CEC regulates.	See RESPONSE 4. Staff considered alternatives to the proposal. The commenter here promotes a "no standards" alternative. Staff disagrees that not setting standards will be as effective at achieving the Commission's mandate of establishing efficiency standards that are cost-effective, technically feasible, and will save energy, even if not setting standards would be less burdensome to manufacturers.8 Commenter claims that the market without standards is already driving high quality, high efficacy LED lamps at low cost. While it is true that such lamps exist (and would generally comply with the standard), staff's review of the market during the rulemaking proceeding demonstrated that there are a significant number of low quality, low efficacy, or both low quality and low efficacy LED lamps in the market. Staff also has evidence from the CFL market that indicates that if consumers do not have high-performing lamp replacements, they will continue to use incandescent technologies, wasting energy

8 http://www.dof.ca.gov/research/economic_research_unit/SB617_regulation/Major_Regulations/documents/SRIA-CEC-LED-regs.pdf page 13 and 14.

		that would be saved if they transitioned to more efficient technologies. As a result, it is important to ensure that consumers receive a product that is equivalent in performance to incandescent technologies and that also save energy compared to baseline LED lamps. These standards ensure that these requirements are met. As a result, commenter's alternative would not save as much (or any) energy compared with the Commission's proposed standards, and is therefore not as effective at achieving the Commission's mandate.
CRI – Small-diameter Directional Lamps		
NEMA	Small Diameter Directional Lamps – CRI Set a minimum CRI of 80 for small diameter directional lamps. There is currently no minimum requirement for these products and adding one will not reduce product availability.	Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80.
NEMA	We note that the CEC did not propose a minimum Color Rendering Index for MR/SDDL products, and NEMA proposes CEC set a minimum score for CRI at 80 for MR/SDDL products	Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a

		result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80.
California IOUs	We recommend that CEC add a minimum CRI requirement of at least 80 or 82 for small diameter directional lamps. As written in the 45 day language, the proposal does not have any minimum CRI requirement for lamps as long as they have an efficacy above 80 LPW, meaning that manufacturers could potentially design low performing, inexpensive products that meet the efficacy requirement by reducing color rendering dramatically (for example to 50 or 60 CRI). This could result in significant consumer backlash to the implementation of this standard.	Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80.
California IOUs	Minimum CRI: We recommend that CEC add a minimum CRI requirement for small diameter directional lamps. As written in the 45 day language, the proposal does not have any minimum CRI requirement for lamps as long as they have an efficacy above 80 LPW. This means that a manufacturer could potentially sacrifice product utility as a way to more easily meet the efficacy requirements. A manufacturer might find a lower cost way to achieve 80 LPW simply by reducing color rendering dramatically (for example to 50 or 60 CRI), which would have negative consequences. CRI is not required to be provided on SDDL packaging so consumers may not be aware that a product has such low color rendering properties. This would likely	Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80. Therefore, staff did not make a change in response to this comment.

	result in significant consumer disappointment with their purchase, and backlash to the implementation of this Title 20 standards. For consistency with the LED Lamps proposal, we recommend setting a minimum CRI of at least 82 for SDDL. The simplest way to make the changes to the 45 day language would be as follows (underlined in red): State-regulated Small Diameter Directional Lamps. State-regulated small diameter directional lamps manufactured on or after January 1, 2018 must have a CRI of at least 82, a rated life of 25,000 hours or greater as determined by the lumen maintenance and time to failure test procedure and meet one of the following requirements: have luminous efficacy of ≥80 lumens per watt. have a minimum luminous efficacy of 70 lumens per watt or greater and a minimum compliance score of 165 or greater, where compliance is calculated as the sum of the luminous efficacy and CRI.	
NRDC	Commenters makes the following recommendations: Add a minimum color quality requirement for all small diameter lamps, not just those with efficacy between 70 and 80 LPW. - The current proposal essentially sets a minimum CRI for lamps with efficacies between 70 and 80 and then sets no CRI limit for lamps with an efficacy above 80. While there has been a lot of debate during this rulemaking about where to set the floor for CRI, there seems to be general consensus that 80 CRI provides a level which eliminates the poor	Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective, as the commercial market will drive the lamps that are available to the residential market. In other words,

	performing products from the market in terms of color quality and is consistent with the CRI requirements set by ENERGY STAR. While it's true that the majority of these bulbs are installed in commercial applications whose purchasers tend to be more knowledgeable, roughly one third of the market are residential customers and they have little to no knowledge of the CRI metric or what CRI value they should be seeking. To prevent a race to the bottom for lamps with efficacy >80 LPW, which would not have any CRI requirement per the current CEC proposal, we recommend CEC adopt the color quality requirements in the ENERGY STAR specification of: a) minimum CRI of 80 and b) R9 requirement of >0, which addresses the color rendering of red objects, an area where consumers complained about CFL color rendition in the past.	manufacturers would not make one set of lamps for commercial customers and a different set for residential customers. This is reinforced by the fact that there are no lamps that have a CRI lower than 80. Similarly, requiring a minimum R9 would add significant cost to the proposed standard without necessarily providing an added benefit, as commercial consumers are sophisticated enough to demand what is needed for their businesses.
CRI – State-regulated LED Lamps		
NEMA	It is important to note that our counter-proposals to the CEC's 45-day language DO NOT sacrifice efficiency. In fact, by allowing more-efficient 80 CRI products to remain in the marketplace, potential energy savings increase since 80 CRI lamps are more efficient than 90 CRI lamps and the CEC avoids increasing the price of LED products to the consumer that will deter market adoption.	See RESPONSE 1.
NEMA	In simple terms, the minimum R1 through R8 requirements that the CEC has included in its proposed rule actually requires a minimum LED lamp CRI of 90 for	See RESPONSES 1 and 3.

	white LEDs based on phosphor conversion technology. The only <90 CRI products with high R8 are high color-temperature, 5000K products (see Figure 1 below). As described above, since no one is binning LEDs for CRI between 85 and 90, to fulfill this requirement at the LED lamp level would require LED packages binned for min 90 CRI. This result will seriously impair consumer adoption and acceptance of LED lamps and would fail the necessity and consistency requirements of the California Government Code §11349.1(a). It would impair California's goals under the Warren- Alquist Act.	
NEMA	While it may be possible to obtain an R8 > 72 LED lamp with adequate efficacy by using an RGBW chipset and multichannel driver, essentially a dumb smart lamp, this is a very expensive solution. See General Comment No. 6, supra. Alternatively, the solution proposed in the staff report, the addition of red LEDs to a white LED, increases the driver complexity, requires color mixing capabilities and increases the cost, while reducing overall lamp efficiency. This would unreasonably and unnecessarily drive up costs and impair consumer adoption. Some of the conclusions in the staff analysis indicate a reliance on publicly posted information regarding LM-79 reports. However, LM79 reports may not include all the R values, leading to mistaken conclusions about R1-R8 overall scoring based on the limited information provided. Based on our members' extensive technical knowledge of LED performance, we note generally that LED lamps with very	See RESPONSES 1 and 3.

	high CRI have R1 through R8 values greater than 72. LED lamps with CRIs in the 80s are deficient in one but not more than two R values. In suggesting a minimum CRI of 82, the CEC staff has reached a conclusion that no reasonable person could have reached, by implying that a CRI 82 lamp can meet the additional R1-R8 > 72 requirement. This must be corrected.	
NEMA	While NEMA shares a desire to foster good consumer acceptance in LED lamps, we disagree with the CEC's attempt to assure consumer satisfaction through stricter requirements on color, consistency and other parameters without scientific justification for these attempted quality metrics. Instead, we ask the Commission to take a step back and observe the excellent sales being enjoyed by lamps certified to meet the ENERGY STAR Lamps program specification. Without the restrictive requirements proposed by CEC, in 2014 ENERGY STAR lamp sales accounted for 75% of market share and nearly 80 million unit purchases. NEMA is undertaking a detailed examination of R1-R8 and other factors to cull the EPA's qualified products list. However, our initial review of the ENERGY STAR qualified products list for lamps which might survive the CEC's proposed requirements is barely 6.8% and this poor outcome is further spread across several lamp types.	See RESPONSES 1, 3, and 8.
NEMA	CRI versus efficacy: We lastly note that a reverse analysis of the CEC's proposed lm/W vs. CRI qualification equation shows a 20% difference in achievable efficiency between 80	See RESPONSES 1, 3, and 4. Government Code section 11346.9 requires an agency to prepare and submit to the office of

	and 90 CRI products: 90 CRI products may be up to 20% less efficient than their 80 CRI siblings. NEMA appreciates very much that the CEC allows for a tradeoff, in recognition of the limitations of the laws of physics regarding red LED efficiency, but we are deeply confused as to why CEC would write a CRI and R1-R8 proposal which effectively mandates CRI = 90, ignoring the additional energy savings that CRI 80 products bring. It makes more sense to allow consumers to choose, and take advantage of the increased energy savings and reduced operating costs that < 90 CRI products afford CA and its citizens. It is for this reason that we submit that the proposed rule's requirements on CRI fail to meet the California Government Code's requirements of necessity and consistency, and that a reasonable person could not have reached the conclusion reached by the CEC, and that NEMA's alternative proposal is as effective or more effective and less burdensome in achieving energy savings without sacrificing product acceptance and quality. California Government Code §§11349.1(a), 11346.9.	Administrative Law (OAL) a Final Statement of Reasons (FSOR) which updates the information contained in the Initial Statement of Reasons (ISOR), and provides responses to comments. Staff's FSOR complies with all the requirements of section 11346.9 by providing detailed responses to comments, updates to the ISOR as appropriate and updates to the Informative Digest. Government Code section 11349.1(a) details OAL's review process and the standards of necessity, authority, clarity, consistency, reference and nonduplication. The proposed regulations meet all of these requirements. The supplemental ISOR details the necessity of each provision of the regulation. The Commission's authority to issue regulations is detailed in the regulatory text after every section under the heading "Authority and Reference." Therefore, each of these rulemaking requirements has been met. Commission staff worked closely with stakeholder to develop clear regulations. That fact that a stakeholder does not agree with a particular regulation does not mean the regulation lacks clarity. The regulations are consistent with the existing framework and structure of the Commission appliance regulations found in sections 1601-

		1607. The reference requirement has been met in the regulatory text where each section contains a list of underlying authority and reference. Finally, the regulations proposed by staff do not duplicate existing regulations. During the development of the regulations, staff carefully crafted narrowly tailored regulations that were feasible and cost effective in meeting the Commission's mandate to reduce the wasteful use of energy in the state from lighting. Staff considered all alternative proposals presented to develop the final proposed regulatory language which maximized energy efficiency and cost savings. As discussed at page 2 of the revised SRIA, Energy Commission staff used a macroeconomic model to estimate the effects of proposed and alternative regulations within the California economy. Three scenarios were modeled and evaluated (more stringent, proposed, and less stringent). The proposed scenario uses the stringency level that the Energy Commission plans to introduce at the outset of the rulemaking. The less stringent level was selected from input provided by interested stakeholders in the pre-rulemaking process. The more stringent level

		incorporated stakeholder feedback and was chosen at the maximum stringency level that Energy Commission staff could propose and still meet the objectives of the rulemaking in terms of time, technical feasibility, and cost effectiveness. Based on the results of this modeling, the lower efficiency levels proposed by NEMA and other stakeholders would not capture all the cost effective energy savings. Alternatively, the most stringent standards would save more energy but may cost more. Staff's proposed standards achieved a middle ground to maximize energy savings yet to ensure adequate products are available to meet the standard. Staff disagrees that NEMA's alternative proposal is more effective or as effective as and less burdensome than the language adopted by the Commission. No change is made.
NEMA	In conclusion: NEMA proposes that CEC restore the global minimum of CRI 80 for LED lamps in California, and if the CEC will not abandon the unnecessary R1-R8 requirements we suggest at the very least that the R8 requirement be set at R8 > 50, leaving R1-R7 > 72. This will allow well-made, high quality CRI 80 products already selling in high volume to remain competitive available in the market and to serve as lower-cost alternatives when high color rendering is not needed. This will also help compete against CFLs, which are	See RESPONSES 1 and 3.

	the leading high-efficiency cost competitor and will remain so. We recommend the following change to the proposal language: 1605(k)(2)(C) A CRI (Ra) of 8280 or greater Individual color scores of R1, R2, R3, R4, R5, R6, and R7, and R8 of 72 or greater, and an R8 of 50 or greater	
NEMA	The proposed rule contains a nominal minimum 82 CRI requirement, but other requirements in the proposed rule render this nominal minimum a chimera: the true minimum is actually 90 CRI. If the CEC's real intent is to only allow nominal CRI 90 products into the market then this should be clearly stated in the proposed requirements language and the CEC should clearly take responsibility for proposing that consumers can only purchase the less-efficient CRI 90 products because that is exactly what the proposed rule is doing and this contravenes the necessity, clarity, and consistency requirements of California Government Code §11349.1(a). Our Comment Nos. 6 and 7 below (taken with our General Comment 7 above) explains why the nominal 82 CRI specification is a chimera, and therefore fails to meet the clarity requirement. It also explains why it fails to meet the necessity and consistency requirements of the Code. "'Consistency' means being in harmony with, and not in 'conflict with or contradictory to, existing statutes, court decisions, or other provisions of law." California Government Code §11349(d). This proposed rule is inconsistent with the Warren-Alquist Act's requirement that appliance efficiency regulations "promote the use of energy .efficient appliances." The proposed rule fails this	See RESPONSE 1. In addition, the proposed rule meets all the provisions of the Warren Alquist Act and Administrative Procedures Act that apply to Title 20: Government Code section 11346.9 requires an agency to prepare and submit to the office of Administrative Law (OAL) a Final Statement of Reasons (FSOR) which updates the information contained in the Initial Statement of Reasons (ISOR), and provides responses to comments. Staff's FSOR complies with all the requirements of section 11346.9 by providing detailed responses to comments, updates to the ISOR as appropriate and updates to the Informative Digest. Government Code section 11349.1(a) details OAL's review process and the standards of necessity, authority, clarity, consistency, reference and nonduplication. The proposed regulations meets all of these requirements. The supplemental ISOR details the necessity of each provision of the regulation. The Commission's authority to issue regulations is detailed in the regulatory text after

	requirement.	every section under the heading "Authority and Reference." Therefore, each of these rulemaking requirements has been met. Commission staff worked closely with stakeholder to develop clear regulations. That fact that a stakeholder does not agree with a particular regulation does not mean the regulation lacks clarity. The regulations are consistent with the existing framework and structure of the Commission appliance regulations found in sections 1601-1607. The reference requirement has been met in the regulatory text where each section contains a list of underlying authority and reference. The regulations proposed by staff do not duplicate existing regulations. During the development of the regulations, staff carefully crafted narrowly tailored regulations that were feasible and cost effective in meeting the Commission's mandate to reduce the wasteful use of energy in the state from lighting. Finally, the standards are cost-effective, based on feasible and attainable levels of efficiency, and will reduce the energy consumption of appliances that use a significant amount of energy statewide,

		therefore meeting all of the requirements of Public Resources Code section 25402(c). NEMA appears to argue on the one hand that because the efficacy standards established under these regulations are less efficacious than an average LED today (regardless of CRI), it does not save a significant amount of energy. Yet, on the other hand, NEMA argues that the Commission cannot set a standard more stringent than the average efficacy of today's LED (see below regarding SDDLs). NEMA cannot have it both ways. For both LEDs and SDDLs, the minimum efficacy standard was set at a level that is technically feasible for all products, that is cost-effective to the consumer, and that will save significant energy statewide. Whether that minimum efficacy level is at, above, or below the average lamp today is something that the Commission considered in developing the standards, but is not relevant to whether the adopted standard meets the state's policy goals or the requirements under the Warren-Alquist Act and Administrative Procedure Act. The Commission made a policy decision that balanced cost and benefits to ensure that the standard was technically feasible, cost-effective to the consumer, and would yield significant energy savings.

		Here, the regulation provides a formula that allows manufacturers flexibility in meeting the standards. The tier 1 formula limits the efficiency at not lower than 68 lumens per watt while the tier 2 formula uses minimal lumens per watt of 80. High CRI lamps can have lower lumens per watt to reduce the cost of the lamp, but not below 68 lumens in Tier 1 or below 80 lumens in tier 2. Lower CRI lamps will have higher lumen per watt efficiencies. This formula will ensure that LEDs have high efficacy while maintaining the necessary performance expected of these lamps. Therefore, no change to the language is necessary.
NEMA	Setting Color Rendering Index (CRI) Levels in Manufacture vs. Regulations: The proposed minimum 82 CRI requirement at the lamp level is inconsistent and incompatible with how industry bins the LED packages within for CRI. LED packages in the market are not binned in stair steps of one or two CRI points. LEDs are binned and supplied to integrators in reels targeting a minimum CRI of 80 or of 90 on each reel. Some leeway for product variation is associated and needed with binning and supply. For example, a typical distribution selection on an LED reel destined for an LED integrator lamp manufacturer would be to include LEDs with a minimum CRI of 80, though more typically the LED supplier aims for a CRI of 82. This distribution ensures that no LEDs on the reel would be below 80. The lamp manufacturer needs the LEDs to have	See RESPONSES 1 and 3. Government Code section 11349.1(a) details OAL's review process and the standards of necessity, authority, clarity, consistency, reference and nonduplication. The regulations meet all of these requirements. Specific to NEMA's comments, the supplemental ISOR details the necessity of each provision of the regulation. And the regulations are consistent with the existing framework and structure of the Commission appliance regulations found in sections 1601-1607. Finally, the standards are cost-effective, based on feasible and attainable levels of efficiency, and will reduce the energy consumption of appliances

	typical Ra ≥ 82 to ensure that the lamp's color performance meets regulatory requirements. What seems to be misunderstood, in terms of reported versus measured CRI performance, is that LED lamp manufacturers rely on known component tolerances to ensure their products satisfy minimum lamp-level requirements in the mass-production environments employed to achieve the economies of scale necessary to achieve lower price points and greater consumer uptake. The limited physical product testing conducted by CEC staff and other entities for this rulemaking has not yielded adequate data to demonstrate quantities of scale and associated variations in performance. Those without an understanding of the need for manufacturing tolerances in volume production may be tempted by limited sample sets of physical testing, such as the 2014 CLTC test report where some claimed CRI 80 lamps demonstrated 82 CRI, as some indication that a minimum CRI of 82 does not represent any additional burden. This conclusion is entirely misplaced. LED technology is still in development, and the impacts of potential regulations on the practices of sourcing and design are not as well- understood. The 2 points of CRI leeway mentioned in the above example are essential to allow for variations in physical manufacture to assure the LED lamps hit 80 CRI at the lamp level reliably. This is especially critical now that the CEC intends to enforce Title 20 requirements, to include possible monetary fines. The CEC's proposal of CRI of 82 results in a requirement of	that use a significant amount of energy statewide, therefore meeting all of the requirements of Public Resources Code section 25402(c). Government Code section 11346.9(a)(4) requires an agency to provide a determination with supporting information that no alternative considered by the agency would be more effective in carrying out the purpose for which the regulation is proposed, would be as effective and less burdensome to affected private persons than the adopted regulation, or would be more cost effective to affected private persons and equally effective in implementing the statutory policy. Staff considered all alternative proposals presented to develop the final proposed regulatory language which maximized energy efficiency and cost savings. As discussed at page 2 of the revised SRIA, Energy Commission staff used a macroeconomic model to estimate the effects of proposed and alternative regulations within the California economy. Three scenarios were modeled and evaluated (more stringent, proposed, and less stringent). NEMA's proposal fits into the "less stringent" scenario modeled. Based on the results of this modeling, the lower efficiency levels proposed by NEMA and other stakeholders would not capture all the cost

	minimum CRI of 84-85 at the LED package level. NEMA notes that the rest of the globe uses a minimum CRI of 80, as well as the United States' popular ENERGY STAR program. For consistency sake and to not disrupt the LED binning and sourcing market, NEMA requests that CEC require a minimum of CRI of 80, rather than 82. We note, and it is not contested, that lighting vision scientists agree that two points CRI are completely imperceptible to the lighting consumer and user. The CEC's proposed rule requiring a minimum CRI of 82 presents a potential compliance nightmare, fails the necessity and consistency requirements of the California Government Code, §11349.1(a), and the minimum CRI 80 reasonable alternative proposed by NEMA does not sacrifice efficiency or consumer satisfaction and is therefore as or more effective and less burdensome than the proposed rule. California Government Code §11346.9(4).	effective energy savings. The adopted standards achieve a middle ground to maximize energy savings yet to ensure adequate products are available to meet the standard. Staff disagrees that NEMA's alternative proposal is more effective or as effective as and less burdensome than the language adopted by the Commission. As noted above, ample number of existing complaint products are already in the market that meet the proposed standard.
NEMA	Higher CCT lamps have a higher R8 for the same value R9. Setting a high R8 requirement in the absence of anything to balance it out may lead to CEC incentivizing the offering and sale of high CCT lamps, that is >5000K, which are not preferred by some consumers.	See RESPONSE 1.
NEMA	While there are applications where high CCT levels are preferable, many if not most consumers prefer the warmer hues of 2700K-3000K in many rooms of the house. Setting overly burdensome R1-R8 score requirements could mistakenly incentivize high-CCT lamps. This would not be	See RESPONSES 1 and 3.

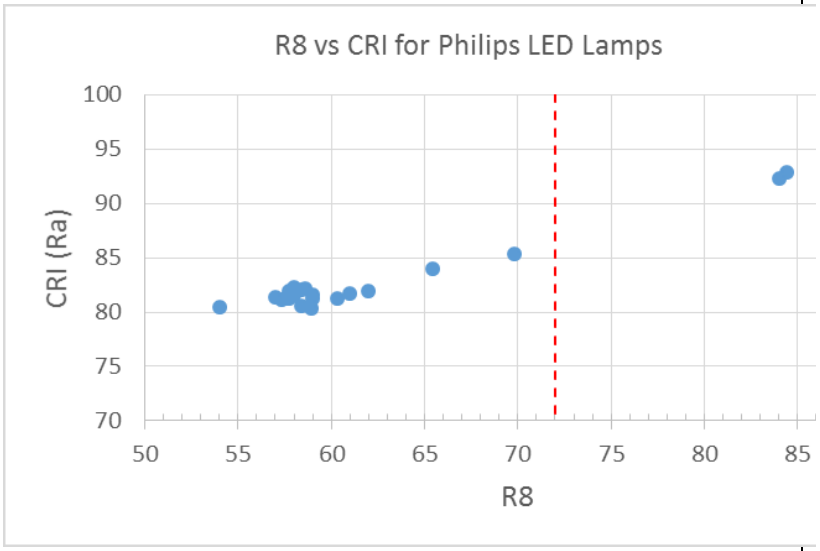
	consistent with the goal of advancing consumer adoption of LED lamps in California sockets or the CEC's purported goal of satisfying consumers. It would not be consistent with the EPA's ENERGY STAR program approach. We provide the following graph of R8 and R9 versus CCT as an illustration of the above described interrelationship (R values gathered from NEMA members):	
NEMA	The CEC should not effectively mandate 90 CRI as the State minimum only to increase the primary obstacle to adoption, i.e. cost. We note that the high-end commercial SSL products which feature the color performance advanced by the CEC's proposed rule are NOT selling in large quantities because they are highly specialized and very expensive. Their higher price is NOT due to economies of scale, it is due to very expensive sub-components, mostly the Red Green Blue White (RGBW) LED chips and other features. To properly examine cost, were the CEC to decline to relax their proposal, cost analyses should focus on high- performance commercial products since they more closely align with the proposal's strict requirements. The CEC has not undertaken such an analysis and as a result has no substantial evidence for its cost impact conclusion, a conclusion that NEMA concludes is speculative and wrong. Once this proper evaluation is conducted, the CEC will no longer be able to reach the conclusion inherent in its proposed rule.	See RESPONSES 1, 3, and 4. This is substantial evidence to support the Commission's findings that the standards are cost-effective to consumers and technically feasible to achieve, as required under Public Resources Code section 25402(c). In contrast, NEMA has not provided any sales data or consumer behavior study to support a claim that staff's analysis was incorrect or based on faulty data. Conclusory assertions that the data in the record is not substantial is not sufficient to outweigh substantial evidence in the record that supports the Commission's decisions. As a result, no change was made in response to this comment.
NEMA	We have also heard the views of some that R8 scores	This comment is not directed toward specific

	can be inferred from publicly available R9 scores. R8 and R9 measure two very different hues. They are related, but not directly proportional. R9's relationship to R8 varies based not only on the overall value of R9 but also on the correlated color temperature of the lamp	regulatory language or to the process of regulation development. It is unclear what response the commenter seeks. No change is recommended.
NEMA	☐ 1605(k)(2)(C) A CRI (Ra) of 8280 or greater Individual color scores of R1, R2, R3, R4, R5, R6, and R7, and R8 of 72 or greater, and an R8 of 50 or greater	See RESPONSE 1.
GE	Second, the Commission should remove the R-1 through R-8 requirements. As with Duv, the R1 through R8 specification should be removed because this information is not commonly available or commonly understood in the marketplace. CRI presents an average of R1 through R8, and the only color fidelity requirement necessary is placing a minimum CRI requirement in the standard. CRI is well understood and CRI data is commonly available in the marketplace. Average CRI is the only color requirement that will be easily understood by the distributors and retailers importing LED products into the California market and therefore the only color fidelity requirement that assures compliance and enforceability.	See RESPONSES 1 and 3.
GE	GE Lighting strongly recommends that the Commission limit its color quality specification to a CRI of 80 or greater. Such action would be the most appropriate approach for a minimum state energy efficiency regulation. Over 1 billion	See RESPONSE 1.

<table>
<tr><td></td><td>CFL lamps have been sold over the past decade with a CRI 80 or greater. Anything more stringent in the color quality space will significantly limit LED product availability and consumer choice in California, and in turn will limit the energy savings achieved by the Title 20 standard. While a CRI greater than 80 is not necessary for most consumer and commercial applications, manufacturers would still be able to compete with higher CRI products that are desired for certain applications.</td><td></td></tr>
<tr><td>GE</td><td>As a third step toward simplification, the Commission should take into account the lower efficiency of high CRI lamps – a premise we support - by setting one efficiency level for LED lamps with a CRI of 80 or greater and a second efficiency level for lamps with a CRI of 90 or greater. We would strongly suggest 75 LPW for 80+ CRI lamps and 65 LPW for 90+ CRI lamps as a very simple approach that will be more effective than the compliance equations currently proposed</td><td>See RESPONSES 1 and 3. The Energy Commission's standard sets a cost effective minimum efficiency and performance standard that achieves greater energy savings than GE's proposed measure. Therefore, GE's proposal would not be as or more effective at achieving the goals of the Commission to achieve significant energy savings.</td></tr>
<tr><td>GE</td><td>Table K-14
Standards for State-regulated LED Lamps
<table><tr><th>Effective Date</th><th>~~Minimum Compliance Score~~ Minimum CRI</th><th>Minimum Efficacy Lu Watt</th></tr><tr><td>January 1, 2017</td><td>~~277~~ 90</td><td>65</td></tr><tr><td>January 1, 2017</td><td>80</td><td>75</td></tr><tr><td>January 1, 2019</td><td>~~297~~ 90</td><td>~~80~~ 75</td></tr><tr><td>January 1, 2019</td><td>80</td><td>85</td></tr><tr><td colspan="3">~~The compliance score shall be calculated as the sum of the efficacy and 2.3 times the CRI lamp.~~</td></tr></table>
The rationale for GE Lighting's recommended changes to the CEC's proposed A-line LED lamp specifications are</td><td>Staff's standard for Tier 1 and Tier 2 is similar to this proposal by GE but staff's equation proposal provides more flexibility for manufacturers by providing a sliding scale between CRI and efficiency. Staff also requires a higher minimum CRI than GE, for the reasons discussed in RESPONSE 1.</td></tr>
</table>

	detailed in the preceding arguments.	
GE	(ii) A CRI (Ra) of 82 80 or greater(iii) Individual color scores of R1, R2, R3, R4, R5, R6, R7, and R8 of 72 or greater. (Alternatively change R8 minimum to 50.)	See RESPONSE 1.
GE	Conflicting Standards: Regardless of how the Commission sets these specifications (e.g., whether by the compliance score method, or the simplified method suggested above), it cannot maintain both a minimum CRI of 82 and an R8 color point minimum of 72. While it is possible to produce a lamp with an R8 over 72, all such products (especially 2700K & 3000K) have an average CRI of approximately 90 or higher due to the naturally high R values occurring at many of the other color points. Therefore, this complex standard as proposed, conflicts with itself as manufacturers cannot meet both a CRI of 82 at 2700K or 3000K (the most popular color temperatures) and an R8 of 72 at the same time. The R8 value would need to be lowered to 50 or higher to allow 2700K LED products with a CRI between 80 and 85. This change is an absolute necessity if the Commission insists on pursuing this complex, multi-faceted approach and to avoid a standard that conflicts with itself. The alternative simplified approach suggested above would avoid these conflicts while achieving the same energy savings.	See RESPONSES 1 and 3.
Philips	Given that LED chips are typically binned as CRI 80 or CRI 90, the minimum color scores effectively mandate a product with a CRI of 90. If that's what the Commission wants, they should state that explicitly in the 45 day language and the	See RESPONSES 1 and 3.

	Energy Commission should clearly take responsibility for proposing that consumers can only purchase the less efficient and more expensive CRI 90 products.	
Philips	CRI 80 lamps are almost always more efficient and cheaper than lamps with a CRI ≥ 90 based on the laws of physics and the additional design complexity required to achieve 90+ CRIs. In order to allow more efficient and cost effective LED products to continue to be sold in California, we would like to propose that the minimum CRI be reduced from 82 to 80. While there are products in the market at 82 CRI, this is because the manufacturer must target this level to ensure that the minimum is 80. If the minimum target becomes 82, then the design target becomes 85-86. There are few if any manufacturers that make LEDs with a CRI of 85, thus 90 CRI becomes the next level. If our proposal for an 80 CRI minimum is adopted, this will allow more efficient and cost effective products to be sold in California. This also means that California consumers will have access to the same less expensive and higher performing products as the rest of the country. Most importantly, it will better allow the CEC to address the energy conservation needs of California.	See RESPONSES 1 and 4. To accommodate the need to adjust manufacturing and supplier processes, the compliance date for tier 1 was changed to 2018 in the 15-day language, and the compliance date for tier 2 was extended by 6 months. This change will allow time to meet the standards.
Philips	Light Source Color: "The Energy Commission proposes to set minimum color scores rather than a higher overall CRI to allow greater flexibility in LED design. "The above statement from the staff report is disingenuous. The required minimum color score of 72 for the individual color indices of R1 to R8 cannot be achieved at the minimum required CRI	See RESPONSES 1 and 3.

	of 82, except possibly at color temperatures of 5000K or higher. At CCTs of 2700-3000K, which the Commission proposes for lamps claiming incandescent equivalency, lamps with R1 to R8 greater than or equal to 72 have CRIs greater than 85. Appendix A has a table with data for 22 Philips LED models and in all cases where R1 through R8 is 72 or greater, the CRI is over 90. Below is a graph for the R8 of these same lamps vs CRI and it shows that lamps with an R8 of 72 or greater will have a high CRI. This is the same conclusion reached based on our analysis of R8 vs CRI from CLTC's report on omnidirectional LED replacement lamp performance testing.  	

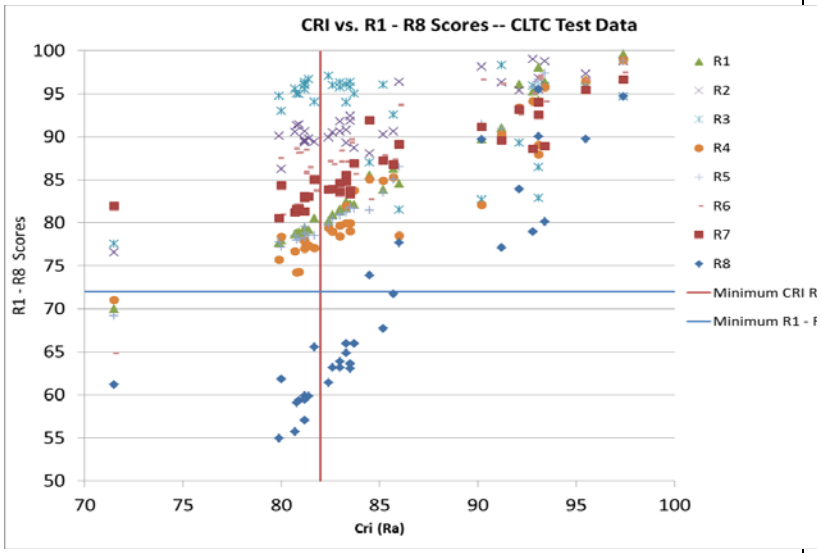
Philips	In addition to the change in CRI, we propose that the minimum requirement for R1 to R8 be removed completely, allowing greater flexibility in LED design. If removing the minimum R1 to R8 requirement is unacceptable to the Commission, then we suggest that the requirement on R8 alone be changed to a minimum of 50.	See RESPONSE 1.
Philips	We see strong adoption and sales of CRI 80 product in today's market despite the availability of both CRI 80 and 90 products. Given that greater than 79 million LED lamps were sold in the US in 2014; the idea that we need to mandate high CRI lamps based on certain residential applications is unfounded.	See RESPONSE 1. Phillips comment related to adoption and sale of 79 million in the U.S. that equates to 9.5 million lamps old in California. California has more than 622 million lamp sockets. Sale of 9.5 million lamps in California equated to a sale of LED lamps to about 1.5 percent.9 Phillips did not provide data that how many of these lamps were 80 CRI lamps and how many were 90 CRI lamps. Sales numbers provided by Phillips does not prove that consumers prefer 80 CRI lamp. Phillips presumes consumers even know what CRI is and purchase products based on CRI. Because most consumers don't know about CRI it is important to ensure an adequate minimal level.
Philips	MAJOR RECOMMENDATIONS: As indicated in our comments, we offer seven major recommendations to the Commission.	See RESPONSE 1.

9 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 69.

	Light Source Color – R1 to R8. Remove the minimum requirement of 72 on the individual color indices of R1 to R8. There is no technical basis for including them as a requirement and they conflict with the minimum proposed CRI requirement. If removing the minimum R1 to R8 requirement is unacceptable to the Commission, then we suggest that the requirement on R8 alone be changed to a minimum of 50.	
Philips	Light Source Color – CRI: Reduce the CRI requirement from 82 to 80 for state regulated LED lamps. This change will allow lamps designed to CRI 80 to meet the requirement, and align with common industry practice and the Energy Star program.	See RESPONSE 1.
MaxLite	CRI: 82CRI with a R1-R8 value of 72 or greater does not align with the way LED chips are manufactured, and the combination of requirements as spelled out essentially means 90CRI chips would need to be used. We support a simple 80CRI requirement for all products.	See RESPONSE 1.
Cree	Item 1) Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), C (ii), (iii): The proposed language in Section C (ii) and (iii) requires a minimum CRI (Ra) of 82 and individual color scores for R1-R8 a minimum of 72. Comments: Cree supports the requirements for high-quality color, as the widespread replacement of incandescent and halogen lamps will require meeting customers' expectations for light quality. Providing GSL and decorative lamps meeting these light quality requirements is reasonable by	CREE supports the requirements for high color quality and CRI Ra 82, and therefore no changes are necessary to these parts of the standard. Based on stakeholder comments, the effective date for compliance was extended in 15-day language from 2017 to 2018 for the tier 1 standards and extended by 6 months for the tier 2 standards. This additional time will allow

	January, 2017, although these requirements will likely result in lamps that are up to 20% more expensive than other high-quality lamps that fall just short of these measures (especially R8). California will need to provide sufficient utility rebate program funding to offset this increased cost.	manufacturers sufficient time to develop products and adjust manufacturing processes to ensure compliance at the lowest cost for consumers.
California IOUs	We support the CEC's proposal to set minimum requirements for the individual color rendering scores R_1-$R_8 \geq 72$. Without requirements set for these individual color samples, products with a Color Rendering Index (CRI) in the low 80's can significantly distort specific colors and will not reliably provide consumers with accurate color rendition. However, products with an R1-R8 score of at least 72 reliably provide adequate light across a wide range of color samples, including the pinkish R8 color sample (red is usually the deficiency in low CRI LED lighting).	The comment supports the standards and does not ask for changes to the standards.
California IOUs	Significance of the individual R1-R8 requirements: Because the CRI score is calculated as a simple average of performance across eight color samples, light sources with CRI in the low 80's can distort certain colors, while making up ground by providing decent rendition of other color samples. In this way, products in the low 80's will not reliably provide consumers with accurate color rendition. Specifically, many LED products with CRI in the low 80's offer significantly distorted color rendering in one of the color samples in the CRI metric, R8, which is a pinkish/red hue (often R8 scores are in the 50's or 60's). Figure 1 below demonstrates test data from the 2012-2013 LED lamp	The comment supports the standards and does not ask for changes to the standards.

	testing at the California Lighting Technology Center (CLTC) that was commissioned by PG&E. The figure shows the individual R1 through R8 scores plotted against CRI (Ra) for all products. It demonstrates that R8 scores are typically the lowest scores for any given lamp, regardless of CRI. By requiring the R1 through R8 scores to be at least 72, the CEC's proposal is essentially requiring that products provide improved R8 performance, which is associated with improved level of red rendition. The proposal ensures that lamps cannot simply meet a given Ra score by off-setting poor performance in the red region with better performance in other colors. We reiterate our past comments submitted to CEC regarding the importance of red content in LED lighting and the importance of improved color accuracy in general. Strong rendition of reds and pinks, which is often missing in high efficacy lighting, is a critical element of lighting performance, as it relates to accurate rendition of skin tones, food, furniture, and other natural objects. Though CFLs have achieved about 40% market share, they have not successfully replaced incandescent in more color sensitive applications such as bathrooms (where people see themselves in the mirror, apply make-up, etc.) and dining rooms and living spaces where families spend much of their time. For more detail on the importance of color rendering, and design strategies for improved color rendering, we refer CEC to the detail provided in the 2013 CASE report and in our November, 2014 comments.	

	CRI vs. R1 through R8 scores in CLTC test data  	
Robert Clear	CRI is not a measure of how "accurate" colors are rendered. It is a measure of color shift relative to a reference light source of similar CCT, but colors also shift when the color temperature changes. This means that objects do not have a "true" color. "Accuracy" under these conditions is a misnomer.	For a detailed discussion on the physics of lighting see the 2015 Staff Report. Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034 No change is necessary.
Robert Clear	I am strongly opposed to minimum CRI requirements. I am in favor of setting the minimum required efficacy low enough to allow high (90+) CRI lamps, as there will be a subset of the population that is attached to the look of	See RESPONSE 1. Proposed regulations require products that make certain claims, such as incandescent equivalence, to meet performance criteria related to those claims, and do not require

	incandescent lighting. I am ambivalent about labeling, as CRI is a very imperfect measure even as applied to the issue of discerning color shifts. CRI was developed using the CIELUV space, which is outdated at this point. There have been criticisms of the ability of CRI to accurately rate color appearance shifts, especially with regard to LED lamps. Note for instance R. W. G. Hunter, and M.R. Pointer, "Measuring Color" https://books.google.com/books?id=0LVMLOSEeqoC&pg=PA147&lpg=PA147&dq=CRI+and+just+noticeable+difference&source=bl&ots=CjMTAjStaK&sig=hzIOlRSzLgu0_yCVH_LNEzwaGuI&hl=en&sa=X&ved=0ahUKEwihh93DhLXJAhWELIgKHU59CBYQ6AEIJjAC#v=onepage&q=CRI%20and%20just%20noticeable%20difference&f=false which describes an example of a CRI 71 lamp that gives color rendering closer to the reference lamp than an alternate CRI 82 lamp. Another example of where CRI may be misleading is that it is not a preference rating. Note: http://www.olino.org/us/articles/2009/11/30/a-close-look-at-the-color-rendering-index-cri-or-ra where a preference test had lamps of CRI 23 (really low) and 63 being rated as preferred to a standard incandescent or halogen lamp (CRI = 98). My preference for labeling would be to block the lamps into low, medium, and high categories, as I do not believe that greater precision is meaningful.	affirmative labeling. There are no mandatory CRI labeling requirements in the proposed regulations. Based on the information provided by the commenter, no changes were made to the proposed regulations.
Robert Clear	The lack of lighting expertise is most noticeable in the	See RESPONSE 1.

	supposed justification for minimum CRIs. The report implies that CRI is a measure of how "accurately" colors are rendered, and is therefore is a measure of "how well a lamp is doing the job of "providing white light"'. In discussing CRI further, the report further states that the work of a general service lamp is "to both illuminate a room and provide the ability to discern colors". To justify a trade-off between efficacy the report states that "a lamp with a fuller color gamut and high color rendering cannot have as many lumens per watt as a monochromatic source at the peak of the curve", and then asserts that "several residential room types demand color accuracy, including the kitchen and bathroom, where grooming and food preparation/consumption occur.".	
Robert Clear	CRI is not a measure of "whiteness". It is a measure of how close the colors of eight test objects illuminated by a test lamp match the colors of the test objects when illuminated by a reference light source (a blackbody or a phase of daylight) of the same color temperature. A high color temperature lamp will tend to have a bluish tint, and can make a matte white surface appear reddish in contrast http://www.lrc.rpi.edu/programs/solidstate/assist/whitelight.asp. Similarly, a low color temperature source will look yellowish or reddish, and will tend to make a matte white surface greener by contrast. You see the color temperature of a lamp directly. You do not directly see the CRI of a lamp.	Staff agrees that CCT and CRI are different measures. For a detailed discussion of these measures, see the 2015 Staff Report. Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034

Robert Clear	Gamut is typically defined as the area of color space spanned by the eight test lamps used in the CRI calculation. A low CRI lamp can have a larger gamut than a high CRI lamp if the deviations from the reference lamp are in the direction of greater color saturation.	See RESPONSE 1.
Robert Clear	CRI is related to color memory. An object that is a particular color under one light source may be discernibly different under a source with a different CRI, or for that matter the same CRI if we use CRI which is an average value, or are looking at a more saturated color than the standard CRI test samples. CRI does not have a straight-forward effect on the ability to discern differences between objects of different spectral reflectance. A low CRI source will increase some differences, and decrease other differences compared to the reference source. If a particular balance between colors is desired, in a room or for a particular artwork, then CRI can make difference. But it should be noted even here that there are major caveats. Aside from the fact that CRI is a very imperfect measure of the color differences, it is easy to design a room or create artwork that has the desired color balance under most low CRI lamps. Complicating the color balance issue further is the influence of time and long-term color adaptation. Long-term adaptation to a different colored environment, such as could be caused by the use of low CRI lamps, causes a long-term shift in perceived color balances http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3025050/. On an anecdotal level I have seen this effect on	See RESPONSES 1 and 3. Staff has reviewed the study that show the color shifts from very long term and short-term adaptation together are cumulative, which indicates that both short-term and very-long-term chromatic adaptation affect color perception during natural viewing. Staff disagrees with the comment because the proposed standard set a baseline of CRI of 82 with R1-R8 of 72. Proposed CRI of 82 provides a reasonable value of light to consumers because it has the ability to display all essential colors in a reasonable manner. Standards cannot be set that take into consideration the specific nature of a certain room or whether a person will be in the room for a short period of time or for years. . No change is necessary.

	myself and on other members of our household. A young lady who has a room in our house responded to my inquiry about how she felt about our house lighting (CRI ranging from 50 to 80) by stating that it seemed different, but not bad, when she moved in, but that now she has been here for several years the lighting of the houses of friends that have incandescent lighting (CRI =100) seems off, or wrong.	
Robert Clear	The assertion that certain rooms "demand color accuracy" (high CRI) can be seen to be hyperbole when viewed against the history of residential fluorescent lighting here, and even more so in places like Japan or Taiwan where fluorescent lighting was essentially standard. I installed low CRI (50 to 60) fluorescent lighting in the 1970s, as that was what was available. To my knowledge, I never been harmed by it, or particularly even noticed that there was a problem. I, and the other members of my household are adapted to the lighting, and no longer see the colors of food, for instance, as being different from what is expected. As noted earlier, a low CRI does not mean that color differences are eliminated. This means that we can distinguish problems with food items. There are also two young ladies in the house who do, at times, wear cosmetics or hair dye. Neither of them reported problems, when asked directly while I was writing these comments, with the color, or color rendering of the lighting. Both young ladies are artists. Neither of them likes to work under incandescent lighting, despite its high CRI, because it is too	See RESPONSE 1 and 4. In addition, the standards do not prohibit the sale of fluorescent lighting.

	yellow.	
Soraa	Color rendition: Two well-known aspects of color rendition are considered by the CEC: source chromaticity and CRI Ra. However, color rendition is a complex topic with many aspects. Among these, two crucial aspects are not considered by the CEC: - Deep-red rendering, quantified by the CRI index R9, is known to have a strong influence on perceived quality of light (arguably even more than the average CRI Ra score), as documented in [Wei15]. A high R9 value requires long-wavelength photons in the spectrum, which has a fundamental efficiency cost. Some manufacturers, including Soraa, make sure that their high-CRI sources also have a high R9 value (for instance, R9>90). However, other manufacturers design sources with a high CRI (say 90) but a moderate R9 (50 or less). Decreasing R9 from 90 to 50 can raise efficiency by ~8%, however it degrades product quality	See RESPONSES 1 and 3.
LumiLEDs	Regarding the proposed color rendering requirements, the minimum LED lamp requirement of 82 Ra conflicts with how Lumileds and its competitors bin and supply LED devices for incorporation into LED lamps. LED devices in the market are not binned this way. A normal distribution would be minimum 80 Ra, typical 82. LED lamp secondary optics (e.g. the outer diffuser of an A-19 lamp) tends to lower lamp Ra scores, thus the ~2 additional points in a type. 82 shipment provide margin for the LED lamp	See RESPONSE 1.

	manufacturer to confidently achieve min. 80 Ra measured at the lamp level.	
LumiLEDs	The matter becomes more complex when the proposed R1 through R8 requirements are considered. Requiring a minimum score of 72 for R1 through R8 essentially, and in simpler terms, calculates to a minimum Ra value of 85 at lamp level. Stated another way, only LED lamps with Ra scores of 85 and higher would meet the proposed R1 through R8 requirements. A lamp manufacturer designing an 85 Ra lamp, as explained above, would need LEDs binned at min 85, typical 87. These are truly uncommon LED devices. The few available min. 85 / typ. 87 LED devices are designed for use in other applications (e.g. higher end outdoor lighting), not for consumer LED lamps. Consequently, the lamp manufacturer would have little choice but to procure more commonly available LEDs binned at nominally 90 Ra, further driving up cost to meet performance levels which simply aren't required for every application a California consumer will encounter.	See RESPONSES 1 and 4.
LumiLEDs	To alleviate these costly barriers to adoption, Lumileds requests that the CEC adopt the industry norm of specifying a minimum of 80 Ra rather than 82. All lighting vision scientists agree that with the color rendering index, two	See RESPONSE 1. Evidence in the record shows that experts in lighting and color support high color rendering scores, contradicting Lumileds assertion that lighting scientists would agree

	points are completely imperceptible anyway (most would also agree with conventional wisdom that less than 10 points difference are imperceptible). We also ask you to reconsider your approach to specifying color rendering requirements by abandoning the proposed R1 through R8 minimum requirements, and sticking with Ra requirements alone.	otherwise. See testimony from Professor Lorne Whitehead,10 and Greg Merritt.11
LumiLEDs	Above and beyond the aforementioned specification constraints, the "minimum compliance scores" detailed in Table K-14 would further reduce the number of LED devices available to support the California market. To ensure a broad range of LED devices are available to support the LED lamp market at consumer-friendly shelf prices, we restate our request for a minimum 80 Ra requirement at the lamp level, and ask you to consider a reduction of the minimum compliance scores as well.	See RESPONSES 1 and 3. Lowering the minimum compliance score would allow for manufacturers to make either less efficacious or lower performance lamp products. Although less costly, this would reduce the overall energy savings from the standards, making it less effective at achieving the Commission's mandates.
American Lighting Association	Considering the timing of the implementation of this effort, we repeat from our earlier in our September 29, 2015 comments that the proposed approach to somehow balance efficacy and color rendering into some kind of total score is flawed. It is well understood in the lighting	See RESPONSES 1 and 3.

10 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN207025_20151215T131447_Transcript_of_the_111815_Public_Hearing_on_Small_Diameter_Direc.pdf Page 32-36.

11 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN207025_20151215T131447_Transcript_of_the_111815_Public_Hearing_on_Small_Diameter_Direc.pdf page 126

	industry and by color experts around the word that CRI (Ra) when evaluating LED light sources does not reliably report what eyes sees. International efforts, now ongoing for more than 10 years, are seeking a fix or a better metric. Adding the R1 to R8 color scores as a requirement does not improve the results that you seek; it makes them worse - more complicated and still unreliable for LED light sources. Ra is to be used by the CEC, please recognize its flaws and use it with simple CRI and efficacy trade-off values.	
IESNA	PS-8-15: Color Rendering Index: The IES recognizes that the CIE Color Rendering Index (CRI), used to determine the accuracy of a light source's rendering of color compared to a reference, has shortcomings that limit its ability to fully represent how humans perceive color. Since its adoption in 1964, several light source technologies have been introduced and commonly adopted for architectural lighting that yield a different visual experience than the CRI metric can describe. As a substantial step toward solving this problem, IES TM-30-15, IES Method for Evaluating Light Source Color Rendition, has been developed for the benefit of the lighting community to provide: (a) a more accurate assessment of color fidelity; (b) an additional, complementary assessment of the influence of the preferred color appearance of objects (related to color gamut); and (c) more detailed information about the rendition of specific colors. As with any IES Technical Memorandum, TM-30-15 is not a required standard, and it does not provide design guidance or	For why the Commission used CRI, see RESPONSE 1. TM-30 was not available at the time the regulation was being developed and is not widespread or widely accepted for color assessment in the lighting industry. For these reasons, the Energy Commission did not use TM-30. This comment does not request a change in the regulations, but merely provides information about the IES efforts related to color rendering. Therefore, no change is needed.

	criteria for best practices. However, the issuance of TM-30-15 will enable the international lighting community to carefully evaluate it, providing a path leading to improved standards and design guidance. Technical analysis and feedback regarding the method described in TM-30 will be critical to continued development and standardization of color quality metrics. The IES recognizes that while color rendering is important for consideration in energy regulations on the basis of maintaining lighting quality, the IES does not endorse any mandatory color rendering measures in energy regulations until there is a national or international consensus regarding an appropriate metric and range of values.	
Data-Related Comments		
Soraa	Comments on the CEC's feasibility analysis: The CEC's approach is data-driven, which is a sound choice. However, we have founds flaws in the implementation of this approach. Namely, the CEC finds some products which nominally meet the proposed limit (in the Energy Star and Lighting Facts databases) and concludes that this establishes feasibility. However, none of the quality aspects mentioned above (beam quality, color rendering beyond CRI, flicker, form factor) are considered. Furthermore, in many cases, the qualifying products do not seem to actually exist.	See RESPONSES 1, 3, and 10. Staff analyzed the technical feasibility of the requirements of the standards across multiple product offerings, following statutory guidelines in determining technical feasibility. Staff reviewed Soraa's comment and could not validate which lamps are listed and do not exist. No change was made as a response.
Soraa	In addition, upon careful study of the CEC's feasibility	See RESPONSES 1 and 3. Staff has reviewed the

	analysis, we have found flaws in its conclusions, in large part caused by inaccuracies in product databases. Once such inaccuracies are corrected, very different conclusions emerge regarding feasibility. Therefore, we find that for some products, the current proposal is very aggressive and would make it challenging to achieve the required efficiency limits – in such cases, the only option for manufacturers will be to worsen some aspects of product quality to gain efficiency, and phase out high-quality products from California. This would undoubtedly hurt adoption in certain markets. Therefore, we suggest that the CEC should mitigate its requirements for certain products. In the following, we discuss these quality/efficiency trade-offs in more technical details; we point out inaccuracies in the CEC's feasibility analysis; and we make a revised proposal for efficiency limits	analysis and is unable to identify any flaws in the feasibility conclusions.
NEMA	To better understand how the CEC has made their cost conclusions, NEMA requests a copy of the CEC's detailed cost analysis data for proposal-compliant lamps and related investigative work. As we note above, the 2015 and 2014 Staff Analyses do not examine proposal-compliant lamps, and therefore do not examine the appropriate corresponding costs.	See RESPONSES 1, 3, and 10. All data used in the rulemaking was identified and publically available during the rulemaking proceeding. Staff also explained its methodology for analyzing the data in its staff analyses. References to all data used in the analysis are cited in the staff report. The development of proposed regulatory language was a multiyear effort that consisted of engagement with industry, manufacturers, utilities, environmental groups, academic institutions and others. Workshops and information exchanges with these stakeholders and independent research

		resulted in the publication of two staff reports and a detailed Standardized Regulatory Impact Assessment. These documents provide the technical analysis and data supporting the proposed regulations. The analysis sets forth data which shows the proposed regulatory language is cost effective and technically feasible. These included lamps that complied with the proposed standards.
NEMA	The early adoption of LEDs through market forces of supply and demand has far exceeded the historical experience with CFLs. There is no parallel here, and no reasonable person could reach the conclusion that the history of CFL market adoption is relevant to LEDs. This mantra is worn out and the belief we are looking at a parallel experience is unfounded for several reasons: 1) Standards that were lacking during CFL introduction have since been developed and have influenced the development of robust LED standards, 2) surging sales in the ENERGY STAR program (nearly 80 million units in 2014) refute any claim that LEDs are at risk of failing to achieve widespread adoption, and 3) the U.S. DOE in 2013 noted that LED uptake had just exceeded CFL uptake in terms of their market introduction timelines, and this 2013 trend has continued into 2015 and is expected to continue in the future. A review of the ENERGY STAR CFL program's unit shipment information for version 1.0 of the specification shows only 21 million	See RESPONSE 8. Government Code section 11349.1(a) details OAL's review process and the standards of necessity, authority, clarity, consistency, reference and nonduplication. The proposed regulations meets all of these requirements. The supplemental ISOR details the necessity of each provision of the regulation. The regulations are consistent with the existing framework and structure of the Commission appliance regulations found in sections 1601-1607. Therefore, NEMA's objections on this ground are unfounded.

	ENERGY STAR CFLs sold in the year 2000, twenty years after CFLs were introduced on the market. This indication of consumer interest contrasts sharply with the ENERGY STAR 2014 LED lamps shipments data for 80 million units after less than 9 years on the market. These figures directly and irrefutably contradict the Staff Analysis on page 64/107, which claims that LEDs are at risk of repeating the low consumer uptake of CFLs and that steps must be taken to prevent it. The CEC staff is not watching what is really happening in the market. To put it another way, the risk of "repeating the CFL experience" has already been conquered and is not a risk unless it is a self-fulfilling prophecy of the CEC attributable to restrictive LED performance requirements that drive LED lamp cost up to the point that CFLs are a more economical option for the cost-constrained consumer. This perverse prospect fails to meet the necessity and consistency requirements of California Government Code §11349.1(a).	
NEMA	In contrast, LED technology is cutting-edge and is still evolving rapidly. No one disputes this. This emergent nature affects all steps in sourcing, design and production. Because LED technology is still a moving target, and there is a limited data set for performance trends compared to older technologies, it is easy to draw mistaken conclusions from limited technical understanding and from limited data sets. This is why is it more important than ever for the CEC to engage manufacturer experts more heavily than before, and to grant significant weight to these expert comments on the	See RESPONSES 1, 3, 6, and 8. The efficiency standards are intended to set a minimum bar. Staff's analysis demonstrates that many products from multiple manufacturers already comply with these minimum efficiency standards. These standards will ensure that consumers receive both energy and cost benefits from the standards, and that the standards will save a significant amount of energy statewide.

	potential impacts of proposed requirements and their potential effects on this emerging technology. While previous regulatory efforts often tried to set the minimum bar as high as possible, the risk of potential strangulation of an emerging technology should require caution pursuing the older regulatory model in the case of LED lamps. We urge the CEC to establish very practical minimum requirements, within the capability of numerous products on the market, rather than seek to identify only a handful of products, set the standard there, and expect the rest of industry to catch up.	
NEMA	We want to thank the Commission for acknowledging the concerns we expressed regarding color consistency, we noted the change in the presentation to the DUV equation, and as we've noted we're going to go back and examine that and get a better picture of how well our products can do in terms of meeting that requirement. But I want to say that that was not an isolated error. Unfortunately, the proposal has numerous errors caused by a combination of factors such as a lack of statistically significant datasets, a pattern of not, I'll say, honoring industry comments given the weight they have based on their experience and their technical expertise, you know, they're the ones who design these products and know what they can and can't do. And the well detailed focus on what are at times arbitrary quality metrics because there have not been the necessary studies to be sure that what can be measured should be	See RESPONSES 5 and 6. Although the Energy Commission recognized and corrected a couple of errors in the regulatory language by publishing 15-day language, these were not errors due to lack of data, but mere transcription errors. The additional "errors" to which NEMA refers are not actually "errors," but areas in which NEMA disagrees with the policy determination made by the Commission. The Energy Commission's adopted standards are cost-effective, technically feasible, and will save a significant amount of energy statewide, and are based on substantial evidence in the record. Therefore, additional changes are unnecessary.

	measured.	
NEMA	We agree with having minimal requirements, everyone agrees that there's a need to protect the marketplace and consumer satisfaction from poor quality, but at the same time a minimum spec is very different from a high performance specification and too much of the proposal pushes into the high performance area, and I don't need to belabor it, I think my members did a pretty good job already. So as you've heard, we have many concerns. And so to talk about datasets and things like that, and where the data is being gathered from, over the past two years during the proposal development process, the Commission and those doing the analysis have built up a view of the performance of LED lamps using a very small amount of data, and at times with small sample sets. And the hazard in failing to use statistically significant sample sizes or lot-to17lot purchasing, for instance, is that you can get a misinterpreted view of the capabilities of mass manufacture to meet a consistency level or always exceed a threshold level reliably.	See RESPONSES 5 and 6. NEMA's criticism of the ENERGY STAR and Lighting Facts datasets and the CLTC analysis as not "statistically significant" misunderstands the legal basis for the Commission's regulations. The cost-effectiveness and technical feasibility of the standards, based on the incremental cost of a compliant product and the energy savings resulting from compliance, must be supported by substantial evidence in light of the whole record. (Pub. Resources Code section 25901.) The data and analysis includes two staff reports, a supplemental staff analysis, and the Standardized Regulatory Impact Assessment, as well as the comments received from the IOU CASE Team during the rulemaking process. These reports and comments included references and citations to publically available data that supported the Commission's proposed standards. In contrast, with the exception of the information provided on the scope of the SDDL standards, NEMA declined to present any data or evidence to contradict the data used by the Commission, and has not provided any other information to rebut the findings that the Commission made, other than bare assertions of disagreement. Therefore, the

		standards as adopted are cost-effective, technically feasible, and supported by substantial evidence in the record.
NEMA	Today, publicly available lists of lamp product performance features do not contain information on all the parameters covered by the CEC's proposed regulatory language. This has caused a significant delay in developing comments while time was spent investigating which products might comply with the proposals. To assist stakeholders in more quickly understanding the impact of the proposed regulations with respect to product compliance and availability, we ask the CEC to publish or otherwise make available the list of lamp products the CEC staff believed were compliant in order to vet the practicality of the proposed regulation in the 45-day express terms. Sharing this list will save industry countless man hours of testing and investigative time, and allow for a more focused and useful application of industry expertise to assist the CEC in satisfying the legal requirements of necessity, clarity and consistency.	See RESPONSES 3, 6, and 10.
NEMA	Although many LED MR16 lamps claim to be equivalent to halogen MR16 lamps, MR16 lamps tested by the DOE CALiPER program demonstrated systemic inaccuracy in equivalency claims.	See RESPONSE 10. CALiPER and ENERGY STAR data has been submitted by manufacturers under the penalty of perjury. Commenter has not provided evidence what lamp data is inaccurate and incorrect, so no changes have been made.
NEMA	It is easier to match center beam candlepower than to match lumens, which is acceptable in applications which	Staff agrees.

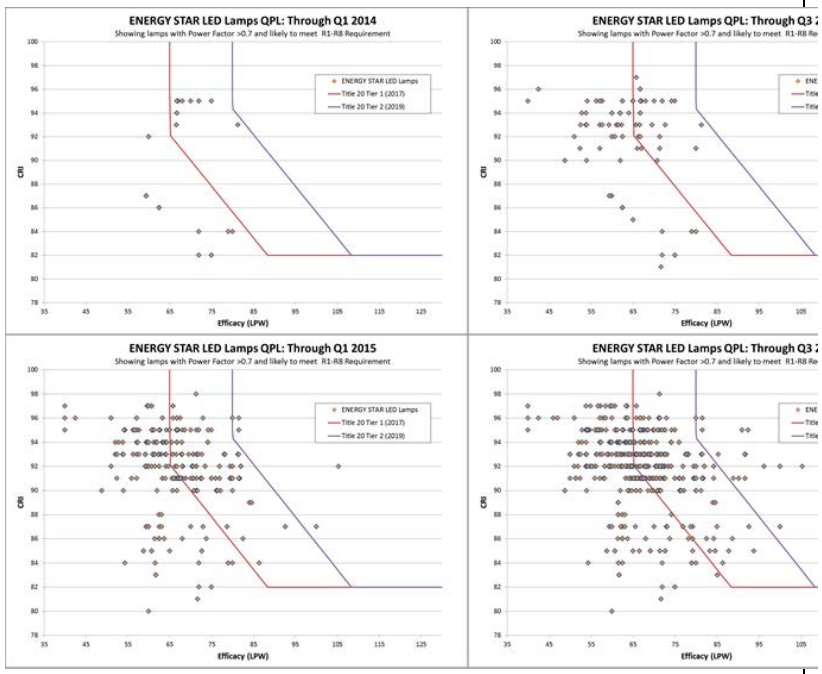
	have a secondary general lighting system.	
GE	Light Emitting Diode Lamps: While Title 20 has historically enacted minimum energy efficiency standards to weed low efficiency consumer products out of the market, this proposal goes far beyond minimum standards. Instead, it sets a high performance benchmark that will eliminate from the market all but a few extremely efficient specialty LED products operating in a very narrow color range that are designed for use in a narrow range of applications. Presentations from CEC staff and California utilities addressing the feasibility of the proposed regulations only take into consideration a subset of the relevant specifications, and incorrectly suggest that many products on the shelf today will comply with the regulations. If fact, it is not possible to determine what existing products would meet all of the proposed regulations from publically available data. If one evaluates existing products against all of the proposed specifications, few, if any products sold today would be able to comply with the proposed regulations.	See RESPONSES 1 and 3.
GE	The unprecedented complexity of the current proposal alone should be a red flag to all stakeholders. The proposal calls out specifications for information that is not publically available and not commonly understood, even by Commission staff, which is troubling. The regulation must be readily understood by all stakeholders in the market, and must be easy for the agency to enforce, or the desired	See RESPONSE 3. Staff is unaware of any information related to the rulemaking or development of the standards that is not publically available. All materials are in the rulemaking docket or cite to publically available information, such as the ENERGY STAR database and the CLTC study.

	energy savings will not be realized.	Subsequent comments seem to indicate that the "not commonly understood" metric is Duv, for which staff has made changes to Duv in 15 day language it reads "A color point that meets the requirements in Table 1 of Annex B of ANSI C78.377-2015 for color targets and color consistency." No further changes are needed.
Philips	Our comments address these reasons in order. Product Availability - Existing Products vs. Proposed Title 20 Requirements. Taking omnidirectional lamps as an example, the October 2015 staff report indicates 658 omnidirectional lamps (E26 and E12 bases) will comply with the Tier 1 equation as of June 15, 2015. As a comparison, we analyzed data taken from the October 21, 2015 ENERGY STAR Certified Products List against some of the metrics from the proposed 45 Day language, including the Tier 1 equation. Using that date as a snapshot, there were 1634 LED lamps classified as omnidirectional (~ 84 had GU24 bases). The point of the analysis is not the difference between 658 and 1634, but to identify 1634 as the base quantity for lamp availability. The graph on the next page shows that of the 1634 certified lamps, 91% meet the minimum efficacy requirement of 65 LPW and that 80% meet the minimum CRI requirement of 82. However, only 39% of the 1634 lamps meet the proposed Tier 1 compliance score of 277. Combining the LPW, CRI, and Tier 1 metrics, and excluding dimmable lamps that do not dim to 10%, we find that only 30% of the 1634 lamps meet the Title 20 language based on	See RESPONSE 3. Staff also notes that dimmability is not a requirement of the standards. Therefore, it is inappropriate to eliminate products from the analysis that do not dim.

	these criteria.	
Acuity Brands	Longer term focus on “quality attributes” We support the work in California to prevent the “race to the bottom” to avoid undesirable quality of lighting products in order to maximize energy efficiency. However, we recommend that CEC’s longer term focus on quality attributes include the unintended consequences of the proposed standards on a broader set of quality attributes when establishing energy standards. The attributes should be based on credible data and preference/acceptability studies that have been vetted by a balanced set of industry experts. This action will ensure that the product development and lighting design standards in California will not only improve the energy efficiency of lighting installations, but will expedite the market transformation of products with superior quality attributes without unintended consequences that restrict attributes other than energy and color that consumers value.	See RESPONSES 5 and 6.
California IOUs	CRI, efficacy, CRI/efficacy compliance score: The graphs below plot CEC’s proposed requirements for efficacy, CRI, and minimum compliance score, for both Tier 1 (red line) and Tier 2 (purple line), so product data points shown to the right and above these plotted standards lines meet all three of these requirements	No change is requested and needed.
California IOUs	R1-R8: The ENERGY STAR QPL does not provide R1-R8 data. However, separate analysis (shown earlier in Section 2.3.2) found that an R9 score above 32 is approximately equivalent to an R8 score of 72, and that R8 is the limiting factor	No change is requested and needed.

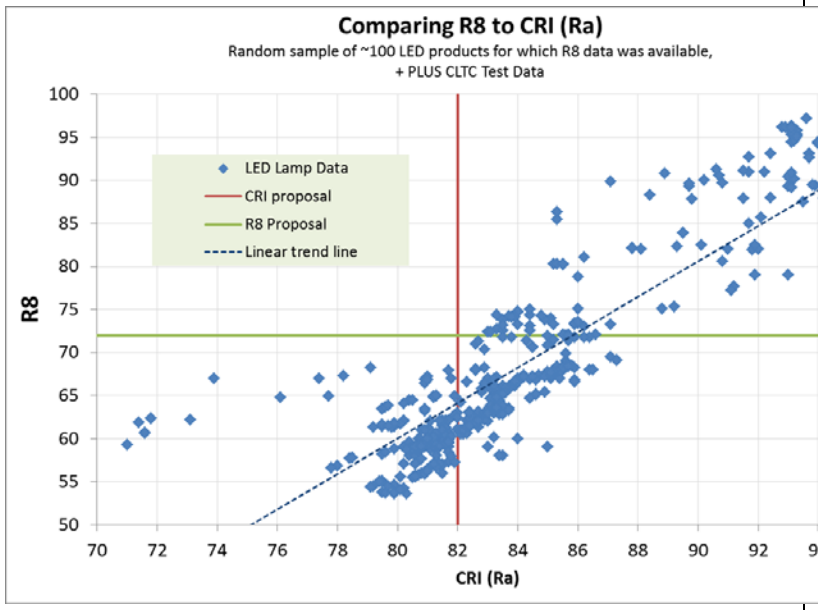
	among all the R1-R8 scores. Therefore, the data represented in the following graphs has been filtered to show only products that have a listed R9 value above 32, as a proxy for R8 above 72. This indicates that the products in the graphs below with a CRI in the range of 82-86 are very likely meet the R1-R8 >72 proposal. However, to take an even more conservative view, one could consider that above 90 CRI, all products are believed to meet the R1-R8 proposal	
California IOUs	CLTC Test Data: Products that Meet all the Proposed Mandatory Requirements: In addition to the hundreds of products that appear to meet the proposed mandatory requirements based on the publically available data about them, testing completed by the CLTC has confirmed additional products that meet CEC's proposal. Table 1 below contains a list of products that meet the proposed standards, and their scores in each of the metrics. The first four are products that were tested through funding from PG&E and the make and model have been kept confidential in that study. Products FF and GG are certified ENERGY STAR products, so they pass the light distribution requirements. The last two products have been tested outside the scope of PG&E's project funding, and CLTC has made the make and model available. The Civilight product passes all requirements but light distribution testing has not yet been completed. The Philips Slim Style product has had only one sample go through the test protocol so far.	CLTC's test data confirms that there are technical feasible and available LED lamps in the market that meet the proposed standards. No change is requested and needed.

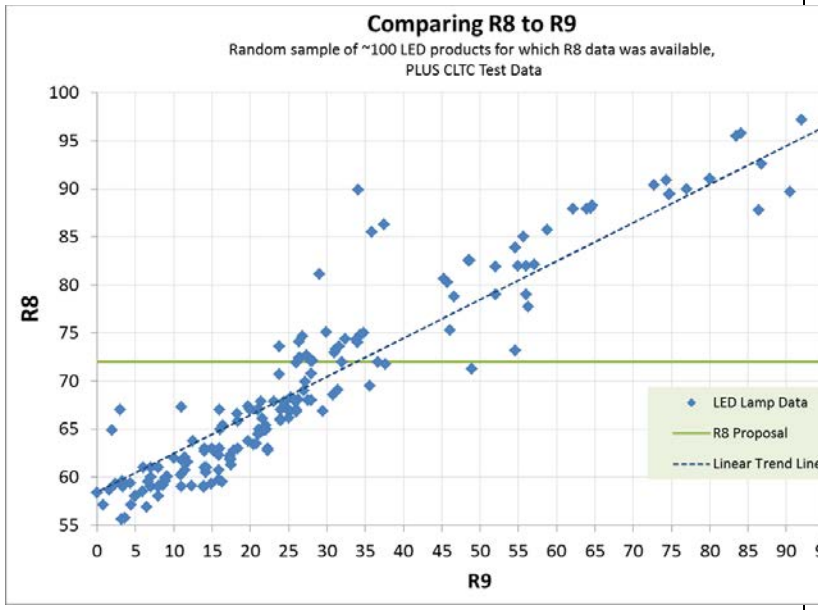
	Lamp	Efficacy (≥65)	CRI (≥82)	Compliance Score (≥277)	R1 (≥72)	R2 (≥72)	R3 (≥72)	R4 (≥72)	R5 (≥72)	R6 (≥72)	R7 (≥72)	R8 (≥72)	Duv (+/- 0.0033)	PF (≥0.7)	Rated Lif (≥10,000 hrs)
	Product J	104	93	318	94	97	83	88	97	97	94	96	-0.00002	0.83	25,000
	Product EE	65	96	285	97	97	96	97	96	97	95	90	0.0003	0.94	25,000
	Product FF	82	91	292	91	96	98	90	91	96	90	77	0.0002	0.84	25,000
	Product GG	77	93	291	95	99	96	94	96	95	89	79	-0.0030	0.93	25,000
	Civilight A19	86	97	310	100	99	95	99	99	98	97	95	0.0005	0.73	25,000
	Philips SlimStyle	79	92	290	92	98	97	90	92	97	89	78	0.0015	0.899	25,000
California IOUs	Performance Improvement Trends: In addition to the data indicating that current products are available that meet the proposed standards, the trends in the LED market suggest that more products will be available by the time the standard takes effect in 2017. The market is expected to experience even more significant improvement before Tier 2 standards take effect in 2019. Assuming current trends continue, omnidirectional lamps will increase in efficacy by 30% between now and 2019; directional lamps will increase by 23%. Decorative lamps are experiencing the fastest efficacy improvement; if their current improvement trends continue; decorative lamps will be 33% more efficient by 2019. Figure 14 below highlights the rate of improvement over the last two years, in terms of the total number of products in the ENERGY STAR QPL that meet all the proposed requirements. The four graphs show progress updates on a 6 month schedule, starting with Q1 2014 in the top left.														
		This IOUs comment is in support of the proposed regulations and provides information on the market and availability of the regulated products in the future. In the revised 15-day language published on January 7, 2016, staff made changes to accommodate stakeholder comments. These changes included giving industry more time to meet the proposed standards by moving the Tier 1 requirements' effective date from January 1, 2017 to January 1, 2018, and delaying implementation of the Tier 2 requirements to July 1, 2019. No change is requested in this comment or further changes needed.													

	Figure 14. Time Series Analysis of Availability of Products that Meet the Proposed Standards: January 2014 – August 2015 	
California IOUs	R1-R8: R1-R8 data are not available in public databases such as the ENERGY STAR Qualified Product List (QPL) or the DOE Lighting Facts Database. These resources provide only CRI (Ra) and R9 (a deep saturated red color). Because R8 performance tends to be the limiting factor for LED products, we have conducted analysis of many products, including those tested by CLTC, as well as over 100 other products with LM79 test reports available, to better	The comment supports the standards and does not ask for changes to the standards.

	understand the relationships between R8 and CRI, and between R8 and R9. Understanding these relationships helps us to better analyze the publically available data using proxy data for R8. Figures 5 and 6 below provide this analysis. Figure 5 demonstrates that the relationship between R8 and CRI is not perfect, but it is good, with an R value of 0.73. The figure also shows that among products with a CRI of 85, about half have an R8 value above 72, and above 88 CRI, all products have an R8 above 72. Figure 6 shows that the relationship between R8 and R9 is even stronger, with an R value of 0.84. This graph shows that among products with an R9 score of 30-35, most products (about 75%) have an R8 above 72. These analyses have helped us to interpret Lighting Facts Database and the ENERGY STAR QPL. For our purposes, we have used an R9 score of 32 as an approximate comparison for an R8 score of 72, since that is the intercept of the trend line and above that point we see that most products meet an R8 of 72. However, to be certain, and to take a conservative approach to analysis of compliant products, we also know that products with a CRI above 88-90 will more definitively meet the posed R1-R8 requirement.	

Comparison of R8 to CRI (Ra) in LED Lamps



	Comparison of R8 to R9 in LED Lamps 	
California IOUs	Table 1 (in the comment letter) provides more detail about some of the products in the ENERGY STAR QPL with efficacy above 80 lpw and life above 25,000 hours. This is not an exhaustive list of proposed standard- compliant products, nor an exhaustive list of the manufacturers with compliant products; rather it is a snapshot that indicates the variety of products and their performance specifications. As shown in this table, compliant products range in beam angle from 15˚ to 40˚, they range in CCT from 2700K to 6500K, and have several different base types. They have lumen outputs up to 680 lumens (though not Energy Star certified, many other	The comment supports the standards and does not ask for changes to the standards.

	products are available that provide even higher lumen output, in the range of 700-750 lumens	
Decorative LED lamps		
NRDC	General Service LED Lamps – NRDC offers three recommended changes to the CEC's general service LED lamp proposal. a) Review the minimum efficacy requirements for decorative LED lamps and if necessary establish a slightly less stringent equation for these products – Decorative LED lamps typically have a lower efficacy level than omni directional lamps that give off the same amount of light. This is due to their small form factor and can result in a 10% or so efficacy penalty (i.e these bulbs have 10% lower efficacy values). As such, we recommend the CEC review the efficacy levels for this subcategory of lamps and see whether decorative lamps are on track to meet the proposed standard or not. If not, we recommend the CEC create a tightly defined subcategory of lamps called decorative lamps and establish a new equation that is a little less stringent and will help ensure that LED decorative lamps will continue to be available in CA after the standard goes into effect. As we stated at the beginning of our comments, the goal of this proceeding is to accelerate the shift to energy savings lamps and away from the much less efficient incandescent and halogen lamps. An unintended consequence of setting too stringent a standard would be to	See RESPONSE 9. In 15-day language, the Commission did extend the compliance period for all general service LEDs, extending the effective date for tier 1 by one year and for tier 2 by six months to allow manufacturers additional time to develop product and solutions that comply with the standards at low cost.

<table>
<tr><td></td><td>block the sale of LED decorative lamps in California and cause sales of incandescent and halogen lamp to rise, resulting in massive lost energy savings. Note, the federal standard for general service incandescent lamps currently only restricts candelabra lamps to 40 or 60W, depending on its base type.</td><td></td></tr>
<tr><td>NEMA</td><td>Analysis based on the ENERGY STAR qualified products list shows that on average decorative lamps are about 9LPW less efficient than omnidirectional lamps.
<table><tr><td></td><td>Omni</td><td>Deco</td><td></td></tr><tr><td>All base types</td><td></td><td></td><td>Delta</td></tr><tr><td># models</td><td>1634</td><td>705</td><td></td></tr><tr><td>Average LPW – all models</td><td>81.6</td><td>73.0</td><td>8.6</td></tr><tr><td>Average LPW - Top 25%</td><td>97.8</td><td>96.1</td><td>1.7</td></tr></table>
<table><tr><td>< 6500K</td><td></td><td></td><td></td></tr><tr><td># models</td><td>1600</td><td>660</td><td></td></tr><tr><td>Average LPW</td><td>81.1</td><td>70.4</td><td>10.7</td></tr><tr><td>Average LPW – Top 25%</td><td>96.3</td><td>87.6</td><td>8.7</td></tr><tr><td>>= 6500K</td><td></td><td></td><td></td></tr><tr><td># models</td><td>34</td><td>45</td><td></td></tr><tr><td>Average LPW</td><td>106.7</td><td>111.5</td><td>-4.8</td></tr><tr><td>Average LPW – Top 25%</td><td>124.5</td><td>118.8</td><td>5.7</td></tr></table></td><td>See RESPONSES 3 and 9.</td></tr>
</table>

	(We acknowledge that some filament LED decorative lamps have high efficacies but they are typically not dimmable, which is an important feature for decorative lamps in most applications.)Our analysis indicates that in order to ensure adequate and reasonable product availability of dimmable decorative LED lamps, a separate compliance score for decorative lamps should be 267 and 287 for tier 1 and tier 2 respectively (vs. 277 and 297 for omnidirectional lamps), i.e. ten points lower. NEMA Proposal: Amend Table K-14 "Standards for State-regulated LED Lamps" to add a column for "Decorative LED Lamps" with minimum compliance scores 10 points lower than those given in the 45-day terms and add the words "All Other Lamps" to the current "Minimum Compliance Score" column to differentiate them.	
NEMA	Efficacy Requirements - Decorative Lamps: Decorative LED lamps, especially those which are dimmable are inherently less efficient than omnidirectional lamps and merit lower performance criteria. The proposed efficacy requirement is 65 LPW. From the prior graphs, we see that 91% of the existing Energy Star omnidirectional lamps meet this requirement, while only 63% of the decorative lamps do. This demonstrates that decorative lamps are inherently less efficient than omnidirectional product.	See RESPONSE 9.
NEMA	Efficacy Limits - Decorative Lamps: As shown in our earlier comments, decorative lamps have an efficacy about 10 LPW lower than omnidirectional lamps. Thus we propose that the efficacy requirements for decorative lamps be reduced by 10	See RESPONSE 9.

	LPW from their omnidirectional counterparts in Tier 1 and Tier 2.	
Philips	Minimum Lumen Level: In our comments, we mentioned that low wattage decorative LED lamps will not meet the minimum compliance score even with the adjustment proposed above. Thus we propose that the minimum lumen output required before a product falls within the scope of the regulation be 310 lumens. This is consistent with the 40W equivalency level proposed in Table K-15. This is a simple solution that keeps low wattage decorative LED lamps on the California market. Thus, section 1605.3(C) would be changed as follows: (C) State-regulated LED lamps with lumen output of 310 lumens or greater and manufactured on or after January 1, 2017 shall have:	See RESPONSE 9.
Dimming and Flicker		
Gregory Jones	Harmonics? Have you even considered the effects of diode-generated harmonics on existing protective devices (i.e. GFI, modern breakers), wiring, motor loads, and distribution transformers?	The staff report reviewed feasibility of the standards based on existing technology and expected development. The standards are directed at existing appliances that use existing technology so it is not expected that the harmonics or any other characteristic of LED will be different based on the proposed standards. No change is needed.
NRDC	Dimmability – lamps claiming to be dimmable must meet	The Energy Commission is preempted from

	CEC's lamp dimmability requirements. If the lamp does not meet the dimming requirements/is a non dimmable lamp, it must include text on the front of the package clearly stating that the lamp is NOT DIMMABLE.	affirmatively require labeling related to energy efficiency or energy consumption on a product that is covered by federal labeling provisions, such as for general service LED lamps. This is why the Energy Commission has carefully crafted its regulatory language to require that lamps with certain labeling requirements meet the performance requirements expected from those labels. Requiring that a lamp be labeled "non-dimmable" must be undertaken by the Federal Trade Commission to avoid conflicting state and federal labeling requirements. The Energy Commission agrees that such a label may be appropriate as part of the federal labeling requirements.
NEMA	Dimming: A recent DOE CALiPER Report, Report 22.1, dated August 2015 documented many performance problems LED MR16 lamps used on dimming systems. We note that, for reasons that are unclear to NEMA and its members, the older 2009 CALiPER report was used by CEC staff in the staff analysis, not the more recent report. In some ways this may be moot, because BOTH reports cited notable challenges in MR product offerings and cautioned against widespread use until they are sorted out. In most cases, the transformer and dimming system had to be replaced for the user to get full dimming performance with these lamps. While this outcome may be cost-effective in some simple dimming applications, it would not be cost-effective	See RESPONSE 12. In addition, NEMA incorrectly states that staff used 2009 CALiPER report in the development of the staff report. Staff reviewed a number of reports and studies, including the June 2014 and August 2015 CALiPER MR 16 reports. Specifically Footnote 73 in the Staff Report cites to: CALiPER Application Summary Report 22 LED MR 16 Lamps, June 2014, see Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication

	for advanced dimming systems used in restaurants and other commercial and custom residential applications. Some of these advanced dimming systems can cost tens of thousands of dollars, some over $100,000 to purchase and install. Even when replacing the components, the system will be unable achieve the deep dimming performance of halogen MR16 lamps required in certain applications such as home theatre applications. The following issues documented in the 2015 CALiPER report illustrate these problems:	Number: CEC-400-2015-034 page 38.
NEMA	To address these issues, the CEC must allow some types of Halogen MR16 lamps to remain on the market to be used on advanced dimming systems and in specialty equipment. Replacing systems that can cost over $10,000, which would be necessary to preserve product efficacy, would not be cost-effective pursuant to Public Resources Code section 25402(c)(1). This is especially true because the lamps used in these applications draw very little power when dimmed. The CEC should also note that halogen MR16 lamp life is greatly increased when dimmed to low levels. Commercial MR16 lamps used at full power, up to 16 hours a day, 7 days a week, require a long lamp life of 3000 to 6000 hours to make their use practical. These applications also use the most power and are well suited to LED conversion in terms of maintenance and product cost. We propose that if the CEC allowed continued use of shorter-life halogen MR16 lamps these systems and specialty equipment could continue to be used, but those using MR systems at full-	See RESPONSE 11. With regard to additional exemptions, NEMA has not provided any back up data, study, or analysis to support their comment related to advance dimming systems and specialty equipment. In contrast, staff has found that either compliant lamps exist today or that the technologies exist that can be utilized in these lamp types to meet the efficiency standards, and at a cost that yields energy savings to the consumer. (See RESPONSE 10.) Therefore, the standards are technically feasible and cost-effective, including for these systems, and no further changes to the standard are necessary.

	power for long hours would be naturally incentivized to convert to LED systems due to sooner halogen lamp failure.	
NEMA	Rationale for proposed changes: Limiting the voltage range to 12 volt and 120 volt products, or products close to these voltages, will appropriately focus the standard on lamps typical to general lighting applications. Specialty lamps made at other voltages (e.g., 6, 8, 10.8, 13.8, 14.5, 17, 19, 20, 21, 24, 30, 36, 68, and 82 volts) will not be affected as there is no possible LED replacement lamp that provides the proper optical performance for specialized equipment. Specialty Halogen MR lamps include products used in airport, airplane, photo, projection, fiber optic, medical, dental, emergency, enlarger, microfilm and many other applications. Limiting Halogen lamp life to 2000 hours or less will ensure that these products are only used in dimming applications. It will also ensure that specialty products designed at 12 volts or 120 volts, but which have limited durations of use, are not affected. Limiting the scope only to lamps rated for less than 825 lumens ensures that there will be MR16 lamps available for all appropriate applications, and that LED MR16 lamps will be deployed where those LED lamps are viable replacements for halogen MR16 lamps. It ensures that specialty MR16 lamp products designed at 12 volts or 120 volts, which have very high lumen output and no known LED MR16	See RESPONSE 11.

	replacements to take their place, are not affected. Placing a floor of 150 lumens aligns the MR/SDDL proposal with the CA LED Lamps proposal and avoids the complexity of the disparate market offerings in the low- lumens category, of which none are effective replacements for higher-lumen products and thus not prone to being abused as replacements for larger halogen products.	
NEMA	In retrofit situations, where other system components are unknown, a significant investment in time and new equipment may be required to achieve acceptable system compatibility and performance. The likelihood that a combination of a new LED MR16 lamp, an unknown transformer, and an unknown dimmer will operate smoothly and meet halogen performance expectations is extremely low and highly unlikely.	See RESPONSE 12.
GE	DIMMING: A recent DOE Caliper Report, Report 22.1, dated August 2015 documented many performance problems with LED MR16 lamps used on dimming systems. In most cases, the transformer and dimming system had to be replaced for the user to get full dimming performance with these lamps. While this outcome may be cost-effective in some simple dimming applications, it would not be cost effective for advanced dimming systems used in restaurants and other commercial and custom residential applications. Some of these advanced dimming systems can cost many thousands of dollars to purchase and install. Even when replacing the components, the system will be unable achieve the deep	See RESPONSE 12. NEMA's $100,000.00 cost example to replace a small diameter directional lamp system appears exaggerated or atypical because relevant equipment costs such as transformers are low. Staff did not find any data or information to validate this comment nor has commenter submitted data in support of their comment. Therefore, no change was made to the standards.

	dimming performance of Halogen MR16 lamps required in certain applications such as home theatre applications. The following issues documented in the Caliper report illustrate these problems:	
GE	The system requirements often require an electronic driver, an electronic transformer and an electronic dimmer, all designed by different manufacturers, to work together. This can lead to unwieldy compatibility issues and result in complications before, during and after installation as well as unacceptable performance. Caliper determined that most LED MR16 lamps are only compatible with certain combinations of equipment. In many cases, MR16 LED lamps exhibited undesirable dimming behavior, such as dead travel or erratic dimming performance due to incompatible electronic circuits in the driver, transformer and/or dimmer.	Transformer compatibility is occasionally an issue for low-voltage LED lamps that are installed on high-wattage transformers. These issues are increasingly less prevalent based on evidence from utility rebate programs that suggest the incidence of compatibility issues is decreasing. LED dimming problems can be resolved by the use of LED drivers that are compatible with electronic transformers.12 Most lamps have built in mechanism to read the transformer frequency and adjust driver frequency to avoid flicker while dimming. Thus, there are many existing technical pathways available to the manufacturers to identify and resolve dimming issue in a way that is cost-effective to their consumers. Therefore, no change was made to the standard.
GE	To address these issues, the CEC must allow some types of Halogen MR16 lamps to remain on the market to be used on advanced dimming systems. Replacing systems that can cost over $10,000, which would be necessary to preserve	See RESPONSE 11. With regard to additional exemptions, GE has not provided any back up data, study, or analysis to support their comment related to advance dimming systems and specialty

12 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 11 and 12.

	product efficacy, would not be cost-effective pursuant to Public Resources Code section 25402(c)(1). This is especially true because the lamps used in these applications draw very little power when dimmed. Halogen MR16 lamp life is also greatly increased when lamps are regularly dimmed, meaning fewer replacements and lower total cost to the consumer.	equipment. In contrast, staff has found that either compliant lamps exist today or that the technologies exist that can be utilized in these lamp types to meet the efficiency standards, and at a cost that yields energy savings to the consumer. (See RESPONSE 10.) Therefore, the standards are technically feasible and cost-effective, including for these systems, and no further changes to the standard are necessary.
GE	Commercial MR16 lamps used at full power, up to 16 hours a day, 7 days a week, require a long lamp life of 3000 to 6000 hours to make their use practical. These applications also use the most power and are well suited to LED conversion in terms of maintenance and product cost. Allowing continued use of some halogen MR16 lamps on dimming systems would enhance the cost-effectiveness of the proposed standard and preserve product and system efficacy for the consumer with minimal impact on statewide energy savings. This can be done by limiting the scope to MR16 lamps with a relatively long lamp life	See RESPONSE 11. With regard to additional exemptions, GE has not provided any back up data, study, or analysis to support their comment related to advance dimming systems and specialty equipment. In contrast, staff has found that either compliant lamps exist today or that the technologies exist that can be utilized in these lamp types to meet the efficiency standards, and at a cost that yields energy savings to the consumer. (See RESPONSE 10.) Moreover, exempting all but long-lived MR16 lamps would essentially allow halogen lamps to remain in the market, as these lamps are typically very short-lived (1,500-3,000 hours). Therefore, no change was made to the standards, which are technically feasible and cost-effective, including for dimming systems.
GE	Limiting Halogen lamp life to 2000 hours or less will ensure	See RESPONSE 11. Exempting all but long-lived

	that these products are only used in dimming applications. It will also ensure that specialty products designed at 12 volts or 120 volts, but which have very short lamp lives, are not affected.	MR16 lamps would essentially allow halogen lamps to remain in the market, as these lamps are typically very short-lived (1,500-3,000 hours). This would eviscerate a significant amount of the energy savings from switching from halogen technologies to LED technologies. Therefore, no change was made to the standards, which are technically feasible and cost-effective, including for dimming systems.
GE	LED MR16 lamp performance on actual transformers demonstrated substantial performance variation and clearly indicated the difficulty in retrofitting LED lamps into existing systems intended for use on Halogen MR16 lamps.	See RESPONSE 12.
California IOUs	In cases where low voltage LEDs do not perform to expectations on existing transformers or control systems, end users have several retrofit options available. End users can switch to line voltage LED systems or they can retrofit their existing equipment to LED- compatible low voltage transformers (or LED-compatible dimming systems). We have conducted an analysis to document the expected costs associated with these retrofits and found that the life-cycle cost savings from installing LED SDDLs are so significant that the measure is still extremely cost-effective even in rare cases where existing equipment is upgraded.	The comment supports the standards and does not ask for changes to the standards.
California IOUs	Compatibility: Compatibility between low voltage LED lamps and existing stock of low voltage transformers and dimming systems is an important issue, and over the course of the	The comment supports the standards and does not ask for changes to the standards.

	last few years we have observed great progress on this issue. For example, we commissioned a study into compatibility issues associated with MR16s, conducted ongoing interviews with driver and lamp manufacturers, and reviewed the research on this topic conducted by United States Department of Energy (DOE). We also have significant experience from IOU incentive programs installing LED SDDLs in a variety of space types, including restaurants, retail, aquariums, and others. Several years ago, dimming MR16s was a challenge; today, most SDDLs are dimmable, and thousands of LED installations are being completed across the country without problems or call-backs. Below is a summary of findings on this issue.	
California IOUs	We recommend that lamps designed for use with forward phase cut dimmers (the majority of LED replacement lamps) be compliant with NEMA SSL7A, the industry's phase-cut dimmer compatibility standard. This standard addresses dimming performance aspects such as improved dimming range, reduced dead travel (switch is adjusted but no change in light), pop-on (when adjusting dimmer from the lowest setting upward, light turns on suddenly in the middle of the range, rather than gradually, from a very low light level), drop-out (light source drops out prematurely as lights are being dimmed), ghosting (light source is at a low-level "on" state when switch is in "off" position), and premature failure of LEDs. Compliance with NEMA SSL7A has already been adopted in Title 24 for lamps and dimmers, with the support of industry stakeholders.	This comment is beyond the scope of this proceeding because dimmers are not part of the rulemaking. The standards only adopt limited requirements related to dimming, and those requirements are only to ensure that manufacturers that make claims that their lamps are dimmable meet certain minimum performance requirements. The Energy Commission does require lamps that are capable of dimming to include information about compatible dimmers. Adopting additional requirements is not shown to result in additional energy savings and would likely add cost. Therefore, the Energy Commission did not make changes to the standard as

	Adopting this requirement would not limit design options for dimming strategy, because it would only be required for lamps designed for forward phase cut dimmers. Lamps designed to work on other less common dimmer types would not have to meet SSL7A.	requested.
California IOUs	We recommend that all lamps be required to be dimmable. However, if CEC does not adopt this recommendation, we recommend that lamps not meet the dimming requirements be required to include text on the front of the package clearly stating that the lamp is "NOT DIMMABLE."	Staff did not require all lamps to be dimmable because it did not find that dimmability was a performance characteristic that was necessary in LED lamps, while also finding that requiring dimmability would increase the costs of the standard without sufficient offsetting energy savings. Therefore, staff did not require that lamps be dimmable. Regarding labeling, the Energy Commission is preempted from affirmatively require labeling related to energy efficiency or energy consumption on a product that is covered by federal labeling provisions, such as for general service LED lamps. This is why the Energy Commission has carefully crafted its regulatory language to require that lamps with certain labeling requirements meet the performance requirements expected from those labels. Requiring that a lamp be labeled "non-dimmable" must be undertaken by the Federal Trade Commission to avoid conflicting state and federal labeling requirements. Such a label may be

		appropriate as part of the federal labeling requirements.
	Dimming: We recommend that CEC require all LED lamps to be dimmable down to 10% of full light output (or lower) and that lamps designed for phase-cut dimming (the majority of LED replacement lamps) be compliant with NEMA SSL7A, the recently developed phase-cut dimmer compatibility standard. However, if CEC does not adopt this recommendation, we recommend that lamps not meet the dimming requirements be required to include text on the front of the package clearly stating that the lamp is "NOT DIMMABLE." This will help inform consumers by making it more clear which products they can expect to work in their dimming sockets, and significantly reducing consumer dissatisfaction. Additional analysis on our dimming-related recommendations is provided in this section, below.	Staff did not require all lamps to be dimmable because it did not find that dimmability was a performance characteristic that was necessary in LED lamps, while also finding that requiring dimmability would increase the costs of the standard without sufficient offsetting energy savings. Because it does not require dimmability, it also does not require that lamps meet any standards related to dimmability. Staff did not require that dimmable lamps be compliant with NEMA SSL7A because dimmers, which are a necessary part of that compatibility, are not part of the rulemaking. The standards only adopt limited requirements related to dimming, and those requirements are only to ensure that manufacturers that make claims that their lamps are dimmable meet certain minimum performance requirements. Regarding labeling, the Energy Commission is preempted from affirmatively require labeling related to energy efficiency or energy consumption on a product that is covered by federal labeling provisions, such as for general service LED lamps. This is why the Energy Commission has carefully crafted its regulatory

		language to require that lamps with certain labeling requirements meet the performance requirements expected from those labels. Requiring that a lamp be labeled "non-dimmable" must be undertaken by the Federal Trade Commission to avoid conflicting state and federal labeling requirements. Such a label may be appropriate as part of the federal labeling requirements. The Energy Commission does require lamps that are capable of dimming to include information about compatible dimmers and to dim down to 10% of full light output.
California IOUs	Lack of dimmability was a major cause of consumer dissatisfaction with CFLs, and as dimming sockets become more and more prevalent in California due to building code requirements, the ability of LED lamps to dim well will be crucial for their mass adoption. The Northwest Energy Efficiency Alliance (NEEA) Residential Building Stock Assessment, the first phase of which was published in late 2012, found that across their study of 1,850 homes in the Pacific Northwest, only 6.6% of the sockets controlled by dimmers had CFL lamps installed in them. For example, in dining rooms, where fixtures are commonly controlled by dimmers, CFL adoption rates were appreciably lower than in other rooms. Considering that total CFL market share is 30-40%, these results indicate that sockets on dimmers have	Staff did not require all lamps to be dimmable because it did not find that dimmability was a performance characteristic that was necessary in LED lamps, while also finding that requiring dimmability would increase the costs of the standard without sufficient offsetting energy savings. Because it does not require dimmability, it also does not require that lamps meet any standards related to dimmability. Staff did not require that dimmable lamps be compliant with NEMA SSL7A because dimmers, which are a necessary part of that compatibility, are not part of the rulemaking. The standards only adopt limited requirements related to

	not been converted to high efficacy sources at nearly the rate that non-dimming sockets have. Though dimming CFLs are now available, many consumers had negative early experiences when trying to install non-dimmable CFLs on dimming sockets. Distinguishing between dimmable and non-dimmable LED lamps will only create unnecessary labeling confusion for consumers and will impede the adoption of LED lamps. Most LED lamps are already dimmable but some are not. Among the thousands of LED lamp products for which we are collecting online price data, about 85% are labeled as dimmable. In the ENERGY STAR database, over 2,000 products (about 65% of the total) are labeled as dimmable. About 75% of those are dimmable to a level of 10% or lower. Over 400 products are listed as dimmable below 5%. Section 5.4.2. of the 2013 CASE Report presented an analysis documenting savings potential for standards compliant dimmable lamps installed on dimmers (savings ranged from 4 to 14 kWh per year), and the weighted average savings for standards compliant LED lamps across the state (assuming 25% of lamps get installed on dimmers). Those tables are provided again here.	dimming, and those requirements are only to ensure that manufacturers that make claims that their lamps are dimmable meet certain minimum performance requirements. The Energy Commission does require lamps that are capable of dimming to include information about compatible dimmers and to dim down to 10% of full light output.

Table 2. Per Unit Energy Savings by Lamp Type (for lamps installed in dim sockets)

Lamp Type	Per Unit Energy (dimming sockets)		
	Non-Qualifying kWh/yr	Qualifying kWh/yr	Savir (kW
General Service A-lamp	13.8	7.6	6.2
Large Diameter Directional	37.9	24.1	13.8
Small Diameter Directional	23.2	14.8	8.4
Decorative	8.7	4.8	3.9

Table 3. Weighted Average per Unit Annual Energy Savings by Lamp Type installed in all CA sockets)

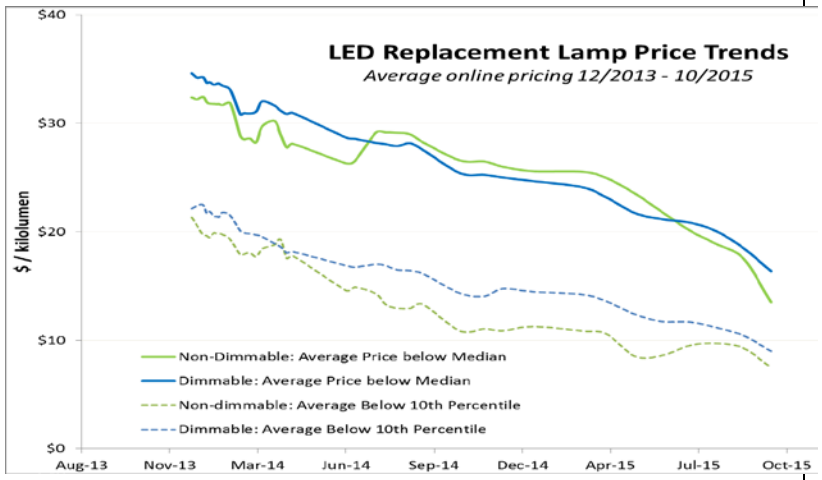
		Annual Energy Savings (kWh)			
		General Service A-lamp	Large Diameter Directional Lamp	Small Diameter Directional Lamp	I
Not Installed on Dimmer	75%	2.1	5.5	3.4	
Installed on Dimmer	25%	6.2	13.8	8.4	
Weighted Average Per Unit Annual Energy Savings		**3.1**	**7.6**	**4.6**	

Off-the-record comments from industry contacts who are either in the driver manufacturer community or who have conducted research into dimming driver ICs suggests that the incremental cost for an LED driver to be dimmable is small and shrinking. Estimates range from $0.15 to $0.20 incremental manufacturer cost, dropping to 5 cents or less in the next few years. To verify that the incremental manufacturer cost to add dimmability is indeed small, the

CASE team has conducted an analysis of thousands of retail prices collected from 9 online retailers. Based on statistical analysis of that data, there is no statistical relationship between dimmability and retail prices for A-lamps.

Additionally, as shown in the figure below, online prices for dimmable LED replacement lamp products (based on price points from hundreds of products) are occasionally slightly lower than prices for non-dimmable products. This suggests that any incremental manufacturer cost associated with making a product dimmable is negligible. It also stands in stark contrast to the CFL market, where historically few products were dimmable and they carried significant incremental retail prices.

Figure 15. 2014 Average Online Pricing for Dimmable vs. Non-Dimmable LED Lamps



	We also recommend that lamps designed for use with forward phase cut dimmers (the majority of LED replacement lamps) be compliant with NEMA SSL7A, the industry's phase-cut dimmer compatibility standard. This standard addresses dimming performance aspects such as improved dimming range, reduced dead travel (switch is adjusted but no change in light), pop-on (when adjusting dimmer from the lowest setting upward, light turns on suddenly in the middle of the range, rather than gradually, from a very low light level), drop-out (light source drops out prematurely as lights are being dimmed), ghosting (light source is at a low-level "on" state when switch is in "off" position), and premature failure of LEDs. Compliance with NEMA SSL7A has already been adopted in Title 24 for lamps and dimmers, with the support of industry stakeholders. Adopting this requirement would not limit design options for dimming strategy, because it would only be required for lamps designed for forward phase cut dimmers. Lamps designed to work on other less common dimmer types would not have to meet SSL7A.	
AccurIC Ltd.	AccurIC Ltd both welcomes the opportunity to offer comment on the proposed wording of the Title 20 regulations relating to small diameter and general service LED lamps and commends the Commission for including flicker-related performance metrics within the proposed regulations. The importance of flicker suppression, as well as dimmability, in terms of the public acceptance of LED lighting technology can hardly be overstated. If LED lighting	The comment supports the standards and does not ask for changes to the standards.

	is to achieve the rollout required to make its full impact on energy and Carbon reduction, it is in our view essential that these two performance metrics improve.	
AccurIC Ltd.	Our comments relate to Section 1604 'Test Methods for Specific Appliances' and in particular, to the fact that certain performance criteria, such as those relating to Flicker, are labelled as 'Optional'. This labelling is designed to indicate that the criteria are conditional upon manufacturers' claims, as described in Section 1607(d)(12). The wording of Section 1607(d)(12) implies that the 'reduced flicker operation' performance criteria, as stated in Title 24, part 6, Joint Appendix 10 (2015) needs to be met if and only if the lamp in question is marked as 'dimmable'. Requiring flicker testing only for dimming lamps is based on the erroneous assumption that flicker at frequencies less than 200Hz arises solely or mainly as a result of dimming. This is not the case.	As the commenter notes, the regulations only require lamp manufacturers to meet the flicker requirements if they make claims that their lamps are "dimmable." The records for both this proceeding and in the Title 24 Energy Standards proceeding demonstrate that flicker is an issue for dimmable lamps. Energy Commission does not have evidence in the record, other than the unsubstantiated claim in this comment, that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed.
AccurIC Ltd.	The main component of photometric flicker arising in LED lighting at frequencies below 200Hz is primarily generated by full-wave rectification of the AC mains, and which occurs at the second harmonic of the mains frequency (in the case of the US, 120 Hz). Whilst it is the case that this flicker component can, in the case of many LED lighting products, be exacerbated by dimming, it is not caused by dimming.	Staff agrees that flicker may occur at frequencies below 200 Hz in some lamps with or without dimming. Flicker may occur due to flaws in the lamp design or use of incompatible components. In this case, the flicker may be caused by low frequency that is produced by the power supply, which is not the subject of this rulemaking and

		therefore no change is appropriate here.
AccurIC Ltd.	We therefore strongly suggest that the flicker criterion given in Title 24, part 6, JA-10 (2015) should apply to all LED lamps covered by Title 20 regulations, with the sole and somewhat obvious limitation that in the case of LED lamps that do not claim to be dimmable, the criterion should only apply at full brightness.	Energy Commission does not have evidence in the record, other than the unsubstantiated claim in this comment, that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed.
AccurIC Ltd.	An aspect of the Title 24 regulations which seems to have been omitted from the present draft of the proposed Title 20 regulations is the requirement that manufacturers record flicker percentages at both 100% and 20% output. In the current draft, they are asked merely to declare whether their products meet the current flicker criterion at these two dimming levels. It is perhaps worth recalling why the recording and reporting of specific flicker levels is required under Title 24. This is to enable the Commission to establish a database, recording flicker percentages of available products, on the basis of which it can decide how and when to update the regulations, such that they come into line with practices recommended by IEEE, on the basis of peer-reviewed research and ballots. Again, there is no rational reason why this database should not also include the performance of products covered by Title 20	Title 24 regulations already require flicker test and reporting for LED lamps that are claimed to be JA-8 compliant. As a result, it is not necessary to require additional reporting under Title 20 for the same lamps. The Energy Commission does not have evidence in the record, other than the unsubstantiated claim in this comment, that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed.

	regulations. We therefore request that the Commission introduce the requirement for flicker performance to be recorded at both full brightness and 20% dimmed, in the case of dimmable lamps and at full brightness for non-dimmable lamps.	
AccurIC Ltd.	The regulations seek, inter alia, to raise product quality and increase adoption of technologies that use less power – such as LEDs. Flicker is one of the key quality criteria on which many LED lamps are materially inferior to incandescent bulbs. The consumer is unable to differentiate between lamps with dramatically different flicker characteristics because there is no disclosure or no meaningful disclosure of flicker measures on consumer packaging or product labelling. Lack of information about the relative quality of lighting products along dimensions such as flicker and power factor in undimmed and dimmed states encourages competition purely on the basis of relative price which in turn may encourage manufacturers to sell lower quality bulbs with shorter operating lives. The lack of consumer information about flicker is a barrier to improving the flicker qualities of lamps and increasing the rate of adoption of LED lamps.	The regulations do not "raise product quality" but simply keep the quality in light with what consumers expect out of light bulbs and then increase the efficiency of those light bulbs. These regulations require manufacturers test and meet the flicker requirement for LED lamps only if they claim incandescent equivalency or to be dimmable. They also set a minimum lifetime requirement for lamps to ensure that manufacturers do not shorten the life of the bulb to lower costs. There is no study or data to support the comment related to consumers having issues with flicker and power factor requirement for non-dimmable light bulbs. As a result, staff does not have sufficient evidence to make this change to the regulation.
AccurIC Ltd.	We believe that consumers should be empowered to make informed choices when buying replacement light bulbs. Disclosure of relevant flicker quality information beside other lamp specifications such as power, lumens, and color temperature would allow the consumer better to	Regulations related to marking under section 1607 require this information if the manufacturer claims equivalency to incandescent lamps. Staff disagrees with the comment that flicker requirements be made mandatory for all lamps.

	judge relative product quality. If all packaging disclosed the flicker characteristics of lighting products by reference to the levels of flicker in GLS incandescent bulbs and to the recommended levels in IEEE1789 consumers would be able to make informed decisions. The key measures set out in IEEE1789, namely light modulation or % flicker and frequency should be disclosed for all lighting products.	There is no study or data that shows that consumers demand it or shows benefits of this requirement. Commenter has not provided any data showing energy benefits by requiring flicker testing and disclosure requirement stated in IEEE 1789. Moreover, consumer-facing lamp disclosures are provided by the federal Lighting Facts program and the Federal Trade Commission; the Energy Commission is preempted from requiring that additional consumer-facing information be provided for all lamp types. Based on the information in comment staff recommends no change is needed.
AccurIC Ltd.	The technology to make suitable power drivers to eliminate or materially reduce flicker exists today. Regulators have the power to require better consumer information and to incentivize or require industry to supply better quality product. Setting medium term targets for relevant quality criteria assists consumers and manufacturers progressively raise standards. Requiring disclosure of flicker information and setting out targets for acceptable levels of flicker in relevant products will progressively raise standards. IEEE1789 published in August, 2015, sets out the appropriate measures and provides recommendations towards which the lighting industry and society can work. Power drivers which meet the recommendations of IEEE1789 are expected to be available at competitive prices in 2017.	This comment describes technologies available to reduce flicker, and does not ask for changes to the regulation.

AccurIC Ltd.	In line with our previous submissions we, along with respected researchers and academics, continue to encourage the Commission to align, at the first possible opportunity, the flicker criteria given in Title 24, part 6, JA-10 (2015) with the recommendations of IEEE Standard 1789. We do so in particular, in view of the fact that the recommendations have passed IEEE ballot twice and are based on peer-reviewed research. Currently, the flicker percentage cited as acceptable by JA-10 – namely, 30% - for flicker frequencies below 200Hz, is more than three times the level regarded as acceptable by IEEE Standard 1789 at 120Hz and more than seven times the level regarded by IEEE as representing No Risk of flicker-related physiological effect at the same frequency.	The records for both this proceeding and in the Title 24 Energy Standards proceeding demonstrate that flicker is an issue for dimmable lamps. However, a major difference between Title 24 and Title 20 is that Title 24 requires that lamps be dimmable, while Title 20, for reasons stated elsewhere in these Response to Comments, does not require dimmability as part of its minimum efficiency standards. The Energy Commission does not have evidence in the record, other than the unsubstantiated claim in this comment, that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed.
Robert Clear	In addition to the above major objection, I am also concerned that the proposal is insufficiently strict with respect to power factor and flicker, and overly restrictive regarding the candlepower distribution for general service lamps	Staff disagrees with comment because the staff proposal is based on the analysis of available data for power factor on page 38 of the staff report.13 Power factor requirements are cost effective and technically feasible for general service LED lamps,

13 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf

		and staff did not find data in support of a more stringent power factor standard. For small-diameter directional lamps, staff did not set a power factor requirement because it did not find that low power factor was an issue for these types of lamps. The proposed labeling standards for flicker do not affect all lamps offered for sale in California. However, if manufacturers want to make certain claims about the dimmability of an LED lamp, that performance must be tested and certified to flicker requirements.14 Staff has not found that flicker is an issue for non-dimmable LED lamps, and so it has not adopted flicker requirements for these lamps. The technical feasibility of the proposed light distribution requirements was evaluated in the staff report. See RESPONSE 3.15
NEMA	Claims about lamp performance based on laboratory power supplies can result in misleading flicker and power quality performance characterizations. Performance on actual	See RESPONSE 12.

14 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 60

15 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 66

	transformers demonstrated substantial variation and clearly indicated the difficulty in retrofitting LED lamps into existing systems intended for use on Halogen MR16 lamps.	
NEMA	The system requirements often require an electronic driver, an electronic transformer and an electronic dimmer, all designed by different manufacturers, to work together. This can lead to unwieldy compatibility issues and result in complications before, during and after installation as well as unacceptable performance. CALiPER determined that most LED MR16 lamps are only compatible with certain combinations of equipment. In particular, the flicker performance for all LED MR16 lamp models was poor and all had much higher flicker index values than Halogen MR16 lamps when dimmed. In addition, LED lamps have very low power factors when dimmed. In many cases, MR16 LED lamps exhibited undesirable dimming behavior, such as dead travel or erratic dimming performance due to incompatible electronic circuits in the driver, transformer and/or dimmer.	See RESPONSE 12.
NEMA	When testing an electronic transformer on an incandescent dimmer most products did not dim in a reasonable manner even though they were marketed as dimmable. Some products dimmed in a non-monotonic manner, meaning light levels could go higher when they were dimmed lower, and many did not dim below 60% light output. The presence of audible noise greatly increased when dimming. In	See RESPONSE 12.

	addition, the overall flicker index was quite poor with lamps exhibiting objectionable flicker when dimmed. The MR16 LED lamps demonstrated irregular or unpredictable dimming, essentially showing a high level of incompatibility with the transformer-dimmer system. None of the LED products matched the dimming curve of the halogen benchmarks, and the flicker performance of most of the lamps was very poor.	
GE	The presence of audible noise greatly increased when dimming. In addition, the overall flicker index was quite poor with lamps exhibiting objectionable flicker when dimmed.	The audible noise generated by the system can be due to system transformer incompatibility with lamp driver frequency of the dimming lamp. See RESPONSE 12.
GE	The MR16 LED lamps demonstrated irregular or unpredictable dimming, essentially showing a high level of incompatibility with the transformer-dimmer system. None of the LED products matched the dimming curve of the halogen benchmarks, and the flicker performance of most of the lamps was very poor.	See RESPONSE 12.
GE	In retrofit situations, where other system components are unknown, a significant investment in time and new equipment may be required to achieve acceptable system compatibility and performance. The likelihood that a combination of a new LED MR16 lamp, an unknown transformer, and an unknown dimmer will operate smoothly and meet halogen performance expectations is extremely low and highly unlikely.	See RESPONSE 12.

California IOUs	In 2014, PG&E funded a research initiative at the California Lighting Technology Center (CLTC) that was designed to investigate compatibility issues between SDDLs, dimmers, and transformers. Twenty LED SDDL products were tested, each with extensive combinations of components and operating conditions: transformer type, dimmer type (including no dimmer), dimming level and number of lamps, resulting in a performance data set of 600 different test scenarios. Most lamps were found to be dimmable but compatibility issues occurred in some scenarios; dimming performance was dependent on transformer type and other factors. The results of the study closely mirrored the results of a DOE study completed in early 2015. In DOE's testing of MR16 LEDs published in its most recent CALiPER report, they found an array of performance levels under different conditions. For LEDs operating on electronic low voltage transformers and dimmers that were optimized for compatibility (i.e. they paired with products from the lamp manufacturer's recommend compatible transformer and dimmer lists), most of the MR16 lamps dimmed smoothly, and all but three dimmed below 10%. A third of the products actually dimmed below 2%. For lamps on electronic transformers with incandescent dimmers (not optimized for compatibility), many products had erratic dimming behavior, though some products still performed quite well – there were a number of products that dimmed below 10%. When installed on a magnetic transformer, dimming performance was good across most lamps – only a	The comment supports the standards and does not ask for changes to the standards.

	handful showed erratic behavior and all but 4 dimmed below 20%. About half the products dimmed below 10%, some below 2%. Both the CLTC study and the DOE report demonstrate that many manufacturers are having increased success in controlling MR16s; what was considered not possible 3 or 4 years ago is now being done by much of the market. We estimate that in most cases (85-95%) low voltage LED lamps are compatible with the low voltage transformer, fixture, and wiring infrastructure specified in a lighting project. However, in cases where there are compatibility challenges (e.g., erratic behavior such as non-linear/non-smooth dimming, flicker, ghosting), one option is to replace the low-voltage transformer(s) with LED-compatible transformers. There is a cost associated with changing out transformers, but in the case of remote transformers or low voltage (mono-rail) systems, multiple lamps are driven from a single transformer, so the per lamp cost is much lower. Changing a low voltage system to a line voltage system is another potential solution that would negate compatibility challenges associated with LEDs operating on low voltage systems. We have done an analysis to assess the most common wiring and installation scenarios for low voltage SDDLs, and to identify the retrofit options available to consumers in each scenario, should they decide to upgrade their low voltage transformers or dimming systems to LED-specific systems or to switch to line voltage LED SDDLs to improve system performance. For each of the identified SDDL configurations, we have scoped out these two options,	

	as well as the total system retrofit costs and per lamp costs that could be expected. We have also conducted an analysis of dimming system retrofit options and costs. The aim of both of these analyses was to determine the per lamp costs associated with these retrofits, should they be needed. The matrices below, which are based on expert interviews with manufacturers and lighting designers, show the results of these analyses.	
California IOUs	Specific Recommended Changes to the CEC's 45-day Language We support the CEC's proposal to limit flicker and noise in dimmable LED lamps but recommend that CEC extend these requirements to non-dimming lamps as well (tested at full output, no dimmer). Flicker and noise could be a major source of consumer disappointment whether it occurs in dimming or non-dimming lamps.	The Energy Commission does not have evidence in the record that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed.
California IOUs	We recommend that CEC provide more specificity around the test procedure for verification of dimming performance, including the selection of dimmer types and dimmer samples to be used in testing. The current language seems to imply that manufacturers are only required to test lamps on one dimmer of their choosing, but this is not clear. Specifically, we recommend that CEC refer to the dimming test procedure methodology already adopted in Joint Appendix JA8 of Title 24, which specifies the dimmer selection process based on manufacturer claims.	There is no specific requirement for dimming in the proposed regulations because dimming labeling requirement applies only if the manufacturers claim their lamps to be dimmable. To address stakeholder comments regarding consistency with Title 24 the proposed regulations include the test method set forth in Title 24, part 6, Joint Appendix 8 (2015) for testing for dimming. The proposed regulations also include the related Title 24 test method for

	Additionally, we recommend that CEC clarify what is meant by the phrase "standard phase-cut dimmer" in Section 1607 (12).	flicker, Joint Appendix 10 (2015). By utilizing these two vetted test methods, consistency is ensured between Title 20 and Title 24. Standard phase cut dimmer is part of the JA8 and NEMA SSL 7. See http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206907_20151209T094324_2016_Reference_Appendices__Joint_Appendix_JA.pdf for more information regarding the JA8 test and its description of phase cut dimmers The labeling requirements in section 1607 require the manufacturer to include the phrase "dimmable with LED dimmer." The objective is that if the lamp cannot be adequately dimmed with a standard phase-cut dimmer, the manufacturer should inform the purchaser that an LED compatible dimmer is necessary for the lamp to perform correctly upon dimming. Based on information from stakeholders and as described in the Staff Report, most LED lamps can function correctly with a standard phase-cut dimmers but to ensure correct product compatibility, the phrase "dimmable with LED dimmer" will be necessary in certain circumstances.

		No change is needed.
California IOUs	In the data collection table format for product certification, the 45-day language appears to allow manufacturers to submit only a "yes/no" response to indicate whether they meet the flicker requirements. We urge the CEC to modify this field in the table to require products to list their specific measured performance. Collecting the specific flicker performance results at 100% light output and 20% light output is a very important aspect of the flicker standard because currently there is no public database of LED flicker data. This data will be extremely helpful for the lighting design community and to distinguish products with the lowest levels of flicker.	The Energy Commission adopts reporting and certification requirements in order to enforce the efficiency standards and to provide consumers information about the products being certified. These requirements are carefully considered to balance the cost and complexity of reporting by manufacturers with the usefulness to a consumer in identifying products that meet their needs and generate sufficient energy savings. The Energy Commission decided to adopt a minimal reporting requirement for flicker because it is not a specific metric of energy consumption and detailed information does not necessarily provide a consumer information about whether the lamp meets their needs. Additional information is unnecessary and would increase costs, so the Energy Commission did not require it. The Energy Commission does not have evidence in the record that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed.

California IOUs	Dimming Test Procedure: We recommend that CEC provide more specificity around the test procedure for verification of dimming performance in Title 20. The CEC has already specified a dimming test procedure in Joint Appendix JA8 of Title 24, which provides guidance on what dimmers should be used for testing. Title 24 JA8 requires manufacturers certifying a lamp to specify which dimmer types are compatible with the lamp. The lamp must be listed as compatible with at least one type (e.g. forward phase cut, reverse phase cut, 0-10V, etc.). JA8 also requires that the lamp be tested on at least one dimmer of any type claimed as compatible. For example, if the product claims to be dimmable using a forward phase cut dimmer, it must pass the dimming, flicker and noise requirements when tested on at least one forward phase cut dimmer. If a product claims to be dimmable on other dimmer types, it must pass these requirements on at least one of each of them. Because this has already been adopted in Title 24, and the data certification efforts are now going to overlap for products certifying to either Title 24 or Title 20, this should be straightforward for CEC to align Title 20 with Title 24. This change should be made by adding "dimmability" to the test procedures listed in Table K1, along with a reference to Section 8.3.7 of Joint Appendix JA8. Additionally, in Section 1606, Table X, the CEC should require lamps being certified to Title 20 to provide the same information that lamps being certified to Title 24 are required to provide (i.e. which dimmer types they have been tested with).	Minimum dimming levels in the proposed regulations are optional. Manufacturers who claim their products to be dimmable must test and certify to the Energy Commission's Appliance Efficiency Database. To address stakeholder comments regarding consistency with Title 24, the proposed regulations (Table K1) include the test method set forth in Title 24, part 6, Joint Appendix 8 (2015) for testing for dimming. Staff has not proposed a standard for dimming; therefore testing for dimming is not mandatory. Requiring lamps to include the same information for Title 20 as for Title 24 would not make sense for lamps that are not required to meet the additional Title 24 requirements for dimmability and flicker, as it would increase costs of reporting with no related efficiency or energy benefit.

California IOUs	Flicker: We support CEC's proposal to require reduced flicker operation in dimmable LED lamps, but if non-dimmable lamps are allowed, we recommend that CEC broaden flicker requirements to apply to those too (at full light output only). The main component of photometric flicker arising in LED lighting at frequencies below 200Hz is primarily generated by full-wave rectification of the AC mains, and which occurs at the second harmonic of the mains frequency (120 Hz). While it is the case that this flicker component can, in the case of many LED lighting products, be exacerbated by dimming, it is not caused by dimming. Objectionable levels of flicker can occur among products that do not claim to be dimmable, and/or are not operating on a dimmer, and we therefore strongly suggest that the reduced flicker operation requirements apply to all LED lamps covered by Title 20 regulations. The CA IOU team has completed a significant amount of flicker testing on a number of different product types, at several different labs, in 2014-2015. This testing has found that the test procedure proposed and adopted in Reference Joint Appendix 10 of Title 24 is repeatable. It also found that there are products available that provide reduced flicker operation in every product category being considered in this rulemaking: A-lamps, directional lamps, decorative lamps, and downlights. Lastly, in the data collection table format for product certification, the 45-day language appears to allow manufacturers to submit only a "yes/no" response to indicate whether they meet the flicker	Regarding requiring flicker testing in non-dimmable lamps: The Energy Commission does not have evidence in the record that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed. Regarding data collection for flicker: The Energy Commission adopts reporting and certification requirements in order to enforce the efficiency standards and to provide consumers information about the products being certified. These requirements are carefully considered to balance the cost and complexity of reporting by manufacturers with the usefulness to a consumer in identifying products that meet their needs and generate sufficient energy savings. The Energy Commission decided to adopt a minimal reporting requirement for flicker because it is not a specific metric of energy consumption and detailed information does not necessarily provide a consumer information about whether the lamp meets their needs. Additional information is unnecessary and would increase costs, so the

	requirements. We urge the CEC to modify this field in the table to require products to list their specific measured performance. Collecting the specific flicker performance results at 100% light output and 20% light output is a very important aspect of the flicker standard because currently there is no public database of LED flicker data. This data will be extremely helpful for the lighting design community and to distinguish products with the lowest levels of flicker.	Energy Commission did not require it. The Energy Commission does not have evidence in the record that flicker is a problem in non-dimmable lamps, or that the flicker test would be able to "catch" flicker problems in non-dimmable lamps. Requiring an additional flicker test for non-dimmable lamps will add additional test and certification cost without any benefit. The Energy Commission has considered and rejected commenter's suggestion. No change is needed.
Soraa	c) Driver quality, flicker: LED drivers provide rectification of AC current. Basic drivers provide limited rectification, which leads to stroboscopic flicker (especially upon dimming). Better-quality drivers provide a smoother waveform and less or no flicker, but this negatively impacts efficiency and product cost. Furthermore, high-end drivers tend to require larger electronic components. Thus such drivers are especially challenging to implement in sources with high heat generation and limited space – namely in directional lamps, and especially so in small form factor lamps. Some drivers can have efficiencies as high as 90%. However, the size constraints of directional lamps (especially small-diameter) lead to typical efficiencies of about 80-85%. Furthermore, improving the quality of the driver to reduce flicker can have an efficiency cost of about 5%.	Dimmability is not a requirement for any lamp type, but only verified if a manufacturer claims to have a dimmable lamp. As a result, staff was not required to analyze the technical feasibility of making a dimmable LED lamp. Nonetheless, staff agrees with Soraa's comment that improved dimming capability can come at an efficiency and product cost. In 15-day language, staff extended effective dates for general service LEDs to allow for sufficient time to implement new and improved LED technologies in non-compliant products that will address flicker issues without sacrificing cost or efficacy. See also RESPONSES 3 and 10 on lamp availability today, demonstrating that the standards are technically feasible.

Downlight retrofit kits		
Acuity Brands	The type of baffle or trim color can reduce the overall lumens by up to 24%, but provide the appearance or brightness control desired by the designer or consumer. These products are optimized for the LED source with performance that cannot be duplicated by simply replacing a traditional lamp in an existing down light with an LED lamp. A significant focus of our product design is to provide products that reduce the brightness or glare, and to occlude the image of the individual LEDs. This is a major quality consideration for consumers and often results in a tradeoff in the energy efficiency. Some products result in a direct image of the individual LEDs, a flush bright lens, or high brightness from a specular reflector. While these products may result in a higher efficacy, they do not provide a superior customer experience. In addition, most manufacturers provide these down lights with a screw base adapter to service both the commercial and residential markets. The screw base may, or may not be installed with the down light, so CEC has unintentionally covered hardwired down lights within the scope of the standard.	See RESPONSE 7.
Acuity Brands	Awareness of scope including retrofit down lights: Because of the confusion associated with the inconsistent definition of a "general service lamp," we believe that many manufacturers of screw based LED down light retrofits are unaware of this proposed standard and have not been engaged in the analysis or feedback. This product type has	See RESPONSES 5, 6, and 7.

	been grouped into the general service LED lamp category yet they are distinctly different from the general classification of LED lamps. The timing of this standard presents challenges to modify the requirements for this product class within the desired timeframe. We suggest that this product class be removed from the current scope. If there is a desire to impose regulatory requirements on this product class beyond those already in effect for Title 24, Acuity Brands will actively work with CEC staff to develop proposals that are representative of the product performance and are cost justified.	
Acuity Brands	Reevaluate or remove Screw-based down light retrofits from the scope of this standard: We request that the CEC provide public access to the data used to evaluate this class of product. If these products have not been specifically evaluated as a separate class in making the performance determinations in Title 20, CEC should remove them from the scope of this cycle for Title 20 standards. Furthermore, if the analysis has not included a reasonable breadth of optical and aesthetic options, the product class should be removed from the scope. Acuity Brands will be glad to assist in the evaluation of appropriate standards for a future rulemaking if it is determined that requirements beyond the existing Title 24 JA8 requirements are necessary. If this class of product has been evaluated with a reasonable breadth of samples in the standards process, then we request access to the analysis for this product class only; specifically the LPW, Compliance Score, color attributes,	See RESPONSE 7.

	with an identification of the type of reflector, lens and trim style. We further request a reevaluation of the proposals with the consideration of quality attributes consumers prefer, such as brightness, glare control and aesthetic appearance. As currently proposed, the regulation will restrict California consumers from purchasing many high quality energy efficient LED retrofit down lights.	
Acuity Brands	Tradeoffs in LPW/Compliance Score versus optical quality: There is a significant tradeoff in the LPW for down light retrofit products that provide superior optical control or aesthetic appearance. Products with these features generally have an LPW between 50-55 LPW, which is significantly higher than the Title 24 JA8 requirement but about 25% lower than the 65 LPW proposed in Title 20. Furthermore, the trim style with a black baffle or designer color can result in a reduction in efficacy from 10-24%. These options align with interior design preference and represent an energy efficient solution that significantly reduces the energy use compared to incandescent or CLF down lights. While a consumer could replace the existing lamp with a standard LED screw based lamp, the overall appearance and optics of the down light would be compromised. Without the breadth of these options, many consumers will simply maintain their existing, inefficient down light rather than replacing it with a white trim.	See RESPONSE 7.
Acuity Brands	A few down light retrofit products meet the proposed R8 requirement of 72, and those products that exceed this	See RESPONSES 1, 3 and 7. Regarding the modification in 15-day language to

	threshold result in a CRI value of 92 or higher. There does not appear to be a good correlation between the minimum 82 CRI requirement and the R8 threshold. We request that the CEC provide the analysis of the R8 and CRI recommendations. None of the products met the duv threshold published in the 15-day language. The CEC modified the upper limit for the duv range at the November 18, 2015 hearing. We have reevaluated the performance of these products based on these modifications and the revisions seem to be reasonable. We thank the CEC for reevaluating and modifying the duv requirement.	the Duv requirement, the comment supports the 15-day language.
Philips	Lamp Availability: In a recent Sacramento Bee article, the CEC is attributed as saying that all manufacturers currently produce bulbs that meet the proposed standards. For Philips Lighting, this statement is not true. Based on our analysis of our product offerings, our LED retrofit kits will not meet the proposed language, nor will any of our small diameter directional LED lamps. This would appear to contradict the above statement. In addition, the rulemaking file appears devoid of evidence supporting the assertion made to the media. Taking a broader view, the following table examines the general availability of lamps that would be regulated under the proposed language. Projected Availability of Lighting Products in California based on Title 20, 45 Day Language Base Year is 2015	See RESPONSES 3, 6, and 10. In the 15-day language staff made changes to accommodate stakeholder comments. These changes include limiting the scope of regulated SDDLs as explained in RESPONSE 11. In addition, industry was given more time to meet the general service LED lamp standards with the tier 1 effective date moving from January 1, 2017 to January 1, 2018 and tier 2 from January 1, 2019 to July 1, 2019. This will provide appropriate time for manufacturers to develop additional products.

	<table><tr><th rowspan="2">Product Type</th><th colspan="3">Projected Availability</th></tr><tr><th>2016</th><th>2017</th><th>20</th></tr><tr><td>Self-ballasted LED lamps</td><td>No change</td><td rowspan="3">Tier 1 Requirements take effect January 1, 2017 Product availability significantly drops</td><td rowspan="3">Product a l</td></tr><tr><td>LED Large Diameter Directional (Diameter > 2.25″)</td><td>No change</td></tr><tr><td>LED Retrofit Kits</td><td>No change</td></tr><tr><td>LED - Small Diameter Directional (Diameter ≤ 2.25″)</td><td>No change</td><td>No change</td><td>Product av significant</td></tr><tr><td>CFL (non-directional)</td><td>No change</td><td>No change</td><td>No change ≥ 45 LPW</td></tr><tr><td>Halogen – Small Diameter Directional*</td><td>No change</td><td>No change</td><td>Not availa (45 day la</td></tr><tr><td>Halogen – General Service Lamp</td><td>No change</td><td>No change</td><td>Not availa (< 45 LPW</td></tr></table> * The availability of small diameter directional CFLs would be affected in a similar manner, however, there are very few, if any of these in the market now.	

Effective Dates

Philips	Timing: The implementation dates of the proposed language are as follows: Product Type Implementation Date Self-ballasted LED lamps – Tier 1 January 1, 2017 LED retrofit kits – Tier 1 January 1, 2017 Lamps sold with a portable luminaire January 1, 2017 –	Effective date in the proposed 15-day language is as follows: Self-ballasted LED lamps – Tier 1 January 1, 2018 LED retrofit kits – Tier 1 January 1, 2018 Lamps sold with a portable luminaire – Tier 1 January 1, 2018 Small diameter directional lamps January

	Tier 1 Small diameter directional lamps January 1, 2018 The Tier 2 implementation date of January 1, 2019 is not shown in the above table.	1, 2018 And Tier 2 implementation date is July 1, 2019. This comment is requesting clarification on the effective date of the proposed standards.
Philips	In 2017, three types of LED products will see their number of models available in the California market reduced significantly as a result of the proposed 45 day language. The lack of availability of these LED products means that consumers in California will continue to purchase halogen lamps and CFLs in 2017, and into 2018.	See RESPONSES 3 and 10.
Philips	We struggle to understand the logic behind an implementation schedule that significantly reduces the availability of LED lamps in 2017 while the sale of halogen lamps and CFLs continues unaffected. The staff report is not clear if the effect of sustained halogen and CFL usage was incorporated into the cost analysis. Certainly this is not what the Energy Commission intended. Fewer LED products will be available for the following reasons: Products on the market now will not meet the proposed requirements. It will take at least a year to design/redesign, test, and market products that comply with the proposed language	In the 15-day language staff made changes to accommodate stakeholder comments. The Energy Commission modified the effective date for the general service LED standards to give industry was given more time to meet the standards. The tier 1 effective date was extended by a year, and the tier 2 effective date was extended by 6 months. This will provide more than sufficient time for manufacturers to develop additional products. The standards for SDDLs will impact halogen lamps as these products will not be able to meet the efficiency requirements and will be replaced by much more efficient and long lasting LEDs.

		Based on this and market trends discussed in the staff report, staff disagrees that there will sustained halogen usage. The SDDL regulation will phae out halogen lamps on the effective date (1/1/18), and the federal general service lamp regulation, which takes effect two years early in California (1/1/18), will phase out general service halogen lamps. While consumers may continue to by CFLs, the Energy Commission found that manufacturers are slowly phasing out CFLs, with some manufacturers making announcements following the adoption hearing about discontinuing their CFL product.16
Efficacy		
AccurIC Ltd	We feel it is vital that the Commission keeps sight of its assertion, made in the context of the drafting and adoption of its Title 24 regulations, that insisting upon 'high quality' in LED products will reduce the likelihood of residents reverting to lower efficiency lighting solutions. We believe strongly that there is no reason why quality standards relating to lighting in existing build (covered by Title 20) should, other than for reasons of practicality,	Title 24 standards apply to lamps and luminaires for installation in new construction, representing a small portion of the total lighting market. Title 20 standards apply to all new lamps sold or offered for sale in California, covering the entire lamp market within its scope. Title 24 is intended to push lamp quality at the highest end of the market, given the low transaction costs for such

16 See, e.g., http://www.gelighting.com/LightingWeb/na/consumer/campaigns/breaking-up-with-cfl.jsp.

	differ from those established in Title 24, covering new-build.	lamps in new construction. In contrast, Title 20 sets a baseline that all lamps will have to meet, regardless of where they are installed. Applying Title 24 standards to all lamps in the market would result in increase in lamp prices with no correlative energy benefit. Because this would increase the costs, but not the savings, from the proposed regulations, the Commission did not make this change to the regulations.
Robert Clear	I have noted that there are errors in the staff report because the types of errors made me concerned that the staff was not familiar with lighting issues, and might make serious errors in their analysis. For example, the report states that "Haitz's Law asserts that LEDs will become exponentially more efficient over time" (page 23). On page 25 the report compounds the error by asserting that "LED manufacturers have made claims to develop LEDs of light intensity tenfold, that is from 50 lumens per watt to 500 lumens per watt.". Any efficiency measure is likely to be bounded, and in fact lighting efficiencies are approaching their theoretical limit. The maximum attainable efficacy of monochromatic 555 nm light is only 683 lumens per watt, and the maximum efficacy for "white" lights is closer to 400 lumens per watt (with the exact value depending on what is counted as "white"). Note that efficiency is unit less, while efficacy has units of lumens per watt. An efficacy of 683 lumens per watt is equivalent to a photopic (visual) efficiency of 100%). A quick check of the references listed	The purpose of the staff report is to demonstrate improvement in LEDs over time, whether in terms of increasing brightness (lumens), lowering wattage, increasing lifetime, or improving color rendering (CRI). The alleged error in the staff report had no bearing on staff's findings that there are lamps today that meet the standards at a cost that still ensures the consumer achieves savings over the lifetime of the product. The standards are cost-effective and technically feasible today, and are expected to continue to be so in the future. Therefore, the Energy Commission did not make any changes to the regulation in response to this comment.

	in the report indicates that the staff did not understand them. Haitz's law is stated as claiming that the lumen output per LED package is increasing exponentially. This is not the same as the efficacy, as the output of the package depends upon its size and its power density, as well as its efficacy. Similarly a check of the reference which supposedly supports the 500 lumen per watt claim indicates that it actually claims an increase in lumen output per area of the LED package, not per watt of input.	
Francis Rubenstein	1. Objections to the CRI and efficacy requirements: Staff has framed the main efficacy requirement by an "equation" that is mathematically incorrect. Staff's formulation: Lamp efficacy (lumens/watt) + 2.3 * CRI (unit less) >= 277 (units undefined!) doesn't survive engineering unit analysis. One cannot take a physical quantity such as lamp efficacy (which has units of lumens/watt) and "add" it to a term such as CRI (which is a pseudo-efficiency without units) and obtain a result that is technically meaningful. Because the "equation" is technically incorrect, it will not (and should not) survive legal challenge.	See RESPONSE 3. In addition, staff disagrees with the commenter's interpretation of the equation as it mischaracterizes the purpose of the equation. The equation is a simple mathematical equation which builds in flexibility to the standard by allowing manufacturers to design lamps on a sliding scale between efficiency and CRI. The use of equations to allow flexibility in meeting standards is a common tool in appliance efficiency regulations. The fact that the units do not cancel out or are not related is not relevant because the equation is not representative of any physical law or relationship but is only applicable to this specific efficiency standard. The equation has been publically vetted with the major stakeholders in industry as well with energy advocates. Therefore, no change is made in response to this comment.

NEMA	The proposed rule imposes unrealistically high color rendering index (CRI) requirements for R8, which will effectively force manufacturers to supply nominal CRI 90 products to the market. The result will be that the CEC is going to compel consumers to buy more expensive and less efficient CRI 90 lamps. Compared to consumers in the rest of the country, Californians will have to spend more and get less in terms of energy efficiency. This proposal fails to meet both the necessity and consistency requirements of California Government Code §11349.1(a). By our calculation, the CEC is sacrificing up to 20% of potential energy savings by taking this ill-advised, over-specified approach to CRI that consumers will not actually benefit from. See Part A, Comments 6 and 7, infra.	See RESPONSE 1. In addition, NEMA has not provided any evidence that there is a problem with consistency with this comment. The standards are internally consistent and not duplicative of or contradictory to existing statutes, court decisions, or other provisions of law.
NEMA	NEMA appreciates the recognition that higher CRI lamps will have inherently lower efficacy and agrees that high CRI lamps should have a lower efficacy limit such as allowed by the proposed CRI vs. lm/W equation. However, instead of proposing a "minimum" efficacy level that will ensure MR16 products are available in 2018 for all general service applications – a hallmark of previous Title 20 appliance efficiency standards – the CEC has instead proposed an efficacy level that will only be achievable by a small number of specialty LED MR16 lamps in a narrow range of applications.	See RESPONSE 3. The record shows that there are many compliant lamps available in the market that meet the adopted standard, and that the standard is cost-effective and technologically feasible. Staff proposed 15-day language to narrow the scope of the SDDL class of products to remove some specialty lamps that may not have adequate energy efficient replacements. Additional changes are not necessary.
NEMA	While we recognize that large efficiency gains have been achieved in LED technology in the past 5 years, the rate of	NEMA appears to argue on the one hand that because the efficacy standards established under

	progress is, comparatively speaking, beginning to slow. Moreover, as noted in our preceding comments, opportunities for future efficiency gains in MR16 lamps are limited relative to general service lamps due to their small size and particular performance requirements. The average efficacy of LED MR16 lamps sold in California today is approximately 56 lm/W according to a recent Navigant report. Even if one assumes an ambitious 10% increase in efficacy in each of the next two years, the average will only reach a little over 65 lumens per watt by 2018. The vast majority of the LED MR16 lamps being sold in the USA in 2018 would still be well below the proposed 80 lm/W standard.	these regulations are less efficacious than an average LED today (regardless of CRI), it does not save a significant amount of energy (see above). Yet, on the other hand, NEMA argues that the Commission cannot set a standard more stringent than the average efficacy of today's LED. NEMA cannot have it both ways. For both LEDs and SDDLs, the minimum efficacy standard was set at a level that is technically feasible for all products, that is cost-effective to the consumer, and that will save significant energy statewide. Whether that minimum efficacy level is at, above, or below the average lamp today is something that the Commission considered in developing the standards, but is not relevant to whether the adopted standard meets the state's policy goals or the requirements under the Warren-Alquist Act and Administrative Procedure Act. The Commission made a policy decision that balanced cost and benefits to ensure that the standard was technically feasible, cost-effective to the consumer, and would yield significant energy savings. ENERGY STAR and Lighting Facts data shows

		there are more than 70 lamps in the market that already meet the standards,17 demonstrating that they are technically feasible. The standards are also cost-effective to the consumer, as described on pages 21-35 of Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034.
NEMA	If CEC's current proposal is adopted without further modification, very few products would qualify at any lumen range. The proposal would set an optimal performance goal rather than a floor designed to ensure a minimum level of performance that meets consumer expectations, achieves additional energy efficiency gains and preserves product availability at a reasonable price. Only a few LED products would be available from a limited number of suppliers. This must be corrected. If desired, the CEC could also move some of this product scope into the California Voluntary LED Lamp Quality Spec, rather than attempt a risky and aggressive once-and-done approach.	See RESPONSES 1, 3 and 6. No changes are necessary.
NEMA	The equation approach has too many degrees of movement and will create compliance and enforcement problems. A	This comment recommends making the compliance equation a simple two-tier approach,

17 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 36.

	random sample of several of the same lamp with varying CRI values and varying LPW values selected for initial testing against the complex compliance score equation will never match a random set of the same lamps selected for enforcement. For products that barely pass, this can create a very confusing enforcement situation as there are too many variables feeding the equation and affecting the outcome. Changing the specification to a minimum LPW and CRI requirement would eliminate a multitude of future problems. This simple approach will lead to much more effective compliance and enforcement, greatly simplify reporting, and ultimately lead to greater energy savings in the state. In addition, most LED chips being manufactured today are binned at or slightly above the 80 CRI level or at or slightly above the 90 CRI level. It makes no sense to create a linear equation when two discrete chip sets are being regulated. A two-step regulation would be the most effective approach.	such as also proposed by Philips. To that extent, see RESPONSES 1 and 3. The equation actually provides manufacturers more flexibility by providing a sliding scale between CRI and efficacy, allowing manufacturers to make appropriate tradeoffs in their products while still meeting the standard. The Energy Commission made changes in 15-day language to address concerns about tolerances by requiring the sample of light bulbs for purposes of testing, certification, and enforcement to match what is required by the U.S. Department of Energy. This sample size is larger than typical for an appliance, allowing for more variation within that sample size while still being able to meet the efficiency standard. No further change was made to the regulation.
NEMA	There is simply no LED lamp available today that can achieve the 1200+ lumens produced by some halogen MR16 lamps and no technological breakthroughs that will change this limitation are currently anticipated. In NEMA member experience, sales of these high lumen Halogen MR 16 lamps are very small compared to sales of 50 watt, 35 watt and 20 watt Halogen MR16 lamps. Narrowing the scope in this way will have no impact on energy savings given there are no high lumen LED MR 16 products available or expected to be available. Moreover, the scope of the proposed standard	See RESPONSE 11.

	must exclude these higher lumen products because replacement LED lamps simply do not exist for such applications.	
NEMA	To address these serious concerns, and to ensure products are available that work in all applications after the regulation is takes effect, the proposed definition must be changed. NEMA proposes the following changes to the proposed scope for MR/SDDL: "State-regulated small diameter directional lamp" means a directional lamp with a diameter less than or equal to 2.25 inches and a GU-10, GU5.3, GUX5.3, GU8, GU4, or E26 base that is capable of meeting performance specifications when operated within a voltage range of 11 to 13 volts, or, 110 to 130 volts, has a rated life of more than 2000 hours, and has a lumen output greater than 150 lumens and less than 825 lumens. 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 E-26 base, which are state regulated light emitting diode lamps."	See RESPONSE 11.
NEMA	1602(k) "State-regulated small diameter directional lamp" means a directional lamp with a diameter less than or equal to 2.25 inches and a GU-10, GU5.3, GUX5.3, GU8, GU4, or E26 base that is capable of meeting performance specifications when operated within a voltage range of 11 to 13 volts, or, 110 to 130 volts, has a rated life of more than 2000 hours, and has a lumen output greater than 150	See RESPONSE 11.

	lumens and less than 825 lumens. 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 E-26 base, which are state regulated light emitting diode lamps."	
NEMA	An Australia E3 study was released in August 2015, which evaluated performance characteristics of LED MR16 lamps on a global basis. Figure 46 on page 79 of the Australian study illustrates that the average worldwide efficacy today of LED MR16 lamps is less than 45 lm/W. Only one lamp in this study reached an 800 lumen output, and its efficacy was less than 50 lm/W. Only two lamps out of over 100 evaluated for this study were over 80 lm/W. Only 6 lamps (or less than 5%) were over 70 lm/W, and these lamps represented a very narrow lumen range of between 340 and 620 lumens. The highest average efficiency of lamps in all lumen ranges between 150 and 825 lumens was approximately 50 lm/W. Thus, even if one assumes aggressive efficiency gains moving forward, available market data indicates that CEC's proposed efficacy levels are at least 10 lm/W too high to ensure that products will be available for all lumen ranges and for all applications.	See RESPONSE 10. Staff is aware of the Australian lighting regulations and cited to them in the Staff Report at page 16. Detailed discussion of the chosen efficiency levels can be found in the following report at pages 32-33, and 38-40: Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034.
NEMA	<u>NEMA Proposal for MR/SDDL Performance Requirements</u> If the state wishes to have many manufacturers competing with high quality (above average) products widely available for consumers, CEC should lower the	Staff has made changes in the 15 day language to address the concerns raised by industry stakeholders regarding specialty products to exempt these from complying with the standards.

	proposed levels by at least 15 lm/W, which would still eliminate over 20% of today's ENERGY STAR products from the market.	See RESPONSE 11. The staff report, Singh, Harinder, Ken Rider, 2015. Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034, demonstrates that the adopted levels are cost-effective, technically feasible, and will yield significant energy savings. Lowering the efficacy levels would not achieve as much in energy savings. Therefore, staff did not make additional changes to the regulations.
NEMA	1605.3(k) (3) have luminous efficacy of ≥8060 lumens per watt. have a minimum luminous efficacy of 7055 lumens per watt or greater and a minimum compliance score of 165150 or greater, where compliance is calculated as the sum of the luminous efficacy and CRI. a CRI (Ra) of 80 or greater	As noted in the staff report, Singh, Harinder, Ken Rider, 2015. Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034, at pages 15-18, staff considered and analyzed a variety of efficiency proposals from all stakeholders. After considering the elements of each proposal staff put forward regulatory language that optimized energy savings while ensuring cost effectiveness (See Chapter 6 of Staff Report). No modification to the proposed standards is needed because the standards adopted by the Commission are cost-effective, technically

		feasible, and will yield significant energy savings. Reducing the efficiency level as suggested by the comment would not capture all the energy savings that are cost effective. A minimum CRI of 80 was not adopted because it did not appear to have a purpose. Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80.
GE	We note at the outset that GE supports progressive energy efficiency standards and the fundamental purpose of Title 20 to push poor performing, low efficiency products out of the marketplace. Experience has demonstrated that these products can negatively bias consumer perceptions of emerging technologies with predictable consequences. With respect to this regulatory proceeding, GE supports an energy efficiency level for general service LED A-line lamps and certain LED MR16 lamps. We also agree that minimum performance specifications are necessary to satisfy consumer expectations relative to incumbent technologies. The challenge before CEC is to strike the proper balance	The Energy Commission undertook a balancing of costs and benefits of the proposed regulations as part of its rulemaking process. Staff has analyzed the costs associated with regulatory compliance and has determined the proposed requirements will not require a price increase and there is no evidence in the record to show that would discourage consumer adoption. In fact, staff found that the standards are necessary to avoid discouraging consumer adoption. See RESPONSE 8. No change is requested or made in response to

	between performance and cost-effectiveness. Just as negative experiences with low quality lamps will drive consumers away from LED technology, too much emphasis on performance will push the price point of LED lamps sufficiently above incumbent technologies to discourage consumer adoption and reduce consumer options. Neither of these outcomes is in the best interest of consumers or the state's ambitious energy efficiency objectives	this comment.
GE	SMALL DIAMETER LAMP PRODUCT EFFICACY REGULATION: For the LED MR16 lamps that will be expected to replace the majority of MR16 halogen 20w, 35w, and 50w lamps which represent the largest amount of energy use, the efficiency levels and equations are much too aggressive.	See RESPONSE 10. As provided in Harinder Singh, Ken Rider, 2015. *Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034, the efficiency levels and requirements in the standards are technologically feasible and cost-effective, and will yield significant energy savings.18 Therefore no change was made to the energy levels and equations for small-diameter directional lamps.
GE	Recommended specification changes: (3) State-regulated Small Diameter Directional Lamps. State-regulated small diameter directional lamps manufactured on or after January 1, 2018 must have a rated life of 25,000	See RESPONSE 10 for why the efficacy-CRI trade-off equation was determined to be technically feasible and cost-effective. Regarding a minimum CRI of 80: Unlike general service LEDs, small diameter directional lamps are predominantly

18 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 36.

	hours or greater as determined by the lumen maintenance and time to failure test procedure and meet one of the following requirements: (A) have a luminous efficacy of >= 80 65 lumens per watt. and a minimum CRI of 80. (B) Have a minimum luminous efficacy of 70 55 lumens per watt or greater and a minimum CRI of 90. compliance score of 165 or greater, where compliance is calculated as the sum of the luminous efficacy and CRI. LED lamps are of crucial importance to the future of the Lighting Business.	used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80.
GE	Higher CRI lamps will have inherently lower efficiency and GE agrees that high CRI lamps should have a lower efficiency limit. However, instead of proposing a "minimum" efficiency level that will ensure MR16 products are available in 2018 for all general service applications – a hallmark of Title 20 appliance efficiency standards – the CEC has instead proposed an efficiency level that will only be achievable by a small number of specialty LED MR16 lamps in a narrow range of applications.	See RESPONSES 10 and 11.
GE	While we recognize that large efficiency gains have been achieved in LED technology in the past 5 years, the rate of progress is slowing as the technology and products mature. Moreover, as previously noted, opportunities for future efficiency gains in MR16 lamps are limited relative to general service lamps due to their small size and particular performance requirements. The average efficiency of LED	For both LEDs and SDDLs, the minimum efficacy standard was set at a level that is technically feasible for all products, that is cost-effective to the consumer, and that will save significant energy statewide. Whether that minimum efficacy level is at, above, or below the average lamp today is something that the Commission considered in

	MR16 lamps sold in California today is approximately 56 LPW based on a recent Navigant report. Even if one assumes an ambitious 10% increase in efficiency in each of the next two years, the average will only reach a little over 65 lumens per watt by 2018. The vast majority of the LED MR16 lamps being sold in the USA in 2018 would still be well below the proposed 80 LPW standard.	developing the standards, but is not relevant to whether the adopted standard meets the state's policy goals or the requirements under the Warren-Alquist Act and Administrative Procedure Act. The Commission made a policy decision that balanced cost and benefits to ensure that the standard was technically feasible, cost-effective to the consumer, and would yield significant energy savings. ENERGY STAR and Lighting Facts data shows there are more than 70 lamps in the market that already meet the standards,19 demonstrating that they are technically feasible. The standards are also cost-effective to the consumer, as described on pages 21-35 of Harinder Singh, Ken Rider, 2015. Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034. Therefore no change was made to the energy levels and equations in the proposed standards.
GE	If CEC's current proposal is adopted without further modification, very few products would qualify at any lumen range. The proposal would set an optimal performance goal	See RESPONSES 3 and 10.

19 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 36.

	rather than a floor designed to ensure a minimum level of performance that meets consumer expectations, achieves additional energy efficiency gains and preserves product availability at a reasonable price. Only a few best-in-class specialty LED products would be available from a limited number of suppliers.	
GE	An Australia E3 study was released in August 2015 which evaluated performance characteristics of LED MR16 lamps on a global basis. Figure 46 illustrates that the average worldwide efficiency today of LED MR16 lamps is less than 45 LPW. Only one lamp in this study reached an 800 lumen output, and its efficiency was less than 50 LPW. Only two lamps out of over 100 evaluated for this study were over 80 LPW. Only 6 lamps (or less than 5%) were over 70 LPW, and these lamps represented a very narrow lumen range of between 340 and 620 lumens. Thus, even if one assumes aggressive efficiency gains moving forward, available market data indicates that CEC's proposed efficacy levels are at least 10 LPW too high to ensure that products will be available for all lumen ranges and for all applications	Australian study released in 2015 is based on the lamps data from 2013 and 2014 and lamps data includes halogens and halogen infra-red lamps. Staff reviewed more recent publically available data as part of its analysis. See RESPONSE 10. Therefore no change was made to the energy levels and equations in the proposed standards.
GE	The Commission can avoid the above noted pitfalls by simplifying the proposed regulations and allowing more flexibility with regard to performance metrics. We respectfully request that you challenge the CEC staff to simplify the proposed standard for Light Emitting Diode (LED) lamps using commonly available market information. In doing so, the agency would allow for a greater variety of	See RESPONSES 1 and 3. The proposed standard is flexible and based on available market information. Simplifying the standard as suggested by the commenter would result in a decrease in performance without a correlated increase in energy savings.

	energy efficient LED products in the marketplace and drive greater energy savings in the state. Such a simplified regulation would also be easier for the Commission to implement, easier for the market to understand, and easier for the Commission to enforce, making it more effective and yielding greater energy savings.	
Soraa	By making these important distinctions, the CEC sets a healthy general framework for discussing efficiency limits. However, we find two main issues with the proposal on efficiency limits as it stands. First, the CEC did not thoroughly extend its analysis of the trade-off between efficiency and quality: other aspects of product quality have not been fully taken into account in the current proposal. Each of these aspects also comes at a slight, but fundamental, cost in efficiency. It is important for manufacturers to be able to balance efficiency and quality in product design; this is only possible if efficiency limits are not too stringent.	See RESPONSE 10.
Soraa	Trade-offs between quality and efficiency below, we review some properties of light sources which can be desirable but can only be improved at a slight cost in energy efficiency.	Improvement in some products may result in additional cost. However, proposed standard is technically feasible and cost effective and many compliant products are available in the market. No change is needed.
Soraa	It is crucial to realize that for directional sources, more lumens can be bad for quality. Especially for sources with beams of 25^{o} and below, it is undesirable to have lumens in the spill of the beam (e.g. large-angle light) because it	Staff agrees that adding spill lumens is a potential compliance pathway for meeting the efficacy requirements for small-diameter directional lamps, but did not make changes to the

	causes glare. Therefore, a good optical designer will strive to remove spill lumens. However, spill lumens are especially beneficial to efficiency. Thus, given a stringent efficiency limit, it can be tempting for a manufacturer to add spill lumens in order to artificially meet requirements, even though this loophole causes an overall decrease in product quality.	regulations because small diameter directional lamps are predominantly made for the commercial market. Commercial consumers are sufficiently sophisticated to demand appropriate lumen distribution and color rendering. It is not clear that this potential compliance pathway will be used or is an issue for quality. However, eliminating a potential compliance pathway could increase costs for some manufacturers, reducing the cost-effectiveness of the standards. Therefore, staff did not make any change in response to this comment.
Soraa	Whiteness rendering. Many white products require violet light or ultra-violet radiation (both present in natural light) to produce a pleasant, bright white rendering. Unfortunately, the vast majority of existing LED products have a spectrum of emission which starts with blue light. They are therefore unable to render white objects properly – an effect which is completely ignored by the CRI, but is very easily perceived [Houser14]. Adding violet light in the spectrum of an LED product is a simple way to restore whiteness rendering, however it costs ~3-4% efficiency. Studies have shown that such proper white rendering elicits a pronounced preference from users [Wei15]. In our experience, this feature is essential for adoption by some customers, including commercial applications.	Proposed regulations are based on the analysis of available lamp data. There is no data on whiteness rendering. There is limited information available on the whiteness rendering. Lamps currently sold in the market are not classified based on the whiteness rendering, and the standard does not require whiteness rendering. Manufacturers of compliant lamps can add whiteness rendering to their lamps as long as the product meets the minimum efficacy levels. No change is needed.
Soraa	The CEC proposal ignores both of these aspects. Therefore,	Manufacturers of compliant lamps can add

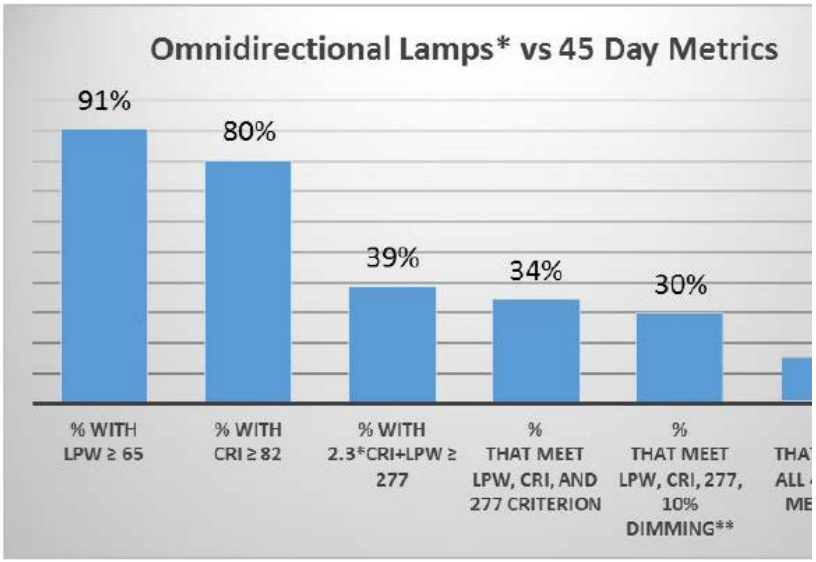
	it places manufacturers in an uncomfortable position: to increase efficiency, an easy choice is to remove whiteness rendering and reduce deep-red rendering. These two steps can boost efficiency by 10% or more, but again hurt product quality.	whiteness rendering to their lamps. Proposed regulations do not require whiteness rendering. Deep red rendering is covered under CRI and would be part of the CRI-efficacy equation. No change is needed.
Soraa	Soraa has strived to offer products ANSI-compliant lamps, and has accepted to deal with the associated design challenges. We are intent on maintaining this aspect of product quality. However it is important to realize that not all manufacturers follow this spirit, and that higher-efficiency products sometimes suffer from non-compliant form factors	The comment supports the standards and does not ask for changes to the standards.
Soraa	For directional small-size lamps, very few low-CRI products meet the proposed spec and only three of those are from a major manufacturer; they lack narrow beam angles and whiteness rendering. Not a single high-CRI lamp meets the proposed spec, due to the weaker CRI-efficiency derating in small-size lamps. This stands in sharp contrast to the CEC's report, which concluded that a large number of products already meet the proposed specs. As it stands, the CEC proposal would lead to a drastic reduction in directional lamp availability.	See RESPONSE 10.
Soraa	We understand that the CEC might expect that future technology improvements will help meet these objectives. Certainly, manufacturers (including Soraa) strive to constantly improve their technology. However, it is important to realize than intrinsic efficiency improvements	See RESPONSES 1, 3 and 10.

	have been nearly non-existent for most manufacturers over the last two years (the wall-plug efficiency of LEDs is unchanged within a few %). Rather, improvements in applications have been obtained by increasing the number of LED chips per lamp. This workaround, however, can no longer be applied in directional lamps where the emitting area is constricted and now reaching its limit value.	
Soraa	Proposal: We believe that the CEC proposal for efficiency limits is too aggressive for directional lamps in general. We realize that including corrective factors for each aspect of product quality may be too complex. Rather, we propose that efficiency limits be somewhat relaxed in order for manufacturers to keep the ability to sell their highest-quality products in California. Therefore, we propose that the CEC create a separate category for medium-size directional lamps, with lower standards than those currently proposed. In addition, we suggest that the CRI-efficiency trade-off should be harmonized to have the same magnitude for all lamp types, as this trade-off is fundamental and does not depend on the product type. This proposal remediates various flaws found in the current CEC proposal. Namely: It harmonizes the CRI-efficiency trade-off for all lamps sizes, as should be the case It makes it possible to design high-quality directional products (including color rendering and spot beams) It recognizes that medium-size directional products are fundamentally less efficient than omnidirectional lamps, and thus slightly relaxes their spec. At the same time, it recognizes that they	See RESPONSES 1, 3, and 10.

	are somewhat easier to design than small-diameter products. We also note that this proposal is somewhat consistent with (although more demanding than) the latest Energy Star 2.0 proposal for high-CRI lamps.	
Philips	We recognize California's goal to reduce greenhouse gas emissions by harnessing the energy savings offered by LED light sources through the development of efficiency standards for these products. Philips Lighting strongly supports this goal, however, we are concerned that California will fail to meet it if the 45 day language is enacted without revision. We believe that the scope of the 45 day language is so broad, and the various requirements taken together are so restrictive, that the overall effect will slow the adoption of LED products and greatly reduce the amount of actual energy savings it is possible to achieve with more reasonable efficiency standards.	Staff revised the proposed regulations and issued 15-day language. The proposed regulations are based on the analysis of the lamps that are currently available in the market. Staff analysis shows the proposed standards are technically feasible and cost effective and will result in significant savings after the stock turnover.20 Staff disagrees with the Phillips comment that proposed standard will slow the adoption of LED lamps because there is no data or study to support this assertion.
Philips	At a minimum, it can be said that at least 70% of the omnidirectional models currently in the market would not meet the Tier 1 requirements in 2017 if the Title 20 language is adopted as written. Other required metrics such as R1-R8 and Duv do not appear on the certified products list. Thus we expect that roughly 90% of the omnidirectional lamps will not meet the requirements. This is based on our knowledge of the metrics since the R1-R8 requirement	See RESPONSES 3, 9, and 10.

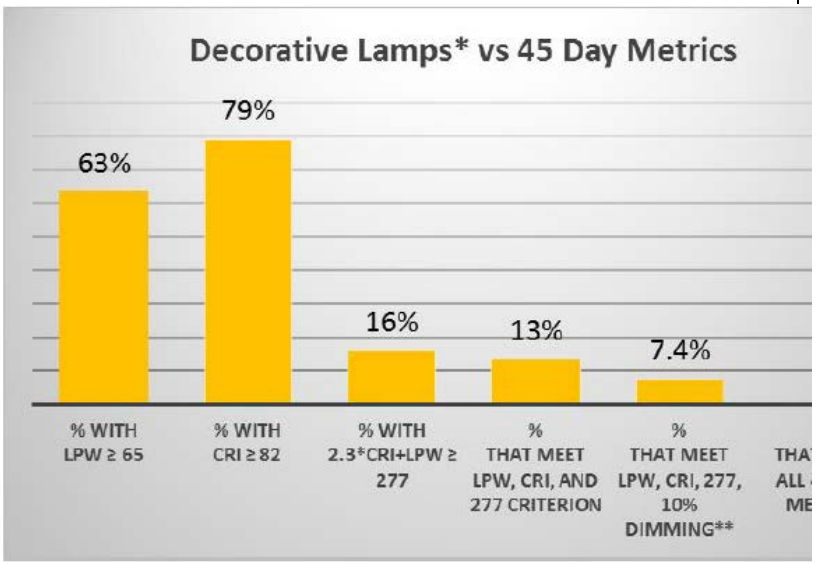
20 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 34 and 77

excludes all lamps with a CRI < 85 and the Duv requirements are overly strict.

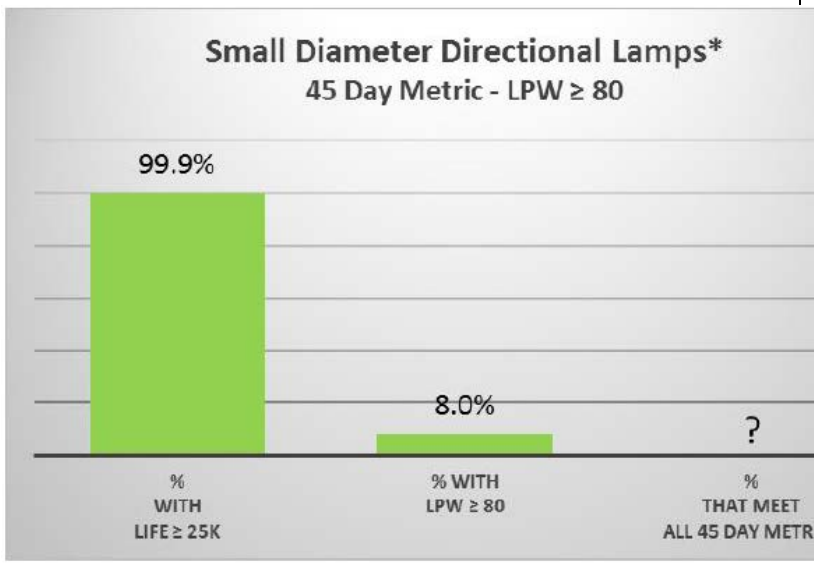


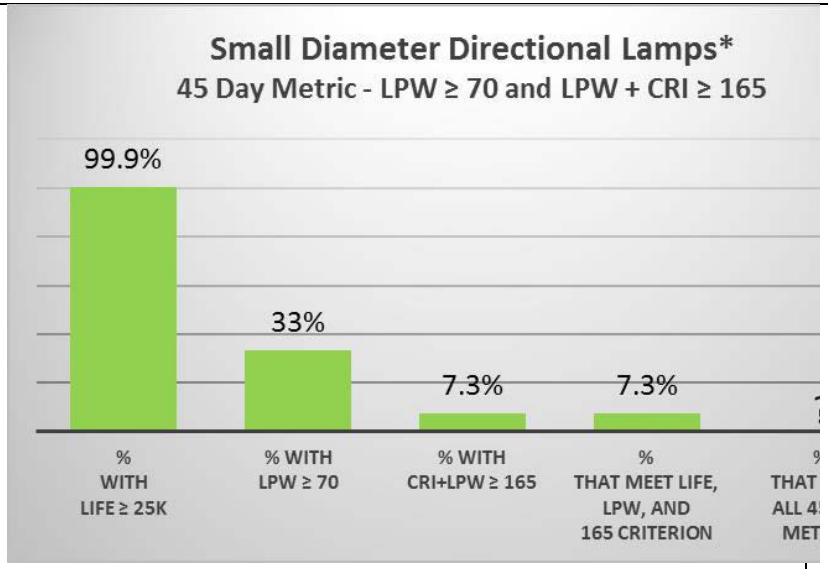
Similarly, we looked at the data for the lamps characterized as decorative. The data show that at least 92% of the 705 decorative lamps on the Energy Star list will not meet the proposed Title 20 combined criteria for efficacy, CRI, Tier 1 equation, and dimming. As with the omnidirectional lamps, when compliance with the R1-R8 and Duv criteria is factored in, the percentage of compliant lamps will be reduced even further. Again, with less than 7.5% of the existing decorative LED lamps unavailable in 2017, consumers will continue to use decorative halogen/incandescent lamps and CFLs. This will reduce the anticipated energy savings. The rulemaking

file does not appear to contain any evidence that the Commission accounted for this in their analysis.



The situation with small diameter directional SSL lamps is similar. The proposed 45 day language has two paths for product compliance: lamps with an efficacy of 80 LPW or greater, or lamps with an efficacy of 70 LPW and a combined score of CRI + LPW ≥ 165. In either case, analysis of the lamps on the certified product list shows that 8% or less of the 741 existing lamps will meet the 45 day metrics. This is illustrated in the graphs that follow. Thus, conservatively speaking, 92% of the currently available small diameter directional LED lamps will not be available to California consumers. This is illustrated in the graphs

	below.  * 741 directional LED lamps with diameter less than 2.25" on the 10/21/15 ENERGY STAR Certified Products List.	

<table>
<tr>
<td></td>
<td> 

* 741 directional LED lamps with diameter less than 2.25” on the 10/21/15 ENERGY STAR Certified Products List.</td>
<td></td>
</tr>
<tr>
<td>Philips</td>
<td>Product Efficiency: As a means to greatly simplify the regulatory requirements, we suggest that product performance be judged on CRI and efficacy only. The compliance score would be changed/replaced as follows:
<table>
<tr><th></th><th>Effective Date</th><th>Minimum CRI</th><th>Minimum Effica</th></tr>
<tr><td rowspan="2">Tier 1</td><td>January 1, 2017</td><td>90</td><td>70</td></tr>
<tr><td>January 1, 2017</td><td>80</td><td>80</td></tr>
<tr><td rowspan="2">Tier 2</td><td>January 1, 2019</td><td>90</td><td>80</td></tr>
<tr><td>January 1, 2019</td><td>80</td><td>90</td></tr>
</table></td>
<td>Staff’s proposed standard for Tier 1 and Tier 2 is similar to this proposal by Phillips but staff’s equation proposal provides more flexibility for manufacturers by providing a sliding scale between CRI and efficiency. Staff also requires a higher minimum CRI than Phillips, for the reasons discussed in RESPONSE 1.

Phillips also recommends eliminating other performance requirements of a lamp, such as</td>
</tr>
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<table>
<tr><td></td><td>The Tier one proposal is now aligned with the proposed Energy Star Lamps v2.0 levels. It also takes into account the lower efficacy of high CRI lamps.</td><td>lifetime, R1-R8, and chromaticity. For the reasons in RESPONSE 3, staff declined to adopt these changes, as it would reduce the performance of the lamp without a correlated increase in energy savings.</td></tr>
<tr><td>Philips</td><td>Digging into this further, we offer the following analysis of the data from the Energy Star Certified Product List:

Comparison of Average Efficacies for Omnidirectional and Decorative Products Energy Star Certified Product List – October 21, 2015

<table>
<tr><th rowspan="2">CCT</th><th rowspan="2"></th><th colspan="2">Self-Ballasted LED Lamp Type</th></tr>
<tr><th>Omnidirectional</th><th>Decorative</th></tr>
<tr><td rowspan="3">All</td><td># Certified Models</td><td>1634</td><td>705</td></tr>
<tr><td>Average LPW – All Models</td><td>81.6</td><td>73.0</td></tr>
<tr><td>Average LPW - Top 25%</td><td>97.8</td><td>96.1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">CCT < 6500K</td><td># Certified Models</td><td>1600</td><td>660</td></tr>
<tr><td>Average LPW – All Models</td><td>81.1</td><td>70.4</td></tr>
<tr><td>Average LPW – Top 25%</td><td>96.3</td><td>87.6</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">CCT ≥ 6500K</td><td># Certified Models</td><td>34</td><td>45</td></tr>
<tr><td>Average LPW</td><td>106.7</td><td>111.5</td></tr>
<tr><td>Average LPW – Top 25%</td><td>124.5</td><td>118.8</td></tr>
</table>

The above table shows the average efficacies for Energy Star omnidirectional and decorative lamps in several different ways. The first section shows the average LPW for all CCTs</td><td>See RESPONSE 9.</td></tr>
</table>

	of a given type and then the average LPW of the top 25% most efficacious lamps. The next two sections are divided by CCT: less than 6500K and greater than or equal to 6500K. The average of all the models, regardless of CCT shows that decorative lamps have an efficacy about ~ 9 LPW lower than omnidirectional models. Lamps on the high end of the distribution show a much smaller spread in efficacy (~ 2 LPW) that can be explained by 6500K decorative lamps that have very high efficacies. When these are taken out of the dataset, the remaining lamps (< 6500K) show a very clear difference of 9-11 LPW between decorative and omnidirectional products. For this reason, decorative lamps merit slightly lower performance criteria to increase product availability. If not, the use of decorative halogen and CFL products will continue. We suggest that the efficacy requirements for decorative lamps be reduced by 10 LPW from their omnidirectional counterparts in Tier 1 and Tier 2.	
Philips	Efficacy Limits – General: In order to simplify the regulatory requirements, in lieu of a compliance equation, we suggest that product performance be judged on CRI and efficacy instead. The Tier 1 levels would align with the proposed Energy Star Lamps v2.0 levels and take into account the lower efficacies of high CRI lamps.	Staff's proposed standard for Tier 1 and Tier 2 is similar to this proposal by Phillips and to ENERGY STAR v. 2.0, but staff's equation provides more flexibility for manufacturers by providing a sliding scale between CRI and efficiency. Staff also requires a higher minimum CRI than Phillips, for the reasons discussed in RESPONSE 1. Phillips also recommends eliminating other performance requirements of a lamp, such as lifetime, R1-R8, and chromaticity. For the reasons

		in RESPONSE 3, staff declined to adopt these changes, as it would reduce the performance of the lamp without a correlated increase in energy savings.
California IOUs	It is also worth noting that there are many other available products that exceed the CEC's proposed efficiency and life requirements, but which are not currently certified to ENERGY STAR. A few examples are provided here: Kobi: 90 lpw, 25,000 hours, 50W equivalent, dimmable lamp with 25 degree beam, GU5.3 base, 3000K Already available below $10 Global Consumer Products: 80 lpw, 35,000 hours, dimmable lamp with 40 degree beam, GU10 base, 5000K Already available below $10 MSI: 80 lpw, 50,000 hours, 50W equivalent dimmable lamp with 15 degree or 25 degree beams, GU5.3, 4000K	The comment supports the standards and does not ask for changes to the standards.
California IOUs	Additionally, LED SDDL performance has been improving in recent years and all indications are that far more products will be available by 2018. For example, based on two years of monthly data collection, Figure 2 below shows average efficacy of LED SDDLs offered for sale online, improving at a rate of about 10% per year (data collection has included	The comment supports the standards and does not ask for changes to the standards.

	over 300 unique SDDL price points collected in each monthly online data pull, i.e. unique product offerings from a specific retailer). Assuming continued efficacy improvements at the current rate, average efficacy will be about 75 lpw when the standards take effect, meaning that far more products will meet the proposed 70-80 LPW requirements in 2018 than at the present time. While there are a number of current products that currently fall just short of the proposed efficacy requirement (within 10%), e.g., GE, Cree, Ushio, PLT, Globe Electric, Westinghouse, EcoSmart (Home Depot brand), given ample time to prepare and current trends, these lamps should be able to meet the standards by 2018. Continued efficacy improvements will also result in increased light output capabilities. Given the wide variety of performance characteristics among products that already meet the CEC's proposed efficacy requirements, and the projected, sustained efficacy and performance improvement in this product category, we support the efficacy and life standards as proposed.	
California IOUs	We support the minimum efficacy requirements proposed in the 45-day language: 65 LPW in 2017 and 80 LPW in 2019. We also support the concept of the efficacy/CRI trade-off equation proposed by the CEC as this acknowledges that higher CRI products may not need to provide as many photopic lumens to generate equivalent perceived brightness.	Staff appreciates support on the proposed standard levels and effective date. However based on comments from other stakeholder the effective date for tier I was moved to January 1, 2018 and Tier II date was moved to July 1, 2019.

NRDC	Regarding efficacy, NRDC would not oppose a flat minimum efficacy level of 70 lumens per watt, as that would help further ensure that a LED bulb is available for all regulated light output levels. This efficacy requirement would be coupled with the minimum CRI and R9 requirements we proposed above. This provides some safety in the CEC proposal for the brighter LED lamps which today have very few models that meet the 80 LPW minimum.	See RESPONSES 1 and 3.
Light Distribution		
GE	Omnidirectional Requirement: The omnidirectional requirement stipulates that lamps with an ANSI Standard shape of A, B, BA, C, CA, F or G lamps must meet the ENERGY STAR® product specification for LAMPS Version 1.1. Based on updated information, ENERGY STAR® is currently in the process of modifying this specification for LAMPS version 2.0. In order to avoid locking an outdated version of Omnidirectional specifications into Title 20, the CEC should modify this proposal to state that lamps must meet the omnidirectional light distribution requirements specified in ENERGY STAR Lamps version 2.0.	The Energy Commission made the requested change in 15-day language.
GE	(vi) State-regulated LED lamps that have an ANSI standard lamp shape of A shall meet the omnidirectional lamp requirements of ENERGY STAR's Product Specification for Lamps Version 1.1 2.0. 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 version 2.0 applies to omnidirectional light distribution requirements. No change to ENERGY STAR version 1.1 to 2.0 for to the decorative lamps is needed because the requirements that apply to decorative lamps are unchanged between versions 1.1 and 2.0 of

	ENERGY STAR's Product Specification for Lamps Version 1.1 2.0.	ENERGY STAR.
Cree	Item 2) Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), C (vi): The proposed language in Section C (vi) for Omnidirectional light distribution requires lamps to meet the requirements of ENERGY STAR's Product Specification for Lamps Version 1.1. Cree's Recommendation is to align the California Title 20 requirements with the Omnidirectional light distribution requirements of the proposed ENERGY STAR Product Specification for Lamps Version 2.0. Comments: Cree supports the commission's efforts to ensure California citizens are provided with high-quality LED lamps that meet their performance expectations while also delivering significant energy savings. The proposed standards for GSL and decorative lamps are reasonable in most respects and for the most part do not present overly burdensome requirements except where they are markedly misaligned with the requirements set by the U.S. EPA for ENERGY STAR. Particularly problematic is the divergence between Title 20 and ENERGY STAR's proposed v2.0 requirements for Omni directionality. While color quality and efficacy can benefit from expected incremental improvements in LED component performance with changes usually limited to the electronic circuitry, light distribution performance requires optical and mechanical capabilities that are fundamentally different between the two proposed standards. Meeting the two different standards would likely require a unique	Proposed changes were made in the revised 15 day language.

	mechanical / optical design for each, effectively doubling the investment in tooling and greatly increasing design, manufacturing and distribution costs. Cree proposes that California align the light distribution/Omni directionality requirements of Title 20 with those of ENERGY STAR v2.0 to allow manufactures to deliver an affordable range of lamps to the California market. The Omni directionality requirements proposed by EPA for ENERGY STAR v2.0 are good and will provide consumers with acceptable light performance. The differences between the v1.1 and v2.0 specs drive fundamental design and cost considerations that will necessitate different designs and products for the two markets. This is not acceptable to Cree, and it is unlikely that Cree would create and support two fundamentally different design platforms.	
MaxLite	General Purpose LED lamps - General Comments LED filament lamps are a new category to the LED lamp market, but one that is poised to have a major impact to the industry within the coming months. Designed to look just like incandescent filament lamps, these LED filament lamps are more efficacious than standard LED omni lamps (LED filaments will hit levels up to 140 lpw very soon) and have better aesthetics in certain fixtures. Given the choice of "frosted-look" LED omni lamps vs. LED filament-style lamps, many consumers will opt for the LED filament lamps as they become more widely available and pricing becomes competitive with low cost omni LED lamps. LED filament	The Energy Commission limited application of the omnidirectional light distribution requirements to A lamps, even though ENERGY STAR version 2.0 applies these distribution requirements to a broader set of lamp shapes. This should address MaxLite's concern regarding LED filament lamps.

	lamps are also designed with ultra-warm CCTs such as 2200K and 2500K to mimic the look of incandescent filament lamps. CEC should be sure to create a path for adoption of these LED filament lamps in the state. By following the ENERGY STAR beam guidelines, the current proposals for Title 20 do not adequately address the LED filament technology. MaxLite has provided the Commission with confidential test reports showing the beam patterns from typical LED filament lamps, and we would urge CEC to include language in Title 20 that recognizes the distribution of a LED filament lamp may not necessarily be the same as a standard omni LED lamp. Since these are so new to the USA market, the best approach at this time would be to include language in Title 20 that exempts LED filament lamps from these general purpose LED lamps at this time.	
MaxLite	Light Distribution requirements: As per mentioned above regarding a path for LED filament lamps. The popular LED filament shapes include B, BA, G, ST and T shapes which all can meet “decorative” beam requirements, but not necessarily “omnidirectional” beam requirements as defined by ENERGY STAR.	Only A lamps are required to meet the omnidirectional beam requirements in ENERGY STAR 2.0. The shapes that the commenter suggests are issues for decorative lamps (B, BA, G) are only required to meet the decorative light distribution requirements, as the commenter requests. ST and T shapes are not required to meet light distribution requirements. Therefore, no change is needed.
California IOUs	We recommend CEC classify products with the shape ST as decorative and require them to meet the decorative light distribution requirements. These products are used for	The ENERGY Commission declined to require ST lamps to meet light distribution requirements because it was not identified as an issue for these

	decorative purposes.	lamps, making the additional requirement unnecessary. Therefore, no change was made to the regulations.
California IOUs	Light distribution: CEC's proposed light distribution requirements for omnidirectional lamps and decorative lamps are the same as ENERGY STAR's. The CEC did not propose light distribution requirements for directional lamps. Therefore, all the products shown in the graphs below meet the CEC's proposed light distribution requirements.	No change is requested and needed.
American Lighting Association	Also, no provision has been made in the proposed language for the new LED filament lamps (also sometimes called "visible filament" lamps). Such lamps are typically made in decorative shapes.They are basically efficient because of their LED light sources, but can be outside of the usual chromaticity limits, and light distribution criteria. They are still being developed and models change frequently.The ALA asks that these lamps be exempted for this rulemaking so that manufacturers can fully develop these products.	Proposed standards are energy efficiency standards and are not design requirement. All regulated lamps must comply with the proposed standards. Many decorative LED filament lamps are compliant with the proposed standards. 21 Light distribution requirements are carefully crafted to avoid subjecting some of these more decorative lamps to omnidirectional light distribution requirements. All other LED filament lamps will need to meet the same requirements as general service LED lamps. No change is needed.
Francis	Objections to the omni-directional performance requirement: The Staff recommendation imposes an omni-	The proposed standards require omnidirectional lamps to produce a light distribution pattern that

21 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 64.

Rubenstein	directional luminous distribution for all general service lamps. There are a huge variety of lamp shapes and types available in the residential market and Staff has not demonstrated that omni-directionality is necessary in all cases. In many instances, it is simply important that there be light, not light of a particular distribution (or spectral distribution). For example, it is far more important for safety purposes that there be a functioning light over a stairwell than that the light have a particular distribution. If consumers have their choices restricted, they may delay replacing failed lamps, which in some cases would result in a safety hazard. Lamp luminous distribution is an aesthetic consideration and it is not the business of the State to impose a purely aesthetic requirement on any product.	aligns with requirements adopted by the U.S. Environmental Protection Agency's (EPA) ENERGY STAR program for lamps. The ENERGY STAR lamps specification and California Quality LED specification both incorporate light distribution requirements for omnidirectional lamps to ensure that a lamp that is omnidirectional when sold as an incandescent performs as expected when the technology used is an LED. Notably, the omnidirectional light distribution requirement from ENERGY STAR was carefully evaluated to balance the cost of meeting the requirement with the energy benefits provided by LED lamps. Only general service A-shape lamps are required to meet omnidirectional light distribution requirements, while certain decorative lamp shapes are required to meet decorative light distribution requirements. Not all lamps or all shapes are required to meet the light distribution requirements, so the commenter is incorrect in asserting that this is the case. Therefore, no change has been made in response to this comment.
Philips	Section 1605.3(C)(vi): The 45 day language requires that the light distribution requirements follow those in the Energy Star version 1.1 specification. We note that Energy Star has just issued the Final Draft of the Lamps v2.0 Specification.	Proposed changes were made in 15-day language.

	In this final draft, they propose to relax some of the omnidirectional distribution requirements. We recommend that the Commission harmonize with Energy Star in this regard and modify the language in this section to refer to the Energy Star Lamps Version 2.0 specification.	
Marking/Labeling		
NEMA	As we have stated in previous comments, NEMA continues to disagree with proposals that a State-specific label or labeling requirements be established. The additional costs and difficulty of assuring proper distribution are not justified in the intangible benefits pursued by the proposals. CEC has routinely stated their intent to set a trend for other States to follow, and should keep in mind that a State-specific label is not in keeping with their attempts to set a standard that can be adopted at the national level. This also respects manufacturer tendencies to produce and label products for sale in multiple regions. It is costly to produce lamp packaging for sale in a single State and challenging to assure proper distribution therein. Additionally, existing labeling is strictly challenged to meet Federal and other disclosure and marking requirements while being simple to read and understand. A State label only complicates this situation	The proposed regulations do not require a separate state label. There are labeling elements which have only limited applicability. For those LED lamps which are not compatible with a standard dimmer, the lamp packaging must contain a mark, "dimmable with LED dimmer", to inform end users that an LED dimmer is required. This will reduce improperly matched equipment that may result in the LED lamp not performing as expected. Other requirements relate only to when a manufacturer affirmatively labels something, requiring that manufacturer to meet minimum performance requirements that reflect the claim. There is no mandatory requirement that a manufacturer label a product in any particular way. However, if a manufacturer chooses to label their lamp as dimmable or as being equivalent to an incandescent, then it must meet certain performance requirements. Labeling requirement

		will not allow lamps in the market that will not perform as claimed. Finally, LED lamps that produce very low lumen output must be labeled as "for decorative purposes," again to avoid consumer confusion or dissatisfaction.22 The cost of these limited labels is minimal because manufacturer can choose not to label their lamp if they do not make affirmative claims on the label. No change is recommended.
MaxLite	Table K-15 (C): Due to many federal and state-regulated labeling requirements that already exist for lamps, manufacturers are already extremely challenged when it comes to adding more text to lamp labels. We don't support any extra labeling to lamps that are less than 150 lm to show "for decorative purposes."	The Energy Commission requires very low lumen lamps to be labeled "for decorative purposes" in order to prevent consumer confusion related to these products. These products are not required to meet efficacy standards or performance standards, and so no additional cost should be incurred in labeling low-lumen lamps, which do not provide sufficient light for illumination, as "for decorative purposes.
Philips	Miscellaneous Issues: There are a few miscellaneous issues that need to be addressed in the language. They are presented along with recommendations for their resolution. Section 1607 – Table K-15: Table K-15 describes	Proposed changes were made in 15-day language.

22 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 60

	incandescent equivalencies for state regulated LED lamps. Within the table itself is a restriction that the table applies to omnidirectional lamps with E26 and GU24 bases. We suggest that it would be clearer if the restrictive language was moved outside the table (underlined text is new): 1607 Marking of Lamps. (12)(B)(iv) Claims of incandescent wattage equivalence <u>for omnidirectional lamps with E26 or GU-24 bases</u> shall have ..Consequently, the second row of Table K-15 would be deleted. <u>Section 1607(12)(C):</u>As written, this section suggests that the lamp itself should be labeled "for decorative purposes". The Commission may be not be aware, but the surface area available for printing on these low lumen lamps is minimal. Thus it is difficult to place additional text on the lamp. We suggest the following modification (underlined text is new): (C) <u>The packaging of</u> a lamp that is certified with a light output of less than 150 lumens for candelabra bases, or less than 200 lumens for other bases, shall be labeled as "for decorative purposes." <u>Section 1607(12)(D):</u> The proposed text states that "Lamps shall certify …". It is not technologically feasible at this time for lamps to self-certify to the Commission. We suggest that this be changed to "<u>Manufacturers</u> shall certify …"	
California IOUs	We support the CEC's proposal to require lamps marketed as incandescent replacements or equivalents to be capable of providing a Color Correlated Temperature (CCT) of 3000K or less and to provide other performance features that are comparable to incandescent (minimum light output,	The comment supports the standards and does not ask for changes to the standards.

	dimmability, etc.) to make sure customers are not mislead into thinking a product is "equivalent" to an incandescent lamp if that product does not perform like an incandescent lamp.	
California IOUs	Separate lumen equivalency values should be provided for directional and decorative lamps. CEC should use the ENERGY STAR values provided for lumen equivalencies for each lamp type, and should also utilize the ENERGY STAR center beam candle power equivalence tool for MR and PAR lamps.	The Energy Commission does not have sufficient data to establish incandescent wattage equivalencies for decorative and directional lamps. Unlike omnidirectional medium screw-base lamps, wattage equivalencies vary more for these other lamp types. In addition, consumers are less likely to shop by "wattage" for these types of lamps, looking instead at other qualities, such as beam angle, CBCP, or dimmability. Therefore, the Energy Commission did not make this change to the regulation.
California IOUs	We recommend that all lamp packaging include a label indicating the product's CRI, and that the date of manufacturer be permanently marked on all products in the format: MM/YYYY.	The Energy Commission is preempted from affirmatively require labeling related to energy efficiency or energy consumption on a product that is covered by federal labeling provisions, such as for general service LED lamps. This is why the Energy Commission has carefully crafted its regulatory language to require that lamps with certain labeling requirements meet the performance requirements expected from those labels. Requiring that a lamp be labeled "non-dimmable" must be undertaken by the Federal Trade Commission to avoid conflicting state and

		federal labeling requirements. The Energy Commission agrees that such a label may be appropriate as part of the federal labeling requirements. Regarding specifying the manufacture date information, the Energy Commission already requires the date of manufacture to be included on the product. Specifying how the date is shown could be problematic for manufacturers without providing a correlated energy or enforcement benefit. Therefore, no change was made in response to this comment.
California IOUs	Labeling, Marking, and Reporting: We support CEC's proposal to require lamps marketed as incandescent replacements or equivalents to have a CCT of 3000K or less. Typical incandescent lamps provide a CCT in the range of 2700K to 2900K, and most consumers expect this warm quality of light from a light bulb. While some consumers may prefer and seek out high CCT lamps, it is misleading to market a product as a replacement for an incandescent if it provides a light color that is dramatically different. This is likely to lead to consumer dissatisfaction, similar to that experienced in the CFL market where many consumers objected to CFLs providing light that was too "cold" and "harsh." However, we recommend that the CEC require lamps to be capable of providing a CCT of 3000K, to accommodate color changing lamps. For the same reason,	Staff appreciates IOU supporting comment regarding requiring that lamps marketed as incandescent replacements have a color correlated temperature (CCT) of 3000k or less. However, staff disagrees with the IOUs proposal to require lamps to be capable of a specific temperature of 3000K because the regulations must remain neutral and non-interfering to market, and limiting the color temperature of a lamp would impact consumer choice without providing a related energy benefit. The Energy Commission modified its table in 15-day language regarding incandescent wattage equivalencies to make it mandatory for all medium screw-base and GU-24 omnidirectional

	we also support CEC's proposal to require lamps marketed as incandescent replacements or equivalents to provide a minimum light output corresponding to the claimed wattage equivalency. However, the values in the table provided by CEC should apply only to omnidirectional A lamps.	LED lamps, regardless of whether they claim to be equivalent to an incandescent more generally. This includes A lamps. No further change is needed.
California IOUs	Lastly, we encourage CEC to consider using the "equivalency" claims or any lamp marketing comparisons to incandescent to enforce other aspects of the CEC Voluntary Specification that are not being required of all lamps. As an example, if the CEC does not require all lamps to provide 90 CRI, it should at least require lamps claiming to be incandescent replacements to meet this level of performance. This would be consistent with the proposal to require a minimum light output (in terms of lumens) and a specific color temperature range to provide light that is similar to incandescent. There are several additional marking / labeling requirements that we recommend that CEC adopt. First, we recommend that all lamp packaging include a label indicating the product's CRI, and for directional lamps, a label indicating the product's beam angle. These two metrics are not included in the Federal Trade Commission (FTC) Lighting Facts Label but they are extremely important product attributes that will help consumers. Though CEC does not have authority to revise or add to the FTC label, we recommend that California require these two product attributes be added elsewhere on the product package, for example directly below the FTC label.	Staff disagrees with these IOUs proposal because it is not cost effective to require the proposed additional requirements. The Energy Commission is preempted from affirmatively require labeling related to energy efficiency or energy consumption on a product that is covered by federal labeling provisions, such as for general service LED lamps. This is why the Energy Commission has carefully crafted its regulatory language to require that lamps with certain labeling requirements meet the performance requirements expected from those labels. Requiring that a lamp be labeled "non-dimmable" must be undertaken by the Federal Trade Commission to avoid conflicting state and federal labeling requirements. The Energy Commission agrees that such a label may be appropriate as part of the federal labeling requirements.

	Lastly, we recommend that the date of manufacturer be permanently marked on all products in the format: MM/YYYY. The Warren-Alquist Act already requires date of manufacturer be marked on covered products in Title 20, but there appears to be either low compliance with this requirement or alternate date formats/codes used that cannot be interpreted by average consumers. Having a clearly marked date of manufacturer will help consumers follow up on product warranties in the event of product failures. Date of manufacture markings will also help with standards enforcement and compliance improvement for regulators in the State.	Regarding specifying the manufacture date information, the Energy Commission already requires the date of manufacture to be included on the product. Specifying how the date is shown could be problematic for manufacturers without providing a correlated energy or enforcement benefit. Therefore, no change was made in response to this comment.
Cree	Item 2) Section 1607 Marking of Lamps, (B): The proposed language in (B) requires LED lamps to meet all of the stated requirements before including comparisons to incandescent lamps, including wattage equivalencies. The requirements include a CCT of 3000K or less. Cree's Recommendation is to permit wattage or light output equivalency claims for higher CCT lamps to simplify the shopping and purchasing decisions for the consumer. Comments: Without the ability to state a wattage comparison for Daylight (5000K) bulb, consumers will be forced to know what lumen output represents the bulb they're seeking. For example, they need to know 800 lumens to replace a 60W incandescent and 1600 lumens to replace a 100W incandescent. Below are examples of our packaging for 2700K soft white and 5000K daylight bulbs. We indicate the color both through text and color treatment to help guide shoppers, in addition to the	The Energy Commission has modified the wattage equivalency requirements in 15-day language to apply regardless of whether a lamp claims to be incandescent equivalent. This means that high CCT bulbs will also be required to meet wattage equivalencies.

	Lighting Facts label prominently displayed on the package.	
NRDC	Modify the lamp marking section regarding comparisons to incandescent lamps– We have reviewed the text which require a lamp to meet multiple requirements in order to make wattage equivalencies— and recommend it be revised. As written, lamps that have a color correlated temperature greater than 3000K would not be able to make legitimate claims such as 11 W = 60W, or replaces 60W bulb. While in the long term we are all working towards a place whereby consumers shop for lumens and not Watts, very few consumers today know how many lumens the old 60W incandescent used and in many cases may not even know what a lumen is. As such these incandescent equivalency claims play an important role in the market. In the absence of this information, some consumers may choose to purchase a 20W bulb when they all they needed was a 13W bulb, resulting in unnecessary extra energy use.	Staff agrees and made this change in 15-day language.
NRDC	As such, we recommend CEC modify section B in the following way: Equivalency claims – do not require usage of equivalency claims, but if equivalency claims are made they must meet the lumen output levels set by the CEC in a published table. (we support the values currently proposed in Table K-15).	The underlying substance of this comment's requested change was made in 15-day language.
GE	Marking of Lamps: To assist consumers in LED lamp selection, manufacturers often make incandescent equivalency claims. LED lamps should not be prohibited	The Energy Commission modified the 15-day language to separate wattage equivalency from claims about incandescent equivalence so that

	from making incandescent "wattage" equivalency claims simply because they have a high color temperature or they are not dimmable. The "wattage" equivalency claims are used to indicate similar light output or brightness. Wattage equivalency claims are not an indication of dimmability or color temperature. Today, LED lamps clearly state whether or not they are dimmable and they provide a clear indication of their color temperature. No further regulation is required. When making wattage equivalency claims, we agree with using the DOE lumen minimums in Table K-15.	manufacturers can claim wattage equivalencies according to the table in the regulations without having to meet other requirements for being an incandescent lamp.
GE	Additionally, the proposed requirements are not consistent with today's customary national packaging approaches. It would force manufacturers to create unique packaging specifically for the California market for several product categories. A requirement to provide unique California packaging would further drive-up LED product costs and create national distribution challenges. It would further limit the number of compliant LED products available in the State.	The proposed regulations do not require a separate state label. The regulations establish labeling elements that have only limited applicability. For those LED lamps which are not compatible with a standard dimmer, the lamp packaging must contain a mark, "dimmable with LED dimmer", to inform end users that an LED dimmer is required. This will reduce improperly matched equipment that may result in the LED lamp not performing as expected. Other requirements relate only to when a manufacturer affirmatively labels something, requiring that manufacturer to meet minimum performance requirements that reflect the claim. There is no mandatory requirement that a manufacturer label a product in any particular way. However, if a manufacturer chooses to label

		their lamp as dimmable or as being equivalent to an incandescent, then it must meet certain performance requirements. Labeling requirement will not allow lamps in the market that will not perform as claimed. Finally, LED lamps that produce very low lumen output must be labeled as "for decorative purposes," again to avoid consumer confusion or dissatisfaction.23 The cost of these limited labels is minimal because manufacturer can choose not to label their lamp if they do not make affirmative claims on the label. No change is recommended.
PAR/BR Lamps		
NEMA	a) Directional sources, beam quality: Controlling the emission pattern of a light source is done through optics. Diffuse sources (such as A-lamps) only require an optical diffuser – whose optical efficiency is typically ~95%. On the other hand, directional lamps (such as MR and PAR lamps) require directional optics to direct the beam. Directional optics has limited optical efficiency, typically ~85%. Furthermore, tighter beams (e.g. 4^{o}, 10^{o}) are more	See RESPONSE 10. The standards don't require SDDLs to have a specific beam angle. However, staff still verified that products ewre available at different beam angles to ensure product availability. LED manufacturers are continuously working to provide lamp options with narrow spot, spot, narrow flood, and flood angles. LED manufacturers now offer MR 16 lamps with 15-

23 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 60

	challenging to design: indeed they require small, bright LED sources (due to the fundamental limit of etendue conservation) which tend to be less efficient and more thermally-constrained.	degree and 40-degree beam angles and the range of beam angles in between. A 12-degree and a 60-degree beam angle lamp is also available in the market at 65 lumens per watt. The effective date of the standards is two years from adoption to ensure that manufacturers have sufficient time to increase product availability at low cost while still meeting the standards.
NEMA	The CEC analysis was focused on A-line general service lamps, those being the focus of research and development to date, but the proposed rule would apply the requirements to all lamps (including specialty lamp types), not just A-line lamps. The technological solutions that make A-line and PAR shape LED lamps a viable product cannot be assumed to feasibly transfer over to all other types without analysis. That is exactly what the 45-day Express Terms do with respect to these other lamps: assume without analysis. The CEC is proposing to regulate a forest of lamp products, and it is not looking at the impact of its proposed rule on the separate species of lamps within that forest. An ecologist would not take this approach to the forest, and neither should the CEC take this approach with respect to the ecology of all lighting environments and the specialty products in that ecosystem.	See RESPONSES 3 and 10. Importantly, the general service LED lamp requirements do not apply to non-LED products. The small-diameter directional lamp requirements apply to all such products, regardless of technology. No change is requested or needed.
NEMA	A separate analysis should be conducted by the CEC to examine the performance and capabilities of other lamps	The standards cover two product classes, Small Diameter Directional Lamps and general service

	rather than mistakenly apply A-line and PAR lamp trends and performance information to other types which will have their own form factor, application and base/shape considerations to address. The CEC has failed to assess the form, fit, function, optical and thermal needs of specialty lamps, and as such cannot apply A-line solutions to them. In our estimation LED lamps that would potentially replace incandescent specialty products designed for display, appliance, and indicator lamp applications will likely not be able to meet the proposed rule's requirements due to size and performance constraints and must be exempted from the general service LED lamp proposal.	LED lamps. This comment appears to be concerned with general service LEDs. Importantly, the general service LED lamp standards do not apply to incandescent versions, and therefore it is not necessary to determine whether there is an incandescent replacement for these lamps. Information about the technical feasibility and cost-effectiveness of the general service LED standards for all lamp types covered is provided in RESPONSE 3. No changes are needed.
Soraa	A detailed discussion of the CEC's feasibility analysis can be found in Annexes A and B. Our high-level conclusions are as follows (we use the term medium-size for general-service directional lamps which are not in the small-size category):	No change is needed.
Soraa	For directional medium-size lamps, a plurality of lamps meet Tier 1. However, only a very small number (seven) meet Tier 1 with high color rendering (Ra>90, R9>90). None of these have a PAR30 form factor, none have a beam angle $<15^{O}$, and none have whiteness rendering.	See RESPONSE 3. Staff analysis did not include lamps that have R9>90 and whiteness rendering. There is no requirements in the proposed regulations for R9>90 and whiteness rendering. Manufacturers may continue to make these lamps as long as they meet the remaining efficiency standards. Staff did extend the effective dates of the regulations to ensure sufficient time for manufacturers to ramp up manufacturing

		processes and distribution of compliant lamps. No further change is needed.
Soraa	For directional medium-size lamps, very few lamps (six) nominally meet Tier 2. None are from major lamp manufacturers, and none seem to actually exist.	See RESPONSES 3 and 7.
Soraa	For medium-size directional lamps, very few high-color-quality lamps and no narrow-beam lamps (10^{O} and less) qualify for Tier 1; none qualify for Tier 2.	See RESPONSE 3 and 7. Specific beam angles and higher color quality are not required under the regulations. Manufacturers may continue to make these lamps as long as they meet the remaining efficiency standards. Staff did extend the effective dates of the regulations to ensure sufficient time for manufacturers to ramp up manufacturing processes and distribution of compliant lamps. No further change is needed.
Soraa	We note that the efficiency 'cost' of directional sources is readily apparent in the CEC's analysis of market data (with directional sources being overall less efficient than omnidirectional sources). The CEC, to some extent, already recognizes this limitation: indeed it places small-diameter directional lamps in a separate category. Surprisingly however, this analysis is not applied to large-diameter directional lamps such as PAR30 or PAR38 lamps. While slightly less challenging to design than small-diameter lamps, these lamps still suffer from a fundamental efficiency penalty versus diffuse lamps.	See RESPONSE 3.
Soraa	Annex A – feasibility analysis for medium-size directional	No response is needed.

	lamps. We use the most recent data form Energy Star and Lighting Facts (November 2015). We consider warm- white (CCT=2700 or 3000) directional lamps (PAR and BR). More than 3.000 lamps meet these criteria.	
Soraa	Tier 1: A fair number of products meet the Tier 1 requirement; most have either low Ra or low R9. However, if we focus the analysis on products with high color rendering (e.g. Ra>=90, R9>=90), conclusions are very different. Only fourteen lamps (all PAR38 lamps) meet such requirement. No PAR30 meets the requirement. Only two products have a beam angle of 15^{o} and no product has a tighter beam angle. No product has whiteness rendering. This indicates that the CEC Tier 1 proposal is already very challenging, considering its timing. Only a handful of products with high color rendering (including R9) are able to meet it. It is unclear how this situation can improve significantly by January 2017. Thus the current proposal would allow only a handful of lamps with high color rendering, none of which have whiteness rendering or spot beam angles.	See RESPONSE 3.
Soraa	Thus none of the qualifying products are from recognized lamp manufacturers, nor do they appear to actually be commercially available. In summary we cannot find any existing product meeting the Tier 2 requirement.	See RESPONSE 3.
Soraa	Tier 2: When considering all directional lamps (either low or high CRI), only four lamps nominally meet the CEC Tier 2 requirements. However the actual existence of these	See RESPONSE 3.

	products is unclear. Namely, the qualifying products are from: Dongguan City Lemark Lighting, a Chinese manufacturer. The qualifying products found on the E* database do not seem to exist on their website. The company's PAR38 spec sheet claims 66lm/W, versus the E* value of 92 (http://lemarklighting.gmc.globalmarket.com/products/par-lamp-3550-1-38.html).Lighting Investments LTD, a division of Epistar. The qualifying lamps are shown on the Lighting Facts database as "not available". The products cannot be found online. To the best of our knowledge, Epistar only sells components and not lamps. (http://www.epistar.com.tw/_english/01_product/01_overview.php)	
Power Factor		
GE	Power Factor: The proposal requires a minimum power factor of 0.7 which is the current Power Factor requirement in ENERGY STAR Version 1.1. EPA is also considering changes to this factor based on new information about updated LED designs to 0.5. In order to be consistent with this national LED quality standard, the CEC should base their Power Factor requirement on the LAMPS 2.0 ENERGY STAR requirement. As such, the CEC should change this requirement to read that lamps must meet the power factor of 0.5 or the Power Factor requirements in ENERGY STAR Lamps version 2.0. Lower power factor designs can lower	See RESPONSE 13. Staff notes that ENERGY STAR adopted a 0.6 power factor for omnidirectional lamps with a rated input power of less than 10 watts, while all other LED lamps must meet a 0.7 power factor.

	costs by approximately 10%, and since LED lamps have leading power factors, they tend to offset the lagging power factors associated with motors in the building.	
GE	(iv) A power factor of 0.7 0.5 or greater (Alternatively, require Power Factor requirements in ENERGY STAR Lamps 2.0.)	See RESPONSE 13.
GE	(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 1.0 watts or less. (As an alternative, require standby mode power specifications in ENERGY STAR Lamps 2.0. To greatly simplify this standard, and allow for much easier manufacturer compliance, CEC can simply require manufacturers to meet the Color, Power Factor, Omnidirectional Lamp requirements, and Standby requirements of ENERGY STAR Lamps 2.0. Although this standard is voluntary, many LED products will be designed to meet this standard in 2017.)	See RESPONSES 1, 2, and 13 for reasons why the Energy Commission did not adopt ENERGY STAR levels related to CRI, standby, and power factor. The Energy Commission did align with ENERGY STAR version 2.0 for the omnidirectional lamp requirements.
California IOUs	We recommend that CEC include a minimum power factor requirement of 0.9 at full light output. Improving power factor has significant financial and greenhouse gas benefits for California consumers. Our research suggests it has minimal or negligible incremental manufacturer cost, and our analysis of thousands of online retail price points did not suggest any link between increased power factor and increased end user prices. Lastly, there is already a	See RESPONSE 13.

	preponderance of products that meet this proposed level.	
California IOUs	Power factor: CEC's proposed power factor requirement of 0.7 is the same as ENERGY STAR's requirement for LED lamps. Therefore, all the products shown in the graphs below meet the CEC's proposed power factor requirement.	No change is requested and needed.
EXAR	2) Power Factor minimum requirement should be kept at 0.9 ---The technology READILY exists to provide cost effective solutions with power factors of 0.9 or greater, and the cost impact of going from a traditional AC/DC driver solution with a Power Factor of 0.7 to one with 0.9 is pennies in cost. In addition the new technology referenced above is also a viable alternative. The solutions that my company offers easily achieve a Power Factor of > 0.95 at the same price points of the existing drivers.	See RESPONSE 13.
EXAR	The goal of these standards is to save energy and reduce loads on the grid for an expanding population. Power Factor is the key to maximizing the benefit of LED lighting and should not be sacrificed when the cost penalty for implementing a Power Factor of 0.9 is negligible.	See RESPONSE 13.
Scope		
MaxLite	This scope roughly aligns with current ENERGY STAR® max/min incandescent equivalency of 20W to 75W INC for 2" diameter lamps (www.energystar.gov/LampsCBCP) . Any lamps below and above these flux levels are likely for specialized applications and shouldn't be included in this	See RESPONSE 11. The Energy Commission did not specifically look at incandescent equivalence to determine the scope, but did look to other factors to determine SDDLs that should not be included in the scope.

	generalized scope	
NEMA	First, NEMA proposes the E12 and E17 base be eliminated from scope until this relevant analysis has been conducted	See RESPONSE 3.
NEMA	Second, with respect to our concerns that the definition and scope are too broad, we disagree with the lower limit of 150 lumens for general service LED lamps scope specified in the 45-day language Table K13. This level of light output equates to a 25W incandescent lamp. We note that Table K-15 in the 45-day language begins at 40W equivalency, which is consistent with the lower limit of federal lamp efficacy standards. 25W products are typically not used for general illumination because of their extremely low level of light ouput (lumens). These products are either in specialty applications, ex. appliance lamps where heat-tolerance is important, or in decorative applications where aesthetics are more important than general illumination to name a few. To align California's proposed regulation with national standards, to harmonize the proposed regulatory language internally between Table K-15 and clause 1602.3(k)(C), and to reduce confusion, disharmony and disruption in interpretation and enforcement of Title 20, NEMA proposes the lower limit be 310 lumens. (Please see comment #4 below for our proposed changes to the 45-day language for this topic.)	The lower limit as articulated in the proposed regulations is 200 lumens for most lamps, not 150 as noted in the comment. Only candelabra bases have the 150 lumen lower limit. A 25 watt lamp output is greater than 200 lumens and less than 310 lumens. There is significant market share of these lamps because these lamps are used in ceiling fans, outdoor lighting, and in many other applications. Staff finds that standards for lamps between 200 and 310 lumens are cost-effective, technically feasible, and will save energy. In addition, the 200 lumen lower limit will close loopholes for 25 W lamps. Therefore, staff did not make this change to the regulation.
NEMA	We also recommend excluding LED Reflector lamps and LED PAR lamps from the scope for the reasons stated above. Given the lack of analysis demonstrating technical	See RESPONSES 3 and 7.

	feasibility and cost effectiveness, we recommend that all of these technologies be removed from the scope of this rulemaking. A future rulemaking covering one or more of these product areas may be appropriate if a future analysis supports such actions.	
NEMA	NEMA members are in the process of developing an overview of the specialty lamp types that are not designed for general service applications. Given the scant, non-existent analysis of smaller-base products, the CEC should avoid setting standards for these products until a proper analysis has been conducted. We submit that this approach is required by the Warren-Alquist Act, California Public Resources Code, §§25402, 25402.5, and 25402.5.4, and the consistency requirements of the California Government Code, §11349.1(a). While the CEC's current undertaking for general service lamps is guided by the California Public Resources Code §25402.5.4, that provision is not independent of §25402 or §25402.5. Section 25402(c) requires that efficiency standards be "feasible and attainable efficiencies or feasible improved efficiencies," and Section 25402.5(b)(1) informs that the CEC must consider "both new and replacement . . . lighting." The clear and unambiguous meaning of these words is that the CEC cannot adopt standards that would only enable compliance by products that do not yet exist and may never exist. Where there are no new replacement LED lights, the CEC should not legislate the current lamps out of existence. Furthermore, it compels the CEC to evaluate the impact of	See RESPONSES 1 and 3. NEMA's position is that there are currently no LED products to replace certain specialty lamp types and therefore, the commission cannot adopt the efficiency standards because the feasibility requirement identified in the Public Resources Code cannot be met. The only means to meeting the feasibility requirement is that there be actual products, currently in the market, that meet any future standard. Staff proposed 15-day language to narrow the scope of the SDDL class of products to remove some specialty lamps that may not have adequate energy efficient replacements. For the remainder of the SDDLs, staff found adequate data to show either compliant LEDs were already in the market or could be by the 2018 effective date of the standards. See chapter 7 of the Staff Report which covers feasibility. Contrary to NEMA's assertion that feasibility can only be shown when actual products are currently being sold in the market, the Warren-Alquist Act does not specify what evidence is sufficient to demonstrate

	proposed efficiency standards for each of the individual products that the CEC proposes to regulate within the broad scope. A separate analysis for these specialty lamps is required in order to properly meet the Warren-Alquist requirements as well as the consistency requirement of the California Government Code.	technical feasibility. While the existence of products in the market shows feasibility, the absence of a particular product does not necessarily mean the regulation is not feasible. In this case, staff has presented evidence that the technology to make SDDLs more efficient exists and is not restricted to a particular form factor or application. This makes a compliant bulb of any form factor and application covered under the scope technically feasible to achieve. NEMA did not provide any information about "specialty" general service LED lamps that could not meet the proposed efficiency standards, so no additional changes were made to the scope for general service LEDs.
NEMA	Scope: The scope of the proposed Title 20 regulation covering small diameter lamps needs to be narrowed. As written it covers many lamp types that have no LED equivalent at any efficiency level, and will likely not have an LED equivalent by 2018. In this regard, NEMA reiterates its comment in Part A, Comment 2 that under the Warren-Alquist Act, the CEC cannot adopt standards that would only enable compliance by products that do not yet exist and may never exist. Where there are no new replacement LED lights, the CEC should not legislate the current lamps out of existence.	NEMA's position is that there are currently no LED products to replace certain specialty lamp types and therefore, the commission cannot adopt the efficiency standards because the feasibility requirement identified in the Public Resources Code cannot be met. The only means to meeting the feasibility requirement is that there be actual products, currently in the market, that meet any future standard. Staff proposed 15-day language to narrow the scope of the SDDL class of products to remove some specialty lamps that may not have adequate

		energy efficient replacements. For the remainder of the SDDLs, staff found adequate data to show either compliant LEDs were already in the market or could be by the 2018 effective date of the standards. See chapter 7 of the Staff Report which covers feasibility. Contrary to NEMA's assertion that feasibility can only be shown when actual products are currently being sold in the market, the Warren-Alquist Act does not specify what evidence is sufficient to demonstrate technical feasibility. While the existence of products in the market shows feasibility, the absence of a particular product does not necessarily mean the regulation is not feasible. In this case, staff has presented evidence that the technology to make SDDLs more efficient exists and is not restricted to a particular form factor or application. This makes a compliant bulb of any form factor and application covered under the scope technically feasible to achieve. NEMA did not provide any information about "specialty" general service LED lamps that could not meet the proposed efficiency standards, so no additional changes were made to the scope for general service LEDs.
NEMA	However, in applications that also rely on the lumen output to provide general illumination to the surrounding	As noted in the Staff Report, the U.S. DOE-issued CALiPER report studied 22 LED MR16 lamps that

	area as well as accent light matching lumens is necessary. Whether the LED replacement MR16 lamp is acceptable ultimately depends on the application. As no LED MR16 lamp has been demonstrated to achieve more than approximately 800 lumens due to the above noted technology limitations, the scope of the CEC standard must therefore be limited by total lumen output.	had measured output of 640 lumens, with a mean of 436 lumens. The study shows a general trend of increasing lumen output and increased efficacy. Staff has plotted the lumen output versus efficacy by using the latest ENERGY STAR and Lighting Facts data and the result shows the efficacy and total lumens of LED lamps continuously increasing. Analysis of the data shows the efficiency of majority of small-diameter directional LED lamps far exceeds 65 lumens per watt.24 In the 15-day language staff incorporated the suggested change by limiting the scope of regulated MR16 lamps and SDDLs to exclude lamps that have a lumen output greater than 850 lumens. Staff finds that adequate 850 lumen LED options will exist by the 2018 compliance date of the standard. No additional regulation changes are necessary.
NEMA	This too is an instance where a reasonable person could not have reached the conclusion to apply the proposed rule to certain MR16 LED lamps, and because of the enormous cost that the proposed rule will impose on consumers, which costs have not been analyzed by the	See RESPONSES 6, 10, and 11. The modifications made in 15-day language address the concerns raised by NEMA regarding certain MR16 LED lamps. Because staff adopted the alternative proposed by NEMA, it is not necessary to

24 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 37-38.

	commission, it violates the necessity and consistency requirements of the California Government Code §11349.1(a) and the requirement that the proposed rule contain a statement of all cost impacts that a reasonable private person would incur. California Government Code §11346.5(a)(9). NEMA's alternative proposal is more effective or as effective as and less burdensome than what is proposed. California Government Code §11346.9.	determine whether that alternative is as or more effective and less burdensome than the Commission's proposal.
NEMA	Emergency Lighting: Life safety equipment has special requirements, standards and performance expectations that cannot reliably be met with replacement LED lamps. The CEC must clearly exempt these products so that they may continue to be served in the market. For example: along with minimum foot-candle requirements for emergency lighting, there are also max to min uniformity ratio (40:1) along the egress path. If unit equipment needs some minimum load power to operate correctly, one cannot just plug in the largest power MR16 lamp available to try and meet the minimum power requirement of the unit equipment circuitry, or one may end up with too much light output and violate the 40:1 min/max requirement. Also, LED lamps do not operate across the full environmental spectrum that traditional lamps do, for example in low temperature applications. Furthermore, such equipment is OFF until needed, so power consumption should not be a concern for these products. NEMA proposal: exempt lamps designed for life safety	See RESPONSE 11.

	equipment.	
NEMA	The CEC's current proposed "scope" definition is: "State-regulated small diameter directional lamp" means a directional lamp with a diameter less than or equal to 2.25 inches and a GU-10, 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 E-26 base, which are state regulated light emitting diode lamps."	This comment accurately summarizes the 45-day language definition of a small-diameter directional lamp, and does not request changes to the regulation.
NEMA	Issues with the proposed definition and approach: Specialty Lamps: The definition is too broadly worded and includes many specialty MR16 lamp types for which there is no LED replacement lamp. The MR16 lamp was originally developed for specialized equipment having a very specific focal point. The main advantage of the halogen MR16 lamp when used in specialized equipment is its ability to use an ellipsoidal reflector to focus the majority of the light into a narrow point at a precise location in front of the lamp (the second focal point of the ellipse). These lamps normally are specified with a very tight focusing plane (working distance) in order to work properly in equipment that can cost many thousands of dollars such as photo, projection, fiber optic, medical, dental, enlarger, microfilm and many other applications. These lamps often have unusual operating voltages,	See RESPONSES 10 and 11.

	relatively short lamp lives and very precise optical focal points. In the early 80's, use of this technology was expanded from only specialty equipment to also include accent lighting in general lighting applications. It soon became a favorite in restaurants, retail stores, and custom residential applications. We note that general lighting MR16 lamps operate at 12 volts, with less expensive versions being designed at 120 volts.	
NEMA	NEMA members are very concerned that the overly broad scope of the CEC's general service LED lamp definition will stifle innovation and product development of the numerous specialty LED lamps needed to replace the wide variety of incandescent lamps available in the market today for these applications.	See RESPONSES 1, 3, and 4.
NEMA	Proposed changes to regulatory language to the scope (see also item 2 above: 1602(k) 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."	See RESPONSES 3 and 7.
GE	Separate analysis and discussion is necessary to ensure that	See RESPONSES 3 and 7. All LED lamps use same

	Title 20 standards address attributes, applications and market circumstances unique to each technology. Once properly analyzed, it is likely that the standards for these products would be set at different efficiency levels (higher or lower) than currently proposed. In this case, the Commission has not performed an adequate analysis for all lamps types subject to the proposed regulations and cannot assume the efficiency levels for A-line lamps would be appropriate for all four categories. Accordingly we recommend the Commission explicitly limit the scope only to medium-based A-line LED lamps at this time.	or similar components, materials, and parts; the only difference is in the outer shape of the lamps. Shape doesn't produce light or color quality. GE does not provide a technical justification for why different products need different standards and staff's review of the available information does not support this claim. Proposed regulations require lamps to meet the minimum efficiency and color quality standards that a lamp must meet irrespective of the lamp type or shape. Therefore, the Commission did not limit the scope of the proposed regulations as requested.
GE	Small Diameter Directional Lamps: Without further narrowing the scope of the proposed Title 20 regulation, some lighting systems and specialty equipment would become obsolete. As written, the staff proposal covers many MR 16 lamp types that currently have no LED equivalent at any efficiency level, and will not have an LED equivalent by 2018, and the proposed specifications cannot be achieved by existing products. Further, it is our understanding that the Commission does not intend to adopt a regulation that would eliminate lighting options for any consumer or commercial application. Accordingly, the Scope of the proposed Title 20 regulation covering small diameter lamps must be narrowed.	See RESPONSE 11.
GE	Limiting the scope only to lamps rated for less than 825 lumens ensures that there will be LED MR16 lamps available	See RESPONSE 11.

	for all applications. It will also ensure that specialty products designed at 12 volts or 120 volts, but which have very high lumen output, are not affected. There are no known LED MR16 products that have a lumen output in the high lumen ranges. Placing a floor of 150 lumens recognizes that such products are already very low wattage products that use very little energy and should not be subject to energy efficiency regulations.	
GE	To address these serious concerns, and to ensure products are available that work in all applications after the regulation takes effect, the proposed definition must be changed. GE supports the industry suggestion to address these issues as follows: a) "State-regulated small diameter directional lamp" means a directional lamp with a diameter less than or equal to 2.25 inches and a GU-10, GU5.3, GUX5.3, GU8, GU4, or E26base that is capable of meeting performance specifications when operated within a voltage range of 11 to 13 volts, or, 110 to 130 volts, has a rated life of more than 2000 hours, and has a lumen output greater than 150 lumens and less than 825 lumens. 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 E-26 base, which are state regulated light emitting diode lamps.	See RESPONSE 11.
GE	Rationale for proposed changes: Limiting the voltage range to 12 volt and 120 volt products, or products close to these	See RESPONSE 11.

	voltages, will appropriately focus the standard on lamps designed for general lighting applications. Specialty lamps made at other voltages (e.g., 8, 10.8, 13.8, 14.5, 17, 19, 20, 21, 24, 30, 36, 68, and 82 volts) will not be affected as there is no possible LED replacement lamp that provides the proper optical performance for specialized equipment.	
GE	SPECIALTY LAMPS: The definition is too broadly worded and includes many specialty MR16 lamp types for which there is no LED replacement lamp. The MR16 lamp was originally developed for specialized equipment. The main advantage of the halogen MR16 lamp when used in specialized equipment is its ability to use an ellipsoidal reflector to focus the majority of the light into a narrow point at a precise location in front of the lamp. These lamps normally specify a working distance in order to perform properly in specialty equipment. These lamps often have unusual operating voltages, relatively short lamp lives and very precise optical focal points. In contrast, General lighting MR16 lamps operate at 12 volts, with less expensive versions being designed at 120 volts	See RESPONSES 10 and 11.
GE	Recommended Scope Change: GE recommends the following changes to the scope: 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 kits that are designed for retrofit within existing recessed can housings that contain one of the preceding bases., and excluding LED	See RESPONSE 9.

	Reflector or LED PAR lamps. State-regulated LED lamp does not include a lamp with a brightness of more than 2600 lumens or a lamp that cannot produce light with a correlated color temperature between 2200K and 7000K. Rationale for scope changes: Eliminating the E12 and E17 base types eliminates some decorative LED lamps from the scope. Due to size and thermal constraints, small base Decorative LED lamps cannot -achieve the same efficiency performance as medium base A-line LED lamps. LED decorative lamps are competing against incandescent, halogen and CFL decorative lamps in the marketplace. They can compete much more effectively and deliver greater efficiency in decorative applications without significant regulatory constraints. However, if CEC continues to pursue regulations for small base LED decorative lamps, a new more simple set of specifications must be developed and based on analyses specific to these lamp types. The extensive proposed regulations for A-line LED Lamps are a poor fit for decorative LED lamps. In particular, the proposed efficiency equations are infeasible for this technology. Minimum efficiency levels must be set lower than proposed for decorative lamp types and we would support the NEMA proposal if CEC does not remove this product class from the scope. The CEC staff analysis focuses on the A-line LED lamps, not small based decorative LED lamps. The particular issues associated with decorative LED lamps have not been sufficiently analyzed to set proper efficiency levels for this technology.	

GE	In addition, the scope of the medium base A-line standard should start at a floor of 310 lumens to be consistent with federal standards for medium base lamps. Lamps less than 310 lumens use very little power, so mandatory specifications will have negligible energy savings in the state. Forcing high quality standards that increase cost on these niche lamps types would increase the likelihood that consumers continue to use incandescent options, since they are not regulated by DOE below 310 lumens and remain widely available in the marketplace. This outcome would undercut opportunities for energy savings and thus would be at odds with the Commission's statutory mandate.	Staff disagrees with the NEMAs comment to set a lower limit of 310 lumens. The lower limit will close the loop holes and will result in greater energy savings to the state. There are many lamps sold in the market that have lumen range from 150 to 310. Many lamp manufacturers are labeling these lamps as 40 watts equivalent. In addition these lamps are inefficient. Setting the lower limit will close the loop holes for the lamps that produce less than 310 lumens. Regulations will require lower lumen lamps to be as efficient by meeting the standard.
Newport Ventures	For typical applications, we believe the proposed requirements are attainable; however, we believe that some changes to the proposed language are still needed to accommodate the application of small diameter directional lamps for task lighting in domestic exhaust hoods. Domestic exhaust hoods are regularly exposed to elevated temperatures from cooking events and are required to be tested and listed to UL safety standards during which they are subjected to ambient temperatures up to 70 ˚C.	The U.S. DOE's LED test procedure requires that LED lamps be tested at 55 degrees and 85 degrees Celsius temperature. This means that lamps used in domestic exhaust hoods would be able to withstand temperatures up to 70 degrees Celsius to meet UL safety standards. Staff's analysis demonstrates that there are energy-efficient small diameter directional lamps that meet the efficiency standards, and there are no technological barriers to these efficient lamps being used in this particular application. See RESPONSE 10 regarding the availability of small-diameter directional lamps that meet the standards. Therefore, no change was made.
Newport	We have not been able to identify any retail availability for	See RESPONSE 10. IES LM79-09 and LM80-08 test

Ventures	small diameter directional LED lamps that achieve CEC's proposed specifications (i.e., ≥ 25,000 hours rated life, and luminous efficacy ≥ 80 or luminous efficacy ≥ 70 and compliance score ≥ 165) and are also rated for the high temperatures experienced when installed in domestic kitchen exhaust hoods (i.e., ≥ 70 ˚C). Further, most small directional LED lamps that we are aware of do not work well with multi-level lighting controls that are typically provided with range hoods, flickering or failing to illuminate at low-level settings. Installing lamps in domestic kitchen exhaust hoods that are not rated at am ambient temperature ≥ 70 ˚C is expected to result in premature failure of the lamps (much shorter than the 25,000 life rating proposed by CEC), consumer dissatisfaction, and high costs to the consumer for frequent lamp replacement. And if these LED lamps are not compatible with multi-level lighting controls (our intel tells us most are not), consumers will be highly dissatisfied with their performance on energy-saving, low-power settings	procedure require that lamps be tested at 85 degrees Celsius, which should address failure due to high ambient temperatures, so the problem identified by the commuter is already addressed in the regulations. These procedures require the lamp be tested at 85 degrees Celsius. Regarding compatibility with multi-level lighting controls (dimmers), see RESPONSE 12.
Newport Ventures	Presumably, CEC previously recognized this lack of available products when the Commission exempted kitchen exhaust hoods from the lighting efficacy requirements in Title 24 Chapter 6, Section 150.0(k)1.F, as follows: Lighting Integral to Exhaust Fans. Lighting integral to exhaust fans shall meet the applicable requirements of	See RESPONSES 1 and 3. Staff does not find that the exemption in Title 24 was based specifically on the lack of availability of lamp products. Moreover, this exemption was first provided in 2008. Lighting technologies have significantly evolved since that time. There are many small diameter directional lamps available in the market

	Section 150.0(k). EXCEPTION to Section 150.0(k)1F: Lighting installed by the manufacturer in kitchen exhaust hoods. Similar consideration should also be provided in Title 20 Section 16.	today that will fit and operate in the exhaust hoods. Therefore, staff has considered and rejected commenter's suggestion and no change is needed.
American Lighting Association	Which Small Diameter Directional Lamps?: The scale of lighting in residential applications is important for the acceptance of lamps and lighting fixtures, so small diameter reflector lamps are widely used in California residential interiors for general, accent, display and decorative lighting. The MR-16 and MR-11 lamps are particularly important because, as indicated by the Staff Report (TN206387), 95% of the small- diameter lamps installed in California are MR types.The ALA feels that the Small Diameter Directional Lamp regulations should be limited to these MR types and, further,to those MR types intended for general illumination, not specialty types. Specific Comments: We have the following comments regarding the proposed requirements in the 45-day Express Terms:	See RESPONSES 10 and 11.
American Lighting Association	The 45-Day Express Terms are disappointing because of their scope which appears to try to include all possible existing and envisioned LED replacement lamp products while burdening them with tighter performance limits than are being achieved or expected in the planning horizon of most lamp manufacturers who have the capability to timely serve the California market.	Staff analysis shows that the standards for the lamp types included in the scope are cost-effective and technically feasible, and will save a significant amount of energy statewide. See RESPONSE 3 for feasibility analysis for general service LED lamps.

American Lighting Association	The ALA feels it is more important from the energy-saving standpoint to (1) focus on the products with the highest sales volume and where there remain the highest number of sockets still filled with low-efficacy products and (2) where product performance improvements appear to be available or have already been announced. Our concern is based upon our experience with the acceptance and subsequent installation of lighting products over many decades and especially in recent years as more efficacious CFLs and now LED residential lighting products have become available. We have found that residential consumers prefer to buy a limited range of LED lamp product types for retrofit into their homes, but appreciate, accept and positively respond to a broad choice of manufacturers, pricing and product features. They will upgrade existing sockets faster as well as better understand product ratings if they have a choice of both new and familiar products that they can compare.	See RESPONSE 4. The products in scope are those that the Energy Commission found to have cost-effective and technically feasible energy efficiency solutions that would save significant energy in the state. Regarding the scope for SDDLs, see RESPONSE 11, as the Energy Commission did modify the scope in response to concerns that there would not be energy-efficient LED technologies for certain market segments covered in the 45-day language.
California IOUs	We recommend that CEC exempt lamps with light output above 900 lumens and with lamp life below 300 hours that are designed and marketed specifically for use in specialty applications such as medical equipment and projectors. We do not recommend that CEC include other exemptions based on operating voltage, or low lumens, because there is not a technical basis that would prevent LEDs from meeting these specifications.	See RESPONSE 11.
California IOUs	Product Class Definitions and Scope: The proposed	The Energy Commission made this change in 15-

	definition of SDDL refers to "directional lamps," but the term "directional lamp" is not defined anywhere by the standards. We recommend that CEC specify that 'directional lamps' are those with at least 80 % light output within a solid angle of π sr (corresponding to a cone with angle of 120˚), which is how they are defined by European Union standards. We believe this definition encompasses all lamps typically thought of as directional lamps (e.g. MR, R, PAR, ER, BR, etc.), and excludes other products that are not typically considered directional lamps, such as snow-cone A-lamps.	day language.
California IOUs	We also recommend that CEC broaden the definition of SDDL to include all bi-pin bases with a distance between them that is greater than or equal to 4mm and less than or equal to 12mm (in addition to E26 screw base lamps). The proposed definition includes a specific list of only six bi-pin base types: GU10, GU11, GU5.3, GUX5.3, GU8, GU4. However, there are many other very similar bi-pin base types that are used for MR16 lamps, or which could easily be used. For example, while the CEC's proposal includes GU5.3 and GUX5.3, it does not include GX5.3, a common MR16 base type. Similarly, there are a wide array of other similar base types, many of which may be interchangeable in the same sockets. For example, our team found a socket type for sale online that is advertised as working with lamps with <u>any</u> of the following bases: G4, GU4, GX4, GZ4, G5.3, GX5.3, G6.35, GX6.35, GY6.35, GZ6.35.	The Energy Commission essentially made this change in 15-day language by expanding the definition of SDDLs to include those with ANSI ANSLG C81.61-2009 (R2014) compliant pin base or E26 base.
Philips	Another factor which the rulemaking does not appear to	Staff did not find, and Philips did not identify, any

	consider is that for a given model of emergency egress equipment, each lamp type that is to be used with the equipment has to be included in the safety listing (UL 924). In other words, even if a LED lamp matched the photometric characteristics of the halogen lamp it replaces, it would still have to be evaluated as part of the product safety approval for emergency egress equipment. There are a host of other technical problems that could surface at this stage that could exclude the LED lamp from consideration. Given the above issues, we ask that the Commission move to exclude halogen lamps used in life-safety equipment from the rulemaking. If they do not, halogen replacement lamps may not be available in California for this critical life safety application.	technical feasibility or cost issue associated with the specific lamp mentioned. See RESPONSES 10 and 11.
Philips	Low Wattage LED Lamps: Low wattage LED lamps are those typically intended as a replacement for incandescent lamps rated 25W or lower, and that have a rated input power of less than 4W. These products, particularly dimmable versions, are less efficient than their higher wattage counterparts. These lamps will be excluded from sale in California unless the 45 day language is modified. A simple solution to this issue would be to increase the minimum lumen requirement for lamps to be regulated from 150 lumens to 310 lumens. This is consistent with the 40W equivalency level proposed in Table K-15.	The lower limit as articulated in the proposed regulations is 200 lumens for most lamps, not 150 as noted in the comment. Only candelabra bases have the 150 lumen lower limit. A 25 watt lamp output is greater than 200 lumens and less than 310 lumens. There is significant market share of these lamps because these lamps are used in ceiling fans, outdoor lighting, and in many other applications. Staff finds that standards for lamps between 200 and 310 lumens are cost-effective, technically feasible, and will save energy. In addition, the 200 lumen lower limit will close loopholes for 25 W

		lamps. Therefore, staff did not make this change to the regulation.
Small-diameter directional lamps		
MaxLite	Additionally, we would propose the Commission sets minimum center beam candle power (CBCP) requirements for beam angle classifications for all SDDLs. Such requirements should align with the current ENERGY STAR requirements for CBCP (same link to CBCP tool referenced above). Doing so would follow a specification that has already been in use in the industry, and would ensure that lumens are distributed where they should be. The CEC analysis document also indicated that most beams are 20-40 Degrees, but note that without a CBCP requirement, the lumens could be emitted anywhere which could lead to underperforming products and customer dissatisfaction.	The adopted regulations require testing and reporting of the CBCP. The Energy Commission did not establish a CBCP requirement because consumers of these products are primarily commercial customers with the sophistication to specify a lamp that meets their needs, making it unnecessary to establish performance requirements. Therefore, the Energy Commission did not make this change to the regulations.
MaxLite	Lastly, the way the specification document is currently arranged, it is not clear what other performance parameters the SDDLs are required to meet. Do the requirements of Table K-13 apply to SDDL as well as "State-regulated LED lamps?" If not, what are the other performance requirements for SDDL?	Generally, the regulatory requirements for SDDLs are provided in section 1605.3 (k)(3), which does not include Table K-13. There are no additional performance requirements for SDDLs. However, a small diameter directional lamp with an E26 base and using LED technologies, and otherwise meeting the definition of a "state-regulated LED lamp," is required to meet the standards for state-regulated LED lamps, described in section 1605.2(k)(2), and including Table K-14.

NEMA	The MR16 form factor and system requirements pose substantial challenges for LED technology compared to line voltage products. The small size poses unique driver design challenges and trade-offs including greatly increased thermal challenges. Lamps that have thermal issues will have significantly shortened lamp lives.	See RESPONSES 10 and 11.
NEMA	Lumens: As stated in the aforementioned CALiPER report: "The MR16 form factor and system requirements pose substantial challenges for LED technology. The small size poses unique driver design challenges and trade-offs including greatly increased thermal challenges." The lumen output of a small LED MR16 lamp is limited by the need to dissipate heat generation during lamp operation.	See RESPONSES 10 and 11. The U.S. DOE-issued CALiPER report studied Series 22 LED MR16 lamps that had measured output of 640 lumens, with a mean of 436 lumens. The study shows a general trend of increasing lumen output and increased efficacy. Staff has plotted the lumen output versus efficacy by using the latest ENERGY STAR and Lighting Facts data and the result shows the efficacy and total lumens of LED lamps continuously increasing. The gains in efficiency are resulting from use of better phosphors, more efficient driver design, and better chip design, packaging, and heat dissipation. All LED lamps initially posed a heat dissipation challenge because earlier LEDs were not as efficiency as currently available LEDs. Manufacturers had to design a lamp with big heat sink. That would restrict the space in the lamp, which was more of an impact on smaller form factors like MR 16s. Today, because of the newer technology, the LEDs do not require big heat sinks because they are very efficient and produce very little heat.

		Therefore, the technical issues raised in the CALiPER report not expected to continue through the effective date of the regulations.
NEMA	We are doing our best to put a matrix together of what the different lamp types and offerings on the market are, and where we know based on our product offerings or awareness of other manufacturers' product offerings, there simply is not or we are not aware of any LED alternatives there. We know that's important because, as is printed right on the front of the building, the Warren-Alquist Act says that, as we understand it, that a product has to be available on the day of adoption that meets the requirements. And if there is no LED offering in some Small Diameter particular beam shape MR lamp, then there isn't one. I think there's been an assumption during the proposal development analysis process that if there's a lamp that doesn't look too different from it, then it's a simple matter to adapt and simply offer that in the new base type or beam shape. If that were so simple, then they really would be there already. There's reasons why they are not offered, it's not just market demand, but also technical feasibility. Something no one has mentioned is the fact that a lot of these incandescent sources you're trying to offset are in fixtures that are tightly enclosed. They are enclosed to protect the consumer from a high degree of heat that comes off of a halogen lamp. That same amount of insulation that protects the exterior of it will also retain the heat generated by the LED that it needs to express and get away from so that it	Staff used the matrix to help determine the scope of the regulation for small-diameter directional lamps. Staff issued 15-day language to clarify the scope of small diameter lamps and excluded the specialty lamps that are not used for general purpose lighting. Although the 15-day language addresses NEMA's comment, the Energy Commission clarifies here a misunderstanding regarding the evidence necessary for showing technical feasibility. Contrary to NEMA's assertion that feasibility can only be shown when actual products are currently being sold in the market, the Warren-Alquist Act does not specify what evidence is sufficient to demonstrate technical feasibility. While the existence of products in the market shows feasibility, the absence of a particular product does not necessarily mean the regulation is not feasible. In this case, staff has presented evidence that the technology to make SDDLs more efficient exists and is not restricted to a particular form factor or application. This makes a compliant bulb of any form factor and application covered under the scope technically feasible to achieve.

	doesn't bake itself. So there's a hazard that the LED lamps, if they fit into a lot of these specialty fixtures will not survive very long.	
NEMA	The LED technology used in LED MR16 lamps has been developed to replace halogen lamps in general lighting applications where the majority of MR lamp- associated energy is consumed. These LED MR16 lamps do not refocus the beam at a second focal point and will not work properly in specialized equipment requiring halogen MR16 lamps. Because an LED is a directional point source, while a halogen lamp is an omnidirectional point source, mandating LED technology will create a technical catch-22 to recreate the exact optics required in specialty equipment with LED technology. Lamp designers will have to increase the size of lamp reflector (and therefore the size of the lamp) to try to refocus efficiently the light through a second focal point, or live with greatly reduced lamp efficiency as only some of the light would hit the focal point. However, if the lamp size is increased, it will not fit in the equipment. We understand that some new specialty equipment is being designed to take advantage of LED lighting technology, but this does not impact the installed base or its replacement should all halogen MR lamps be eliminated from the market as proposed by the 45-day express terms. Specialty equipment already in service will continue to require halogen MR16 replacement lamps. If those lamps are taken off the market upon the effective date of the proposed	See RESPONSES 10, 11, and 12. Public Resources Code25402(c)(1) requires appliance efficiency standards to not result in any added total costs for consumers over the designed life of the lamp. When determining cost-effectiveness the Commission shall consider the value of the energy saved, impact on product efficacy for the consumer, and life cycle cost to the consumer of complying with the standard, impact on housing costs, total statewide costs and benefits of the standard over its lifetime, economic impact on California businesses and alternative approaches. With the changes made in 15-day language, the Energy Commission finds that the standards for SDDLs are cost-effective consumers. Importantly, the Energy Commission is not required to consider attributes that are not part of the standards, such as dimmability or beam angle, in its cost-effectiveness analysis. The Energy Commission did, however, verify that the standards were still cost-effective and technically feasible across a wide range of beam angles and dimming needs. Government Code section 11349.1(a) details OAL's

	regulation then the equipment they are used in, which can cost up to tens of thousands of dollars, will become immediately obsolete. Such forced obsolescence cannot be justified as cost effective pursuant to Public Resources Code section 25402(c)(1) because CEC would not be able to demonstrate that the proposed standard "does not result in any added total costs for consumers over the designed life of the appliances concerned," which in this case would necessarily include the cost of replacing the specialty equipment. We note that the CEC's cost analysis does not include assessment of the impacts to specialty equipment and the small CA businesses relying on it. For all of these reasons, halogen MR16 products used in specialty applications must be excluded from the regulations by redefining the scope. This can be accomplished by limiting the lamp voltage, lamp life and lumen output currently covered by the proposed scope (some equipment uses very high lumen output specialty lamps). This is an instance where a reasonable person could not have reached the conclusion to apply the proposed rule to specialty lamp equipment, and because of the enormous cost that the proposed rule will impose on consumers, which costs have not been analyzed by the commission, it violates the necessity and consistency requirements of the California Government Code §11349.1(a) and the requirement that the proposed rule contain a statement of all cost impacts that a reasonable private person would incur. California Government Code	review process and the standards of necessity, authority, clarity, consistency, reference and nonduplication. The proposed regulations meet all of these requirements. Specifically in response to this comment, the supplemental ISOR details the necessity of each provision of the regulation, and the regulations are consistent within the existing framework and structure of the Commission appliance regulations found in sections 1601-1607. Government Code section 11346.5(a)(9) requires that the Energy Commission include in its Notice of Proposed Action a description of all cost impacts known to the Commission at the time the NOPA is submitted to OAL that a representative private person or business would necessarily incur in reasonable compliance with the proposed action. This information is included in the NOPA published on October 16, 2015. Therefore, this requirement has been met. Government Code section 11346.9 requires an agency to prepare and submit to the office of Administrative Law (OAL) a Final Statement of Reasons (FSOR) which updates the information contained in the Initial Statement of Reasons (ISOR), and provides responses to comments. Staff's FSOR complies with all the requirements of

	§11346.5(a)(9). NEMA's alternative proposal is more effective or as effective as and less burdensome than what is proposed. California Government Code §11346.9.	section 11346.9 by providing detailed responses to comments, updates to the ISOR as appropriate and updates to the Informative Digest. Because staff adopted an alternative to the SDDL regulation proposed by NEMA, it is not necessary to evaluate whether it is as effective as the Commission's proposal.
GE	The MR16 form factor and system requirements pose substantial challenges for LED technology compared to line voltage products. The small size poses unique driver design challenges and trade-offs including greatly increased thermal challenges. Lamps that have thermal issues will have significantly shortened lamp lives.	See RESPONSES 10 and 11.
GE	When testing an electronic transformer on an incandescent dimmer most LED MR16 lamps did not dim in a reasonable manner even though they were marketed as dimmable. Some products dimmed in a non-monotonic manner, meaning light levels could go higher when they were dimmed lower, and many did not dim below 60% light output.	Staff agrees that transformer compatibility is occasionally an issue for low-voltage LED lamps that are installed on high-wattage transformers. See RESPONSE 12.
GE	LUMENS: As stated in the Caliper report: "The MR16 form factor and system requirements pose substantial challenges for LED technology. The small size poses unique driver design challenges and trade-offs including greatly increased thermal challenges." The lumen output of a small LED MR16 lamp is limited by the need to dissipate heat generation	See RESPONSE 11.

	during lamp operation. It is easier to match Center Beam Candlepower than to match lumens, which is acceptable in applications which have a secondary general lighting system. However, in applications that also rely on the lumen output to provide general illumination to the surrounding area, as well as accent light, matching lumens is necessary. Whether the LED replacement MR16 lamp is acceptable ultimately depends on the application. As no LED MR16 lamp has been demonstrated to achieve more than approximately 800 lumens due to the above noted technology limitations, the scope of the standard must be limited by total lumen output. We note that there is a high lumen scope limitation on the Light Emitting Diode (LED) lamp proposal. There is simply no LED MR16 lamp available today or anticipated by 2018 that can achieve the 1200+ lumens produced by some halogen MR16 lamps. Sales of these high lumen lamps are very small compared to sales of 50 watt, 35 watt and 20 watt Halogen MR16 lamps. Narrowing the scope in this way will have little impact on energy savings. Moreover, the scope of the proposed standard must exclude these higher lumen products because replacement LED lamps simply do not exist for such applications.	
GE	While there are many specialty lamp types, the majority of power is consumed in general lighting applications due to their long operating hours. LED MR16 lamps used for general accent lighting do not refocus the beam at a second focal point and would not work properly in specialized	See RESPONSE 11.

	equipment requiring halogen MR16 lamps. Therefore, the specialty equipment already in service will continue to require specialty halogen MR16 replacement lamps. If specialty MR16 lamps are taken off the market upon the effective date of the proposed regulation, the equipment they are used in, which can cost up to tens of thousands of dollars, will become immediately obsolete. Such forced obsolescence cannot be justified as cost effective pursuant to Public Resources Code section 25402(c)(1) because CEC would not be able to demonstrate that the proposed standard "does not result in any added total costs for consumers over the designed life of the appliances concerned", which in this case would necessarily include the cost of replacing the specialty equipment. For these reasons, halogen MR16 products used in specialty applications must be excluded from the regulations by redefining the scope. This can be accomplished by limiting the lamp voltage, lamp life and lumen output (some equipment uses very high lumen output specialty lamps) currently covered by the proposed scope.	
Philips	Small Diameter Halogen Directional Lamps and Emergency Egress Applications: The small diameter directional lamp requirements are sufficiently broad that they include almost all existing halogen directional lamps. While this subject is covered broadly in the NEMA documents, we wish to call the Commission's attention to a potential life-safety issue	See RESPONSE 11.

	with the current language. Philips Lighting's Chloride brand manufactures emergency lighting units that use halogen MR lamps of various wattages to provide emergency egress illumination during a power failure. A copy of the product literature for one model that uses a 6V, 5.5W halogen MR16 lamp follows at the end of our comments. NFPA 101 and local life-safety codes require that these units provide a specific amount of foot-candles over the egress pathway when in operation.	
Philips	The staff report examines the technological feasibility of small diameter directional LED lamps from the standpoint of lumen output and beam angle. The critical lamp characteristic in egress applications is not lumen output, but center beam candlepower (CBCP), and to a lesser extent, beam angle. Furthermore, the staff report erroneously asserts that "One of the factors that determine the beam intensity is the field angle. Thus giving the impression that intensity and field angle are correlated. Field angle describes how far the beam spreads from center, i.e., whether the beam is a spot or flood, but it does not correlate with absolute intensity. Thus it is not a replacement for CBCP.	See RESPONSE 10. The staff analysis considered various aspects of SDDLs in determining whether the standards would be cost-effective and technically feasible to achieve. This included lumen output, beam angle, and center beam candle power (CBCP). Staff analyzed each of these characteristics and determined that technical solutions exist to meet the efficiency standards while producing the necessary characteristics for a particular lighting application, whether it be lumens, beam angle, or CBCP. No additional changes are necessary.
NRDC	Small Diameter Reflector Lamps – Small diameter reflector lamps are currently not regulated by the CEC or at the national level and this product category offer energy savings of 75% or more compared to the incumbent halogen lamps. We believe the goals of this standard are to move the market from halogen and halogen infrared based lamps	The comment supports the standards and does not ask for changes to the standards.

	to LED lamps due to the dramatic energy savings such a shift accomplishes, and to make sure the new lamps do not disappoint the users.	
NRDC	NRDC continues to strongly support adoption of the proposed standards for small diameter reflector lamps. - These products are currently not regulated by either CA or DOE, and savings of up to 85% will be achieved by these standards.	The comment supports the standards and does not ask for changes to the standards.
MaxLite	CEC's analysis document of the SDDL market indicates that 95% of SSDL are MR types and 5% are PAR types. Also 80% are 12V and 20% are 120V. Therefore, instead of such a broad definition of SDDL lamps, we feel the Commission should more narrowly focus on the high usage MR product types instead of the current definition in the 10/15/15 CEC proposal (which shows SDDL includes directional lamps 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). The specification should limit bases types for SDDLs to include GU10, GU5.3, GUX5.3. This will be the majority lamp types that contribute to the state's SDDL energy usage. We also feel the Commission should limit the SDDL scope to include only lamps that are greater than equal to 200lm and less than 750lm.	See RESPONSE 11.
Soraa	Annex B – feasibility analysis for small-size directional lamps. We use the most recent data form Energy Star and Lighting Facts (November 2015). We consider warm- white (CCT=2700 or 3000) directional lamps (16-diameter). More	See RESPONSE 10. High CRI is not required under the regulation and was therefore not specifically analyzed. Manufacturers may continue to make these lamps as long as they meet the remaining

	than 600 lamps meet these criteria. Among low-CRI lamps (Ra<90), 35 products nominally meet the CEC requirement. We did not pursue an in-depth study of each. However, we note that all are products from minor manufacturers, for which availability and existence are unclear – except for three lamps from Philips Lighting. Among high-CRI lamps (Ra>90), nine products nominally meet the CEC requirement. However upon inspection of the database, the efficiency data is incorrect for all of these. Namely, the qualifying lamps are from: Therefore we conclude that no single existing small-diameter lamp with high CRI actually meets the proposal. This is in large part due to the CRI-dependent efficiency derating, which is much weaker for small-diameter lamps than other lamps. This, in practice, makes high CRI products more challenging to design in small-diameter lamps than in other form factors – an inappropriate situation, since there is a clear call for such products in applications like retail. The trade-off between efficiency and CRI is fundamental, and it should be the same for all lamps	efficiency standards.
Soraa	Surprisingly, the CEC report does not justify feasibility by considering data on small-diameter lamps but medium-diameter lamps instead, and states (see p.40) "Figure 13 below shows the number of general service, medium screw base directional lamps with high CRI and high efficacy, demonstrating that the LED chips, drivers, and controllers exist and simply need to be included in small-diameter directional lamps." Of course this reasoning does not hold: the smaller size of small-diameter lamps makes it	See RESPONSE 10. The purpose of figure 13 in the staff report is to demonstrate that same path way can also be used to comply with the small diameter directional lamps. No change is needed.

	impossible to include as many LED chips, and to use the same optics and electronics as in larger lamps (otherwise, manufacturers would have done so long ago) – especially while conforming to a standard form factor. This is precisely the reason why they belong in a separate category, as recognized by the CEC, and why using data from larger lamps to demonstrate technical feasibility makes no sense.	
Soraa	For small-diameter lamps, no high-color-quality lamp qualifies whatsoever. In short, the highest-quality products would be phased out from the California market.	Contrary to the commenter's assertion, there are small diameters lamps of high color quality available in the market as shown in ENERGY STAR database.25 See also RESPONSE 10. No change is needed.
California IOUs	There is a wide variety of SDDL products available today that meet the proposed standards, including products at different color temperatures, different beam angles, and from many different manufacturers. Products continue to improve at a very fast pace as well, and even more products are projected to be available by 2018.	The comment supports the standards and does not ask for changes to the standards.
California IOUs	Compatibility between low voltage LED lamps and systems is improving and MR16 lamp designs have gotten much better at achieving backwards compatibility with existing systems.	The comment supports the standards and does not ask for changes to the standards.
California IOUs	The proposed definition of SDDL refers to "directional lamps," but this term is not defined anywhere by the	The Energy Commission made this change in 15-day language.

25 ENERGY STAR lamp data available at https://data.energystar.gov/Active-Specifications/ENERGY-STAR-Certified-Light-Bulbs/v33x-ybr3

	standards. We recommend that the CEC specify that 'directional lamps' are those with at least 80% light output within a solid angle of π sr (corresponding to a cone with angle of 120°), which is how they are defined by European Union standards.	
California IOUs	We recommend that CEC broaden the definition of SDDL to include all bi-pin bases with a distance between them that is greater than or equal to 4mm and less than or equal to 12mm.	Definition in proposed regulations was modified in 15-day language to include all ANSI ANSLG C81.61-2009 (R2014) compliant pin base lamps or E26 base lamps.
Jonathan Baty	Following are two options that the Commission could pursue to address the lack of available LED MR16s must be compatible with Existing Transformers: At present we are not aware of any low voltage LED MR16 lamp manufacturer who will warrant that their lamps will not cause the existing line voltage to low voltage transformer to fail. Manufacturers should be able to do this before LED MR16s are mandated for retrofit activities. It is often challenging and expensive to identify and/or replace existing LED MR16 transformers if they fail as a result of a relamp effort.	See RESPONSE 10 regarding availability of products and RESPONSE 12 regarding transformer compatibility.
Standby Power/Connected Lamps		
Acuity Brands	Standby Power: The Tier 2 standby power requirement of 0.2 watts or less will likely limit future innovation for products that provide a variety of smart features, including non-lighting features. While the CEC staff indicated that there are products on the market today that have a standby power lower than this limit, it is unclear whether these products	See RESPONSE 2. A comment that identifies an unspecified theoretical future use which would require greater than .2 watts is not sufficient to warrant changing the regulatory language. If this were the case no standards could ever be developed because of some potential limitation of

	offer robust features and consumer benefits. It would be inappropriate for the CEC to limit the innovation of smart features that can provide additional energy benefits in the future with overly restrictive standby power. We recommend a limit for standby power of 1.0 watts or less. This threshold will limit excessive standby power while maintaining the flexibility to design innovative features into future products.	future technology.
Ken Whiting	As you have noted in your analysis, connected lighting is a rapid growing segment of the general service lamp market and will soon represent a significant portion of the installed base. Also noted, the standby power consumption of connected lighting can represent a significant portion of the total annual energy use of a lighting system. We feel that the 0.2W limit for simple communication standby power is attainable by the proposed January 2019 implementation date. We also see cases where added functionality in standby mode could be desired and beneficial. However, this added functionality would require additional power consumption. We are concerned that a single low standby power limit will negatively impact new products from entering the market which seek to provide functionality beyond lighting control. As an alternative, an approach similar to the Energy Star requirements for Small Network Equipment could be followed. For instance, in that standard a base power allowance of 2.0W is given for a wireless access point. Then added power allowance is given for added functionality such as 0.7W for Wi-Fi and 0.3W for	See RESPONSES 2 and 6.

	gigabit Ethernet. A similar approach could be included in the updated Appliance Efficiency Regulations. For instance, communication via a single wireless protocol could have a base consumption of 0.2W and then a second communication network could be implemented with an added 0.2W power allotment. Unfortunately as this market is rapidly developing and changing, we do not believe it is possible to compile an appropriate list today. As such, we suggest that this topic should be revisited again to evaluate the state of the technology and the market in time to include this concept by the 2019 implementation date.	
Ken Whiting	Currently no limit on standby power is proposed until 2019. This will allow for a great deal of experimentation in the market regarding the potential different uses for standby power in LED lamps. With no limit however, the market may be tempted to add features which consume substantial power, but do not provide reciprocal benefits. As such we feel that a 2.0W limit for standby power consumption could be implemented in January 2017 when these lamps become state regulated. A 0.5W limit is currently attainable for a simple connected product, but an added 1.5W would allow new products to come to market with added functionality and prove both the benefits and market acceptance of new technologies.	See RESPONSES 2 and 6.
Ken Whiting	We believe that establishing limits on standby power are an important aspect of increasing LED lighting efficiency while at the same time allowing for advancements in new	This comment supports the standards and does not ask for changes to the standards.

	technology which can lead to added efficiencies.	
NEMA	Standby Power: With its proposal for standby power, the CEC should not drive too hard to reach low levels without studying what functionality might be lost. The overly restrictive proposed level for standby power ignores the growing popularity of lamps with multiple features and with increased capabilities of communications and control within the connected household. Lamps that not only turn on and off, but are also color tunable, act as WiFi repeaters, or support some other functionality may be a critical component of Internet of Things connectivity moving forward. This is because not only is lighting popular thanks to the advent of LED technology, but also because lighting is ubiquitous – it is found in every room in the house. This presence means that strategically placed connected-capable lighting products may serve to connect rooms and floors that would otherwise require hardwired connections or the installation and commissioning of dedicated communications platforms or gateways. The CEC must recognize from their detailed work into lighting controls and into building systems that using functionally-integrated products versus dedicated platforms results in overall energy savings and increased interoperability. Thus it would be counterproductive for CEC to set the standby power maximum limits for LED Lamps so low as to preclude anything but "barely-smart" lamps that only turn on and off, such as the proposed 0.2 watts of standby power suggests. To any potential "loophole"	See RESPONSES 2 and 6. Staff did not find any information that would validate NEMA's comment or that would support its hypothetical. Therefore, no change was made to the standard.

	criticism we note that connected products often cost more, so budget-minded consumers will not be tempted to buy them. Connected lamps are bought specifically because of their connect capabilities and then used for those capabilities. The balance of cost and function in these products is a self-limiting factor which will ensure that they are only purchased when specifically desired. Should the CEC wish to dig further into the energy profiles of connected products, NEMA is open to working with CEC staff to investigate levels of connectivity to see if energy-use profiles can be developed based on functionality, or the CEC could fund CLTC to study connected features and associated standby power levels. The CEC cannot set standby power requirements low and plan to raise them later if technology heads that way for two reasons, 1) CEC influences other regulators and programs, and those entities may seek to similarly restrict product functionality based on CEC's baseless conclusions, and 2) the CEC will not be able to backtrack later on standby power limits without being accused of backsliding. It makes much more sense to set a reasonable level now, and lower it later if technology proves able to deliver the increased connectivity demanded by 21st Century consumers for fewer watts.	
NEMA	Until the capabilities and demands of the functionality of lamps and the associated standby power needs are more well-defined, NEMA recommends the following changes to the standby power clause in the 45-day	See RESPONSE 2.

	language: (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 1.0 watt or less.	
NEMA	(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 1.0 watt or less.	See RESPONSE 2.
GE	Standby Power: As smart lamps with integrated management technology is a developing area containing very few product sales and consuming very little energy, the CEC should not set an overly stringent requirement which will stifle innovation in the area. GE strongly recommends that CEC set the standby power specification for connected lamps at a maximum of 1 watt until such time as more is known about this developing product area. The current 0.2 watt maximum is overly restrictive and could retard development and deployment of smart energy management systems, diminishing opportunities for much greater energy savings than would be achieved through an incremental standby power specification. As an alternative, the CEC could also tie its standby power requirement to the ENERGY STAR LAMPS 2.0 standard.	See RESPONSE 2.
MaxLite	Standby Mode: 0.2W does not take into account many popular features of connected lamps that is now being	See RESPONSE 2.

	requested by customers, and will grow in popularity in the future. We support an increase to 0.5W.	
Philips	Connected Lighting. Standby Power: Others have eloquently commented on the need for an increase in the proposed limit of 0.2W for standby power, even with a January 2019 implementation date, so our comments will be brief. Connected lighting is in its infancy and not even industry, much less the Commission, can foresee its potential. Current applications include remote control, color changing, and Wi-Fi. On the horizon is Li-Fi. As such, it is premature to set a standby power limit as restrictive as 0.2W. Such a limit will hamper innovation and limit non-lighting features which can be incorporated into future products. We urge the Commission to support the NEMA standby power proposal of 1.0 watt and revisit a lower value in a future rulemaking if technologically feasible.	See RESPONSE 2.
Philips	Efficacy: Connected lamps have inherently lower efficacy than their non-connected counterparts. Additional power is used for microprocessor control and RF components. Tunable and color changing lamps use some lower efficacy LEDs (e.g. 2200K white LEDs or RGB LEDs), and require extra optics to mix the light from the different LED colors. The net result is efficacy about 10 LPW lower than a non-connected equivalent. Efficacy limits higher than 70 LPW for connected omnidirectional lamps will severely limit product options. Thus we propose the following efficacy limits for omnidirectional lamps:	See RESPONSE 2.

	<table><tr><th></th><th></th><th>Non-Connected Products</th><th>Connected F</th></tr><tr><td>Effective Date</td><td>Minimum CRI</td><td>Minimum Efficacy (LPW)</td><td>Minimum Effic</td></tr><tr><td>January 1, 2017</td><td>90</td><td>70</td><td>60</td></tr><tr><td>January 1, 2017</td><td>80</td><td>80</td><td>70</td></tr><tr><td>January 1, 2019</td><td>90</td><td>80</td><td>70</td></tr><tr><td>January 1, 2019</td><td>80</td><td>90</td><td>80</td></tr></table> There are few non-omnidirectional connected lamps available at this time, thus it is difficult to make efficacy recommendations for those products now.	
Philips	Efficacy Limits - Connected Lamps: Connected lamps have inherently lower efficacy than their non-connected counterparts. Thus we propose that the efficacy limits for connected omnidirectional lamps be 10 LPW less than those of their non-connected counterparts.	See RESPONSE 2. There is no data in the record that supports Phillips statement that connected lamps have inherently lower efficacy than their non-connected counterparts.
California IOUs	We support the CEC's proposed standby power requirement of 0.2 W maximum. Testing has shown this level to be feasible and given how much time lamps spend in the off or standby state, it is critical that we limit standby power draw.	The comment supports the standards and does not ask for changes to the standards.
Sony Electronics	We are also concerned with the proposed standby mode requirement of 0.2 watt or less. Connected lighting and lightning devices with additional features require standby mode levels similar to those described for consumer audio and video products. In addition, power adders may be required to account for Wi-Fi, Fast Ethernet, Giga Ethernet, occupancy sensors, proximity sensors, webcams and perhaps others. Sony is in the process of developing advanced features to be included in lighting products. We	See RESPONSE 2.

	can only expect to see more of these combination products on the market in the future. No document produced by the Commission includes data or investigations for devices with additional features. Absent any data investigating these devices, Sony believes it is premature to regulate these devices at this point.	
Sony Electronics	Sony recently developed and launched a dimmable LED lamp with audio capabilities. The device connects to a conventional E26 socket just like a general replacement lamp does. The audio and acoustics design make this product similar, but not identical to an ANSI standard lamp shape A. The device connects via Bluetooth to network connected devices to reproduce music from a number of Apps available online. The Bluetooth connection does not provide means to dim the lamp. This device allows consumers to reproduce music and enjoy light at the same time at any location in the home without the need for another standalone audio product that would consume additional energy. It is important to note that incorporating the audio portion into a lamp presented challenges, making it impossible to meet any lamp shape available on the market today, as well as the omnidirectional luminous intensity distribution requirements.	Audio from the device built into the lamps can be and should be turned off when not in use. A standby allowance of 0.2 watts is sufficient to turn on and off any device built in the bulb. Audio can also be turned off during the testing of the lamp. This means that it is not necessary to have an additional allowance for audio capabilities. Staff recommends no change to the proposed standard.
Test Procedure		
Philips	<u>Product Availability - New Product Design and Testing</u> As stated above, only a very small percentage of existing LED	Given concerns raised by manufacturers regarding the time to redesign, manufacture, and test

	lamps will meet the proposed requirements in the 45 day language. This means new models will need to be developed or the design of existing models will need to be modified. There are two elements of the proposed requirements that create bottlenecks in the product development process: the first is the uncertainty associated with the final DOE test procedure for Integrated LED Lamps; the second is the test procedure called out in the 45 day language for LED life and lumen maintenance, IES LM-84/TM-28. The staff report indicates that the final rule for the DOE LED lamp test procedure is expected to be issued in November 2015 before the proposed regulations become effective. It is now December and the DOE final rule has yet to be issued, and may not be before the regulations are finalized. Furthermore, in both the staff report, and in the public hearing on November 18th, the Commission indicated that they would revise the regulations to match the DOE test procedure. This leaves manufacturers in a quandary. Do they start designing and testing now to LM-84/TM-28 which is in both the DOE and CEC proposals, or do they wait until the DOE final rule is issued? Regarding the second bottleneck, IES LM-84/TM-28, as Philips mentioned in the public hearing, and as stated in the comments submitted by NEMA, this method is not in common use. IES LM-80/TM-21 is the preferred method for determining lumen maintenance.	products, the Energy Commission has modified the effective date of the proposed general service LED lamp standard for Tier I from January 1, 2017 to January 1, 2018 and for Tier 2 from January 1, 2019 to July 1, 2019. This will provide sufficient time to manufacturers to test and submit their data for certification to the Energy Commission. The Energy Commission wrote its proposed regulatory language to match the then-proposed U.S. DOE test procedure for general service LED lamps. Ultimately, the Energy Commission will be preempted from using a different test procedure than DOE for those products covered under DOE's rule.[26]

26 http://energy.gov/sites/prod/files/2014/05/f15/led_tp_snopr.pdf

	A lamp manufacturer begins their design with LM-80/TM-21 information from the LED chip manufacturer. The LM-84/TM-28 process would add another 6000 hour test on top of the LM-80/TM-21 testing. This adds approximately 9 months of testing to the product development cycle before a product could be certified. Add a few months on the front end for product design, and a manufacturer will have to start the product development process in January 2016 at the latest to have a product certified to the Commission for January 2017. This process would have to be repeated for hundreds of models in order for model availability to return to 2015 levels, stretching problems with availability until late 2017. It is also possible that in the absence of significant changes to the 45 day language, manufacturers could elect only to redesign a portion of their full portfolio for the California market. We also wish to caution the Commission that using LM-84/TM-28 as a test procedure does not increase product reliability. These methods only take into account factors that affect lumen maintenance; reliability of the circuit components, for example, is not accounted for. Thus, any thought that using LM-84/TM-28 will improve reliability is unfounded. As a way to encourage quicker adoption, once the minimum performance requirements are in place we encourage the Commission to engage California utilities to expand their rebate programs to those lamps that meet the Title 20 minimum requirements.	
Philips	Alternate Certification Path: We request that the CEC allow that lamps which meet the final Title 20 requirements and	The Energy Commission is required to use the DOE test procedure for covered products, and

	meet the Energy Star criteria can be certified using the same data that were used for Energy Star certification. The point of this request is to avoid duplicate testing for life and lumen maintenance.	cannot choose to use a different test procedure. As long as the appropriate test procedure is used and the test laboratory that conducts the testing is approved by the Commission, the data certified may be used to certify to both ENERGY STAR and the Energy Commission's Appliance Efficiency Database. No change is necessary to implement this.
Sony Electronics	Lastly, the ENERGY STAR Program Requirements for Lamps version 1, and the soon to be released version 2, exclude lamps incorporating power-consuming features which do not provide illumination (e.g. audio functions, air fresheners, and cameras); and LED lamps that could be mistaken for a general purpose A-lamp replacement that do not meet the omnidirectional luminous intensity distribution requirements.	Additional features as described in the comment are allowed to be turned off during test. If they cannot be turned off then their wattage or energy consumption should be included in the lamp wattage. There is no exemption for additional features in the proposed standards, and the commenter has not provided sufficient evidence to justify an exemption, other than a hypothetical future product. Staff recommends no change to the proposed standard.
GE	Test Methods: GE supports the NEMA comments on testing concerns. In particular it is extremely important for the CEC to continue to allow the use of LM-80 and TM-21 to show compliance. The LM-84 and TM-28 standards are inappropriate to mandate at this time given the rapid pace of change in these methods. Alternatively, allowing a manufacturer to use either set of standards to show	The Energy Commission wrote its proposed regulatory language to match the then-proposed U.S. DOE test procedure for general service LED lamps. Ultimately, the Energy Commission will be preempted from using a different test procedure than DOE for those products covered under DOE's rule.[27]

27 http://energy.gov/sites/prod/files/2014/05/f15/led_tp_snopr.pdf

	compliance would also be acceptable.	
Tolerances/Sampling		
NEMA	CRI and its Subcomponents: It is clear to NEMA and its members that the CEC's treatment of CRI demonstrates some fundamental misunderstandings of the science of light. The CEC is straying from its expertise in the area of energy efficiency, and unreasonably impairing innovation, consumer choice, and market opportunities to accelerate market adoption of LED products. Manufacturers of lighting products have been deeply engaged in the science of lighting and the confluence with consumer preference for decades. NEMA manufacturers compete and design lighting products with consumer acceptance, adoption, and preference as the primary target of their endeavor. It is a complex subject that balances important variables, and it should not ignore the importance of manufacturing tolerances and supply chain logistics that can be critical to accelerating consumer adoption.	This comment appears to recommend lowering the CRI requirements to permit greater tolerances in the manufacturing process. To that extent, see RESPONSES 1 and 3. The Energy Commission made changes in 15-day language to address concerns about tolerances by requiring the sample of light bulbs for purposes of testing, certification, and enforcement to match what is required by the U.S. Department of Energy. This sample size is larger than typical for an appliance, allowing for more variation within that sample size while still being able to meet the efficiency standard. No further change was made to the regulation.
GE	If enacted as proposed, these regulations would create an unworkable enforcement environment, where no one in the supply chain can be certain that any product ever actually complies. This is especially true for importers, distributors and retailers doing business in California. For instance, a single Duv number listed on an LM-79 report does not provide adequate information to the Commission and Distributors about the manufacturing process tolerance	The Energy Commission made changes in 15-day language to address concerns about tolerances by requiring the sample of light bulbs for purposes of testing, certification, and enforcement to match what is required by the U.S. Department of Energy. This sample size is larger than typical for an appliance, allowing for more variation within that sample size while still being able to meet the

	capability that this metric measures.	efficiency standard. In addition, staff modified the 15-day language to use ANSI C78.377- 2015 requirements, which specify tolerances for Duv. This should clarify Duv tolerances specifically.
General/Miscellaneous		
Betty Grose	In 2018, and after, (in other words, always,) I still want to be able to use incandescent, halogens, fluorescents, and HID, even if they are 2.5" diameter or less! Can you please help me out?	Proposed standard is technology neutral and those technologies can continue to exist if they can meet the standard. No change is needed.
California IOUs	Overview: The Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas (SoCal Gas), San Diego Gas & Electric (SDG&E) Codes and Standards Enhancement (CASE) Initiative Program seeks to address energy efficiency opportunities through development of new and updated Title 20 standards. This document outlines the California Investor-Owned Utilities' (IOUs) CASE team response to the California Energy Commission's (CEC) Express Terms (45-day language) published in October 2015, "Small Diameter Directional LED Lamps and General Purpose LED Lamps" (herein referred to as the 45-Day Language) and discussion in the subsequent CEC workshop on November 18, 2015. The comments in this document focus on the proposed standards for state-regulated light emitting diode (LED) lamps. We are supportive of the CEC's proposals to set minimum efficacy, performance and quality requirements for LED	This comment provides an overview and describes the history of CFLs and LED lamps in California. It supports the Commission's standards and does not request changes to the standards.

	lamps to help ensure consumer satisfaction and thus increase market adoption of LEDs. As we saw with Compact Fluorescent Lamps (CFL), an initial sales surge is not indicative of complete market transformation. CFL market share skyrocketed from below 1% to over 30% in approximately 5 years in the late 2000's as soon as their price dropped below $5-10, but market share plateaued after that, even as prices continued to decline below $2. This experience proved that low prices alone are not enough – product performance is an important aspect of consumer acceptance and complete adoption. Fortunately, we've seen a trend towards improved LED performance over the last several years, resulting from the great innovation of the LED industry, in concert with California's recent work in this area of LED quality standards and specifications. The market has responded to the CEC's 2012 Voluntary LED Quality Specification with a steady stream of high quality products, at ever dropping prices, and ever improving efficacy. Lamps have been introduced with extremely high color rendering, with great dimming capability, long life, etc. The CA IOUs' rebate programs have been supporting these products for the last two plus years. While the CEC's Voluntary Specification and the associated rebates helped to incentivize these high performing products, it cannot prevent products that don't render colors well, that flicker or buzz when dimmed, or that mislead consumers with their packaging from undercutting these products. Another simultaneous recent trend in the LED market is a "race to	

	the bottom" in terms of product quality and performance, with manufacturers cutting corners wherever possible and competing on price alone for early market share and early adopters. These products may be good replacements for CFLs, but they do not provide the level of service and amenity needed to compete with incandescent lamp performance and fully transform the market. The CEC's Title 20 proposal in the 45-day language goes a long way towards preventing products like these from "poisoning the well" and resulting in a loss of consumer confidence in LEDs. The CEC's Title 20 proposal does not require LED lamps to be "best-in-class" – it is not as strong as the CEC Voluntary Specification for example, nor is it as strong as the original CASE proposal from the CA IOUs. But it does require a solid foundation for a minimum performance standard, and it establishes a level playing field upon which manufacturers can compete. This rulemaking is California's opportunity to drive the market transformation to LED lamps by ensuring that LED lamps provide a minimum level of amenity and efficiency. If CA can convert the remaining low efficacy sockets to LEDs, the annual statewide savings would be on the order of 30,000 GWh, enough to achieve the State's AB 1109 goals. Below is a summary of the specific comments and recommendations made in this document regarding the CEC's proposed LED lamp standards.	
NRDC	NRDC is very supportive of the CEC proposal and recommends CEC make some small modifications to its	Staff appreciates NRDC comment. No change is

	proposal and publish 15 day or 45 day language, and then vote to adopt the updated proposal without further delay.	needed here.
Acuity Brands	1) The proposed Title 20 standards for General Service LED lamps result in conflicting standards with the current Title 24 Joint Appendix JA8.	Proposed standard has no conflict with current T24 and Appendix JA 8. No change to the proposed standard is recommended.
Acuity Brands	Title 24 is focused on the installed performance of a lighting system for new construction and major renovations. Title 20 is a prescriptive equipment standard for covered products sold in the state of California. Title 20 requirements apply to all covered products for replacement, renovation or new construction. However, differences between Title 20 and Title 24 JA8 result in the unintended consequence for manufacturers to design products to meet the most stringent requirements for both standards. (See Appendix A). Manufacturers could design and market a product to meet only the Title 20 requirements and another product to meet both Title 20 and Title 24 JA8. This solution increases the manufacturer's engineering time, additional cost associated with the administration of additional SKU models, marketing materials to describe the different products, and creates confusion in the market place. Furthermore, retailers who serve customers in the replacement, retrofit and new construction market are not willing to double the shelf space dedicated to this product type.	Title 20 standards do not conflict with Title 24 requirements. It is possible to design a lamp that meets both JA8 and Title 20 – in fact, a JA8 compliant lamp would have to meet most of the Title 20 requirements, although Title 20 requires significantly higher efficacy than JA8. This is frequently the case with appliances that may be used in new construction, including HVAC products and lighting products. Title 24 may set performance levels that push the envelope on efficiency for the limited new construction market, while the Title 20 standards are minimum standards for what is sold or offered for sale in the state.
Acuity Brands	We recommend that the CEC: Address the conflicts between Title 20 and Title 24 JA8. The CEC must immediately	There are no conflicting requirements between T20 and T24. A lamp can be designed to meet

	address the conflicting requirements between Title 20 and Title 24 JA8. The analysis mentioned by staff in the November 18, 2015 hearing should be made publically available for industry revaluation. We strongly urge the CEC to remove prescriptive requirements from Title 24 JA8 if a product is covered in the scope of Title 20. This will streamline the focus on high efficiency retrofit products available in the California market and will eliminate confusion among retailers, designers and consumers. While it is not our recommendation to attempt to harmonize the requirements between these two standards, if the CEC chooses this course of action as a short term solution, the requirements that present the most significant issues include LPW (including the Compliance Score), the color metrics (CRI and R1-R9 values) and standby power.	both the Title 20 and the Title 24 requirements. Moreover, the standards under Title 20 and Title 24 are for different purposes. Title 20 covers new products sold or offered for sale in the California market, and applies to all lamps identified under the scope of the regulations. In contrast, Title 24 applies to products installed in new construction, and the scope of the products covered under those standards is significantly broader (all residential lights, including lamps and luminaires). What may be appropriate for a minimum standard under Title 20 may not be appropriate for a minimum standard under Title 24.
Acuity Brands	Conflicts between Title 20 and Title 24 JA8: As mentioned above, we are concerned about the conflicting standard between Title 20 and Title 24 JA8, specifically for down light retrofits. Appendix A illustrates the combined requirements that will be applied to this product class. The cost to provide a product meeting both Standards and the cost to manage the development and administration of different grades of products for each California standard has not been evaluated and diverts manufacturing focus on future energy innovations. Furthermore, retailers who provide products for residential and commercial applications are unlikely to devote shelf space to multiple product offerings based on	Title 20 standards do not conflict with Title 24 requirements. It is possible to design a lamp that meets both JA8 and Title 20 – in fact, a JA8 compliant lamp would have to meet most of the Title 20 requirements, although Title 20 requires significantly higher efficacy than JA8. This is frequently the case with appliances that may be used in new construction, including HVAC products and lighting products. Title 24 may set performance levels that push the envelope on efficiency for the limited new construction market, while the Title 20 standards are minimum standards for what is sold or offered for sale in

	conflicting standards.	the state.
Acuity Brands	At the November 18, 2015 hearing, CEC staff indicated that there was an evaluation of the proposed requirements in Title 20 compared to Title 24 JA8 and concluded that there is no conflict between the two standards. We request that this analysis be made publically available. We further request that the CEC take immediate action to resolve issues associated with more stringent or additional metrics required by Title 20 that are not included in Title 24 JA8. Longer term, we request that CEC take action to remove the redundancy of standards in Title 24 for products that are covered in the scope of Title 20.	Title 20 standards do not conflict with Title 24 requirements. It is possible to design a lamp that meets both JA8 and Title 20 – in fact, a JA8 compliant lamp would have to meet most of the Title 20 requirements, although Title 20 requires significantly higher efficacy than JA8. This is frequently the case with appliances that may be used in new construction, including HVAC products and lighting products. Title 24 may set performance levels that push the envelope on efficiency for the limited new construction market, while the Title 20 standards are minimum standards for what is sold or offered for sale in the state. The analysis requested was not prepared in a document, but conclusions regarding the analysis are available as part of the NOPA. Modifications to Title 24 are outside the scope of this rulemaking proceeding, so no change was made there.
Green Creative	As a California based LED lighting manufacturer, GREEN CREATIVE supports the commission on the advancement of higher quality Solid State Lighting Products as a path to greater energy savings and market transformation. As stated during the recent public hearing we support the recent Title 20 draft	The comment supports the standards and does not ask for changes to the standards.

	language and will work with your staff on helping to resolve issues toward final adoption	
Green Creative	GREEN CREATIVE does not see any supply issues related to title 20 in terms of California having access to high quality Title 20 compliant lamps, especially within the time frames specified.	The comment supports the standards and does not ask for changes to the standards.
LumiLEDs	In closing, the proposal for LED lamps as detailed in the 45 day language is a somewhat arbitrary definition of high performance which would drive up cost and leave a great many LED devices behind that could otherwise support the CEC's effort to reduce energy consumption in California. National LED lamp shipment data illustrate that consumers are rapidly adopting LED lamps, and that the adoption curve for LED lamps in no way resembles that of CFLs. There is still, however, tremendous room for growth of the LED lamp market which would be enabled by lower shelf prices, not by unnecessarily restrictive regulations which would eliminate consumer choice and drive up shelf prices.	See RESPONSES 4 and 8.
Cree	Summary: Assuming the Title 20 omnidirectional light requirements are aligned with the proposed ENERGY STAR 2.0 requirements, Cree believes that providing GSL and decorative lamp products that meet the proposed standards as of January 1, 2017 is quite possible. However, in some cases, these products will be priced at least 20% higher than otherwise high-quality products that fall slightly shy of the proposed standards. Once again, contingent on the assumption that Title 20 omnidirectional light requirements are aligned with the proposed ENERGY STAR 2.0	In 15-day language, the Commission extended the effective dates for the general service LED standards to provide manufacturers additional time to adjust manufacturing processes and designs to make compliant lamps at a low cost. Staff updated the omnidirectional light requirements to align with the ENERGY STAR 2.0 requirements in revised 15-day language. No other changes are requested or needed.

	requirements, Cree is confident that technology developments can lead to compliant lamps at relative price parity later in 2017. If California is prepared to compensate for the price delta with sufficient utility rebate programs, then California consumers can begin to enjoy the benefits of products meeting the proposed specification after January, 2017. Otherwise, we propose that the effective date be delayed until later in 2017 or early 2018.	
Philips	Oversights in the 45 Day Language: There appear to be a few unintended consequences of the 45 day language which could be characterized as serious oversights. These include lamps for emergency egress applications; efficacy requirements for decorative lamps; efficacy limits and low wattage lamps, particularly dimmable lamps; and connected lighting.	This comment is an overview of several specific issues raised in more detailed comments. See detailed comments for responses to each issue.
Philips	Our comments will show that the proposed 45 day language will: Penalize California consumers financially. They will have no choice but to buy more expensive and less efficient bulbs than consumers in the rest of the country. Reduce the availability of LED lamps in California by at least 70-90%, depending on the product type. We will also address a number of significant oversights in the language that merit correction. We ask that the Commission review our comments and recommendations,	See RESPONSES 1, 3 and 4.

	and address them with new 15 or 45 day language.	
Philips	In future rulemakings, we hope to see a greater level of scrutiny towards the requirements and associated technical analyses before regulatory language is published for comment. In particular, Philips and our industry colleagues wasted many hours investigating the technical feasibility of the Duv limits proposed in the 45 day language. We appreciate that the intended limits were presented by staff at the public hearing and look forward to the publication of new language that includes the correct Duv requirements for review.	45-day language is an opportunity for stakeholders to raise and point our issues and errors in the proposed regulatory language. Stakeholders are welcome to contact the Energy Commission at any point if there is a concern or issue in the regulatory language, and need not wait until the end of the 45-day comment period. The Energy Commission corrected any errors and made additional modifications through subsequent 15-day language, as required under the Administrative Procedure Act.
NEMA	The CEC appears to be undertaking its proposed course of action with the prospect of federal preemption, as provided in Section 327 of the Energy Policy and Conservation Act (EPCA), 42 U.S.C. §6297, in full view. As the CEC Staff Report in this proceeding acknowledged, the United States Department of Energy (DOE) has initiated an energy conservation rulemaking for general service lamps that is expected to be completed before January 1, 2017. A Notice of Proposed Rulemaking (NOPR) in the DOE's general service lamp rulemaking is currently understood to be under review at the U.S. Office of Management and Budget, and publication of the NOPR in the Federal Register is expected shortly. While the DOE's proposed position on the scope of a general service light emitting diode lamp in the NOPR is not officially known, a Preliminary Technical	The Energy Commission has reviewed the relevant statutes and existing and ongoing federal regulations and considered the potential for federal preemption. LED lamps are not a "covered product" for purposes of 42 U.S.C. § 6297. The Commission has concluded that the proposed regulations are not presently preempted and, therefore, the rulemaking is not affected.

	Support Document released by DOE in December 2014 signaled DOE's pre- NOPR view on the definition of a general service light emitting diode: "DOE appreciates NEMA's proposals for definitions to support the LED lamps covered in this rulemaking. As stated previously, DOE has tentatively determined that the term general service LED lamp includes both integrated and non-integrated LED lamps. Therefore, DOE has decided to propose a more general definition similar to the definition proposed for "compact fluorescent lamp" discussed in section 2.3.2 to clearly explain this determination. DOE is proposing the following definition for general service LED lamp: General service light-emitting diode (LED) lamp means an integrated or non-integrated LED lamp designed for use in general lighting applications (as defined in 430.2). As stated in the definition, general service LED lamps are used in general lighting applications. In the framework document, DOE considered including in this rulemaking all LEDs that serve general lighting applications and are not the lamp types or shapes excluded from the GSIL definition in 42 USC §6291(30)(D)(ii). As discussed in section 2.3.2, DOE reassessed its interpretation of the exemptions from the GSIL definition, referred to in the GSL definition, and determined that because the definition of GSL in 42 USC §6291(30)(BB)(i) explicitly states that the term includes general service LEDs, the intent of the definition was to	

	consider all general service LEDs to be GSLs. DOE determined that the exemptions for certain bulb shapes and lighting applications in the GSIL definition do not generally apply to the other lamp types included in the definition of GSL. Otherwise all LED lamps would be considered exempt, rendering the inclusion of LED lamps in the GSL definition a nullity. In this preliminary analysis, DOE assessed whether LED lamps exist that are designed for specialty applications and therefore cannot provide overall illumination. DOE identified LED lamps that were designed for specialty applications and are not able to provide overall illumination, including black light lamps, bug lamps, colored lamps, plant light lamps, and silver bowl lamps. DOE is considering providing exemptions for these specialty applications, which are discussed further in section DOE requests comment on the LED lamps identified for specialty applications that cannot provide overall illumination and if there are other LED lamps that should be considered. DOE also requests comment on its proposed definition for general service LED lamp." What will emerge from DOE's rulemaking and DOE's definition of "general service light- emitting diode (LED) lamp" is the scope of what DOE considers to be the LED "covered product" included in Congress' definition of general service lamp in the Energy Independence and Security Act of 2007 amendments to the Energy Policy and Conservation Act. 42 U.S.C. §6291(BB). The DOE's proposed	

	definition cited above includes both omnidirectional as well as directional and reflector LED lamps as well as integrated and non-integrated LED lamps. If the DOE continues with this definition through its Final Rule expected later in 2016, which is what NEMA currently anticipates, it is clear that nearly all (if not all) of the LED products that the CEC proposes to regulate in this rulemaking will be covered products under federal law, and under Section 327 of EPCA the CEC's energy conservation standards for these covered products will be preempted. Section 327(b) of EPCA, 42 U.S.C. §6297(b), preempts state laws and regulations with respect to covered products before a federal energy conservation standard becomes effective for that covered product. There are exceptions to this express preemption spelled out in the statute, and only one is applicable in the case of the CEC's proposed action in this proceeding. 42 U.S.C. §6297(b)(1)(B)(ii). Federal preemption is effective for the entire scope of the covered product, whether or not the DOE establishes an energy conservation standard for every class or type of product within the scope of the covered product. If, as expected, the DOE promulgates energy conservation standards for general service LED lamps prior to January 1, 2017 with the definitional scope that the DOE has proposed, the CEC's regulation will be preempted at that time. In view of the manner in which the DOE rulemaking appears to be unfolding, the proposed CEC regulations in this proceeding might be expected to have a	

	shelf-life of less than one year from now. "The exclusive exception to preemption that Congress provides to California in the event that a federal standard was adopted for general service lamps is to permit those two states to accelerate the adoption of the federal rule to "no earlier than 12 months prior to the Federal effective dates prescribed under subparagraphs (A), (B), and (C) of section 325(i)(1), at which time any prior regulations adopted by the State of California . . . shall no longer be effective."" Id (emphasis supplied). The CEC staff's treatment of federal preemption in the Staff Report, while explicitly acknowledging federal preemption, is vague on the scope of what might be preempted, and NEMA has interpreted this vagueness to the fact that the DOE's general service lamp rulemaking was in its "preliminary analysis stage." The CEC staff report states: "In addition, the DOE is in the preliminary analysis stage of a "general service lamp" performance standard that would, as currently proposed, cover medium screw base LED omnidirectional lamps. The performance standards that would be finalized through this process would also eventually replace state-specific standards where the scopes overlap. The standards, however, are not likely to take effect until 2020, leaving a significant amount of energy and cost savings opportunity unrealized in the meantime." While it is true, as the CEC staff notes, that the DOE appears to be focused on regulating medium screw base LED	

	omnidirectional lamps at this time, the DOE has clearly indicated that that is not the scope of the general service LED lamps that they intend to "cover" as a federally-covered general service LED lamp product. Federal preemption applies to the covered product as a whole, not specific classes within that covered product for which the Secretary of Energy may choose to enact an energy conservation standard.	
NEMA	Since the release of 45-day express terms on October 15, 2015, lamp manufacturers represented by NEMA have put significant resources into investigating whether existing lamp products could comply with the proposed regulation. It was not possible for manufacturers to complete that investigation for their entire catalog during that short period, but preliminarily, as of the date of the November 18th hearing, NEMA members were finding that only a very tiny number of lamps available today could meet the proposed regulation. This outcome would not bode well for California residents or lamp manufacturers in and out of California. Conversations with CEC before, during and after the November 18th hearing indicated that there are some errors in the text of the 45-day express terms that led to this preliminary determination and we understand revisions are likely. The manufacturers' preliminary determinations raised a significant question whether the proposed regulation reflected in the 45-day express terms met the necessity, clarity and consistency requirements of California Government Code §11349.1(a).	See RESPONSES 3, 5, 6, and 10. In addition, changes were made in the 15-day language addressing the availability of energy efficient SDDLs for certain specialty applications. See RESPONSE 11. Staff acknowledges a few errors in the 45-day language, which it corrected both at the workshop, in 15-day language, and in revised 15-day language. With these corrections, the express terms meet the necessity, clarity, and consistency requirements of the Administrative Procedure Act as well as the other requirements of the Warren-Alquist Act.

	Our conclusion is that the proposed regulation did not, and our more detailed set of comments that follow our general comments is aimed at meeting those requirements, as well as other requirements of the California Government Code, §§11346.2, 11346.5, 11349 and the Warren-Alquist Act.	
NEMA	Past versus Present: Time and again over the past two years, NEMA has heard from Commission staff and others the refrain "We can't repeat the CFL experience!" NEMA understands and appreciates the spirit of this remark insofar as the intent is to avoid the historical issues with market adoption of CFLs. NEMA does not understand or appreciate the refrain's application to the market's already phenomenal early-stage adoption of LED technology.	See RESPONSE 8.
NEMA	Lastly, we suggest that some of the misunderstandings noted in these comments may stem from the use of an older regulatory model, older ways of thinking, employed in this rulemaking. Previous regulations addressed well-established technology or technology evolved from well-established components (new applications of old technology).	See RESPONSES 5 and 6.
NEMA	In the course of our detailed comments below, we may indicate in some places that the CEC's proposed rule has reached a conclusion that "no reasonable person could have reached the same conclusion." We do not intend any disrespect to the commissioners or the CEC staff by this remark, but we note that it is a legal requirement in	See RESPONSES 1, 3, 6, and 10. In reviewing the entire record, under any standard, "substantial evidence" or "reasonable person", staff has provided ample factual and empirical evidence to support the feasibility and cost effectiveness of the proposed regulations. In contrast, NEMA has

	California that agency determinations be supported by substantial evidence and the appellate courts in California have stated that regulatory conclusions will be reversed if, based on the evidence "a reasonable person could not have reached the same conclusion." Families Unafraid to Uphold Rural El Dorado County v. Board of Supervisors, 62 Cal.App.4th 1332, 72 Cal.Rptr.2nd 1 (3d Dist. 1998). Key aspects of the proposed rule do not meet this requirement. We have endeavored to provide our reasoning in that regard, but we welcome dialogue with the commissioner and commission staff if further clarification is required.	not provided any data or evidence to support a different conclusion. Rather, NEMA has simply disagreed. Mere disagreement is not sufficient to support a change in the regulation.
Robert Clear	I nonetheless have found a number of significant errors, general sloppiness (in both directions with regards to supporting or not supporting staff proposals), misinterpretations, and unexplained or unjustified assumptions in the supporting staff report. I am therefore submitting an objection to the proposed amendment	See RESPONSES 1, 3, and 6. The commenter did not provide additional information about the "significant errors" or misinterpretations in the staff report or regulations. The Energy Commission identified some errors and issues, and modified these in 15-day language. Additional changes were not necessary.
American Lighting Association	Additionally, with on-line sales continuing to grow and no broad enforcement of such sales on the horizon, we believe that California consumers will increasingly order unqualified lamp products from out-of-state to get what they want at lower prices. This, of course, puts local retailers, including scores of ALA retailers in California, who sell qualified products as well as invest in an increasing range of lighting training for consumers ,at a	Online retailers, like brick-and-mortar retailers, who sell or offer for sale products in California that are subject to the Commission's appliance efficiency standards are subject to administrative penalties and other enforcement action under sections 1608 and 1609 of Title 20.

	significant disadvantage	
American Lighting Association	The proposed Title 20 regulations will further slow the adoption rate of LEDs in California,which in turn will decrease the amount of potential energy savings. Without significant changes to the proposed regulations, the ALA feels the CEC will fall well short of their desired energy savings. Again,thank you for the opportunity to comment and we hope the CEC will address our Concerns.	See RESPONSE 4.
MaxLite	Portable Luminaires: The standards now state portable luminaire must "be an LED Luminaire or a portable luminaire with an LED light engine with integral heat sink." The use of the word integral is unnecessary in this sentence and could cause confusion. The IES RP16 definition of a LED light engine already includes by definition a heat sink (along with LED module and driver).	Comment is related to existing portable luminaire regulations and beyond the scope of this proceeding. No changes were proposed to this section of the portable luminaire regulations. Therefore, no changes are recommended.
MaxLite	Table N-2: As referenced above, the use of the term "Integral Heat Sink" is not necessary here.	Comment is related to existing portable luminaire regulations and beyond the scope of this proceeding. No changes were proposed to this section of the portable luminaire regulations. Therefore, no changes are recommended.

November 18, 2015 Hearing Transcript

Commenter	Comment	Response
Chromaticity/Consistency		
GE	In the Staff Report, there was a discussion of the white color space or, for those that might be more familiar with the DUE definition, Modified Spectrum Lamp. That is no longer found in the express terms. There are products GE reveals, one that we manufacture today, that actually operate in this white space. This is below the black body, and what has over time shown a consumer preference for that color of white. We've talked a lot today; you've heard a lot of different people talk about preference. Well, what you need to make sure is that you are offering the right amount of preference to the end user. These products are just as efficient and actually have seen a higher amount of adoption. The Lighting Research Center and others back as far as 2012 have actually shown this in real world data and studies that this color point is something that is real, and with more research you will see more and more products be manufactured to that spec. Indeed, the Staff Report indicated the CEC intended to allow this lamp type to continue, however, the proposed restrictive color requirements were not	This comment relates to the chromaticity and color consistency requirements of the general service LED regulations. The Energy Commission established standards for lamps that were blind to specific models or technologies. The Energy Commission modified its regulations in 15-day language to allow use of national standards, such as ANSI C78.377-2015, Annex B, Table 1, as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). Alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.

	allowed the continued sale of this lamp.	
GE	Number one, the DUV. As Jim mentioned, we spent a lot of time focusing on the overall DUV equation that was in the action express terms. As a part of that, what we have actually seen and would like to make light of is that the overall specifications today for DUV come from ANSI. That overall standard has been in effect since 2008. ENERGY STAR has used it as part of their overall certification since 2009. We have not seen an outpouring of disapproval from the consumers regarding that spec, and we continue to see mass adoption in other parts of the country and in the world with that spec as the baseline. Our recommendation is actually to keep it consistent with the actual ANSI spec so that in time when we would like to make an update as technology does increase, we can make small changes to the overall regulation to add total control. The constriction of the DUV space from seven steps to four has a fundamental cost impact. That cost impact is, as Alex has described, is at the LED level, but is even greater at the lamp level. So every time an LED actually costs more, it actually is also very difficult for a manufacturer like ourselves to handle all the different bins of LEDs. Currently today we have to recipe LEDs which essentially is a technical way of taking one LEDs from one reel to another reel to try to mix them together and actually get a consistent color point. Once you start taking down the number of bins that we can	The Energy Commission modified its regulations related to chromaticity and color consistency in 15-day language to allow use of the ANSI C78.377-2015, Annex B, Table 1 (4-step ANSI quadrangle), as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). A 7-step ANSI quadrangle would not be as effective at achieving this goal, although it costs manufacturers less to make a lamp that complies with 7-steps instead of 4 steps. Other alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.

	actually go through and mix, you actually start to us to lose yield, right? And once you start to lose yield, your economies of scale grow much much smaller, and that fundamental cost impact will be simply passed on to the consumer. So to say that there's no cost impact with respect to going to a four step eclipse is fundamentally technically wrong.	
GE	We have found that the number one parameter for adoption is cost. If you were to go ask any consumer what DUV their lamp is, and what they really would like, they wouldn't be able to even explain to you what it is. I spend some of mine, and people laugh, at least one week a month in a big box retailer or a store simply sitting in the lighting aisle trying to understand what the consumer habits are. You know, at GE we feel that the consumer is the ultimate voice. And what you'll see is that most of them don't understand the majority of the different technical discussions we're having today. And what we kind of try to do is use them and understand and be their trusted advisor. The other large inconsistency that we see is something called the White Color Space.	The Energy Commission modified its regulations related to chromaticity and color consistency in 15-day language to allow use of the ANSI C78.377-2015, Annex B, Table 1 (4-step ANSI quadrangle), as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). A 7-step ANSI quadrangle would not be as effective at achieving this goal, although it costs manufacturers less to make a lamp that complies with 7-steps instead of 4 steps. Other alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation. It is exactly because consumers are not familiar with Duv that it is necessary to prescribe parameters around a light bulb's performance to ensure that customers receive the light that they expect.

Cree	I think this published language with the DUV correction, and I will echo the comments earlier about someone that said they worked, but I think the specs as published represent a good body of work and I offer my thanks to both the staff and the Commission. That's all. Thank you.	This comment supports the standards and does not ask for changes to the standards
Philips	I'd also like to make a comment on what Mark said. NEMA has been operating under the assumption that the written text regarding DUV in the 45-day language is correct. Mark's statements were based on the document, which limited DUV to less than plus or minus two MacAdam steps from a band of less than two steps. That was changed in the presentation we just saw this morning, so there are actually some products that do meet the spec with that DUV change; however, that doesn't change our objection to the elevated color performance specs. So we're pleased that CEC has realized the error in the definition of the color uniformity requirements and in the future we'd like to see a greater level of scrutiny and internal checking of the technical analysis and requirements prior to publication of the language. Industry members spent a lot of time fretting over the color uniformity spec and investigating its technical feasibility, doing data mining and analysis. Given the short time period between publication of 45-day language, this hearing, and the deadline for public comments, it's very unfortunate that considerable time and effort was wasted on the	45-day language is an opportunity for stakeholders to raise and point our issues and errors in the proposed regulatory language. Stakeholders are welcome to contact the Energy Commission at any point if there is a concern or issue in the regulatory language, and need not wait until the end of the 45-day comment period. The Energy Commission corrected any errors and made additional modifications through subsequent 15-day language, as required under the Administrative Procedure Act.

	incorrect spec.	
LumiLEDs	We have four technical comments for the Commission's consideration. The chromaticity requirements create a two-step band of acceptability which is too restrictive and would eliminate more than 70 percent of LED packages falling within the American National Standard for LED chromaticity. So Lumileds requests that you simply make normative reference to Table 1 of the American National Standard and CC78.377, the 2015 version. That takes care of it and makes it very simple, straightforward, and aligns with what the industry is doing.	Staff has made the requested change in the 15 day language.
Consumer Choice		
Philips	Product cost is recognized as the most significant hurdle to adoption, I think everyone knows that. It's the very reason why rebate programs exist in many states for high efficiency products. Low cost, but good performing products with CRIs of 80 and 65 and above lumens per watt products are flying off the shelves in stores nationwide. They're typically priced in the $5.00 range and in 2014, over 18 million CRI 80 lamps were sold in the U.S., alone. At the same time, the sale of CFL products has slowed dramatically as customers show a clear preference for led bulbs. It's obvious in the market that the conversion to SSL and away from incandescent halogen and CFL products is occurring	Phillips' comment that "good performing products with CRIs of 80 and 65 and above lumens per watt products are flying off the shelves in stores nationwide. They're typically priced in the $5.00 range and in 2014, over 18 million CRI 80 lamps were sold in the U.S., alone" is factually inaccurate. The sale of 18 million CRI 80 lamps nationwide means that about 2 million lamps were sold in California (based on California's lamp sales share being about 12 percent of national sales). There are 622 million medium screw base sockets in California; therefore the sale of 2 million LED lamps is less than 1 percent. See also RESPONSE 8 (regarding the CFL experience) and

	rapidly, and the mistakes that hindered CFL adoption are not being repeated. This is being clearly articulated by the DOE in recent reports where the led adoption rate is almost a factor of 50 times faster than CFL was in a similar stage of its product lifecycle. Given the radical market shift voluntarily towards led products, we're extremely concerned that over regulation may slow the adoption of led products and greatly reduce the amount of actual energy savings it's possible to achieve with more reasonable Standards. The CEC should not be mandating high performance as a state minimum, only to increase the primary obstacle to adoption, i.e. cost.	RESPONSE 4 (regarding consumer choice). See RESPONSE 1 regarding the necessity and determination regarding CRI.
Green Creative	And as an example on that front, I mean, the gentleman up here mentioned you now have $.99 LEDs in the store. So if that was going to be something, maybe this is a non-parallel, but something required two years ago, everyone in the room would have balked at that. But case in point, within two years the market adapted and the costs have come down. But what I also see is that's a great motivation, but we also see a lot of lower quality products being supported, you know, at the utility level and on the market sign, of course, it's cost driven. Consumers may have different flavors or appetites, but at the core it is a cost. And if there's not a line in the sand, not some clear mandate, that gets thrown to the wayside and you can see some poor quality things go in, and I don't think that's what any of	The comment supports the standards and does not ask for changes to the standards.

	us want to see. You know, and I wanted to highlight in terms of the product side, these are two items we have today that meet the majority of these applications, or the majority of the requirements of these specs. So this is a product, you know, I'm not trying to plug the brand, but just to show that we are there today, and there is a Small Diameter product that meets the majority of these requirements. So in drawing a parallel with the CEC spec, you know, these same debates came up with the California Energy Commission proposed this voluntary specification and, case in point, today we are one of the first manufacturers to roll these out, I'm saying the CEC spec compliant. And we see a lot of our competitors follow suit as there is an incentive to do so, and as the market sort of requires that. So that's the type of parallel we want to draw to this, is that once that line in the sand is drawn, we'll see market wide, you know, catch-up with our competition. And again, I wish I had more sound data to back some of this up and we're going to try to muster resources to do so in writing, but some of the concerns that may be raised, and we're hearing them today, things like a low brightness, to me case in point, ENERGY STAR develops things like the TM 21 measurement which requires a specific center beam candle power to match, you know, the given output.	
Professor Lorne	The first involves the value of color. It's obvious that color is important to people, there's a huge color	The comment supports the standards and does not

Whitehead	industry consisting of a great deal of time and money being spent, and art, and design, in printing, paints, textiles, jewelry, cosmetics, what have you. It's such an obvious part of our society, we sometimes don't think about it, but it's everywhere you turn. And in order to take advantage of color, for it to be meaningful, for it even to exist, we need color vision. So most of us are blessed with very good quality color vision. We sometimes don't realize it, but it's something that people are really good at. But in order to have good color vision, you also have to have lighting that enables good color vision to work, and that's what color rendering is about. So if you have poor color rendering, you're actually impairing the quality of our color vision. So that sounds like a terrible thing, why would we even imagine that it would make sense to have electric lights that cause color distortion?	ask for changes to the standards.
Professor Lorne Whitehead	Personally, I bike to work, my wife and I share a small hybrid care, we're totally into the idea that people should have a smaller energy footprint. But nevertheless, and again I'm stating the obvious, if you'll pardon me, it's a fact that some ways of saving energy are good. They're better in every way. They make life better, they save energy, it's good; and there are other potential ways to save energy that aren't good in the sense that they cause net harm, even though they save energy. So I'll throw a silly example, but it makes the point, I think. Take automobiles. We could remove from	The comment supports the standards and does not ask for changes to the standards.

	automobiles air bags and seat belts, and they would weigh less and they would therefore be more fuel efficient. Nobody even considers doing that because it would be a net loss. But we always have to ask, what is the trade-off? What is the relative value? And I'm here to say, caring deeply about energy savings, that the idea of diminishing color quality to save a little bit of electricity is a bad idea, it's in the bad category of ways to save energy, especially because when it comes to lighting there are so many better ways. So I'll just mention a few. In this room, as an example, the surfaces are dark. If the surfaces were ever so slightly lighter in this room, we could use significantly less electricity and see just as well. The Luminaires in this room and virtually every room could be made much more efficient by using just slightly more reflective surfaces that are commercially available, and just aren't the cheapest or most cost-effective thing to use. And those savings don't even compare to what's possible with better lighting controls, making sure that every lumen counts. But, you know, even if you don't want to do those, if you want to get high quality color, you can simply back off the lumens, say 10 percent, which nobody can see. So there are at least four really good ways to save energy and reducing color rendering simply isn't one of them. And I think there's widespread agreement with that now, and I applaud the fact that CRI is taken into account in the discussion	

	today. So that takes us to a third issue, there are concerns expressed about CRI because it isn't perfect yet. And it's not. As was mentioned, I'm one of many people working on improving it. And we are in the process of improving it, we hope within a year or two we'll have a slight upgrade to the CRI. But the upgrade won't really change anything; nevertheless, at least it won't change existing lamps' ratings an amount that would matter for our discussion today. But nevertheless, there are some people that say, "Well, shouldn't we wait until we get the CRI perfect?" And I'll use an analogy for that. You know radar guns that people use, police use to measure the speed of cars, well, they're not perfect, they can have a slight error in the reading. But it's not too big an error. Imagine somebody saying, "Well, we're going to stop controlling speed, or stopping speeders until radar guns are perfect." That would make no sense. And there's I think a similar -- the analogy applies to CRI. It's perfectly good enough for the purpose and the rulemaking that we're discussing today. So that's really all that I wanted to say, to summarize color rendering, it has always been and remains extremely important, and the good news today is we really don't have to sacrifice it. Thank you.	
NEMA	Mark Lien mentioned it, I'll mention it again, the California Lighting Technology Center is an excellent source of analysis and we've seen in the past year the	This comment is not within the scope of this proceeding as it is not directed at the adoption of the proposed standards. This comment does not require a

	EPIC solicitations have drifted away from things where, you know, lighting folks sort of think it's finished, we think there's a lot of work left to do, we've mentioned there's a lot of consumer satisfaction analysis that can be done and we think it would be great if CEC solicited that sort of stuff in EPIC, so that CLTC and others could bid on it and continue this analysis because, you know, this doesn't have to be the last time we have a rulemaking for these products. And we want the next one to be as well-informed as possible. So I talked about the cost debtors…. So what we've tried to do here today is not just criticize, but suggest that there's alternatives where tweaks or relaxations in the stringency could enable the products that are available today to continue to be made available January 1, 2016.	response.
Sony Electronics	The second comment as a consumer, I'd like to echo a few things that Mary stated as a consumer. But in fact, when I go out and buy lamps, I do look at three essential factors, one is price, the other one is whether the tone or color of the light fits my needs, whether it's warm white, natural white, or super bright white, and price. Never in my life have I looked at CRI and honestly I can say that it's irrelevant for the average consumer. So setting specifications regarding CRI, to me as a consumer, is irrelevant. I believe many people do not focus on that, and so I do not see the need to include that on a specification. Any light bulb, any lamp that consumes 13 watts or less, to me is acceptable. If it	Consumer awareness of a particular property of an energy consuming product is not relevant or a necessary requirement under Public Resources Code for the Commission to adopt efficiency standards. See RESPONSE 1 on the CRI levels chosen and RESPONSE 3 on the analysis of compliant products.

	consumes nine watts or less, that's even better. So without further ado, I would like to ask the CEC to look at the current specifications. If you don't have a complete analysis on everything that is on the market today, please do so before publishing the final language. Thank you.	
Cost/Cost-Effectiveness		
Philips	The high end commercial SSL products which feature the high degree of color performance advocated by the CEC are not selling in large quantities because they are highly specialized and very expensive.	The Energy Commission analyzed the cost of its proposed regulations in it staff analysis: Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034, and even considered the cost of requiring 90 CRI in its supplemental staff analysis, Driskell, Kristen, 2015. Memorandum to Docket: Supplemental Staff Analysis for General Service Light-Emitting Diodes (LEDs), California Energy Commission. The analysis demonstrated that the standards can be met at a relatively low cost while yielding significant energy savings to consumers, making them cost-effective. Philips has not presented evidence to contradict this. Therefore, no change was made in the regulations.
Philips	Their higher price is not due to economies of scale, it's due to very expensive subcomponents, mostly RGB W chips and other features.	The Energy Commission analyzed the cost of its proposed regulations in it staff analysis: Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter*

		Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities, California Energy Commission. Publication Number: CEC-400-2015-034, and even considered the cost of requiring 90 CRI in its supplemental staff analysis, Driskell, Kristen, 2015. Memorandum to Docket: Supplemental Staff Analysis for General Service Light-Emitting Diodes (LEDs), California Energy Commission. The analysis demonstrated that the standards can be met at a relatively low cost while yielding significant energy savings to consumers, making them cost-effective. Philips has not presented evidence to contradict this. Therefore, no change was made in the regulations.
Philips	The Staff Report's analysis is inadequate and simplistic. Claims of efficacy and product cost being uncorrelated are simplistic and neglect the value of the brands and perceived quality levels to name but two factors. The cost conclusion sites some preceding paragraphs in the Staff Report which note that design changes and additional components are likely to be needed to meet the proposed specification with added costs, but then goes on to dismiss significant cost adders of as much as 20 or 30 percent, as likely to be swept under the carpet due to market competition. This is absurd.	Staff analysis is based on the DOE's Solid-State Lighting R&D Plan (May 2015) and the California IOUs, Codes and Standards Enhancement Initiative for LED Lamp Quality (July 29, 2013).28 Staff found several estimates relating to the potential incremental cost of a standard. There are many compliant lamps already in the market for which no additional cost to comply was needed. There are other lamps in the market that may need to improve one component to comply the incremental cost will be very small. Then there are lamps that may need a maximum of $0.50 to $1.50 to improve

28 See http://energy.gov/sites/prod/files/2015/06/f22/ssl_rd-plan_may2015_0.pdf, see also http://www.energy.ca.gov/appliances/2013rulemaking/documents/proposals/12-AAER-2B_Lighting/PG_and_E_and_SDG_and_Es_Responses_to_the_Invitation_for_Standards_Pro sals_for_LED_Quality_Lamps_2013-07-29_TN-71758.pdf.

	Adding 20 percent to a bulb cost for a CRI 90 is not doing to help market adoption. The biggest driver of the massive adoption rate of led bulbs to date has been the rapid decline in the cost price. As led bulb prices approach those of halogen and CFLs, i.e. a few dollars, all cost adders are significant. Case in point, and I'm not sure how many people are aware of this: a major home improvement retailer is selling LED lamps for $.99 today. Now, they're not ENERGY STAR compliant, but the point is when you can see they're getting down to that price level, it's crazy to be suggesting adding a dollar to the lamp to put another bad LED in.	the lamp. So the cost to improve the lamp is relative to how much improvement is needed to comply. In addition, the California IOUs submitted incremental cost estimates for improving CRI to 90 – the costs were $1.84 per unit. While the IOU proposal differs from staff's proposal, improvement in CRI also provides a pathway to compliance because of the nature of the tradeoff equation. Staff expects that improving the efficacy will be less expensive than improving the CRI of LED lamps because of existing strong trends of improved efficacy in the industry, and because improvements in efficacy have counterbalancing cost savings in thermal dissipation components such as heat sinks and LED drivers.29 The purpose of the proposed regulations is to remove poor color quality, unreliable life, inefficient lamps from the market that may be sold at low prices at retail stores but would consume more energy, be short lived, and provide consumer unpleasant experience. Commenter did not request any modifications to the proposed standard, and no change is recommended.
Philips	The lamps will take off and sell when the cost gets down to where it needs to be to compete with the incumbent technologies. So additionally, the cost	The cost analysis was performed on lamps that meet the proposed standards (see RESPONSE 3). The incremental costs were derived by evaluating the cost

29 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf, page 71.

	analysis is largely based on price trends of entry level CRI 80 lamps, whose performance does not come close to the 45-day performance requirements. As such, the cost analysis has not been done on representative products.	to improve a noncompliant lamp (e.g, a lamp with a CRI of 80) to be compliant. Thus, the cost analysis was done on representative products. See also RESPONSE 6. No change is requested in this comment, so no change was made.
Philips	High performance commercial grade products more accurately reflect all the 45-day performance requirements. So the cost analyses should start with them. As previously stated, relaxing the R8 requirement from 72 to greater than 50 will allow many CRI 80 products to be sold in California. These products are typically 15 to 20 percent more efficient than the CRI counterparts and are lower cost. This will help the adoption rate and will greatly impact the overall energy savings. This would be one of the best things the CEC could do to help the state meet its energy requirements.	See RESPONSES 1 and 3.
CRI – Small-diameter Directional Lamps		
NRDC	I want to move next to comments about the Small Diameter Directional Lamp Specification. We, too, support the establishment of minimum of efficacy requirements. These will ensure that we have energy saving lamps and will be phasing out from the less efficient alternatives such as halogens and HIR. To us, that's the prize that we think everyone should be after here. We can go from a lamp that used to use 45 watts	Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. The products manufactured for commercial consumers are likely to be the same as purchased by residential consumers, as manufacturers are unlikely to make two sets of products for the

	down to one that uses about nine watts or so. That, we believe, is the primary objective and, again, we need to be careful in this proceeding how far we go in terms of trying to squeeze an additional half watt or watt there. We also want to make sure that people have a decent experience and we heard a lot of interesting comments from a consumer, which all of us are, as well. We want to make sure it doesn't fail prematurely, and you have some requirements on that. And we also want to make sure that bulb delivers good color experience. While there's been a lot of debate how high you need to go, I think everybody agrees there should be a floor in terms of color quality. And the way the Small Diameter specification is written in terms of color quality, the only time that there's a requirement is if the efficacy is between 70 and 80 lumens per watt. If you're above 80, then you could have a CRI of 50 if you want, and I think we all agree that's not what anybody wants. So our suggestion should be you set a floor and one potential landing point that I think you won't get objection from industry or others is let's adopt what ENERGY STAR has, which is a CRI of 80 and an R9, no less than zero. That way we can keep the junk out of the market in terms of color experience. We also think this is important, while two-thirds of the lamps from Harinder's data are in the commercial space, about a third of them are in residential. Consumers don't know anything about CRI, they're going to be confused, we	market. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80.

	want to make sure they're not disappointed.	
CRI – State-regulated LED Lamps		
Osram Sylvania	Another solution proposed in the Staff Report is the use of a red phosphor, which will have the effect of reducing efficacy. The minimum compliance equation, which is based on a combination of efficacy and CRI, and the 72 minimum R1 through R8 requirements, runs the risk of forcing consumers to seek out less efficient products due to cost, or lack of available LED products that meet their needs. Osram Sylvania with our NEMA partners is very interested in working with the CEC to save energy and to increase LED adoption rates. Rational reasonable appliance Standards for lighting products can help us meet these goals together. We encourage the CEC to revise the proposed additions to Title 20 to ensure quality products are available to meet every application at the highest possible efficiency levels. Thank you.	See RESPONSE 1.
Professor Lorne Whitehead	Thank you very much. As mentioned, I'm Lorne Whitehead. Good morning, CEC, Honorable Commissioners, and staff. I'm making really overview remarks, and they'll be relatively brief, both on the value of color rendering and also some misunderstanding concerning color rendering. As mentioned, I think I'm qualified to make these comments and they'll be quite simple.	The comment supports the standards and does not ask for changes to the standards.

Professor Lorne Whitehead	And the historical fact is we didn't have a lot of choice if we wanted to have energy efficiency, but now we have a choice. So now that we can have excellent color quality, as was mentioned previously, why would we consider not doing that? Well, I'll answer that, or at least I'll address a few kind of understandable concerns that come up from time to time, and just suggest that they really don't apply anymore. Maybe the simplest concern, I'd call it the "existence of color rendering deniers," there are people that don't care about color. I was recently at a conference were various team persons stood up and said to the group that he doesn't care about color rendering, and neither does his wife. And that's just fine. There's no need for everyone to care about anything in a great society, there are people that probably don't have good -- or aren't interested in good color vision, or using it. But there are a great many people that really do care about it. They care about color, they care about color vision, and they care about color rendering. So, you know, we're a Democracy, we should be open to a range of use on that topic and not deny those who care about color the 9 to see it.	The comment supports the standards and does not ask for changes to the standards.
Professor Lorne Whitehead	So a much more interesting issue is the question of energy efficiency. This is the last place anybody needs to say that the things we value, almost all of them have an energy cost. So comfort, convenience, safety, it never comes for free from an energy perspective. And color rendering is the same. It's another good thing that	The comment supports the standards and does not ask for changes to the standards.

	doesn't come for free from an energy perspective. But let's just talk about that in a bit of detail. And before I do talk about that question of squeezing a little bit more light out of a watt of electricity by means of reducing color rendering, I will say one more introductory thing about me. And this is just so you know where I'm coming from. I have dedicated my career to energy efficiency. So I actually have over 100 U.S. patents on things, inventions or devices that use light more effectively to save energy.	
California IOUs	I'll speak to D Whitehead's comments. The good news is we are improving color rendering. We're getting away from CFLs which have a color rendering of somewhere in the 70s, so 80, 82, because we over design, is an improvement. It could be as much as 10 points. And that is noticeable, and people do like it. The hazard of increasing cost, as Dr. Woodward shared, is that if cost becomes a problem at the point of purchase, they're going to buy a CFL. CFL is covered by Federal Regulation, it's going to stay in the California market until such time as the DOE phases it out and the indications are they're not phasing it out this time around, so it could be many many years. And so people will be attracted to CFLs if they are in a budget-minded consciousness.	See RESPONSES 1, 4, and 8.
Cree	We believe Standards for quality, not only color quality, but also dimming light distribution, are very important,	The comment supports the standards and does not ask for changes to the standards.

	especially going forward because, as noted, there is a bum's rush to lower price, lower quality bulbs going on, and I think it was characterized as a race to the bottom earlier. The CRI discussion, which has taken up the bulk of the comments today, I think as expected, I would comment on a couple of things that were said. I think an RA of 50 is a nonstandard to lay-up, I think the comment about saturated light being preferred over fidelity is valid, but I don't believe that an RA of 72 makes it unavailable to have higher saturation	
LumiLEDs	Secondly, the minimum 82 CRI requirement is inconsistent with how Lumileds and how our competitors bin for CRI. LED packages in the market are not binned this way. A typical distribution would be a minimum of 80 with the typical of 82, in which no parts on the reel would have a performance below 80 CRI. And it is those two additional points that provide margin for LED lamp manufacturers to hit the 80 CRI at the lamp level. So, thus, the CEC's proposal results in a requirement that's essentially a minimum 85 at the LED package level in order to hit that 82 at the LED lamp level. So Lumileds requests that the Title 20 require a minimum of 80 CRI, rather than 82. This would be more consistent with the way the business is done. All the lighting vision scientists also agree, or I think most all of them agree, that two points are completely imperceptible, anyway.	See RESPONSE 1.

LumiLEDs	Third, the minimum R1 through R8 requirements, while they appear to benefit one specific California manufacturer, in simpler terms this boils down to a CRI minimum of 85. If you take all of those together, you end up with simply an 85 minimum CRI requirement. No one is binning LED packages for CRI between the 85 and 90, thus to fulfill this requirement at the LED lamp level would require LED package binned at a minimum of 90 CRI. So altogether, you end up with essentially a 90 CRI spec by way of these sort of various piece parts. So again, for the sake of rapid market adoption, Lumileds requests that Title 20 require a min 80 CRI at the LED lamp level.	See RESPONSES 1 and 3.
LumiLEDs	And then my fourth and final technical comment is that Table K-14, Minimum Compliance Scores, would then further reduce the number of LED packages available to support products for the California market. To ensure LEDs are available to support the market at consumer friendly shelf prices, we restate our request for an 80 CRI requirement at the LED lamp level, and ask you to consider a reduction of the minimum compliance scores. So in closing, the Title 20 proposal for LED lamps is a somewhat arbitrary definition of high performance, which would drive up cost and leave most LEDs that could otherwise support the CEC's effort to reduce energy consumption, would leave most of those LEDs behind. So echoing what you will hear from other manufacturing colleagues, there really is no adoption	See RESPONSES 1 and 3. The Energy Commission also modified the effective dates in 15-day language to extend the time to comply by one year for tier 1 and six months for tier 2. This will allow sufficient time to adjust manufacturing and design processes to ensure that products are available at low cost.

	problem; rather, there's a problem with initial consumer cost that needs to be addressed, and this proposal works against that goal. Thank you.	
Philips	We're looking forward to seeing 15-day language with corrected color chromaticity requirements. Okay, regarding CRI greater than 82 and R1 to R8 greater than 72, the minimum CRI requirement of 82 actually inherently conflicts with the mandatory requirement that all R's be greater than 72. With today's technology, data from chip manufacturers, analysis of our own lamps and the study done by CLTC, shows that CRI, if you require R1 to R8 to be greater than 72, you have to have a CRI of at least 85. And that means, as Alex said, you have to design for 86, 87. So in some sense, this is still a CRI 90 requirement given the unavailability of LEDs from 85 to 89. The CRI requirement implies widespread feasibility between the minimum CRI score of 82 and the individual R factor minimums. They're interdependent. If the CEC's real intent is to only allow nominal CRI 90 products into the market, then this should be clearly stated in the proposed legal requirements, and the CEC should clearly take responsibility for proposing that consumers can only purchase these less efficient and/or more expensive CRI 90 products.	See RESPONSES 1 and 3.
Osram Sylvania	I'm Susan Callahan, Manager of Energy Relations from Osram Sylvania. I'd like to point out that Osram is the	No change is requested.

	second largest manufacturer in the world of LEDs, and we have locations also here in California. I'm going to comment in particular on our values and CRI and their impact on the proposed specifications.	
Osram Sylvania	First some observations. Generally, LED lamps with very high CRI, in the neighborhood of 90+, have lower efficacies than LEDs with CRIs in the 80s. LM-79 reports are not required, too, so they may not include all of the R-values required in this version of Title 20. Generally, LED lamps with very high CRI have R1 through R8 values greater than 72. LED lamps with CRIs in the '80s are deficient in one, but not more than two R-values. It is disingenuous to suggest that 82 CRI LED lamps will be able to meet the proposed specification	See RESPONSE 1.
Osram Sylvania	It appears that R9 has been used in error as a proxy for R8, leading to the incorrect conclusion that there are large numbers of lamps in DOE's Lighting Facts and EPA's ENERGY STAR Database that will meet the minimum requirements of 72. There is no physical basis to use R9 as an indicator of other R-values, particularly R8. R9 is a saturated red and R8 is an unsaturated light reddish purple. We are concerned that the R1 through R8 minimum requirement of 72 is more relevant to fluorescent rather than LED lamps which are a unique source in many ways. It may be possible to obtain an R8 greater than 72 LED lamp with adequate efficacy by using an RGBW chip set,	See RESPONSE 3.

	essentially a dumb smart lamp. This is a very expensive solution to the problem. A solution proposed in the Staff Report, the addition of red LEDs to a white LED, increases the driver complexity, requires color mixing capabilities, and also increases the cost	
Osram Sylvania	I'm Mark Lien, I'm the Director of Government and Industry Relations for Osram Sylvania. Previous to working for Osram, I ran the educational facilities for both Cooper and Hubbell Lighting and taught in those. I'm also the Chair of the Light Source Section for NEMA, and you will be hearing from some NEMA representatives today	No change is needed because this comment is about personal introduction
Osram Sylvania	Our research that we've been doing extensively over the last few weeks has revealed that in Title 20, we can't find any products that meet all of the requirements. We can find products that meet any one or two of the requirements that are listed, but you'll hear from representatives today that we don't have products that can meet this. And the timeline is very aggressive. And you'll hear why. Now, we've raised these concerns before at previous meetings and in written comments, but today we brought a team of globally recognized technical experts to go into some detail on this, so you will hear specifically what the concerns are and why they aren't attainable. Some of it is what Lorne referred to earlier, is trade-offs. You indeed can get to one of these categories, but you're going to trade off another.	See RESPONSES 3 and 10.

	And so you'll get some technical background on that. Title 20 does have quite a reliance on CRI and, as the industry has recognized, it is an incomplete metric. An argument could certainly be made that it is what we had and have had since 1964 with some revision in 1974, but basically for 50 years.	
Osram Sylvania	Yesterday, I was at the Solid State Lighting Conference in Portland that the Department of Energy puts on, and another member of the same committee that Lorne is on at the Color Metrics Committee, actually the task force for TM-30, presented, Michael Royer. And he showed his latest research, some of which hasn't been published yet, on color preference studies that he's actually doing at PNNL Labs. And what was shown were samples of light fixtures on specific objects -– fruit, scarves, things with lots of different colors. And in every instance, the fidelity, CRI being a measurement of fidelity, the highest fidelity was not preferred. And in the studies that he has done, the preference is for higher color saturation. But there's a tradeoff: when you raise color saturation, you lower color fidelity numbers. And this new research that's coming out of TM-30, and from PNNL Labs specifically on color preference, it's showing us some of the problems that are inherent in using CRI as synonymous with quality. It's not synonymous with quality at all, and when you raise the saturation for specific applications and for consumer preference, you will reduce the fidelity	For why the Commission used CRI, see RESPONSE 1. TM-30 was not available at the time the regulation was being developed and is not widespread or widely accepted for color assessment in the lighting industry. For these reasons, the Energy Commission did not use TM-30. This comment does not request a change in the regulations, but requests funding for work outside of the regulations. Therefore, no change is necessary.

	metric. So some of these fidelity metrics are going to limit the types of products that consumers would actually prefer in the marketplace. I would encourage the Energy Commission to engage some of your technical experts, and certainly at the CLTC, you have Michael Siminovitch and Michael Costa that are extremely knowledgeable in this area, they could work perhaps on your funding programs to deliver some more research to validate the quality discussion that's ongoing and accelerating in the lighting industry right now. Thank you.	
Philips	I'd like to make a comment on Lorne's remark. The person who mentioned that he and his wife don't care about color is Francis Rubenstein, who is a very well-known California lighting expert. He didn't say he doesn't care about color, but that they don't see the difference between 80 and 90 CRI.	This comment doesn't require response because Philips is repeating what other stakeholders stated.
Philips	By having unrealistically high requirements for R8, manufacturers will be forced to effectively supply nominal CRI 90 products to the market; the net result is going to be that the California consumers is going to be forced to buy the more expensive and less efficient CR 90 lamps. Compared to consumers in the rest of the country, Californians will have to spend more and get less efficient bulbs. We're not aware of any scientific evidence in the U.S. or other countries that consumers do not want CR 90 greater than 90 overall as their	See RESPONSES 1 and 4.

	minimum, nor has the CEC produced any evidence to support this claim. What we do see are strong sales and strong adoption of CRI 80 products in today's market, despite the availability of both CRI 80 and 90 products. This is very clear based on greater than 80 million CRI 80 and above LED lamps sold in the U.S. in 2014, and we see similar trans-globally. However, CRI 80 products are almost always more efficient and cheaper than CR 90 based on the laws of physics and the additional design complexity required for CRI 90.	
Philips	We would like to propose that the R8 requirement be reduced to greater than 50, as we stated in our last series of comments, and the minimum CRI to 80. This will allow CRI 80 products to meet the color rendering requirements and allow more efficient and cost-effective products to be sold in California. This will also mean that Californians have the same access to less expensive and higher performance products as the rest of the country, and most importantly will allow the State of California to address its energy conservation needs. Thank you.	See RESPONSES 1 and 3.
NEMA	So, yeah, we can hit 82, but if it tells you have to hit 82, we have to design 84. And it's all about giving an acceptable amount of variation because those economies of scale everyone is counting on, if you're going to mass manufacture you have to over-design. Something taken in a snapshot may well have been a	See RESPONSES 1 and 3.

	good day and perform quite well, but it's not indicative of its siblings made at another factory even though it's the same design, different components, different day, different people. So we're concerned that things like this can result in inconsistencies or misunderstanding of what's capable. So besides fixing the technical feasibility of the proposal, there's also gaps in considerations that have to be made relative to scope. Mr. Gatto spoke at length on that, I won't belabor it, but as he mentioned during the follow-up question.	
Data-related comments		
NEMA	And the physical, the performance requirements require that the LEDs be expensive, so I won't belabor that, you've heard it. But the damage of that is it could force the market adoption backwards. I'm trying to get NEMA data released early because I'm told the third quarter this year shows an uptick in adoption. Again, those are the more affordable products. If we can share it, we'll share it as soon as we can, and if I can share it in time for this proceeding, I will. I talked about that	See RESPONSE 4. NEMA did not provide any data in support of this comment.
Philips	Now I'd just like to move on and address a couple of other points which haven't been brought up so far. Analysis based on the ENERGY STAR qualified product list shows on average decorative lamps are about nine lumens per watt less efficient than Omni-directional lamps, and we'll provide data to support that with our	See RESPONSE 9.

	comments. If you go into that and you look at the top 25 percent, so we'll just shoot for the best products, the numbers between Omni and decorative are the same from the point of view that Omni-directional is about nine lumens per watt more efficient. Now, we do acknowledge that, say, filament led LED decorative lamps have high efficacies, but they're typically not dimmable, which is a very important feature for decorative lamps in most applications. So based on our analysis, in order to ensure accurate, adequate, and reasonable product availability of dimmable decorative LED lamps, we would propose that a separate compliance score for decorative lamps be 267 and 287 for Tier 1 and Tier 2, respectively, versus 277 and 297 for Omnidirectional lamps. So in essence, we would like to see the decorative lamps given a 10 LPW reduction in requirement.	
California IOUs	So the first one is just on the data that went into these proposals and how reliable it is. We are definitely relying on data that is out in the public sphere. We relied heavily on ENERGY STAR's Qualified Product List, we rely heavily on Lighting Facts database, in addition to product testing that we've completed that PG&E has funded at the California Lighting Technology Center. So one thing that we've done is to try to correlate the test data to the public databases to see if they match, and the good news is that they tend to match very closely, and I'll give an example. On the DUV, several people	The comment supports the standards and does not ask for changes to the standards.

	have commented on DUV and the requirements. In the Lighting Facts Database of thousands of products, 87 percent of them meet the DUV requirements proposed by the CEC. When we tested over about 30 now Omni-lamps, something like 20-30 par lamps, and something like 15-20 MR lamps, 87 percent of those also passed the DUV requirements, and that is a freak coincidence, of course, both numbers were 87 percent, it's not always that perfect of a correlation. But the point is we are extrapolating test data that we have because it matches very well with publicly available data, and if the consensus from the industry is that this data that is publicly available shouldn't be trusted, then I'd really welcome them to submit other test reports and data that they believe is more representative of products on the market.	
California IOUs	Specifically, I wanted to follow up on Chris's comment just now from Max (Sic) Light. Thanks, Chris, the filament lamps in particular it would be great to see some data on their distribution if they don't meet the true Omni requirements of ENERGY STAR. So if you have data that shows that, that would be really valuable to the record. In terms of products that meet the spec or don't meet the spec, I know there was a lot of confusion about the DUV values, so some people today have commented that the products weren't available, but that maybe if once they do the analysis with the new DUV number, that will change. So our analysis with the	Staff support IOUs request to stakeholder's to submit data in support of their comment. Staff appreciates and agrees with the IOUs comment that a large number of lamps meet the proposed Duv requirements. Staff agrees that the Duv compliant products sell at cost effective. No change was requested and made.

	right DUV numbers has shown that there are a lot of products that are available, many of which have great price points.	
California IOUs	They were shown in CEC's graphs earlier in the presentation today, we're not talking about $2 or $3, in many cases it's $10, $20, $30, or even hundreds if you count all the different variations of products. So in the A Lamp market, there are products from multiple manufacturers, often below $15, even below $10, and some of those are coming down it looks like now $6.00 products that meet all these requirements based on all the data that we have publicly available. And the same is true of Directional Lamps, there's a lot of products in that $8, $9, $10, $11, $12 range, that appear to meet all of the requirements proposed.	The comment supports the standards and does not ask for changes to the standards.
Decorative LED lamps		
NRDC	Let me start first with Decorative Lamps. As the data has shown and some of the industry representatives have mentioned, these lamps have a much smaller form factor, think of the little candelabra lamps, they're about 10 percent less efficient, more or less, and our concern is if we squeeze too hard here, we may have some unintended consequences and provide a boost to the sale of the current bulbs that are 40 watts. Those 40 watt incandescent bulbs are exempt from the next level of ISA depending on how that moves forward, so	See RESPONSE 9.

	we want to go from 40 watt bulbs down to bulbs at around 10 watts, and we want to be careful not to squeeze too hard or eliminate all the LED options that are out there. We might be forcing things only to filament type LEDs, and then we've got the dimmability questions where people might not like the appearance of the filament LED lamp. So we encourage you to review the data carefully here and, based on your review, consider a slight relaxation. So if the bulb is allowed to use 10 watts instead of nine watts, we still think that's a win.	
Westinghouse	We do strongly support the energy savings goal of the Commission. Westinghouse has added more than 100 new LED lamps in the last 12 running months, and we have, God help me, hundreds more probably on the horizon. But we're concerned about the scope. So as it relates to general service LED Lamps, the expanded definition is just simply too broad. It impacts products that it is not possible to replace with LEDs that are available today, and to be perfectly honest, in some of the smaller decorative styles, it will not be possible to replace them any time soon, definitely not in time, or at least we don't think so, to meet the compliance date. From a general service standpoint, true general service, we would agree that the efficacy requirements are appropriate and I would kind of repeat Mark Lien's statement that, you know, in the absence of some of these other requirements, we wouldn't have any	See RESPONSES 3, 9, and 10. Because compliant lamps are already available in each product category, or the technology to make compliant lamps is readily available, the standards are technically feasible. These lamps are available at a cost that yields significant energy savings to consumers, making the standards cost-effective. Because the standards will save significant energy statewide, the Energy Commission adopted the standards as proposed in the revised 15-day language.

	objection at all.	
Dimming and Flicker		
NRDC	Lastly, I want to talk about the Labeling Requirements. I don't have the exact language in front of me, but basically it says if you're making a comparison to an incandescent lamp, including wattage equivalencies, you must meet the following requirements. The lamp temperature, the CCT can't be more than 3,000, the lamp must be dimmable, and you must meet the equivalency requirements. We think this construct has some unintended consequences and we want to propose an alternate approach for your consideration. And in doing so, we want to point out that most sockets are not dimmable, and by requiring adding dimmability adds cost and could potentially result in a less reliable product if someone puts in a cheap dimming circuit that could fail. While we agree most consumers prefer and want the lamp that looks like the old incandescent, call it 2,700 or 3,000 K, there's certain people who prefer bulbs that provide a cooler experience, whether it's 5,000 or 5,600 K, and sometimes that's cultural or where you come from; if you come from Southeast Asia, the cooler lamps are a lot more common, and we don't want to prevent people who want that product from being able to see on the package 13 Watts equal 60 Watts.	Proposed labeling requirements are not mandatory because they apply only in case the manufacturer claims their lamp to be equivalent to incandescent. In case manufacturer makes an equivalency claim they are required to test, and certify to the commission. The additional labeling requirement proposed by NRDC, are not necessary because most LED packaging already notes the approximate incandescent replacement the LED is designed to cover. 9 watt LED lamps with a 5000 K color typically and prominently display a 60 watt replacement notation. The Staff Analysis does not show, on a cost benefit basis, the need to include equivalency information as part of the proposed regulatory language. Staff recommends no changes to the proposed standards.

NRDC	We think people don't understand lumens and in this transition, that sort of equivalency claim makes sense, and that's a very powerful tool. So in summary, we recommend the following construct that I think goes to what the intention of this language was, but without the unintended consequences: 1) if the lamp is dimmable, it must meet the dimming requirements, if it's not dimmable, you must need to label it clearly on the package, "Not Dimmable." That's different than saying you must be dimmable if you make an equivalency claim.	Staff appreciates NRDC's comment which is similar to the IOUs comment regarding labeling of non-dimmability. In evaluating the cost effectiveness of various labeling, staff did not perform an analysis regarding the costs and benefits of including a "NOT DIMMABLE" label. Therefore at this point staff is not able to make the suggested change. In addition, during the development of the regulations no cost benefit information was provided by stakeholders nor did there appear to be a potential problem that required inclusion of a "NOT DIMMABLE" label. It is also not clear what advantage saying "NOT DIMMABLE" has since most LED's that are dimmable will so state so it is an accurate assumption by a purchaser that a lamp with no statement regarding dimmability, would not be dimmable. By the 2018 effective date of the standards, staff expects most LEDs will be dimmable. Based on the above staff does not believe the suggested changes are necessary
Soraa	And to be clear, it is more difficult to be efficient in the power lamp than in an A lamp just because of these beam quality aspects. Shortly, I'll mention other aspects of quality which are not being talked about here, flicker and other aspects of color rendering such as deep red and whiteness. Again, by skimping on these by making an LED with a bad driver which has more flicker, and by	The proposed standards are flexible and many manufacturers are already complying with the proposed Tier I and Tier II requirements. See RESPONSES 3 and 10. The concern raised by Soraa is also addressed by extending the effective dates in 15-day language to allow additional time to comply with the general service LED requirements at low cost and

	having poor red rendering, it is easy to improve lumens per watt by five, 10 percent, and sometimes more. That's probably not a good thing in terms of product quality and in terms of adoption. So at the end of the day, the risk for us is the following, right? If we're faced with having products that don't meet these limits in a year, we may have to make the choice of lowering other aspects of quality which are not being monitored by this proposal, so that we pass the spec. We'd rather not do that. So my suggestion is that there be more classes of products in the limits, specifically I think there should be a directional large lamp limit which is in between Small Diameter Directional and Diffuse Lamp to recognize the fact that there are aspects of quality that haven't been taken into account, and to give us more wiggle room to include those. Thank you.	without reducing the quality of the products. No further changes to the standard are necessary.
Downlight Retrofit Kits		
NEMA	We don't know what that is because it's not a sector that NEMA is deeply involved in; we've asked the American Lighting Association to comment if they can on it. But it's one of those things that does stand to reason, but as I said we're going to focus on just what's available and where the offerings are. Sorry, bear with me here.	This comment does not require a response.

Effective Dates		
Philips	We are struggling to understand the logic and energy saving benefits resulting from the timing of the implementation of these Standards, which will significantly reduce the availability of led lamps in the market in 2017, while the sale and supply of halogen and CFL lamps continues unaffected. Surely this is not what the CEC intended -- promotion of less efficient products at the expense of more efficient products. We believe the overall effect, while unintended, of the proposed regulations will in fact slow the adoption of led products and greatly reduce the amount of actual energy savings it's possible to achieve with more reasonable Standards.	In the 15-day language, staff made changes to accommodate stakeholder comments. Industry was given more time to meet the standards with the Tier 1 effective date moving from January 1, 2017 to January 1, 2018 and Tier 2 from January 1, 2019, to July 1, 2019. On January 1, 2018, a 45 lumen per watt standard will take effect for all other technologies which may remove inefficient halogen and incandescent lamps from the market. Staff disagrees with Phillips' comment because there are no unintended consequences. No further changes are needed.
Efficacy		
Soraa	Aurelien David. I'm Chief Scientist at SORAA. SORAA is a manufacturer of LED chips and lamps based in Fremont, California, and we do R&D and manufacturing here. I've been doing R&D on LEDs for 14 years and I feel that expertise are efficiency and color science. So before I complain, I'd like to congratulate the CEC for some of the features in this proposal, especially the tradeoff between efficiency and CRI, which I'm happy to see in here. And I think the idea behind that is this regulation should not prevent manufacturers from making high quality products right, there is a tradeoff	This comment is an introduction about the commenter. SORAA's comment is supporting the proposed trade off color and efficacy equation. No change to the proposed regulations is requested.

	between efficiency and quality, and you should be able to take the level of quality in full. That is very much in line with SORAA's approach, which is to make high quality products because we believe in some fields high quality is instrumental for adoption	
LumiLEDs	We have research marking and production facilities located in San Jose. We're concerned that the 45-day language discussed today proposes a series of requirements which, taken individually, would set a very high bar, but when combined together create a leading edge performance specification, which we don't think is an appropriate floor for the California market. We respectfully submit that the CEC's well-intentioned efforts to drive quality along with efficiency is sort of upside down, with the proposed regulation representing higher performance than the CEC's so-called voluntary California quality LED Lamp specification.	See RESPONSE 3. The Voluntary Quality Specification is intended as a "reach" standard to encourage development of incandescent-equivalent light bulbs. The standards adopted for LEDs and small-diameter directional lamps are not a "reach" standard, and are therefore less stringent than the Voluntary Quality Specification. There is room for both a regulatory floor and a "reach" level in the context of the LED market, and this is the role performed by the standards and the Voluntary Quality Specification, respectively.
Soraa	I think to some extent the CEC recognizes this tradeoff because there are two proposals, one is for MR-16 essentially, or Small Diameter Directional, and then there's another spec for everything else. So I think there is some level of understanding that Directional light is more difficult to achieve than diffused light. But I think to some extent the CEC dropped the ball in the middle by putting in the same bag A lamps, BR lamps, and power lamps, which have very different technical	See RESPONSES 3 and 7. Staff found that the efficiency standards for medium-size directional lamps are technically feasible and cost-effective, and will result in significant energy savings. Distinctions between small-diameter directional lamps and medium-size directional lamps are driven not by their directionality, but by their form factor, as smaller form factors (as for SDDLs) make it more difficult to dissipate heat from the LEDs.

	challenges	
Light Distribution		
MaxLite	This is Chris Primous from X Light. I just wanted to make a quick comment regarding the Omni-Lamp Requirements, the Omni- Directional Requirements for A Lamps. There's a requirement that A Lamps must meet the ENERGY STAR Version 1.1 Omni-Lamp Specifications, also it goes on to talk about the other lamp types must meet decorative requirements. I want to caution on that not to tie it to an old ENERGY STAR lamp specification right now, there's a new one that's under revision, the 2.0 for lamps, it's supposed to be implemented or finalized by the end of this year, maybe the beginning of next year.	Staff has modified the express terms and issued revised 15-day language changing ENERGY STAR specification version 1.1 to Version 2.0 for omnidirectional lamps.
MaxLite	Also, there is a very popular new lamp type called the LED Filament lamp. With regards to these LED filament lamps, they are not generally able to meet the Omni-Directional Beam Requirements of the traditional Omni-Directional type of lamps. And you know, these are very popular replacements for high wattage halogen lamps and also they are very efficient, actually more efficacious than a lot of the Omni-Lamps going on the market today, approaching levels up to 130 lumens per watt. And so I would take a look at those types of products and allow them to meet now the decorative lamp specifications for ENERGY STAR lamps and not make them have to meet the Omni-Directional Lamp	Only A lamps are required to meet the omnidirectional beam requirements in ENERGY STAR 2.0. B, BA, and G lamps, which are typically used for LED filament lamps, are only required to meet the decorative light distribution requirements. ST and T shapes are not required to meet light distribution requirements. Moreover, low-lumen filament lamps (under 150 lumens for candelabra or 200 lumens for other bases) are not required to meet light distribution requirements. Therefore, the standards have already taken this into account for the product in question, and no change is needed.

	Beam Requirements. So I would just take that into account as we look at the requirements for the beams. That's it.	
Marking/Labeling		
NRDC	Second, if you are making an equivalency claim, you know, 13 watts equal 60 watts, or eight watts equal 40, then indeed you must deliver an equivalent amount of light as the incumbent product. There's a table in the Proposed Standards, we think that table is done right, and the way it should be is, if you make an equivalency claim, you must hit those numbers.	Staff agrees with the NRDC comment. No change is needed.
NRDC	But again, if you do make an equivalency claim, that shouldn't prevent you from making an equivalency claim if you're a cool temperature bulb. And then lastly, in terms of CCT that's already on the package, it tells you if you're 2,700 or 5,600 K and whether you're cool or warm, so we think that's addressed there. So in summary, we think you're off to a great start here, with a few tweaks you'll get across the finish line and you have our support. Thank you.	The additional labeling requirement proposed by NRDC, are not necessary because most LED packaging already notes the approximate incandescent replacement the LED is designed to cover. 9 watt LED lamps with a 5000 K color typically and prominently display a 60 watt replacement notation. The Staff Analysis does not show, on a cost benefit basis, the need to include equivalency information as part of the proposed regulatory language. Staff recommends no changes to the proposed standards.
PAR/BR Lamps		
Soraa	And so that brings me to my concerns with the proposal, which is there are many other aspects of quality in an LED product beyond CRI which are not	See RESPONSE 3. Staff issued 15-day language to modify the effective date to January 1, 2018 for Tier I requirements and to July 1, 2019 for Tier II

	really being considered by this proposal, and the worry is considering the high levels of efficacy in some of these scenarios, it will be hard to maintain other aspects of quality. So I'm going to take one specific example. Let's think about a spot lamp, a 10- degree spot lamp. I have a very nice lamp which has a good beam pattern, everybody likes it. But come January '17, it doesn't meet the spec, it's a few lumens per watt below spec.	requirements. The extended effective date will provide manufacturers sufficient time to catch up on few lumens per watt on desired lamp. No further change is needed.
Soraa	The easiest way for me to make it meet spec is to go back and degrade my optic in order to add lumens in the scale of the beam, okay? So that's going to boost lumens per watt a lot. It's also going to make for a worse lamp which has more glare. That's bad, right? Consumers don't want that. But again, if that's the only thing I can do to meet spec, I'm going to do that. Now, is that a good thing for adoption? Probably not. And the lumens per watt may have increased, but that's really artificial because you're putting lumens where you don't want them.	As mentioned in the response to the above comment, the additional time added to compliance will be sufficient to address this particular issue raised by Soraa. Staff reiterates that there are already compliant products available in the market that meet the proposed Tier I and Tier II requirements almost 2 years prior to the standards taking effect. No change is recommended to the proposed regulations.
Scope		
GE	The next point is more on the small diameter lamps. The current expressed terms go so broad that it includes many different specialty MR16 lamps for which there is no LED replacement. These specialty lamps are used in expensive specialty equipment, have different operating voltages, different focal lengths,	See RESPONSE 11.

	and other technical characteristics that LED lamps of today or future will be unable to match. Industry is proposing new scope language for these products that focuses on very specific technical characteristics that would allow them to be excluded, to ensure that there are no issues in the marketplace and to ensure that people can still use the equipment in other specialty applications.	
Westinghouse	But within the scope, we think that the inclusion of E-12 and E-17 base, particularly with no exemptions or room for small profiles, small diameter lamps, as well as specialty lamps that are not general purpose in their normal use, sign, display, and other specialty applications, that you're going to unintentionally pull into scope products that consumers need and that there's nothing to replace. The definition actually doesn't describe the general service lamp very well because it includes all these specialty applications, so we think a more practical approach would be to limit the scope to the proposal so it more accurately covers the products that you're aiming for, and we do think that at least from a base-type standpoint, you wouldn't necessarily be able to stick with simply E-26 and GU-24. I think if you bring E-12 or potentially E-17 in, then you're going to need to, and we would propose some exemptions for specialty lamp types, not just lower lumens, which is something that we're going to dialogue, but there are some appliance lamps that are	See RESPONSES 1, 3, and 9. Standards for these lamp types were found to be technically feasible and cost-effective, and will result in significant energy savings. No changes to the scope are necessary.

	very tiny that have 300-400 lumens and would not easily be replaced by LEDs, particularly with the CRI requirements that simply don't apply for our appliance.	
Small-diameter Directional Lamps		
Green Creative	And for example, our MR 16 product hits that mark and we can claim a 75 Watt equivalence. The point is, you know, you can pick apart any number of product and show that it's not there, but once you have the spec, we can design around it and in our view it's not so aggressive that it can't be met. Other things not ready for all application, there is some truth, I mean, there's niche applications out there that folks are highlighting this today, we're hearing this, but again we stand by the fact that the market will adjust for that. You know, I don't think there's fundamental flaws or I don't there there's a fundamental hurdle to the design aspects for some of these niche applications, and they do represent a small portion of the market. In terms of compatibility, we welcome the spec because especially in the Small Diameter Space, it will be nice to have more clearly defined definitions, and that's basically because I think all of us want to see some uniformity and more consumer confidence in the application that it's going to work with everything that they have, so when they install it, it does what it should and what they expect it to do. So unfortunately, again, I don't have a lot of sound data to back all this up, but I can say as a	The comment supports the standards and does not ask for changes to the standards.

	California-based manufacturer focused on quality, and how we focus specific to the space that these rulemakings cover, we do feel that the majority of the requirements are sound within reasonable -- reasonably achievable within the market and if we don't draw that line in the sand soon, we're going to continue to see a lot of lower quality stuff kind of flood the market. So that's all. Thanks.	
Westinghouse	As it relates to Small Diameter Reflector Lamps, unlike general service LED lamp Standards being proposed which only apply to LED light sources, the small diameter reflector lamp standard will impact every product made that meets the definition, regardless of the technology currently used to make the product. The product definition for this category is very broad and, in conjunction with the Standards, it could result, I think will result, in a huge reduction of available products in the market. The increased cost to consumers, while I understand the Commission has addressed the incremental cost, what we believe has been left out of the analysis is the loss of stranded assets. There are products that consumers own today, decorative and commercial fixtures, where there will not be, and is not today, an LED product that can replace. High wattage, low diameter MR-11 and MR-16, alternate voltages, as Tom Stimac mentioned, that go into certain medical and other specialty equipment, this equipment is part of the installed base for California	See RESPONSES 10 and 11.

	residents, and we would hate to see them have to throw that equipment away, and we think the cost of those products that they already owned should be included in the feasibility analysis. (Pause) Forgive me, I was making changes in my notes because other people covered some things, and I don't want to duplicate it. What I would suggest, or what I think we would suggest from some conversations with other NEMA members is a continued dialogue, 15-day as part of your process, but with industry and other stakeholders, we think with scope changes and some minor changes in the proposal itself on the regulation side, that we can find something that works for everyone and can actually meet the goals that CEC set out to address with this regulation. Thank you. I think the short answer is that's what we're aiming for, we're looking to provide specific like literally wattage voltage lamp-type shape. I think in some cases that will be easy, particularly in the Small Diameter because there are some very specific models that have already come up for a lot of us that, while I don't necessarily make some of these, I can clearly recognize that there's no current or path to an LED that would replace it. I think in General Service, it's a little tougher and it's tougher because of how big the variety is. There's literally hundreds of shapes and sizes and wattages that would fall in scope, so we're going to point as many out as we can, but if nothing else we would appreciate the Commission's interaction and it	

	doesn't just have to be here, but as we provide this information we know that you're going to respond, but also maybe have an open dialogue because there are some things that I think we could be missing, as well.	
Standby Power		
Sony Electronics	Going to the first one, there is some concern with the Regulations. I do agree with pretty much everything that Noah has said just a few seconds ago, but I'd like to expand on a comment made by the gentleman from GE where the technology is to a point where lights are shaping the way of the future. To that extent, we are manufacturing and developing new products, and one of them is a combination of an audio-video or audio product combined with a lamp. We recently contacted the Commission to enquire about whether this product would be in the scope or not, and to our dismay, we understood that they are in scope. ENERGY STAR exempts products that offer other features besides lighting in the lamp, and we would like to request the Commission to either do analysis, or absent the analysis exclude these products from the Regulations. There are a number of factors that prevent these products from meeting the proposed requirements, that there are some technical challenges, those being mechanical and electrical that need to be evaluated before saying rules for specifications for these kind of products, power factor, standby power, it's going to be	The concept of a regulated product imbedded in another product is not new, is well understood by staff and is considered during the development of all standards. An example of a commonly imbedded product is a battery charger found in another product such as a robotic vacuum cleaner. The point of compliance is with the battery charger, not the vacuuming element of the product. Component regulated products are subject to the standards if the component product falls within the scope of the standard and meets the definition of the product. In addition, the component product must be able to be tested using the required state or federal test method. Test methods are also designed with embedded products in mind which is why they require other functionalities be turned off so only the relevant energy draw can be measured. All LED lamps that are general service are in the scope. If the LED meets the definition set forth in the regulations and its energy use shall be measured by using the required test method, and the LED lamp

	an issue for these products, so we would like to request the CEC to conduct further analysis before deciding whether these products are in the scope of the Regulations or not.	must comply. See RESPONSE 2 regarding standby power. See RESPONSE 13 regarding power factor.
GE	The final comment is regarding off state wattage. You know, as we have seen more and more, the idea of a smart lamp has come about, nobody wants a dumb product anymore, everybody wants the overall lamps or the lighting in their home to be intelligent. Yesterday we actually heard some feedback from different people at the DOE meeting from Intel, Google, Apple, everyone else, that lighting is the prime real estate of the future. This will be the actual avenue for controls, for video, for being able to talk from room to room. With this in mind, the express terms show a .2 off state wattage specification. This is very limiting and doesn't allow much functionality or room for development. The current specification would actually eliminate the use of certain technologies like WiFi because of some higher off state wattages that are needed to ensure that that technology works correctly. The Commission is actually in a very unique position as they can actually enable and accelerate the use of this technology and to ensure that the overall system gains of reduced wattage in the home, if someone leaves their lights on, they can turn it off from their phone; if their kids are playing with the lights, they can turn them off; if their neighbor forgets the lights and you have the password, you can	See RESPONSE 2.

	actually turn off your neighbors' lights. There are a lot of different things that can be done and we really recommend that the Commission as a whole allow the one-watt allowance that you see, or use other industry specs such as the EPA and others that have a much wider tolerance. Thank you.	
Test Procedure		
Philips	Consensus among NEMA members is that the cycle time for new lamp design is six to eight months, and manufacturers have the difficult task of keeping up with led innovation during product development and market introduction. Manufacturers are the experts of their particular designs and need to have an option to be able to change critical components like the LED chip in a short period of time, without having to conduct system-level testing for three or 6,000 hours for every single model that uses the same LED. The ENERGY STAR Lamps Program, for example, allows product changes including LEDs which gives manufacturers the needed flexibility to make changes from a high level without having to repeat all system-level testing. So to summarize, LM 84 is relatively new, at this time manufacture experience with it is low, and it may not deliver any better results for predicting lumen	Staff modified, in 15-day language, the proposed effective dates of the general service LED standards for Tier I from January 1, 2017 to January 1, 2018 and for Tier II from January 1, 2019 to July 1, 2019. Regarding testing, the Energy Commission wrote its proposed regulatory language to match the then-proposed U.S. DOE test procedure for general service LED lamps. Ultimately, the Energy Commission will be preempted from using a different test procedure than DOE for those products covered under DOE's rule.[30]

30 http://energy.gov/sites/prod/files/2014/05/f15/led_tp_snopr.pdf

	maintenance than the current incumbent procedures of LM 80 and TM 21. Finally, although LM 84 and TM 28 are not in common use, there may be early adopters that wish to use those Standards, thus NEMA proposes that the CEC allow manufacturers to test and certify using either LM 80 and TM 21, or LM 84 and TM 28, at the manufacturer's discretion until such time as the industry has gained sufficient familiarity with the new Standards so this issue can be reevaluated and a more informed decision made about which Standards are best. So in conclusion, we're very concerned that the scope of the current proposals as written are so broad and the various requirements taken together are so high that if enacted without revision it will fail to achieve these goals. Instead, we believe that the overall effect, while unintended, will in fact slow the adoption of LED products and greatly reduce the amount of actual energy savings that is possible to achieve with more reasonable Standards. Thank you.	
Tolerances/Sampling		
NEMA	I'll give two examples. One, we know that a lot of folks have looked at the database for the DOE's LED Lighting Facts Program regarding the expressed and claimed performance capabilities there. This database, while extensive, is very rarely swept and updated. Data, once it's in there, can often stay for a long time and some of the data itself is suspect if you look at something like	This response appears to recommend lowering the CRI requirements to permit greater tolerances in the manufacturing process. To that extent, see RESPONSES 1 and 3. The Energy Commission made changes in 15-day language to address concerns about tolerances by

	the LM 79 tests that are posted there. That's something that was tested once, but then the lamp enters mass manufacture, and then you get production variation that can significantly or at least noticeably change. And there are tolerances granted by DOE for the Lighting Facts label that are not part of the tolerance ranges in this proposal.	requiring the sample of light bulbs for purposes of testing, certification, and enforcement to match what is required by the U.S. Department of Energy. This sample size is larger than typical for an appliance, allowing for more variation within that sample size while still being able to meet the efficiency standard. No further change was made to the regulation.
NEMA	Another example would be the more recent studies done –- oh, he's not here now -- done at CLTC, wherever Michael Siminovitch is, where they examined up to 26 different lamp types and up to 10 samples of each, but not always 10 samples of each. Ten is not a very big number. And in that data, while it's very interesting to look at the CRI variations and the efficiency variations among those lamps, those were all purchased off the shelf, so they're a single lot of manufacture, they don't represent the widespread variance that can happen as manufactures source their components for multiple vendors and combine those to make a product. So if you look at the CRI capabilities in there, you say, "Oh, look, we see lots of stuff that comes above 82 CRI, even though it says 80 on the package, and so why don't we make the minimum CRI 82 in the spec?" Well, the reason they're at 82.4, 82.7, is because they want to be sure through an annual variation of manufacture they're always above 80 because, as we all know, there will begin to be Title 20 enforcement and fines levied against those who fail to	NEMA's criticism of the CLTC analysis as not broad enough to understand all light bulbs misunderstands the legal basis for the Commission's regulations. The cost-effectiveness and technical feasibility of the standards, based on the incremental cost of a compliant product and the energy savings resulting from compliance, must be supported by substantial evidence in light of the whole record. (Pub. Resources Code section 25901.) The data and analysis includes two staff reports, a supplemental staff analysis, and the Standardized Regulatory Impact Assessment, as well as the comments received from the IOU CASE Team during the rulemaking process. These reports and comments included references and citations to publically available data, such as the CLTC study, that supported the Commission's proposed standards. Here, NEMA has pointed to a limitation in the CLTC study (which is only one source of data used in the development of the regulations), but has not provided any contradicting or new data to support a change to

	meet the minimums and no one wants to be the next iRobot and having to pay a $1 million fine here.	the regulations. Therefore, the standards as adopted are cost-effective, technically feasible, and supported by substantial evidence in the record.
General/Miscellaneous		
Acuity Brands	Good morning. I'm Cheryl English with Acuity Brands Lighting. We're a manufacturer of Luminaires and control equipment with multiple manufacturers here in California. I appreciate the Commission's interest in promoting energy efficiency and lighting quality market adoption. I think that's really the goal of everyone here, and we're here to support that.	This comment is about the commenter's introduction. No response is required.
Acuity Brands	I'm here to talk about two specific items in this Title 20 hearing, the first one being conflicting recommendations between Title 20 and Title 24 JA8 requirements. So I'll start out with the first topic of Title 20 versus Title 24 JA8. There are many products that have been scoped into this Title 20 hearing that are covered also in the Title 24 JA8, but with distinctively different requirements. I appreciate that Title 20 is a restriction on the sale of products in California regardless of whether that's new construction or retrofit consumer use, while Title 24 is a building standard. When JA8 was first introduced in Title 24, we expressed concerns with regard to the inclusion in an Applications Standard or a Performance Standard of the very proscriptive requirements of JA8 that restrict product,	Title 20 standards do not conflict with Title 24 requirements. It is possible to design a lamp that meets both JA8 and Title 20 – in fact, a JA8 compliant lamp would have to meet most of the Title 20 requirements, although Title 20 requires significantly higher efficacy than JA8. This is frequently the case with appliances that may be used in new construction, including HVAC products and lighting products. Title 24 may set performance levels that push the envelope on efficiency for the limited new construction market, while the Title 20 standards are minimum standards for what is sold or offered for sale in the state.

	because that is really not the goal of Title 24. We're now facing a situation where there are conflicting requirements between Title 20 and Title 24, and the interrelationship of these requirements does not appear to have been studied in the Title 20 Technical or Cost Analysis. So I recommend that the CEC evaluate and resolve the conflicting requirements between these two different Standards. I will also add that the products that we sell, we sell based on different grade products, so cost versus quality of product. We do not distinguish different products for retail off the shelf sales versus new construction. We allow the consumers to choose the price point and the quality of the product that they want. So we wouldn't be designing one product for Title 20 in a different product for Title 24, that's just not the way the construction market works.	
Osram Sylvania	We agree with all of the Efficacy Standards that are laid out in this current version of Title 20. And we understand the need in California to move forward with progressive regulations on energy efficiency and to do so rapidly. So we're supportive of that. We're also supportive of performance metrics, that there are some metrics that bring us a higher quality light and differentiate products in the marketplace for consumer preference.	The comment supports the standards and does not ask for changes to the standards.
Sony Electronics	My name is David Maciel, representing Sony Electronics, as far as energy efficiency is concerned. I've been doing	This comment is about the introduction, no change is requested.

	this for many years. I've been in several rulemakings, including the Television Consumer Audio Video Products, displays, rulemakings, and now to some degree involving the lighting rulemaking. I would like to make two comments today, one as a company representative and the other one, if I may, as a consumer.	
NRDC	Good morning. I'm Noah Horowitz for the Natural Resources Defense Council. And I know a lot of people are hungry, so I'll be brief here. I'm the Director of our Center for Energy Efficiency Standards and I'm here today on behalf of our more than 1.2 million members and eActivists. Overall, NRDC is very supportive of the CEC proposal which we believe will accelerate the shift to good quality, energy saving lamps. This has been a long and somewhat contentious rulemaking and we think the proposal you have is a reasonable middle ground, and we encourage you to move forward in an expeditious manner.	The comment supports the standards and does not ask for changes to the standards.
NRDC	I'm going to comment on three points, one is the stringency of the efficiency requirements as they relate to decorative LED Lamps, which have a smaller form factor; 2) I'm going to point out and make a suggestion, there's a lack of minimum color quality requirements for most of the Small Diameter Directional Lamps, and we think that's an omission; and 3) I have some comments and concerns about the combination of the	This comment is an outline on what NRDC wants to address in specific comments. Staff specifically addresses the substantive comments in this document.

	Labeling and Reporting section and have some recommendations to improve it there.	
NRDC	As a result of what you've heard today, I think it makes sense for CEC to consider all the input and make minor adjustments to the proposal and hopefully that can only trigger -- that only requires 15-day language and you could move forward in a timely basis.	Staff issued 15-day language and revised 15-day language to make minor adjustment to the proposed standards.
California IOUs	Hello. Thank you for the opportunity to participate in this important rulemaking on behalf of the California IOUs. We are supportive of the CEC's proposal to set minimum performance and quality requirements for LEDs. As with CFLs, an initial sales surge will not transform a market. Low product prices are not sufficient. Product performance is important to customer acceptance and complete market transformation. LED performance has dramatically improved over the last few years. The market has responded to the CEC's 2012 Voluntary LED Quality Specifications with a steady stream of wonderful products, at increasingly low prices and improving efficacy, lamps with extremely high color rendering index, with great dimming capabilities and long life. The California IOU Rebate Programs have been supportive of these programs for the last two years. While the CEC's voluntary specification and the associated rebates helped incentivize high performing products, it cannot prevent products that don't render	The comment supports the standards and does not ask for changes to the standards.

	colors well, that flicker or buzz when dimmed, that mislead consumers with their packaging from undercutting the high quality products.	
California IOUs	Another recent trend in the LED market is a race to the bottom in terms of product quality and performance, with manufacturers' value engineering wherever possible and competing on price alone for early market share and early adopters. These products may be reasonable replacement for CFLs, but they don't provide the level of service and amenity needed to compete with incandescent lamp performance and fully transform the market. The CEC's Title 20 proposal goes a long way towards preventing products like this from poisoning the well and reducing customer confidence in LEDs, similar to what happened with CFLs.	Staff agrees with the IOUs' comment. No change is requested and needed.
California IOUs	The proposed Standard does not require lamps to be the best in class. It isn't as stringent as the CEC's voluntary specification or the California IOUs' proposals, but it does require a solid foundation for minimum performance and establishes a level playing field upon which manufacturers can compete. We want to commend the CEC for its work with all parties to get to this point. The CEC made several compromises throughout the rulemaking in response to stakeholder input, and we believe the proposed standard represents a good middle ground that we are willing to support. With LEDs, we can have high efficacy and great	The comment supports the standards and does not ask for changes to the standards.

	performance, as well, if we ask for it. This rulemaking is California's opportunity to drive this market transformation. If California can convert the remaining 50 percent of sockets that still have low efficacy sources in them to LEDs, the annual statewide savings would be on the order of 30,000 gigawatt hours, which is sufficient to achieve the state's AB 1109 goals in one fell swoop. We appreciate the opportunity to participate and look forward to continuing to support the CEC in this important cause. Thank you.	
California IOUs	Mike McGaraghan representing the California Investor Owned Utilities. First of all, I want to reiterate our support for the proposals, but I just in addition wanted to add a few comments in response to other things that have come up today.	The comment supports the standards and does not ask for changes to the standards.
Nancy Anton	My name is Nancy Anton. I'm here as a consumer, it's kind of interesting to me that there's no one else that's taken that role. And I will say, as a consumer, if you are looking for more consumer input, it was very difficult and took a lot of work to find my way here, and I'm happy to give you some feedback about that, but maybe you don't want more consumer input. Anyhow, I would like you guys to hear from me how you can help me as a consumer and I've recently had a lot of frustration with lighting related to a home remodeling project and I've become more of an expert than I wanted to be, and I wanted to share some of that experience to help you	Staff appreciates the commenter's experience in trying to navigate the lighting transition to LEDs. The transition from incandescent and CFLs to LEDs will take some consumer education to understand the variety of features LEDs have and to select the LEDs with the desired light level. Most retailers have point of purchase displays coupled with product labeling that help inform consumers about product characteristics. This will help those new to LEDs select the appropriate product for their specific application. To complement point of purchase information, the US EPA Energy Star webpage contains information on

	guide some of the decisions you make. Regarding LED lighting and a little about me, I'm an energy nut, I don't have a Prius, I ride a bicycle, I use light rail, I worked for the Legislature for over 25 years. I'm currently a Governor Appointee on other commissions, I'm familiar with rulemaking, and regulations, and legal requirements, although not in this area. I go to buy lights for my house and the first thing I encountered, I'm not always price driven, that is important and I'm sure the manufacturers know that, but I also am willing to spend more to get the product I want and also to generate energy savings. I sometimes wonder if the cost and price point is overrated. I looked the array in specialty lighting stores, as well as big box stores of lighting options, and I was nearly overwhelmed. I bought some fixtures that said LED because my understanding is that's the way to go. And I found out there are two different -- in fact, I may not be right, this is what I think I've learned -- two different ways to go with LED, I can buy an LED bulb and retrofit an existing fixture, or I could buy a fixture that said LED. I didn't understand that, so I generally went for an LED fixture assuming it was more energy savings, I don't know if that's true. I certainly had many more fewer options. And I get home and the Electrician installs the fixture, which I then learned meant it's no longer returnable because it's now been installed, and I discover that this fixture doesn't take bulbs, it comes with a built-in --	understanding LEDs. See https://www.energystar.gov/products/lighting_fans/light_bulbs/learn_about_led_bulbs. California also maintains the Energy Upgrade California webpage which contains information about LEDs. See http://www.energyupgradeca.org/en/save-energy/home/take-control-for-savings-and-comfort/save-with-energy-efficient-products/energy-efficient-lighting. Staff appreciates the issues raised regarding fixtures and believes based on the statements made that a replacement LED bulb would have fit the existing fixture. The current array of LEDs available generally corresponds to most fixtures. The comment is not directed to the proposed regulatory language or the process for approving the regulations therefore no change to the text is needed.

	you guys must know the technical terms -- right, which means when this fixture doesn't work, I throw it away. I don't know what the costs of that are.	
Nancy Anton	I don't know how you address this, some kind of rating system that lets a consumer know relatively what it's like versus incandescent or an independent scale; if incandescent is going to be phased out, let's have a scale that informs people. I like dimmable lights. I don't understand why, although I've had an electrician tell me this, I don't know if it's correct, why some of mine flicker and why some of mine make noise. I was told it has to be a dimmable compatible light. So now I look for bulbs that say "dimmable." But then I learned some of those still make noise and flicker. And then I found out, oh, you need to have a dimmable compatible switch. Well, that's a whole other kettle of fish to find one and that requires an Electrician to install. Now we've got a different price point. None of that is made clear to me as a consumer, that when I take this dimmable bulb home, it is not going to perform to my satisfaction, or that I'm buying a bulb that won't even dim. I wanted to make a comment about my term, what I call projected, the longevity, the technical viability. We had a home remodel project about five years ago and at that time we had to put in compact fluorescent bulbs that have either two or three pins, and what I gather is these are history now. But I have these fixtures that only take them. And the other part of them, I guess not	The proposed regulations set forth dimming, flicker and noise compatibility and marking requirements for those LEDs that are claimed to be incandescent like or dimmable. These requirements should provide additional clarity for consumers seeking an LED replacement. The pin based CFLs were likely installed as part of the building code under Title 24. The regulations at subject to this rulemaking are under Title 20. The comment is not directed to the proposed regulatory language or the process for approving the regulations; therefore no change to the text is needed.

	having overtaken the market, is that when I asked my son to change the light bulb, which stopped performing well before when it should have, he, which I thought was reasonable, and he's college educated, which could be the problem, he unscrewed it. Well, as you know, a bulb with pins doesn't unscrew, it's kind of hard, so he turned it really hard. Well, what do you think happened? It broke. So now I have a fixture that doesn't work at all because the pins are stuck in it, and I didn't even know or realize from five years ago that this was a pin fixture. There's nothing that indicates to an average person, I presume an Electrician might know, that when you want to change this bulb hanging down that looks like a compact fluorescent, it's got pins and not a screw base. I don't know how you let people know that, but for all the pinned bulbs that were sold and installed, and I was told we were required to put those fixtures in, when those bulbs go, I think there's a good chance that people are going to try to unscrew them because there's no way to know, there's nothing that looks different about it.	
Nancy Anton	When I hear the discussion about cost, I don't get to replace this fixture with a $3.00 on sale bulb or a $9.00 not on sale bulb, I have to get rid of the whole fixture, which to me I thought was kind of a bargain price at about $30.00, but I didn't realize I have to throw it away when it ceases working. It says it will be 10 years, and experience I have with a compact fluorescent that	Staff appreciates the issues raised and believes based on the statements made that a replacement LED bulb would have fit the existing fixture. The current array of LEDs available generally correspond to most fixtures. The comment is not directed to the proposed regulatory language or the process for

	was installed five years ago was it stopped working, although I don't know what the guarantee is because, really, do you keep warranties for your light bulbs? I barely keep them for my big appliances. So I asked my son to take that light bulb out. In the process, I'm going to come back to that example, I'm going to stick with the bulbs or the built-ins. So now I have a $30.00 light fixture that when it goes, I throw it away.	approving the regulations. No change is needed
Nancy Anton	There's another term I have that it may or may not be related exclusively to LED, but certainly to lighting, and it's what I call asleep lighting. So I have a little frustration, I hope I'm not -- I'm very happy with our television monitor, it's a Vizio, and when you turn it off, the name Vizio lights up, it's on 24/7. When we're not home, it is advertising to my couch that it's a Vizio. It's advertising that to us and I know that. I'm sure someone will say that it uses an infinitesimally tiny amount of electricity. I wonder when you add all that up, what does that amount to? And the message it sends, it sends the message to my kids and to their friends that it's okay to have lights on.	Staff appreciates this comment; however this comment is beyond the scope of this proceeding which does not cover televisions. Staff will keep in mind this type of energy using application for any future updates to the TV standards. As an option to address your specific situation you can plug the TV into a surge protector and switch the surge protector off when the television is not in use. No change to the regulations are needed
Nancy Anton	Our new dishwasher, it has a nifty little sign after you run it that says "Clean." So when I run the dishwasher before I go to bed at night, that "Clean" sign stays on all night long when nobody is in the kitchen and needs to know. And when I go to work, it's on all day long because I tend to run it as I'm leaving the kitchen, and	Staff appreciates this comment; however this comment is beyond the scope of this proceeding which does not cover dishwashers. In developing regulatory language, the goal is to have language that is relevant for a long enough period of time to achieve the desired results of energy or water savings. The regulations need to

	when I go on vacation, run those dishes so they'll be clean when I get back? It's on for weeks. I would certainly consider do you need to address that these should just be prohibited? What is the value of them? Particularly the ones that advertise their name. The last thing I would suggest, based on other aspects, more with my experience with Title 24, is whatever direction you go, consider can one size fit all? My experience in a different area of law is the answer is generally no. So having an appeals process, or a method where exemptions can be granted, I think is extremely important. Allow for expected unintended consequences and a way to be able to deal with them without wringing your hands and going, "We have to wait until the next rulemaking process. We have to go back through OAL, it's too big a process." Have a method where you can stay nimble and you can stay flexible, and that as technology changes in the future, is LED going to be it, the two-pin and the three pins weren't, that you can be nimble and respond and so can consumers. And I'm happy to give you examples if you want more consumer input about how I think you might better be able to reach people. Thank you very much.	account for special cases but not create openings that allow too many products exemptions. These regulations are good examples of this where certain specialty products have been excluded because there are limited energy efficiency replacement products. The objective is to build into the standard the exemption as opposed to having a case by case waiver that creates additional complexity and administrative burden. No change is needed.
Westinghouse	You heard a lot of technical comments this morning and I'm supportive of them, particularly the ones related to CRI and consumer preference. I'm mainly going to talk about the scope for a few minutes. I am	Commenter has not requested any change to the proposed standards in this comment. No change is needed.

	going to break it into two pieces because I think it's different, we have some different concerns with general service LED lamps than we do with Small Diameter. So as outlined in the recent Staff Report, we recognize the goal is to capture the energy savings that are outlined in your goals, AB 1109, and with what the Commissioners look for. Jim said something that I really liked the way it sounded, I think the challenge that we have here is that the current proposals as they're written today are so broad, and the requirements are so detailed that we run the risk of eliminating the very products we want to sell. And that would take us backwards from energy savings.	
Green Creative	Hi everyone. My name is Eric Bluvas and I'm with an LED Manufacturer based here in California called Green Creative. I'm not sure if all of you are familiar with us, we are a bit smaller. And I do think it's good, and I'm glad to have the opportunity to comment because I have a unique perspective as a small manufacturer, especially also a California-based manufacturer. And not that it's an excuse, but given the size of our company, resources are a bit constrained, so fortunately I don't have a lot of sound detailed statistics or data, but I do have some general comments on the overall rulemaking for both of these, the General Service and the Small Diameter that I wanted to get on the record here, so thanks for the opportunity. I think one thing that's failing to be addressed is that if you	The comment supports the standards and does not ask for changes to the standards.

	pick apart any aspect of the market today, yeah, there's concerns with all these requirements because a lot of us, you know, some of my colleagues and competitors here don't have products that are going to meet that. But we're not talking about today, these go in effect far in advance, in fact the Small Diameter, it's 2018, as I understand. And although I'm not specifically tied to the R&D side of things with our company, it's my job to track all these requirements, Codes and Standards, utility requirements across the country, so I have a good perspective of what the flavor is across the country and even a little bit internationally, and I want to say about 18 months ago some of the initial proposals for the Title 20 Rulemaking, I ran by our R&D folks, and you know, obviously initially they balked, some of the same concerns you hear from some of our competitors, but once I said the timelines, they said, oh, that's not a concern at all.	
Green Creative	So the underlying point I want to make is that we welcome this kind of thing because it is a line in the sand. And I'll highlight some things, but we're there now in a lot of respects, and we'll certainly be there market-wide with the timelines that are proposed, I think the gentleman, the PG&E consultant said it best, and I'll draw a parallel to the voluntary spec that's out there now, that kind of proves that. I mean, once you draw that line in the sand, as long as it's reasonable, and you're accounting for the majority of applications	The comment supports the standards and does not ask for changes to the standards.

	and whatnot, I think the market itself adjusts and matches that. So I do want to be clear that, as a company, you know, designing quality primarily screw-in and some of these Small Diameter products, specializing in that and the LED space, we support the spec for the most part as it, but we'll try to gather resources if there's any other various specific comments we have taking issue with any of the detail R&D side things. But on the whole we do support this. And I think everything for the most part that's laid out is sound science, we hold in high regard some of the studies that went into this, and we appreciate the fact that cost is factored in.	
Cree	This is Greg Merrit from Cree. I'm the Vice President of Marketing and Public Affairs. For those of you that may not know, Cree is a U.S.-based developer of both LEDs and LED lighting products. And we also have a facility in California. Cree is focused on 100 percent LED adoption and very key to accompany that is better light experiences. There have been a number of good comments previously today, so I'll amend my comments to avoid being too repetitive. All of the specs that are contained in the 45-day language are in our opinion attainable and reasonable.	The comment supports the standards and does not ask for changes to the standards.
Cree	I also very much agree with the earlier comment about the use of LM 80 and TM 21 which are widely accepted, and in practice versus LM 84 and TM 28, and would	To test for lumen maintenance and time to failure, manufacturers can use the IES LM-84 (2014) and TM-28 (2014) with additional guidance provided in 80 Fed.

	also agree with Noah's comments on labeling of equivalency of bulbs that use daylight CCT.	Reg. 39665-39667 (July 9, 2015),§430.23(dd), and Appendix BB to Subpart B of Part 430. Because the Energy Commission will be preempted by the federal test procedure by the time the standards take effect, the intent of this provision is to align with the extent possible to what is anticipated to become the federal test procedure. The Energy Commission will need to update its regulations once the federal test procedure takes effect to clarify the applicable test procedure. The Energy Commission modified the wattage equivalency requirements in 15-day language to apply regardless of whether a lamp claims to be incandescent equivalent. This means that high CCT bulbs will also be required to meet wattage equivalencies.
Philips	I'm Jim Gaines from Philips Lighting. I'd like to thank the CEC for the opportunity to give comments on the proposed 45- day language. We recognize California's goal to capture the increased energy savings promise to buy LED and we support that goal. However, we are very concerned that the scope of the current proposals, as written, are so broad and the various requirements taken together are so high, that if enacted without revision it will fail to achieve these goals. The lamps won't be adopted. Instead, we believe the overall effect, while unintended, will in fact slow the adoption of LED products and greatly reduce the amount of actual	See RESPONSE 4.

	energy savings it's possible to achieve with more reasonable Standards.	
Pacific Gas & Electric	I am Gary Fernstrom, retired from PG&E and currently working as a consultant for it. And I've represented PG&E and the California utilities at various CEC and Department of Energy rulemakings over the last 15 years. As Lorne Whitehead did -- and by the way, in consideration of his perspective on color, I'm wearing my R9 shirt this morning -- I'd like to make a brief statement and a couple of points. In my experience in these 15 years of rulemaking, I have again and again heard industry and individual manufacturers make the statement that products are not available, that it can't be done, that it's too expensive, and that consumers really don't want it. And time and time again, after rules have come into effect, I've seen compliant products come into the market to consumers' delight at reasonable price points. So if we're to use history as an example, products can be made that serve consumers' needs, that work better than expected, and cost less than is represented. The second point I'd like to make is a few years ago when I had the opportunity I bought one of the Philips L-prize lamps. I still use it at home, it's probably going to last well in excess of 20,000 hours, and it does all the things we're talking about here. It may not be advantageous from a lighting industry business perspective, but the reality is that these performance criteria that we have recommended,	The comment supports the standards and does not ask for changes to the standards.

	which the Commission has compromised on, can be done. I have the proof in my very own home. Thank you.	

15-day and Revised 15-day Written Comments

Commenter	Comment	Response
Chromaticity and Color Consistency		
LumiLEDs	We thank and applaud the CEC for making the requested normative reference to the American National Standard for SSLchromaticity, ANSI C78.377-2015. Referencing standards helps to ensure quality and consistency, and to enable high volume cost reductions that will benefit California consumers and drive adoption of this energy saving technology. This change settles the matter of specifying chromaticity, however, the draft regulation still includes problematic language regarding color rendering.	The comment supports the standards and does not ask for changes to the standards.
Philips	Also, whether the CRI requirement is ultimately changed or not, the Commission needs to clarify whether the limit is an individual minimum, i.e., no lamp can be below this value, or whether the average of a given sample must meet the minimum. As written, the language indicates that state regulated LED lamps shall have a CRI(Ra) of 82 or greater. Given that proposed DOE test procedure talks about averaging samples, the intent of the Commission is not clear in this regard.	The Energy Commission made changes in 15-day language to address concerns about tolerances by requiring the sample of light bulbs for purposes of testing, certification, and enforcement to match what is required by the U.S. Department of Energy. This sample size is larger than typical for an appliance, allowing for more variation within that sample size while still being able to meet the efficiency standard. No further change was made to the regulation.
NEMA	We appreciate that the commission accepted our comment	The reference to Table 1 in Annex B is

	to reference ANSI C78.377 Annex B regarding chromaticity. We note that the correct reference is "Table B1." Citing the correct reference will help reduce confusion and burden.	sufficiently clear to avoid confusion.
Cree	Item (2) Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), (2) C (i): The proposed language for color point and color consistency references Table 1 of Annex B of ANSI C78.377-215. Comments: Cree commends the commission for aligning this requirement with industry practice.	The comment supports the standards and does not ask for changes to the standards.
Consumer Choice/Preference		
NEMA	This rulemaking began almost 3 years ago, and based its approach on the fundamental assumption that there is, or was, a reluctance to adopt LED lamps by consumers. At that time, general service LED lamps were just introduced the market, and --- not surprisingly and consistent with the price behavior of many other newly-introduced products --- prices for these new products were initially high and much more expensive than other general service lamp technologies --- fluorescent and halogen incandescent. The higher prices of LED lamps that were initially placed on the market naturally presented a problem for widespread consumer adoption. However, a market-driven revolution spurred by manufacturer innovation tied closely to consumer needs and interests has changed all that. In three short years, the price of	See RESPONSE 4.

	general service LED lamps is nearly on par with the product they are primarily intended to replace in sockets, the halogen incandescent, and they are continuing to fall. Numerous studies done by the CEC and the Investor Owned Utilities confirmed that the largest impediment to adoption of these products was price. The Staff Analysis mentions this fact, but fails to reach conclusions consistent with market realities. As to the price of LED lamps, the staff analysis indicates their proposal will INCREASE price.	
NEMA	A fundamentally flawed premise --- a hypothetical if you will --- that underlies the 15-day language is that the new and innovative LED products now on the market do not satisfy the consumer, and that government needs to tell manufacturers how to make more expensive, less energy-efficient LED products in order to overcome this hypothetical concern.	See RESPONSES 1, 4, and 8.
NEMA	While we understand that the basis of this concern is that some CEC staff members want to be absolutely certain that the experience the consumer had with the compact fluorescent lamp (CFL) in the 1990s is not repeated, that experience is entirely irrelevant to the vast majority of general service LED lamps on the market today. It ignores the fact that lighting manufacturers already had this concern in their view as they planned and implemented their innovations aimed at satisfying consumer preferences while substantially lowering the	See RESPONSE 8.

	cost and price of LED lamps now on the market. At no time have any credible studies been performed to ascertain any adoption challenges or consumer preference influences except price. Sadly, at the same time CEC staff has dismissed multiple studies from the Lighting Research Center in Troy, NY which contradict staff's assumptions about consumer color preferences.	
Philips	The 15 Day language will: Penalize California consumers financially. They will have no choice but to buy more expensive and less efficient bulbs than consumers in the rest of the country.	See RESPONSE 4.
Philips	Reduce the availability of LED lamps in California, depending on the product type.	See RESPONSES 3 and 10. In addition, the Energy Commission had extended the effective dates of the standards for state-regulated LED lamps to ensure that manufacturers would have sufficient time to produce lamps that met the standard as well as demand in California.
Philips	The first point is a matter of public policy, i.e., should California force consumers to pay more for a less efficient product, and should be at the front of the discussion.	See RESPONSE 4. The Commission's statute does not allow the development of an efficiency regulation that would result in less energy efficiency and greater cost. In order to issue regulations the commission staff produces extensive cost benefit and technical feasibility analysis to support the proposed standards. In this case the LED standards will result in a savings to consumers of $2 billion. (See table

		17 page 78 of the Staff Report).
Cost/Cost-effectiveness		
NEMA	Numerous studies affirm that the largest impediment to adoption of LEDs has been price. LED prices have dropped substantially since this rulemaking began while at the same time consumer LED adoption rates have been increasing.	No change or response is needed because staff agrees with the comment and commenter makes no request.
NEMA	Today's market price of general service LED lamps is nearing parity with the product they are primarily intended to offset, the halogen incandescent lamp. And their price is continuing to fall. By contrast, CEC staff analysis acknowledges the proposal will INCREASE the price of LED lamps and that the proposed designs are less energy-efficient than today's more popular LED options.	See RESPONSE 4.
Philips	In the Supplemental Staff Analysis for General Service Light-Emitting Diodes, the Commission indicates that "the total estimated cost of compliance for medium screw-base LEDs is $0.50, compared with over $7.00 in estimated energy savings." We wish to point out consumers are very sensitive to first cost, not the savings over time, thus adding $0.50 to the price of a lamp is significant.	Under Public Resources Code section 25402(c), the Energy Commission is required to set standards that are cost-effective to the consumer over the lifetime of the product. Nearly all efficiency standards will increase the first-cost to the consumer as part of the incremental cost of efficiency improvements to the product. However, the Energy Commission must ensure that these costs are recouped through lower operational costs for the product. The Commission has done so here.

CRI – Small Diameter Directional Lamps		
Philips	Small Diameter Directional Lamps – CRI: We repeat our request to set a minimum CRI of 80 for small diameter directional lamps. Currently there is no minimum requirement for these products and adding one will not reduce product availability.	Unlike general service LEDs, small diameter directional lamps are predominantly used by commercial consumers. Commercial consumers are capable of specifying the CRI they need for any given lighting application and cost. As a result, staff does not expect that there is a need to establish CRI from a regulatory perspective. This is reinforced by the fact that there are not any lamps that have a CRI lower than 80.
CRI – State-regulated LED Lamps		
NEMA	We continue to disagree with the CEC's approach of over-specifying R8 CRI and simultaneously implying that lamps with CRI = 82 are feasible in terms of meeting the unrealistically high requirements for R8 > 72. A reasonable person easily recognizes that by over-specifying the CRI of R8 in the manner the CEC proposes results, as a practical matter, in a lamp with an overall CRI of 90. There are no CRI 82 LED lamps with R8 = 72. For lamps with an overall CRI 82, R8 is considerably lower. Furthermore, CRI 82 and R8 >72 is not common at all, and likely impossible to achieve this with currently existing phosphors which are optimized for lamp efficacy.	See RESPONSES 1 AND 3.
NEMA	The revised 15-day language continues to promote unrealistically high color rendering index (CRI)	See RESPONSES 1, 3, and 4. In addition, the proposed rule meets all the provisions

	requirements for R8, which effectively forces manufacturers to supply nominal CRI 90 products to the market instead of the CRI 82 specification elsewhere in the 15-day language. In other words, the CRI 82 specification is illusory. The result will be that the CEC is going to compel consumers to buy more expensive and less efficient CRI 90 LED lamps. Compared to consumers in the rest of the country, Californians will have to spend more and get less in terms of energy efficiency. This proposal fails to meet both the necessity and consistency requirements of California Government Code§11349.1(a). By our calculation, the CEC is potentially sacrificing up to 20% of energy savings by taking this ill-advised, over-specified approach to CRI that consumers will not actually benefit from.	Administrative Procedures Act that apply to Title 20: Government Code section 11349.1(a) details OAL's review process and the standards of necessity, authority, clarity, consistency, reference and nonduplication. The regulations meet all of these requirements. The supplemental ISOR details the necessity of each provision of the regulation. The regulations are consistent with the existing framework and structure of the Commission appliance regulations found in sections 1601-1607. No change is necessary.
NEMA	Using the energy savings estimates from the October 2015 CEC Staff Analysis, CEC is foregoing up to 172 gigawatt-hours (GWh) annually if it approves the revised 15-day language as written. Through 2029 this represents up to 1253 gigawatt-hours of lost energy savings. This is a serious result which would seemingly be at odds with public policy objectives in California to improve energy efficiency and reduce carbon dioxide emissions. For more information on energy efficiency concerns, see Part A, Comments 6 and 7, infra. Cost Analysis: We note the efforts to revise the cost analysis, as shown in the Supplemental Staff Analysis (footnote 2). We offer the	See RESPONSE 1. NEMA has not presented evidence to support the lost energy savings numbers presented in this comment. A lamp can be made to produce slightly more lumens by sacrificing color quality, but those few extra lumens of poor light are not even noticed - and the net result is not better light. The efficiency of a general service light is, however, even more complex than just the lumen-per-watt rating. The job of a general service light goes beyond simply filling an area with perceptible light; it must also provide color differentiation.

	following additional information regarding the feasibility of red phosphor and call in to question the CEC's determination that this is a feasible technical alternative at the costs claimed. While NEMA and CEC staff agree that there is a cost increase associated with the change of the red phosphor (to, for instance, the phosphor used for CRI 90 lamps), we note that the CEC has not considered the additional cost associated with the need to increase efficacy: the addition of the phosphor typically reduces the efficacy approximately 15%. The effect of this reduction in efficacy is to cause the lamp to not meet the 68 lm/W requirement. The CEC's analysis does not examine the financial or technical impacts of such considerations.	Monochromatic light, for example, would not be sufficient for general service lighting in either residential or commercial spaces. A second metric is therefore necessary to determine the amount of "white light" produced per lumen. The ideal color content of "white light" is defined by correlated color temperatures and scored by the color rendering index. A lamp that increases lumens per watt but decreases CRI is therefore not necessarily more efficacious. Correspondingly, a lamp that decreases the lumens per watt but increases the CRI is not necessarily less efficacious.31 A combination of quality metrics is essential for optimizing lamp design. High-color-quality lamps can use the same amount of power as lower-color-quality lamps, and the net result is much better color quality without a perceptible reduction in illuminance for the same energy. Lamp prices are sharply dropping every year. Lamp price calculations were based on January 1, 2017 effective date. Staff has changed the effective date to January 1, 2018. This will lead to a reduction in the actual price of the

31 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 50.

		products compared to what staff assumed for the report. Any increase in cost to make a compliant lamp will balance out with the reduction in cost over time.32 Product innovators have already responded to the California marketplace, and we are already seeing high-CRI lamp configurations with retail pricing less than $10 per lamp. Data have already been compiled and presented to the CEC demonstrating that the cost differential between high-color-quality products and products that meet the minimum Energy Star requirements is small, diminishing, and will largely disappear with time and volume.33 No change is requested by NEMA and after considering the comment in full, staff finds that no change is needed.
NEMA	The Commission's proposal continues to misunderstand the complex interplay in lamp design and performance between CRI aggregate, individual CRI color rendering indices (R1 – R8), Correlated Color Temperature, and other factors as outlined in detail in our comments to 45-day	See RESPONSES 1 and 3.

32 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 22 and 23.

33 http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206387_20151016T152059_2015_Staff_Report_Analysis_of_SDDL_and_General_Service_LED_Lamp.pdf page 23 and 25

	language. As we noted in our 45-day language comments, high CCT lamps have higher R8, but lower CCT lamps are more often chosen for their "warm" appearance. The data submissions from other entities supporting the R1-R8 requirements have not accounted for CCT in their submissions, and the CEC's Supplemental Staff Analysis also ignores this important factor. Again, a person might look at the graphs in the Supplemental Staff analysis and mistakenly infer that there is a wide variety of products available that meet the revised 15-day proposal. There is not.	
Nichia American Corporation	Regarding the CRI requirement a CRI (Ra) of 82 or greater and R1 –R8 requirements, it is truly uncommon for LED components. The industry has already long accepted a Minimum Ra of 70 or 80 or 90 at the LED and fixture level requirements. All LED Manufacturers are currently making LEDs to this standard	See RESPONSE 1.
Nichia American Corporation	By going against the industry standard, Title 24 is forcing manufacturers to either: Use 90+ CRI LEDs: This equates to higher costs and lower efficiencies. or LED manufactures will need to completely modify and customize phosphor combinations solely for the purpose of Title 24. This also brings higher costs and lower efficiencies. *** These cost barriers will make for slower adoption.	Nichia incorrectly refers to Title 24 (instead of Title 20), which is not within the scope of this rulemaking. The Energy Commission does not require 90+ CRI in its standards for Title 20. See RESPONSE 1.
Nichia American	Nichia strongly requests the CEC to simply align with the industry standard requirements by setting the minimum at	See RESPONSE 1.

Corporation	CRI 80, instead of 82 and eliminate the R1-R8 requirement so to reduce additional cost and efficiency barriers.	
Philips	The 2015 staff report predicts that in 2029, the projected energy savings will be 859 GWh/yr for general service LED lamps. These savings are based on a less efficient CRI 90 lamp. What the report does not address, and what many observers do not realize, is that the savings could be greater if the Commission allowed the more efficient CRI 80 lamps into the regulation. CRI 90 lamps would still be available as part of the California Transparency Philips Lighting, as a member of NEMA, supports and echoes their comments.	See RESPONSES 1 and 4.
Philips	We note that many individuals have written to the Commission in favor of product with CRI 82 and an R1-R8 value of 72 or greater. These individuals appear to be unaware that lamps that meet these criteria are available. Philips offers at least one model in the California market that meets those criteria right now. It is very likely that any lamp which meets the California Voluntary Quality Specification will meet those criteria. We understand your desire to have LED lamps that are very similar in performance to the incandescent and halogen lamps that will be legislated out of the market due to the 45 lumen per watt minimum that takes effect on 1/1/2018. We respectfully disagree that incandescent- like performance should be the minimum requirement to sell LED lamps in the state. That's why the Voluntary Quality Specification	See RESPONSES 1, 3, and 4. The Voluntary Quality Specification is intended as a "reach" standard to encourage development of incandescent-equivalent light bulbs. The standards adopted for LEDs and small-diameter directional lamps are not a "reach" standard, and are therefore less stringent than the Voluntary Quality Specification. There is room for both a regulatory floor and a "reach" level in the context of the LED market, and this is the role performed by the standards and the Voluntary Quality Specification, respectively.

	exists. The citizens of California should be allowed to make their own decisions about what type of lamps they are able to buy with their money.	
Philips	In order to allow more efficient and cost effective LED products to continue to be sold in California, we would like to propose that the minimum CRI be reduced from 82 to 80. While there are products in the market at 82 CRI, this is because the manufacturer must target this level to ensure that the minimum is 80. If the minimum target becomes 82, then the design target becomes 85-86. There are few, if any, chip manufacturers that deliberately make LEDs with a CRI of 85, thus 90 CRI becomes the next level	See RESPONSES 1 and 3.
Philips	RECOMMENDATIONS: As indicated in our comments, we offer the following recommendations to the Commission. Light Source Color – R1 to R8 Remove the minimum requirement of 72 on the individual color indices of R1 to R8. There is no technical basis for including them as a requirement and they conflict with the minimum proposed CRI requirement. If removing the minimum R1 to R8 requirement is unacceptable to the Commission, then we suggest that the requirement on R8 alone be changed to a minimum of 55. This is a change from 50 which appeared in our comments to the 45 Day language.	See RESPONSE 1.
Philips	Concurrent with a change in CRI from 82 to 80, we propose that the minimum requirement for R1 to R8 be removed completely, allowing greater flexibility in LED design. If removing the minimum R1 to R8 requirement is	See RESPONSES 1 and 3.

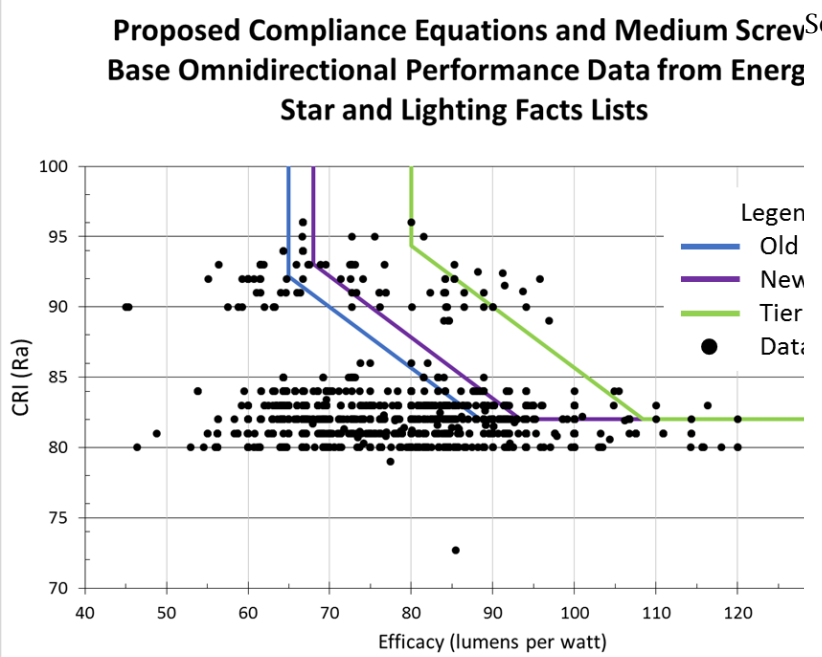
	unacceptable to the Commission, then we suggest that the requirement on R8 alone be changed to a minimum of 55. In parallel with, and tied to a change in the minimum CRI, we recommend that the minimum efficacy increase from 68 LPW in the 15 Day language to 70 LPW. This is for omnidirectional lamps only. We continue to recommend a lower limit for decorative lamps.	
Philips	Light Source Color – CRI: Reduce the minimum CRI requirement from 82 to 80 for state regulated LED lamps. This change will allow lamps designed to CRI 80 to meet the requirement, and align with common industry practice and the Energy Star program. In parallel with, and tied to a change in the minimum CRI, we recommend that the minimum efficacy increase from 68 LPW in the 15 Day language to 70 LPW. This is for omnidirectional lamps only. We continue to recommend a lower limit for decorative lamps.	See RESPONSES 1 and 3.
Philips	Light Source Color: As we and others such as NEMA and Lumileds pointed out in the comments on the 45 Day language, there is an underlying fallacy that the required minimum color score of 72 for the individual color indices of R1 to R8 can be achieved at the minimum required CRI of 82.	See RESPONSE 1.
Philips	As we have previously shown, at CCTs of 2700-3000K, lamps with R1 to R8 greater than or equal to 72 have CRIs greater than 85. Thus, with this language, the Commission	See RESPONSE 1.

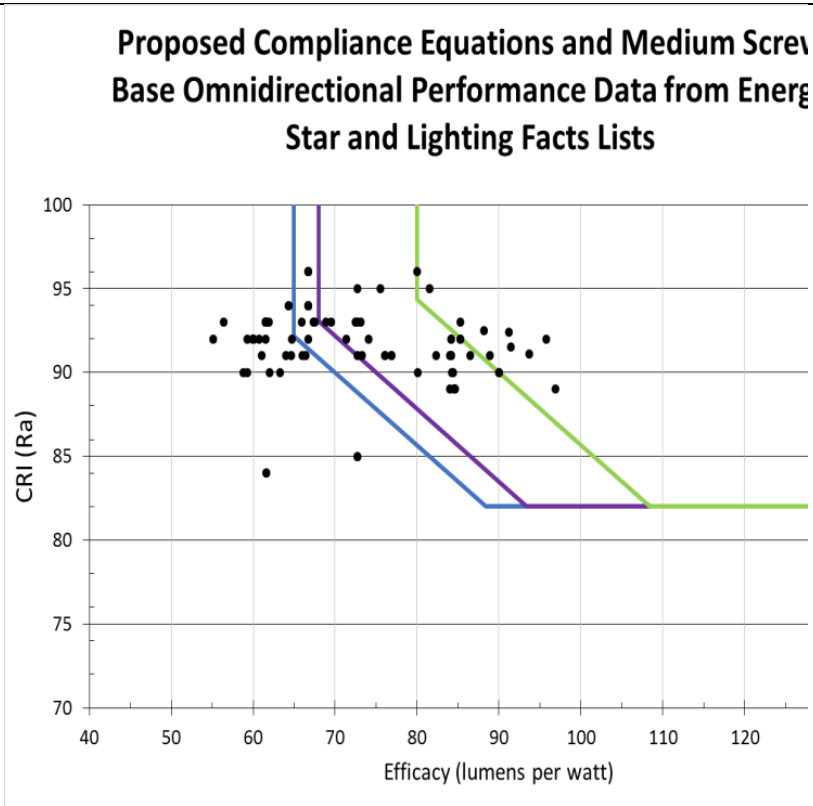
	is effectively mandating product with a CRI of 90.	
LumiLEDS	In a conversation immediately following the CEC's 13 January 2016 Business Meeting, Commissioner McAllister advised me and other NEMA member representatives that the Commission has compromised, and expects the lighting industry to also offer compromises. We would agree that the one year implementation delay proposed by the Commission is a step in the right direction. We would also agree that the CEC's new reference to ANSI C78.377-2015 is an appropriate response to industry requests, while industry adoption of the 4-step tolerances within that standard are also a significant compromise, though it necessarily eliminates 42% of ANSI-compliant LED package binning space, which will certainly drive up costs.	This comment supports the standards and does not request changes to the standards.
LumiLEDs	ENERGY STAR Luminaires V2.0 and ENERGY STAR Lamps V2.0 specifications and all versions before them: minimum 80 Ra and positive R9. The Consortium for Energy Efficiency's (CEEE) Specification for Integral Replacement Lamps Sold at Retail, Tier 1: minimum 80 Ra and positive R9. DesignLights Consortium's V3.1 specification: min 70 and min 80 Ra for indoor applications. Lumileds and other manufacturers have repeatedly requested but not received the CEC's explanation for the proposed minimum 82 Ra value. In the absence of an explanation from the Commission, the specification of min 82 Ra, with the min 72 requirement for R1 through R8, along with the "minimum compliance score", create the appearance that	See RESPONSES 1, 3, and 6.

	the Energy Commission is attempting to implement a minimum 90 Ra requirement for LED lamps sold in California. The minimum 82 Ra will force an LED lamp manufacturer to either source rare min 85 Ra LED packages, incurring expenses which are incompatible with the price points consumers expect of light bulbs, or they will select the slightly higher volume min 90 Ra packages.	
LumiLEDs	Special Color Rendering Indices R1 through R8 quantifies the derived lengths of the color difference vectors, but they do not indicate the directions of those vectors. The average of those values (Ra) also provides no information about the directions of those vectors. Consequently, it is quite possible, and indeed common, for lamps with identical Ra and CCT values to appear different and to render object colors differently (see CIE 13.3 section 7.4). Most visual perception experts would agree that Ra values differences of less than 10 points are usually imperceptible, and less than 3 points are imperceptible and statistically insignificant.	See RESPONSE 1.
LumiLEDs	A certification body considering a reported lamp Ra value of 81 knows that the actual Ra value lies somewhere between 78 and 84. The lighting industry at large has a tribal knowledge of the CIE's color rendering index, including the above but also well beyond what is printed within the standard. This knowledge is the result of 50 years of daily use of the metric developed by our industry, for our industry. These additional facts are widely accepted	This comment is about the lighting industry's knowledge of CIE's R1-R8 values. No changes is requested and needed.

	knowledge employed by lighting practitioners daily:	
LumiLEDs	For these reasons, the lighting industry has long specified product minimum CRI specifications in multiples of ten (i.e. Ra ≥ 60, Ra ≥ 70, Ra ≥ 80, Ra ≥ 90). By way of example, any lamp of any technology on the market with a measured and calculated Ra value of 82 (or 81, 83, 84, etc.) has in all likelihood been designed to meet a minimum 80 Ra specification. The additional ~2 points above 80 are either: Real, and a reflection of manufacturing performance distribution and the manufacturer's intent to achieve a margin above the minimum specified performance threshold; or, Not meaningful, because the 2 points are within the published uncertainty range of the Index.	See RESPONSE 1.
LumiLEDs	The color rendering index was originally designed for linear fluorescent technology, and has significant, widely known shortcomings when it is applied to LED technology	See RESPONSE 1.
LumiLEDs	With these points in mind, we would like the Commission to understand that for an LED lamp to meet or exceed the proposed minimum 82 Ra specification, the lamp manufacturer must source min 82, type 84 LED packages. As one of the world's leading LED package manufacturers, Lumileds enjoys deep insight into the LED subcomponent market. It is our estimation that LED package binning for min 85 Ra – or any other min Ra between 80 and 90 – represents far less than 1% of the total global LED package market.	See RESPONSE 1.

LumiLEDs	These are truly rare LED packages, with few suppliers to choose from. The reasons for this are twofold. First, as explained above, the lighting industry has historically specified minimum CRI product performance in tens (i.e. Ra ≥ 70, Ra ≥ 80, Ra ≥ 90). Secondly, for years now, economies of scale across the global LED manufacturing industry have been optimized to support these specifications, around which most North American LED products are designed:	See RESPONSES 1 and 3. The Energy Commission also extended the effective dates in 15-day language to provide an additional year to comply with Tier 1 and an additional 6 months for Tier 2. This will allow manufacturers to increase competition at the component level and to adjust to the requirements of the standards.
LumiLEDs	It must also be acknowledged that by deciding California consumers must have minimum 90 Ra performances for every application, the CEC is – in every single lamp installed – leaving significant energy savings behind. The additional red conversion materials required to meet the proposed regulation (phosphors and the like which convert blue LED die output to produce an LED lamp's luminous efficacy by 15%. The CEC could decide to allow California consumers to select between min 80 and 90 Ra, which would allow additional energy savings in applications which do not require higher color rendering, such as in garages, basements, utility rooms, and outdoor lighting.	See RESPONSE 4.
Acuity Brands	Voluntary Quality Specification. If our proposal for an 80 CRI minimum is adopted, this will allow more efficient and cost effective products to be sold in California. This also means that California consumers will have access to the same less expensive and higher performing products as the rest of the country. Most importantly, it will better allow the CEC to address the energy conservation needs of	See RESPONSES 1 and 4.

	California.	
NEMA		See RESPONSE 3.



The foregoing graphs copied from the IOU comments to 45-day language seek to illustrate their claim that lamps with an R8 of 72 have a CRI close to 90. They are based on data for omnidirectional lamps taken from the ENERGY STAR and DOE LED Lighting Facts lists. Both show CCT's less than or equal to 3000K. The second figure shows that

	when using R9 > 32 as a proxy, as the IOUs did, only lamps with a CRI ~ 89 or greater will meet the Tier 1, either new or old.	
NRDC	NRDC appreciates the various positions that exist amongst stakeholders regarding color rendering and the compromises that CEC has made to date. – NRDC has stated throughout this proceeding their support that some minimum requirement should be set around color rendering and there seems to be consensus that a color rendering index (CRI) between 80 and 90 would be appropriate. In the absence of hard evidence or data that consumers have not been happy with lamps that have CRI of 80 (the value currently set by ENERGY STAR), or conversely that consumers will be dissatisfied unless the lamp has a CRI of 90 or higher, we have not been able to support efforts to set CRI at levels much above 80. That is because the higher CRI lamps use more power and are more expensive. As a compromise to the various positions and concerns that have been expressed, we believe the CEC has come up with a structure that works, which includes setting the minimum CRI at 82 (and not 90) and providing a sliding scale that allows lamps with higher CRI to have lower efficacy levels. It is unclear at this time what path manufacturers will need to take in order to achieve the CEC's compliance score, which is a blended formula of efficacy and CRI. If it requires manufacturers to have to shift to CRI 90 or higher	See RESPONSE 1.

	lamps, this might not be the optimal outcome for California or the environment. If the CEC is able to continue to evaluate this issue or modify its proposal, we suggest CEC take a closer look at its requirement for R8 of at least 0.72 as it has the effect of requiring bulbs to have an overall CRI of 84 or higher, and further constrain LED designs.	
Cree	Item (3) Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), (2) C (ii)-(iii): The proposed language requires a minimum CRI of 82 and minimum individual R1-R8 scores of 72. Comments: Cree supports these requirements, as they will help guarantee that customers will receive lamps that meet their expectations without requiring a CRI minimum of 90. This flexibility will allow manufacturers to adjust lamps to better meet customer preferences.	The comment supports the standards and does not ask for changes to the standards.
Data-related comments		
NEMA	We note that the CEC has not answered our request for a list of compliant products detailing compliance with all the many parameters proposed to be required by the revised 15-day language. The public databases from ENERGY STAR and DOE LED Lighting Facts lack several of the proposed mandatory parameters, and thus graphs and arguments developed from them are incomplete, but imply again that the regulation is feasible. We contend that the CEC is obliged to clearly list in detail compliant products and their performance parameters to ensure that their own analysis	See RESPONSES 3 and 10. All data used by the Commission was referenced in the staff analyses and publically available through ENERGY STAR or DOE websites. The Energy Commission's analysis looks at existing lamps that comply, but the purpose is to identify characteristics and technical solutions that can allow all lamps to meet the efficiency standards at low cost. This analysis considers the cost of improving existing lamps

	and interpolation about current and future performance is adequately tested An example of recent misleading statements can be found in the CEC Supplemental Staff Analysis (footnote 2) page 5 of 6 where CEC staff assert "that a significant number of lamp models already meet the CRI-efficacy tradeoff equation proposed in 15-day language for Tier 1: However, staff did not complete the analysis for the other proposed requirements, nor did they take into account the CCT of the lamps (to make sure that there are some less than 5000 K). This statement and related omissions display a serious lack of due diligence and a significant misunderstanding of lighting engineering	to meet the regulation. The incremental costs further characterized in table 15 demonstrate that the Energy Commission expects changes to existing products, and not simply a shift to an existing compliant product that costs more. In fact, the supplemental staff report page 6 acknowledges the need for more time specifically to achieve the expected changes to products.
LumiLEDs	Lumileds certainly supports fostering a cooperative spirit between industry and the Commission. Lumileds and its customers can reasonably be expected to make compromises based on hard facts and reliable data. However it must be acknowledged that in total, the Energy Commission's expectation is for the lighting industry to completely overturn its ways of working – its ways of designing, procuring, manufacturing, and marketing – all to achieve a statistically insignificant, imperceptible, and costly 2 point improvement in CRI score. Underlying this is the Commission's expectation that the lighting industry will create new economies of scale to support this technically unjustifiable specification. Overturning the whole industry is not an acceptable compromise.	See RESPONSES 3 and 10. To ease the potential burden on manufacturing processes and design time, in 15-day language, the Energy Commission extended the effective date of the general service LED standards by one year for tier 1 and by six months for tier 2, ensuring that manufacturers will be able to make products at low cost that meet the standards.
LumiLEDs	Finally, throughout this regulatory process Lumileds has	See RESPONSES 3, 5, and 10.

	noted the wide range of interpretations of the available market performance data. The Commission and the electric utilities seem to have the understanding that the market is already full of products that will meet the proposed regulation. Meanwhile, manufacturers' collective view is that when all of the proposed requirements are applied, exceedingly few products are in fact available. There is clearly a gap to be bridged, and we respectfully submit that in this regulatory process it is the responsibility of the Commission to attempt to resolve such differences to arrive at a common understanding of the facts upon which the regulation will be based.	
LumiLEDs	We respectfully submit these inputs and request that the Commission slow down this process, assemble all stakeholders at one meeting to analyze the market data together, and based on those discussions, establish new 45-day language. We thank you again for the opportunity to provide input, and ask that you consider Lumileds a resource for any questions you may have throughout the remainder of this process.	See RESPONSE 6.
Philips	Data Transparency: Throughout the recent rulemaking process, it has been extremely difficult to verify some of the analysis claimed in the 45 Day language. For example, if an analysis is based data from the Energy Star Qualified Product List on June 1, 2015, it is almost impossible to go back in time and obtain that same dataset. Thus we would suggest that any data files and other analyses referred to in	See RESPONSE 6. Databases are dynamic searchable collections of records. It is not necessary to review the database as it existed in June of 2015 as the most current ENERGY STAR lamp data is equally, if not more, relevant because it reflects the current availability of lamps that are sold in the market. Typically

	the staff reports and elsewhere be docketed so others can review the data and understand how the conclusions were arrived at.	products are added to the database so viewing the database in 2016 will include the products found in 2015 plus new ones. The Staff Report provided references to data used and it is publically available. No change is recommended because data is available.
Philips	Data Transparency: We suggest that the data files used in the analysis be docketed so that anyone can review the data and perform their own analysis on data the Commission uses to reach their conclusions. .	See RESPONSE 6. The Staff Report provided references to data used and it is publically available on ENERGY STAR and Lighting Facts websites.
Decorative LED lamps		
Philips	Efficacy Requirements - Decorative Lamps: Decorative LED lamps, especially those which are dimmable are inherently less efficient than omnidirectional lamps and merit lower performance criteria. In our comments on the 45 Day language, we provided an analysis that decorative lamps are inherently less efficient than omnidirectional product. We offer the following analysis of the data from the Energy Star Certified Product List: Comparison of Average Efficacies for Omnidirectional and Decorative Products Energy Star Certified Product List – January 19, 2016	See RESPONSE 9.

	<table><tr><th></th><th>Omnidirectional</th><th>Decorative</th><th>Differ</th></tr><tr><td>Average LPW</td><td>83.0</td><td>72.8</td><td>10</td></tr><tr><td>St Deviation</td><td>12.5</td><td>15.0</td><td></td></tr><tr><td># of Lamps</td><td>1849</td><td>873</td><td></td></tr></table> For this reason, decorative lamps merit slightly lower performance criteria to increase product availability. If not, the use of decorative halogen and CFL products will continue and reduce the potential energy savings for the state. We suggest that the efficacy requirements for decorative lamps be reduced by 10 LPW from their omnidirectional counterparts in Tier 1 and Tier 2. This could be achieved by a straightforward modification of the compliance equation/score.	
Philips	Efficacy Limits - Decorative Lamps: As shown in our earlier comments, decorative lamps have an efficacy about 10 LPW lower than omnidirectional lamps. Thus we propose that the efficacy requirements for decorative lamps be reduced by 10 LPW from their omnidirectional counterparts in Tier 1 and Tier 2.	See RESPONSE 9.
NRDC	NRDC recommends CEC modify the requirements for decorative LED lamps greater than 150 lumens. Decorative lamps are those lamps that often have a candelabra base and/or have a flame shape enclosure. These lamps are typically placed in chandeliers and sconces. Due to their small size/form factor, it is harder to achieve the same efficacies as bigger, more common bulbs such as the A	See RESPONSE 9.

	lamps. A review of the CEC data base shows that decorative lamps typically have a lower efficacy of around 10 lumens per watt (LPW) compared to general service lamps of similar brightness.	
GE	Halogen decorative lamps use 4 to 5 times more energy than equivalent LEDs do and also have a lower first cost. In addition, lamps with candelabra shape or bases are currently allowed under EISA to consume up to 40 and 60W, respectively. As such its critical that there be sufficient availability of decorative LED lamps in California and that they can compete with halogens as it is still not clear how these lamps will be treated under Tier 2 of the federal lighting standards which are under development. To address this concern, we recommend CEC either extend the effective date of this portion of the standard by one year, to January 1, 2019, or reduce the required compliance score for these products by 10 points, to reflect their 10 LPW lower efficacy.	See RESPONSE 9.
Dimming and Flicker		
California IOUs	Flicker: We support the proposed requirements for low flicker operation for lamps that are designed and marketed as dimmable. The importance of controlling flicker has been widely documented and due to the fast response of light emitting diodes (LEDs) to current, LEDs are now the subject of the standard IEEE PAR1789 "Recommended Practice for Modulating Current in High-Brightness LEDs	The comment supports the standards and does not ask for changes to the standards.

	for Mitigating Health Risks to Viewers." Excessive flicker, even imperceptible flicker, can have deleterious health effects, and lesser amounts can impact satisfaction and productivity. The California reduced flicker operation definition is far less stringent than the recommended levels in IEEE PAR1789, but would impact approximately 50% of the LEDs that have been sold in the past. Once quantified by a repeatable test method, flicker can be substantially reduced through better design. We refer the CEC to the completed test report provided to the docket under separate cover. This report documents the recent testing funded by PG&E and completed at multiple private test labs, utilizing the CEC's own test procedure (from Title 24 Joint Appendix 10).	
	This testing demonstrated that the proposed requirements are feasible. Overall, the results show that more than half of the products tested meet the California definition of "reduced flicker operation," including a wide variety of products with different lamp shapes and sizes. In fact, we have measured a number of LED designs that have even less flicker than incandescent lamps operating on AC current. The testing completed by PG&E also explored the relationship between measured flicker levels and rated power factor, and examples of many products that achieved both very low levels of flicker and very high power factor. This suggests that these two design factors need not be traded off against each other. Lastly, the flicker testing completed in that study demonstrated that	The comment supports the standards and does not ask for changes to the standards.

	the test method being used by CEC (from Joint Appendix 10) is repeatable and reliable.	
Effective Dates		
Philips	Thank you for recognizing the comments from Industry and modifying the color requirements to reference ANSI C78.377-2015. We also appreciate that an additional year has been granted to comply with the Tier 1 requirements.	No change is requested and needed.
Philips	SDDL Lamp Availability: In our comments on the 45 Day language, we indicated that future availability of omnidirectional, decorative and directional LED lamps will suffer as a result of the requirements and timing. The 15 Day language grants additional time before the requirements become effective and thus mitigates the availability issue slightly for the omnidirectional and decorative lamps.	This comment supports the 15-day language changes and does not request changes.
California IOUs	We were disappointed to see the delay in the standards effective dates, since we believe there is a sufficient supply of compliant and cost-effective products available now. We believe that these standards will have maximum impact the sooner they take effect; it would be ideal to have only high quality, high efficacy LED lamps on the market, in greater quantities and with significant market competition, well before the January 1, 2018 effective date for California's 45 lumen per watt (lpW) halogen ban. That said, the requirements as proposed will still provide very clear guidance and a timeline to the industry, and help ensure	Changes to proposed effective dates made in 15-day language are reasonable and considered after careful analysis. There is no energy loss in the delaying the implementation date, only energy savings will be delayed for about a year. The effective date for the chromaticity, color rendering, light distribution, product life, and power factor requirements remain in line with the new Tier 1, and so are proposed to take effect on January 1, 2018, while the connected

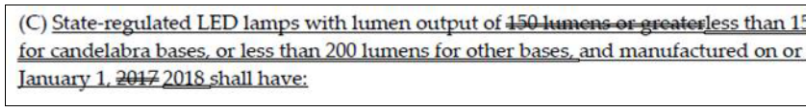
	maximum product availability by 2018, if not sooner.	standby requirements remain in line with Tier 2, taking effecting July 1, 2019. These changes are proposed to address stakeholder concerns raised during the public comment period on the 45-day language. Stakeholders expressed two primary concerns with the original Tier 1 standard: (a) that the least cost pathway for meeting the standard was inconsistent with current manufacturer processes with respect to "binning" LED packages and chips, and (b) that the lifetime test would take approximately 4 months to complete, reducing the actual time that manufacturers had to redesign their products. Extending the effective date for Tier 1 addresses both of these concerns by giving manufacturers additional time – more than a year from the originally proposed effective date – to optimize their processes to meet the standards at the least cost. As the cycle time for lamp design is 6-8 months, this gives manufacturers approximately two design cycles as well as time for testing to meet the proposed standard. No additional change is recommended to effective dates.

Efficacy		
NEMA	Worse still, the proposed LED designs in the proposal are less energy-efficient that today's more popular LED options. The 15-day language would represent a major setback for the innovative consumer-based revolution that has occurred; a step-backward for California.	See RESPONSE 4.
NEMA	It is our hope that the Commission will exert the same amount of interest and collaboration shown in addressing our MR/SDDL comments towards our continued concerns for the State-Regulated Light Emitting Diode (LED) General Service Lamp (GSL) language. This has not been done satisfactorily to date, but it is not too late to adjust the proposed regulatory language to ensure high-efficiency products in wide availability and performances are present in the market to suit the varied consumer preferences in this market.	See RESPONSE 4.
NEMA	Directional Lamps: We appreciate that the Commission drafted a definition for Directional Lamps in response to our comments suggesting that need. However, the reason to define said lamps was and is to couple that definition with a 10% relaxation in efficacy requirements (compared to A-line LED GSLs), owing to these products' well established lower efficacy (see page 11 of 32 in the NEMA comments linked in footnote 1). We ask the commission to recognize a 10% allowance for these lamps in the efficacy/CRI equation.	See RESPONSE 10. Reducing the efficacy requirements for these lamps would not yield as many energy savings to consumers. Staff found these saving to be both cost-effective and technically feasible. Therefore, staff rejected NEMA's proposed alternative.

Cree	Item (5) Section 1605.3 State Standards for Non-Federally-Regulated Appliances (k), (2), Table K-14: The proposed language increases the minimum efficacy from 65 to 68 lumens-per-watt, and also increases the minimum compliance score from 277 to 282. Comments: The proposed increases in efficacy and the compliance score somewhat counter the benefits of the delay in the implementation date. If the rationale for delaying the effective date was to allow manufacturers time to develop the technology necessary to meet the requirements, then increasing the difficulty of the requirements would argue for additional time. Cree Recommendation: Use the minimum efficacy and compliance score requirements from the 45-Day language.	The effective date for the chromaticity, color rendering, light distribution, product life, and power factor requirements remain in line with the new Tier 1, and so are proposed to take effect on January 1, 2018, while the connected standby requirements remain in line with Tier 2, taking effecting July 1, 2019. These changes are proposed to address stakeholder concerns raised during the public comment period on the 45-day language. Stakeholders expressed two primary concerns with the original Tier 1 standard: (a) that the least cost pathway for meeting the standard was inconsistent with current manufacturer processes with respect to "binning" LED packages and chips, and (b) that the lifetime test would take approximately 4 months to complete, reducing the actual time that manufacturers had to redesign their products. Extending the effective date for Tier 1 addresses both of these concerns by giving manufacturers additional time – more than a year from the originally proposed effective date – to optimize their processes to meet the standards at the least cost. As the cycle time for lamp design is 6-8 months, this gives manufacturers approximately two design cycles as well as time

		for testing to meet the proposed standard. The compliance numbers were modified in the 15-day language to increase the level of energy efficiency to ensure that the standard is not made irrelevant by the rapid improvements being made in terms of efficacy, quality, and cost of general service LED lamps. Staff has found that a significant number of lamp models already meet the CRI-efficacy tradeoff equation proposed in 15-day language. This demonstrates that the revised compliance equation, all other standards being held constant, remains technically feasible. No change is recommended.
Light Distribution		
Cree	Item (4) Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), (2) C (vi): The proposed language in Section C (vi) for Omnidirectional light distribution requires lamps to meet specifications that are aligned with the recent ENERGY STAR Product Specification for Lamps Version 2.0. Comments: Cree commends the commission for aligning this requirement with the ENERGY STAR Specification.	The comment supports the standards and does not ask for changes to the standards.

Marking/Labeling		
CREE	Item (6) Section 1607 Marking of Lamps, (B): The proposed language in (B) requires LED lamps to meet all of the stated requirements before including comparisons to incandescent lamps, but allows reference to wattage equivalence if the lamps meet the specified minimum lumen output. Comments: Cree commends the commission for adjusting this requirement to allow comparisons to incumbent technologies that will help consumers make informed choices.	The comment supports the standards and does not ask for changes to the standards.
Scope		
NEMA	NEMA notes the CEC addressed and resolved many of our previously stated concerns regarding the 45-Day proposed language for Multi-Faceted Reflector (MR) and Small Diameter Directional Lamps (SDDL) A few small concerns remain for this category which we describe below in our detailed comments.	NEMA comment talks about the issues raised in their comments are resolved. No change is requested or needed.
Philips	Philips Lighting has completed our initial review of the proposed 15-Day Language issued December 28, 2015 for Small Diameter Directional Lamps, General Purpose LED Lamps, and Portable Luminaires. We greatly appreciate that the Energy Commission has carefully reviewed our comments, and those from industry, on the 45 Day language. As indicated in those comments, there were many difficulties in meeting the proposed requirements.	The 15-day language on which Philips submits these comments were issued in obvious error. The language accidentally regulates only very low lumen lamps, instead of regulating all general service LEDs *except* very low-lumen lamps. Staff corrected this error in revised 15-day language.

	Thus we are pleased to support the following text that appears in the 15 Day language:  (C) State-regulated LED lamps with lumen output of ~~150 lumens or greater~~less than 1 for candelabra bases, or less than 200 lumens for other bases, and manufactured on or January 1, ~~2017~~ 2018 shall have: We applaud the Energy Commission for taking a gradual approach to implementing the onerous requirements that appeared in the 45 Day language. By introducing the requirements with lamps that produce less than 200 lumens, the Commission now has two opportunities to evaluate market adoption: Will manufacturers see sufficient interest from the market to produce lamps at 200 lumens or below that meet all the requirements in the 15-day Title 20 language? If so, then it indicates that the requirements are becoming easier to meet. Extending the requirements to higher lumen products may then be desirable. Will consumers adopt lamps that do not meet the requirements proposed in the 45 day language? Since the 15-day language will allow sale of products above 150/200 lumens that do not meet those requirements, the Commission can evaluate consumer adoption of products with performance lower than the 45-day language. Information from this study may result in future changes to the requirements, if consumer adoption is deemed to be sufficiently high without them. We are still evaluating the remainder of the 15 Day language and will issue additional comments by the January 12 deadline.	

Philips	We greatly appreciate that the Energy Commission has carefully reviewed our comments, and those from industry, on the 45 Day language. As indicated in those comments, there were many difficulties in meeting the proposed requirements. Thus we are pleased to support the following text that appears in the 15 Day language: (C) State-regulated LED lamps with lumen output of ~~150 lumens or greater~~less than 1 for candelabra bases, or less than 200 lumens for other bases, and manufactured on or January 1, ~~2017~~ 2018 shall have: We applaud the Energy Commission for taking a gradual approach to implementing the onerous requirements that appeared in the 45 Day language. By introducing the requirements with lamps that produce less than 200 lumens, the Commission now has two opportunities to evaluate market adoption: Will manufacturers see sufficient interest from the market to produce lamps at 200 lumens or below that meet all the requirements in the 15-day Title 20 language? If so, then it indicates that the requirements are becoming easier to meet. Extending the requirements to higher lumen products may then be desirable. Will consumers adopt lamps that do not meet the requirements proposed in the 45 day language? Since the 15-day language will allow sale of products above 150/200 lumens that do not meet those requirements, the Commission can evaluate consumer adoption of products with performance lower than the 45-day language. Information from this study may result in future changes to the requirements, if consumer adoption is deemed to be	The 15-day language on which Philips submits these comments were issued in obvious error. The language accidentally regulates only very low lumen lamps, instead of regulating all general service LEDs *except* very low-lumen lamps. Staff corrected this error in revised 15-day language.

	sufficiently high without them.	
Philips	Philips Lighting appreciates the opportunity afforded by the Energy Commission to submit written comments on the revised 15 day language for small diameter directional lamps, general purpose LED lamps, and portable luminaires. We offer the following technical corrections specific to small diameter directional lamps. Technical Corrections Section 1602 Under the definition of "state regulated small diameter directional lamp" the following changes should be made, noted in bold: Has a rated voltage of 12 volts, 24 volts, or 120 volts; Has an E26 base or a pin base listed in ANSI ANSLG C81.61-2009 (R2014) compliant pin base or E26 base; Is a non-tubular directional lamp with a diameter of less than or equal to 2.25 inches; Has a rated lumen output of less than or equal to 850 lumens, or has a rated wattage of 75 watts or less; and Has a rated life greater than 300 hours. The proposed change to item 1 clarifies that it is the rated voltage which is used to determine whether a lamp is in scope or not, rather than whether it operates at a given voltage. The word 'capable' is too vague and not appropriate. A 12V lamp, for example, is capable of	Staff disagrees with Phillips' proposed change to item a) because it may create unintended loopholes in the regulations. As Philips correctly notes, lamps that are rated for one voltage are capable of (and, in fact, do) operating at another nearby voltage. Regulating only "rated" voltage could drive some manufacturers to produce 11 volt lamps for 12 volt applications in order to get around the efficiency standards. Therefore, staff has deliberately chosen language to ensure that manufacturers do not try to evade the efficiency standards by using non-standard rated voltages that still allow the lamp to function properly. Staff also notes, however, that a lamp would not be considered "operating" at a particular voltage if it does not perform as designed. Staff disagrees with the comment regarding items (b) and (d) because they are unnecessary and do not add clarity to the regulations. The language adopted was provided by industry in response to 45-day comments. Further clarification regarding ANSI ANSLG C81.61-2009 (R2014) is not necessary as it is not incorporated into the test procedure or standard, so "compliance" with it regarding the

	operating at 24V, but its performance may not be the same as that at 12V. Item 2 has been changed to remove the word 'compliant', as to avoid the case of whether or not the base actually complies with the construction in the ANSI standard and has to be tested for such. The change above simply means that if the pin base is claimed to be one of the listed ANSI bases, the product is in scope. Item 4 clarifies that it is the rated, not measured, values for lumen output and wattage that determine is a lamp is in scope or not. It is also consistent with the phrasing of item 5.	base is not required by the regulation. The term is simply used to describe the scope of base-types covered.
Philips	Philips Lighting's Chloride brand manufactures emergency lighting units that use halogen MR lamps of various wattages to provide emergency egress illumination during a power failure. One such model uses a 6V, 5.5W halogen MR16 lamp follows at the end of our comments. While this particular lamp is now excluded from the rulemaking, lamps at other voltages are not. The concern is that when these lamps need to be replaced in the future, they will not be available in California nor will a suitable and approved LED replacement exist. Given the above issues, we ask that the Commission move to exclude halogen lamps used in life-safety equipment from the rulemaking. If they do not, halogen replacement lamps may not be available in California for this critical life safety application.	Staff did not find, and Philips did not identify, any technical feasibility or cost issue associated with the specific lamp mentioned. See RESPONSES 10 and 11.
Cree	Following are Cree's comments and recommendations on the 15-Day Express Terms for Small Diameter Directional LED Lamps and General Purpose LED Lamps. We address	Describing the sections for proposed changes, no change is needed for this comment.

	the following items: Section 1602 Definitions, Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), (2) C (i), Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), (2) C (ii)-(iii), Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), (2) C (vi), Section 1605.3 State Standards for Non-Federally-Regulated Appliances, (k), (2) Table K-14, Section 1607 Marking of Lamps, (B).	
	Item (1) Section 1602 Definitions: The proposed language in Section 1602 Definitions augments the criteria for a "State-regulated small diameter directional lamp" by adding "capable of operating at 12 volts, 24 volts or 120 volts." Comments: Cree supports the most recent modification of this definition to prevent evasion of the requirements.	Staff appreciates CREE's support in its comment. No change is needed.
Small-diameter directional lamps		
Philips	For directional lamps, however, the issue remains that unless the requirements in the 15 Day language are modified, 92% of the currently available small diameter directional LED lamps will not be available to California consumers. Emergency Egress Applications and Small Diameter Directional Halogen Lamps. We believe this is a serious issue that was not addressed in the 45 Day language nor in the 15 Day language. We appreciate that the Commission narrowed the scope for SDDL lamps in the 15 Day language, but the issue with SDDL and emergency	See RESPONSES 10 and 11.

	egress products remains.	
California IOUs	We are also supportive of the proposed standards for small diameter directional lamps, which are designed to push the lamp market to high efficiency options such as LED. There are a number of compliant products already available, and given the ongoing expected efficacy improvements forecasted between now and 2018, we expect many more will be available by the standards effective date. We also support the change made in the 15 day language to clarify that the standards apply to any SDDL lamps that are capable of operation at 12V, 24V, or 120V. This is important given that products rated just off of these voltages could easily be operated at these voltages, with minimal impacts to light levels or lamp life. For example, 12.5V or 11.5V products can be operated on 12V transformers, so the proposed change is a critical improvement to the scope of the standards to prevent gaming and loophole products.	The comment supports the standards and does not ask for changes to the standards.
Standby Power		
California IOUs	The CA IOU team has completed an initial round of testing of the standby power of connected LED lamps, using the test procedure proposed by the CEC for use in Title 20. This testing has shown the 0.2W level to be feasible for products on the market today. Despite relatively few internet-connected lamps on the market, our testing has found that there are already at least three products that	The comment supports the standards and does not ask for changes to the standards.

have standby mode power of less than 0.2 watts. These lamps also have functionalities of leading smart products, including color tunability, remote on/off control, remote dimming, light level scheduling, and geo-fencing. Similarly, these three products all use different common communication protocols, demonstrating that the proposed standby mode power draw does not limit the way connected lamps communicate. Table 1 below summarizes the capabilities, communication protocol, and standby power of the three lamps tested to have standby mode power below 0.2 watts.

Table 1. Capabilities, Communication Protocol, and Standby Mode Power of Three Currently Available Connected Lamp

Lamp	"Smart" Capabilities					Communication Protocol
	Color Tunable	Remote On / Off	Remote Dimming	Light Level Scheduling	Geo-Fencing	
A	✓	✓	✓	✓	✓	ZigBee Light Link[4]
B	✓	✓	✓	✓		Wi-Fi[5]
C		✓	✓	✓		6loWPAN[6]

The fact that these products already achieve the capabilities described above while drawing less than 0.2 watts during standby mode (despite the lack of any current

	mandatory or voluntary requirement to do so), suggests that the requirement will be even easier to meet by 2019 after several years of continued innovation and design work aimed at that requirement.	
California IOUs	Supporting Comments and Data: Standby Mode Power. We support the CEC's proposal to require LED lamps to have a standby mode power of 0.2 watts or less. In the residential sector, lamps are only on for about 10% of the year, which means they spend the vast majority of their time in the off or standby state. It is therefore critical that we limit standby power draw; high standby power draw can effectively negate the efficacy gains LED technology has experienced in recent years. For example, a 10W LED lamp with 1W standby power draw will likely use as much energy in the "standby" state in a year as it will in the "on" state, assuming typical residential hours of operation. In other words, left unchecked, residential LED lighting energy use could double if connected lamps proliferate.	The comment supports the standards and does not ask for changes to the standards.
Philips	Take a limit of 0.2W for example. While it is technically feasible, lamps with this amount of standby power are typically a dimming only product and run one of a limited number of wireless operating protocols. Also, when the lamp is operating, the feature associated with the standby power may save additional energy such as when the lamp is dimmed. So, while 0.2W may appear feasible, some of the unintended consequences are: Lamps are limited to dimming only (no color tuning or color changing). Only one	See RESPONSE 2.

	of a few wireless protocols may be used. Protocols such as Zigbee and Thread, for example, will not meet 0.2W. Features such as embedded Bluetooth speakers, WiFi repeaters, etc., are not possible Features that could save energy, such as an integrated occupancy or daylight sensor, are not possible.	
Acuity Brands	We also reiterate that the requirements limiting standby power have not been substantiated and have the potential to limit valuable features that provide incremental energy savings or consumer utility. As the features for smart capabilities increase in the future, the standby power is likely to increase even though the overall standby power is very low. Establishing a limit for standby power in LED lamps in California has the potential to restrict the ability to incorporate these features, resulting in inferior products as compared to the rest of the nation. In addition, the limit proposed in this rulemaking is substantially lower than other recognized standards or regulations. It is premature to establish a stringent and unjustified limit on standby power. The following are examples of how other recognized standards organizations have addressed standby power with a limit of 0.5 watts:	See RESPONSE 2. A comment that identifies an unspecified theoretical future use which would require greater than .2 watts is not sufficient to warrant changing the regulatory language. If this were the case no standards could ever be developed because of some potential limitation of future technology.
Acuity Brands	Energy Star Lamps Specification v2.0 - Lamps with integral controls (e.g., motion sensors, photo sensors, wireless control, standby mode, or connected functionality) shall consume no more than 0.5 watt in standby mode or	See RESPONSE 2.

	network mode	
Acuity Brands	The COMMISSION REGULATION (EC) No 1275/2008 of 17 December 2008 addresses "standby and off mode electric power consumption of electrical and electronic household and office equipment". Four years after this Regulation has come into force: (a) Power consumption in 'off mode': Power consumption of equipment in any off-mode condition shall not exceed 0.50 W.	See RESPONSE 2.
Acuity Brands	Until the capabilities and demands of the functionality of lamps and the associated standby power needs are well-defined and analyzed, we recommend that CEC establish a reasonable limit to restrict excessive standby power. This allows CEC to review and adjust the standby power limit as technology progresses to ensure the most robust features are available to California. We recommend the following changes to the standby power clause, which is justified and consistent with national and international standards: 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 0.5 watts or less.	See RESPONSE 2.
Philips	Connected Lighting: Standby Power We acknowledge that a very limited number of connected lamps with a standby power of 0.2W are currently available in the market. Energy Star is enacting a limit of 0.5W in their recently released Lamps v2.0 specification, and we (along with NEMA)	See RESPONSE 2.

	advocated a limit of 1.0W in our 45 Day comments.	
Philips	The proper limit for standby power depends on the ultimate intent of those setting the limit. For maximum energy savings, no standby power should be allowed – for any appliance. Consumers want products with features, however, and the market for connected lamps is in its infancy. Some would argue that this is the perfect moment to set limits, right before the market takes off. If the Commission's intent is to limit innovation and the choices consumers have, then now is the time to set the limit. It would almost be like deciding what career your infant child would have before he or she even begins to speak, however.	See RESPONSE 2.
Philips	We note the staff report indicates that "…staff found feasibility white papers discussing connected standby power levels as low as 0.05 watt" We checked the reference and found that the claim of 0.05W is for the power consumption of only the microprocessor in the standby power circuit. It does not represent the standby power of a complete lamp. Thus is it misleading to suggest that lamps can have a standby power of 0.05W in the future.	See RESPONSE 2. Staff reviewed this comment and disagrees with comment because information about 0.05 watts of standby in white paper is calculated based on the current and voltage provided in the white paper to perform the standby operation. Staff agrees white paper does not say 0.05 watt; however a simple calculation performed by staff from the information in the white paper showed that 0.05 watt is feasible and the information in the staff report is accurate. No change is needed because the comment is not valid.
Philips	The Energy Star limit of 0.5W is more realistic and is what many connected lamps are targeting. Philips supports this limit for Title 20. Thus, before the Commission sets what	See RESPONSE 2.

<table>
<tr><td></td><td>some see as a perfect solution and others see as draconian limit on a technology in its infancy, we ask you to seriously consider raising the standby power requirement to 0.5W.</td><td></td></tr>
<tr><td>Philips</td><td>Efficacy: Connected lamps have inherently lower efficacy than their non-connected counterparts; some additional power is used for microprocessor control and other components used for communication. Tunable and color changing lamps have some lower efficacy LEDs (e.g. 2200K white LEDs or RGB LEDs), and require extra optics to mix the light from the different LED colors. The net result is efficacy about 10 LPW lower than a non-connected equivalent. Efficacy limits higher than 70 LPW for connected omnidirectional lamps will severely limit product options at this time. Thus we propose the following efficacy limits for connected omnidirectional lamps:
<table><tr><td></td><td>Connected Products</td><td></td></tr><tr><td>Effective Date</td><td>Minimum Efficacy</td><td>Minimum</td></tr><tr><td>January 1, 2018</td><td>65</td><td>80</td></tr><tr><td>July 1, 2019</td><td>70</td><td>80</td></tr></table>
There are few non-omnidirectional connected lamps available at this time, thus it is difficult to make efficacy recommendations for those products now There are few non-omnidirectional connected lamps available at this time, thus it is difficult to make efficacy recommendations for those products now</td><td>Staff disagrees with the comment because lamps that have additional features are allowed a standby of 0.2 watts and standby has no direct relation to lumens per watt (efficacy). No additional allowance is recommended for color changing lamps, as there is no evidence to support that these lamps specifically require a higher standby mode, as standby mode only applies when the lamp is off, not when it’s on.</td></tr>
</table>

Philips	Standby Power – Connected Lamps: Philips supports and recommends a limit of 0.5W for standby power in Title 20. This is a practical limit for industry and much less restrictive than the proposed 0.2W. Efficacy Limits - Connected Lamps Connected lamps have inherently lower efficacy than their non-connected counterparts. Thus we propose that the efficacy limits for connected omnidirectional lamps be 10 LPW less than those of their non-connected counterparts.	See RESPONSE 2.
Test Procedure		
LumiLEDs	The revised 15-day language includes the terms CRI, Ra, and R1 through R8. Lumileds understands these to be references to the color rendering index (CRI) as published by the International Commission on Illumination, also known as the CIE. If Title 20 regulatory compliance is to be based on the specification of minimum performance levels on this index, it is incumbent on the Energy Commission to make normative reference to CIE 13.3-1995, Method of Measuring and Specifying Color Rendering Properties of Light Sources. Without this, the terms will be undefined, and the calculations which form the basis of these notations will also be undefined.	Staff disagrees with this comment. Manufacturers must follow guidance and definitions provided in the proposed test methods for CRI (Ra), R1-R8.
LumiLEDs	Within CIE 13.3, we would like to (re)direct the Commission's attention to section 7.2, Uncertainties in the determination of R. Like any metric, the color rendering index has a known range of uncertainty. The uncertainty of	The Energy Commission incorporated then-proposed federal testing requirements into its standards, including testing requirements for CRI. The Energy Commission will ultimately be

	the CRI is ±3 points, which results from the uncertainties inherent in the measured spectral data entered into the CRI calculation. This means that the actual Ra value of any product lies within ± 3 points of its calculated Ra value. Here are a few examples to illustrate: A laboratory technician reporting a calculated Ra of 89 knows that the actual Ra value lies between 86 and 92 (89 ± 3). A manufacturer's compliance engineer knows that a lamp with a calculated Ra of 79 has an actual Ra value between 76 and 82.	preempted from requiring different testing requirements for the same purposes. If there are concerns about repeatability and replicability in the test procedures, they should be raised to the U.S. Department of Energy.
Tolerances/Sampling		
LumiLEDs	The non-LED package components of LED lamps (secondary optics, reflectors, heat sinks, plastics and paints) are known to drag down the calculated Ra value of an LED lamp. Thus, in the process to design an LED lamp, to meet a minimum 80 Ra specification, a lamp manufacturer must source LED packages with Ra values that are minimum 80, typical 82 (min 80, type 82). As an example, if Lumileds ships LED packages with min 80, type 82 performances, the additional 2 point margin will help to ensure the LED lamp meets the minimum 80 Ra requirement.	This comment appears to recommend lowering the CRI requirements to permit greater tolerances in the manufacturing process. To that extent, see RESPONSES 1 and 3. The Energy Commission made changes in 15-day language to address concerns about tolerances by requiring the sample of light bulbs for purposes of testing, certification, and enforcement to match what is required by the U.S. Department of Energy. This sample size is larger than typical for an appliance, allowing for more variation within that sample size while still being able to meet the efficiency standard.

		No further change was made to the regulation.
General/Miscellaneous		
Stakeholder Opposing Proposed Regulations.	I am writing to express my non-support of the CEC's proposed 15-day language for LED general service lamps and Small Diameter Directional Lamps. The CEC's arguments display clear bias towards a very specific product design, despite no credible evidence to justify the proposed measures. The CEC has failed to prove there is a problem with consumer acceptance of 80 CRI LED lamps that needs to be solved. In fact, ENERGY STAR and other sources point to ever-increasing sales as consumers embrace the growing number of high quality 80 CRI LED lamps constantly being introduced at consumer friendly pricing in the market.	See RESPONSES 1 and 4.
Stakeholder Opposing Proposed Regulations.	The CEC's decision to continue down the path of an argument based on consumer satisfaction ignores the skyrocketing sales figures for 80 CRI LED bulbs and the overwhelmingly positive consumer reviews about these products. Ignoring these facts showcases the CEC's unwillingness to admit they no longer have a problem to solve with LED bulbs.	See RESPONSES 1 and 4.
Stakeholder Opposing Proposed Regulations.	While there is no longer a problem with LED bulb adoption across the nation, there are still problems in California; high electricity prices and climate change. Governor Brown recognized these issues in his direction to the State to save as much electricity as possible. How is it then that the CEC	See RESPONSE 4.

	is promoting LED bulbs that are both MORE EXPENSIVE and LESS EFFICIENT than those commonly sold today? There is no justification for this and the CEC's insistence on a flawed argument is counter to the State goals and is a disservice to California residents.	
Stakeholder Opposing Proposed Regulations.	The CEC should not be deciding for citizens what light bulbs they can have in their homes by setting unfounded performance requirements for appearance and color. Instead, the CEC should allow consumers to make the choice for themselves, and respect that some consumers are more cash-conscious than others. The CEC also ignores the fact that the bulbs on the market today are MORE EFFICIENT than the bulbs the CEC is seeking to mandate. This ignores the CEC's primary mission to identify and encourage high-efficiency products. By seeking to mandate more expensive, less efficient, less desirable (according to sales figures) light bulbs in the market, the CEC is losing touch with their mission to help Californians save energy.	See RESPONSES 1 and 4.
Stakeholder Opposing Proposed Regulations.	I respectfully call on you to DROP THE 15-DAY PROPSAL AND CANCEL THE RULEMAKING so that CEC staff can make the revisions to LED general service lamps and Small Diameter Directional Lamps that are aligned with our state goals.	See RESPONSES 1, 3, 4 and 6. Staff disagrees with this comment. For the reasons discussed above in response to this stakeholder's comments, staff recommends no change to the proposed regulations.
California IOUs	Overview: The Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas (SoCal Gas), San Diego Gas & Electric (SDG&E) Codes and Standards Enhancement (CASE) Initiative Program seeks to	Explaining the background, no response is required.

	address energy efficiency opportunities through development of new and updated Title 20 standards. This document outlines the California Investor-Owned Utilities' (IOUs) CASE team response to the California Energy Commission's (CEC) Express Terms published on January 7, 2015, "Notice of Commission Adoption Hearing, Availability of Revised 15-Day Language" (herein referred to as the 15-Day Language). The comments in this document focus on the proposed standards for state regulated light emitting diode (LED) lamps and small diameter directional lamps (SDDL).	
California IOUs	For the reasons provided in our previous written comments on the 45-day language, we remain supportive of the CEC's proposals to set minimum efficacy, performance and quality requirements for LED lamps. These new requirements provide an optimal combination of key performance attributes, such as luminous efficacy, color rendering, light distribution, and longevity, and they ensure that LEDs will provide a level of quality and amenity that is similar to or better than the incandescent technology they are intended to replace. We commend the CEC for being innovative in its approach to setting effective color rendering requirements – requiring a minimum level of performance in each individual color score (R1 – R8) in the CRI system, rather than solely using the average color rendering value, "Ra" (in which very poor performance in certain colors can be masked by better performance in	The comment supports the standards and does not ask for changes to the standards.

	other color areas).	
Stakeholder Supporting Proposed Regulations	The California Energy Commission (CEC) has proposed that general service LED lamps manufactured on or after January 1, 2018 shall have a CRI of 82 or greater and individual color scores (R) of 72 or greater. These new regulations provide an optimal combination of key performance attributes, luminous, color rendering and longevity. The CEC has proposed stronger standards for LED lighting, which will save Californians billions in the coming years, and cut greenhouse gas emissions (GHG). These standards also allow us to enjoy the quality of full-color lighting we had with traditional light bulbs, but in an eco-friendly way. However, opponents of the proposal claim the CEC wants to promote LED lighting that is more expensive and less efficient. This is a misunderstanding of what is being required of the lamps. The function of the general service lamp is to both illuminate a room and provide the ability to discern colors. Efficiency would be defined as its ability to perform both tasks with less energy. The opponents want to "improve" efficiency by making light bulbs that only do half the job. That's not efficiency, that's poor service. In other words, the opponents want me to pay for bulbs that don't deliver. As a consumer, I don't want the industry to short change me. I want robust standards that allow me to enjoy quality lighting at a price I can afford. I support the CEC's proposal and reject the opposition's efforts to weaken the	This comment supports the standards and does not request changes to the standards.

	standards.	
Philips	The Commission appears to have decided not to address the majority of the comments related to general purpose LED lamps. Thus, the main points of our 45 Day comments are still valid.	Staff has reviewed all comments submitted by the stakeholders during 45 day comment period and 15 day comment period and finds that the proposed regulations are justified and feasible, cost effective, and would save significant energy statewide. See responses to comments on the 45-day language herein for specific reasons why the requested changes were not made. No further change is recommended.
NRDC	I am writing on behalf of the Natural Resources Defense Council, a leading environmental advocacy group, that has been an active participant in the CEC's Title 20 proceeding to adopt regulations for small diameter directional lamps and general service LED lamps. Our comments below supplement earlier oral and written comments we previously submitted.	This comment is NRDC's introduction. No change is requested.
NRDC	Enclosed are comments from the Natural Resources Defense Council (NRDC) on the CEC's revised 15 day language. NRDC has been an active participant throughout the CEC's Title 20 proceeding to adopt regulations for small diameter directional lamps and general service LED lamps. Our comments below supplement oral and written comments we previously submitted to the docket.	A change is not requested.
Sunrise Lighting	We welcome the opportunity to offer comments in support of the California Energy Commission's (CEC) proposed Title	This comment is Sunrise Lighting's introduction. No change is requested.

	20 standards for general service light emitting diode (LED) light bulbs. Our company is LED manufacturer and distributor. We are in lighting business for over 15 years. Currently our LED products include LED A-Lamp, LED BR and LED PAR lamps. Our factory is based in China for the last nine years with over 260 workers there. Also, we have our shipping facility in Los Angeles area. Our headquarters is based in Gilbert, Arizona.	
Sunrise Lighting	We support the CEC's proposal to require LED lamp products sold in California provide a minimum level of performance and quality to help ensure that they will meet consumer expectations and help make LEDs viable replacements for incandescent lighting in all applications. Specifically, we emphasize our support for the CEC's requirements for accurate color rendition. We support the proposed minimum color rendering index (CRI Ra) score of 82, as well as the proposed minimum individual color scores (R1-R8) of 72. These requirements will result in better rendition of red hues, which has been lacking from most energy saving light sources to date. Red content is especially important for the rendition of food, skin tones, wood furniture and other natural materials. Combined with the proposed efficacy requirements, the CEC's standards also ensure that LED lamps will be extremely energy efficient and will save consumers on their energy bills. Products that meet these requirements are available and affordable already today – given another two years before the effective date, there will be even more product	The comment supports the standards and does not ask for changes to the standards.

	availability and even lower prices. The CEC's proposed standards support the State's goals of widespread replacement of energy-intensive incandescent and halogen lamps by requiring that LEDs provide a level of quality and amenity that equals — or exceeds — that of the incandescent technology they are intended to replace. If Californians convert the remaining halogen and incandescent sockets to LEDs the annual energy savings would be enough to meet the State's lighting energy reduction goals mandated by AB1109. We realize we are one business day past the comment period, but we ask that you consider our position of support.	
NEMA	It is not the practice of the National Electrical Manufacturers Association (NEMA) to write directly to each individual commissioner about a rulemaking. The potential negative impact to California and its consumers, however, warrants our exception in this case.	No request made in this comment and no change recommended.
NEMA	To our knowledge, this will be the first time that the CEC pursues regulatory action that will reduce potential energy savings, increase the cost of energy saving products for California consumers and make it less likely that California consumers will want to buy these products.	See RESPONSES 4 and 6.
NEMA	As detailed in our submitted comments (copy enclosed), the proposed Amendments to Appliance Efficiency Regulations relating to certain General Service LED lamps are inconsistent with the CEC mission. We are appealing to you to halt the adoption of 15-day language currently	See RESPONSES 4 and 6.

	scheduled for your January 27, 2016 business meeting. The proposed changes to Title 20 are based on poorly analyzed data of the emerging LED lamp market.	
NEMA	Adjusting the U.S. EPA ENERGY STAR data for LED-qualified products reveals over 188 million LED bulbs sold last year -- a 237% percent increase in sales over 2014. The adoption of LED bulbs by consumers is rapidly moving forward and the 15-day language cannot but have a negative effect on this growth, the efficiency gains that accompany them and the prices citizens of California have to bear. Thank you for your time and consideration of our point of view regarding the proposed amendments. The rule would be a serious mistake and does not represent sound policy. Therefore, please vote "No" on the adoption of the subject 15-day language.	See RESPONSES 4 and 8.
Cree	Summary: Cree believes that providing GSL and decorative lamp products that meet the proposed standards as of January 1, 2018 is quite possible, and will provide California consumers with the Better Light they deserve.	The comment supports the standards and does not ask for changes to the standards.
Acuity Brands	Acuity Brands appreciates the opportunity to provide comments on the Revised Title 20 15-day express terms for small diameter directional LED lamps and General Purpose LED lamps. We want to thank the Commission for your consideration of the comments submitted by Acuity Brands on 11/30/2015. We also want to thank the Commission for the revision to the effective dates to allow for additional	No change is requested and needed.

	time to align new designs with the CA requirements.	
Opto Light	We are a lighting manufacturer located in Santa Fe Springs, CA with a great deal of market activity in California for LED products that would meet the California Energy Commission's (CEC) proposed Title 20 standards 15 day language for general purpose light emitting diode (LED) light bulbs in color quality and efficacy. We continue to make strides in improving efficacy each year, as well as in reducing cost. Most or all of our general service LED business in California is associated with the rebate programs of the California investor-owned utilities. We look forward to a future in which all California customers can enjoy the high quality LED lighting that our company is proficient in supplying.	The comment supports the standards and does not ask for changes to the standards.
Opto Light	Opponents of the proposal want to weaken the standards often for increased short-term profit. This could harm the reputation of LED lighting. Long-term profit might be better for manufacturers and retailers when customer satisfaction is high, leading to more energy savings and environmental benefit.	The comment supports the standards and does not ask for changes to the standards.
Opto Light	We support the proposed Title 20 code and feel it benefits manufacturers of high quality LED products, as well as customers in all sectors, the State, and the planet. We realize this comment is arriving one business day late, but we ask that you add to your knowledge that there are high volume manufacturers serving California already putting	The comment supports the standards and does not ask for changes to the standards.

	millions of compliant products into the market.	
NEMA	We appreciate that the CEC responded to a few of our requests for additional information in the Supplemental Staff Analysis document published on December 28, 2015. However, this document and the Supplemental Initial Statement of Reasons published on the same day fail to address many of the questions raised --- factual and legal --- and requests for additional information made in our comments to 45-day language. We again ask the CEC to respond in writing to these concerns, before the adoption hearing and not in the Final Statement of Reasons document, which might lag weeks or months after adoption.	The Commission must consider all comments during a rulemaking proceeding. However, the Commission is only required to respond to comments in writing in the Final Statement of Reasons, and not during interim parts of the rulemaking proceeding.34 While the staff tries to address relevant comments during the proceeding, sometimes staff is unable to do so to the satisfaction of all commenters.
NEMA	Federal Preemption: There also remains the issue of federal preemption that should be considered in this rulemaking, which may render nearly all (if not all) of the energy standards adopted in this proceeding superseded by federal law. This factor strongly suggests that CEC should cease this proceeding in light of the pending Department of Energy's federal rulemaking on general service LED lamps.	The Energy Commission has reviewed the relevant statutes and existing and ongoing federal regulations and considered the potential for federal preemption. The Commission has concluded that the proposed regulations are not presently preempted and, therefore, the rulemaking is not affected.
NEMA	Finally, we have noted that this docket contains a number of recently submitted comments from citizens who apparently believe that NEMA's comments in its 45-day	Staff reviews and considers all comments, researches the merits of each claim, and makes recommendations to the Commission based on

34 See Cal. Gov. Code §§ 11346.8(c), 11346.9(a)(3)

	language comments are aimed at reducing energy savings in California. While it is not clear who is motivating these comments and why, and they may have been submitted to the docket in good faith notwithstanding their erroneous assumptions and statements, we trust the Commissioners will see from our comments and analysis that these comments are entitled to no weight in this proceeding because NEMA's recommended changes to the regulatory proposal will encourage continued and increasing rates of adoption of more efficient products.	the merits of the comments. No change is requested or needed.
Steve Uhler	What if? What if the effort that went into this standard went in to encouraging non power grid sources to power these type of lighting systems?	This comment is beyond the scope of this proceeding as it is not directed at the adoption of the proposed standards. This comment does not require a response.

January 27, 2016, Adoption Hearing Transcript

Commenter	Comment	Response
Chromaticity/Color Consistency		
GE	The second comment of three, the proposed regulations also prohibit the sale of lamps that operate in the white color space. Now, GE submitted research to the docket which shows that there is consumer interest in these lamps. So, we would submit that providing for their continued sale should help facilitate the transition to LED lighting. And, indeed, the staff report on the 45-day package, at page 58, indicates that that is the Commission's intent. The problem is we've got a requirement for chromaticity that references an ANSI Standard in the regulation that is too narrow to accommodate the design of these lamps. They're actually designed to operate outside of the prescribed color space. We think that's an unintended consequence of the first round of 15-day changes. We've offered language to staff and Commissioner McAllister that we hope will address that issue.	The Energy Commission modified its regulations in 15-day language to allow use of national standards, specifically ANSI C78.377-2015, Annex B, Table 1, as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). A 7-step approach, as suggested by some manufacturers, would allow a noticeable variation in the color consistency while simultaneously allowing significant deviations from "white" light. Alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.
Consumer Choice		
Osram Sylvania	Certainly. We have shared efficiency goals with the CEC in past versions, take no issue with the general service	See RESPONSE 4.

	efficiency levels you've suggested in this version. Please do not adopt this proposal. It is a step backwards in terms of price, efficiency, and allowing consumer choice. Thank you.	
Philips	We intend to change that with the Title 24 process, as that moves forward. Now, in straight forward terms, the proposed Title 20 15-day language is about the consumer choice. As written, the 15-day language would, among other things, restrict the sale of general purpose LED lamps sold in California to only those with a CRI greater than 82, in an R-1 to R-8 of at least 72. As shown in our written comments, an R-8 of 72, matched to a CRI of about 84 to 85, like one previous commenter mentioned. The chips at this level are not readily available. Thus, CRI 90 will become a de facto required. And we respectfully disagree with Mr. Rider and others on this point. We also wish to mention or point out that lamps with these color characteristics, i.e. CRI 82, and R-8 greater than equal to 72, are currently available in California. Consumers can go out and buy them right now. They will not go away if the 15-day language is approved. Rather, they will become required in the future. Looking at the opposite case, if the 15-day language were not approved they would still be available. Lamps with a CRI of CRI 90 or greater, however, are generally less efficient and more expensive than lamps with a CRI 80, as you have also heard from other commenters.	See RESPONSES 1, 3, and 4.

NEMA	And many of my members remain concerned about the Commission pushing toward a standard that defines a very narrow band of products. You know, echo Dr. Rubenstein's comment about choice being reduced in the marketplace, and the concerns about light and health is still being studied. We sympathize with consumers who want product choice, particularly if they're budget-minded.	See RESPONSES 3 and 4. There is nothing in the record that would raise a concern that existing lighting products cause health issues.
CREE	Is it still morning? So, good morning. And thank you for the opportunity to comment today. Cree is supportive of the proposed regulations. We are committed to the full adoption of LED lighting and we believe that full adoption requires better light. For someone who's been involved in technology adoption for over 30 years, I've seen that the only way you get everybody to adopt something is to make it better than what they had before. And we're convinced that light quality and the experience that consumers will have with the light is critical to that happening. Compromise light and hoping people won't notice is not a path to success. I think we've seen that with the CFLs that were just mentioned. Good enough isn't good enough. I would like to thank the Commission for considering the many comments that were made on the previous language and making some very valuable, and important changes. I would also like to comment on the fact that the current standards do provide some flexibility to meet customers' preferences. One example of that is the fact that, contrary to some comments, it	The comment supports the standards and does not ask for changes to the standards.

	actually doesn't mandate 90 CRI. You can meet an R-8 of 72 with less than 90 CRI. We believe these requirements will help Californians get the quality of light they deserve and will help drive adoption. And, in fact, one point on that topic, you know, there have been some comments made on the need to maximize energy savings. And one of the easiest ways to do that is to incent people to adopt faster, than they otherwise would. So, one consideration we would ask the Commission is to consider aligning the voluntary lighting spec with the Title 20 requirements. We believe that will incent manufacturers to do this more quickly, which will accelerate adoption and will accelerate savings. Thank you very much. COMMISSIONER MC ALLISTER: Thank you.	
CRI – State-regulated LED Lamps		
Feit Electric	Today, I wish to address two items of concern. First off, after extensive testing and evaluation, we have concluded an R-8 individual color score of 72 or greater is not possible for mass production lamps with a CRI less than 90. We have found only 90 CRI lamps are reaching this high benchmark. We do not believe an R-8 score of 72 is currently obtainable for an 82 CRI lamp. We strongly recommend setting an R-8 minimum color score of 50. As most people in this room understand, 90 CRI lamps are less efficacious than lamps of CRIs in the 80s. There's an approximately 10 percent or higher reduction in efficiency or efficacy between the two. To achieve the	See RESPONSES 1 and 3.

	Commission's primary goal of saving energy, together with establishing better color quality, it makes a great deal of sense to reduce the R-8 value as we are suggesting. To adopt a minimum R-8 value of 72 or greater would signal the Commission's desire to effectively adopt a 90 CRI specification. If this is the case, we believe the Commission is overestimating the value of color quality metrics at the expense of lost energy savings and the related costs to Californians.	
Jon McHugh	Great, thank you. Yeah, this is Jon McHugh. I'm calling from the ASHRAE Orlando meeting and I've just met with the ASHRAE 189 Energy Committee, and we're looking at the national energy standard of making the transition to LED lighting in the – as the basis of that national standard. And one of the big concerns from members of the Committee, and commenters on that standard, had to do with sufficient lighting quality. There was an ongoing concern with the Committee and looking at products, now, many of the products that they were referencing were products that did not have both high efficacy, or at least good efficacy, and high CRI. And these are very knowledgeable folks. And even though there's been a lot of discussion about the value of color quality, almost without exception most of the comments were around issues associated with color quality. The big picture to think about for the end game, in regards to light efficiency, has to do with the AB 1109 and whether or not the State is able to hit their goal. It's my belief that the	This comment supports the standards and does not request changes to the standards.

	State will not hit their goals unless they are able to enforce the 2018 requirements for high efficacy lighting in 2018. My belief is that unless we have a mature market of High Color Rendering Index lamps that do not reduce the amenity, as compared to the lamps that we replace, that we are going to see a backlash similar to Joe Barton's ball back, which NEMA opposed. But the primary focus of the ball back was around the low color quality of CFLs and that was repeated, even though that particular standard didn't even necessarily require CFLs. So, I think this is a key element to the Energy Commission's strategic plan. Thank you very much.	
NEMA	When I refit my home, I chose 80 CRI products because I could put more of them in sooner and, thus, begin saving energy sooner. And like many people, as is noted in the International Standard for Color Rendering, I don't see a lot of difference between 80 and 90, myself. So for me, it's not a big deal, and so budget was more important. So, I refit my house and I'm satisfied.	See RESPONSES 1 and 4.
NEMA	That is because of the innovations particularly in the manufacture of 80 CRI products. If the Commission goes to this proposal and resets the clock back to recycling and going to the 90 CRI, and what can we do to drive these down, can industry do that? I think, given enough time progress could be made. Will it ever catch back up to 80? Probably not, because the rest of the world -- and LEDs are made and sourced globally, the rest of the world	See RESPONSES 1 and 4.

	is focused on 80 because that's where the sweet spot between the balance of price and performance has occurred. And that is what has driven that particular adoption.	
GE	This is Joe Howley from GE. And, yes, the points that Jeff raised were our primary points. That we are very concerned about the allusion that it appears as if 80 CRI lamps or 82 CRI lamps would be allowed. But the fact, given the nature of how these come together, it really forces the manufacturer into 90 CRI chips. And as you heard from many folks, we do not believe that is a good outcome for the citizens of California. We believe they should be allowed to purchase the 80 CRI A line products. And that the R-8, in particular, that particular specification needs to be adjusted downward. Also, the other two points about the white light space, products that we call GE Reveal, will not meet the current regulations.	See RESPONSES 1, 3, and 4. Regarding white light space, the Energy Commission established standards for lamps that were blind to specific models or technologies. The Energy Commission modified its regulations in 15-day language to allow use of national standards, such as ANSI C78.377-2015, Annex B, Table 1, as recommended by manufacturers. This standard is necessary to ensure that lamps produce white light (chromaticity) (unless they are specifically color lamps, in which case they are not subject to the regulations) and that two lamps side-by-side look the same (consistency). Alternatives to this approach were not provided, so the Energy Commission did not make additional changes to the regulation.
LumiLEDs	The CEC is creating a regulation that prevents manufacturers, including my customers, from shipping the most efficient products. Meanwhile, manufacturers invested thousands of hours trying to share our knowledge, our experience with this metric to help the CEC use the metric effectively and meaningfully. We were trying to educate the Commission and interested	See RESPONSES 1 and 4. Staff agrees that there is no perceptibility between 80 and 82 CRI. But based the current products in the market and what is feasible, the lowest CRI, where R1-R8 is no lower than 72, is 82. Therefore the standard was set at 82 CRI.

	stakeholders that the existing economies of scale the industry has achieved would be abandoned by this regulation, to achieve a 2 point increase in CRI which is, scientifically speaking, has not perceptibility and is statistically insignificant in terms of its benefit to consumers. At a minimum, you need to make normative reference to CIE 13.3, otherwise these terms won't be defined in the regulation.	The Energy Commission incorporated then-proposed federal testing requirements into its standards, including testing requirements for CRI. The Energy Commission will ultimately be preempted from requiring different testing requirements for the same purposes. If there are concerns about repeatability and replicability in the test procedures, they should be raised to the U.S. Department of Energy.
LumiLEDs	Manufacturers have been asking for the option to ship minimum 80 CRI because it's much more energy efficient, on the order of 15 percent more efficient. And consumer adoption of these products, as Alex Boesenberg showed, is already robust. It's dramatic. It's straight forward physics that the proposed regulation will use more energy than the minimum 80 CRI Energy Star-certified products that are rapidly transforming the market. And it's simple economics that if an entire industry is set up to meet one specification and then another specification comes along that's a lower volume, it's going to cost more to comply with. The intent and the will of these petitions should be honored and taken seriously, but the physical and economic arguments that the petitioners have signed on to are demonstrably false.	See RESPONSES 1 and 4.
Francis Rubenstein	First, because a high CRI lamp is, in general, going to use a few more watts than, say, an Energy Star LED, the lighting footprint of California households will end up	See RESPONSE 4.

	being somewhat higher than typical households elsewhere, who don't have the same rulemaking to deal with. Admittedly, it's not a lot of extra energy, maybe about 150 kilowatt hours per household, per year. Hopefully, there aren't too many households who can't afford an additional $15 or $20 on their annual PG&E bill. But if you consider that there's some 11 million households in California, this actually does add up to a fair amount of energy. It's about enough energy to power, maybe, 300 homes. And as an environmentalist, I've got real issues with an additional -- with this additional energy use, when it's a direct consequence of an appliance standard which is intended to diminish energy use.	
Francis Rubenstein	And, third, and this is where I'm kind of wearing a scientist hat here, by eliminating 80 CRI LEDs and promulgating high CRI lamps, the rule would significantly add to the amount of blue light that we have in our homes. Now, I know I'm bringing up another issue that you guys probably don't want to deal with right now, but I've got to talk about this a little bit. It turns out there are only about 8 percent of the energy from an incandescent that's below 500 nanometers is there. But a high CRI lamp has actually about twice that amount, by more like 17 percent, so it's significantly more. Now, the effects of blue light on health, both bad and good, is a real hot topic button issue, which you don't want to talk about here, today. Very briefly, I was at an IS conference a	It is unclear if the commenter believes that the required minimum 82 CRI level set by the standards has more or less blue light than the 80 CRI or 90 CRI. While the Energy Commission is aware of research regarding blue light, it has not seen any evidence that ties the amount of blue light to CRI in lamps. Typically, in fact, a lower CRI lamp would have more blue light than a higher CRI lamp. The Energy Commission chose its CRI levels as explained in RESPONSE 1. No changes are needed.

	few years ago, and during a forum discussion one of the members of the audience shouted out that blue light was the next asbestos. And I wanted to tear my hair out. But, anyway, the issue is that it's a very big issue, the blue light, and more of it, less and so forth.	
Francis Rubenstein	But the staff recommendations sort of have the opposite effect. They reduce people's choice by making it harder for Californians to get LED bulbs that might have less blue light. And it turns out that those 80 CRI lamps don't emit as much blue as the 90 CRI lamps. I'd like to see more information on this. But, anyway, I think you can see this is going to represent a pretty obvious legal exposure, having State regulation that precludes consumers from buying lower LED content -- sorry, lower blue content.	The commenter appears to be confused regarding a possible connection between blue light and CRI. Typically the lower the CRI the more blue light compared to other individual colors. A 90 CRI light has more red colors than 80 CRI light. All LEDs have more blue light than incandescent lamps. The Energy Commission set its CRI requirements for reasons explained in RESPONSE 1. There is insufficient evidence of the technical feasibility or cost of lamps without blue light, or of the impact on human health, to make policy decisions to modify the regulations in response to this comment. Therefore, no change was made.
Southern California Edison	I'm Richard Greenburg and I represent the program side of Southern California Edison. MR. KIM: I'm Charles Kim of Southern California Edison Company and I'm representing coding standards program. MR. GREENBURG: So, on the program side, I'm also the statewide lead of the lighting program for all three IOUs. And I have been heavily involved in the selection of products since 2013, when we went to a high CRI product with the CEC voluntary standard, quality standard. And	The comment supports the standards and does not ask for changes to the standards.

	I've seen the evolution take place. And I'd like to go through it just briefly because it indicates that some of the claims are being over-stated in terms of the efficacy differences and things like that. So, in the beginning we had a 13.5-watt, 800 lumen, 60-watt incandescent, 90 CRI product at Home Depot, and the equivalent LED at 80 CRI was 10 watts. So, we had a big gap that was very shocking to everyone, including the people who wrote the voluntary code. However, as time went by, what we now have is a 9-watt, 80 CRI, 60-watt equivalent, high CRI, which is the new generation for this year. And it was in the program last year, as well, but it's going to be predominant in the program this year. It is -- the 80-watt equivalent is also nominally 9-watt. So, we might have up to 1-watt, where one is eight and a half watt measured and one is nine and half, or less. It has shrunk, okay. So, also, the price difference has shrunk considerably, as well. High-efficacy products go down in price. The higher the efficacy, the fewer chips and the lower the price. And they also continue to improve price in other ways by the economies of scale, and things like that. So, with the economies of scale, as soon as this code is enacted, the economies of scale will cause a price decrease in these higher quality products, such that there will be very little distinguishable price difference between this and the 80 CRI counterparts throughout the country, in my opinion, okay. I want to mention that the -- we put 3.1 million CEC voluntary spec products into the Southern California	

	Edison territory last year, through the Primer Lighting Program. And we have slated, right now, to put 6.1 million in the program, in 2016. And the concept behind that is that for years and years, with various technologies, the utilities have gone before the code to prepare the way for a code change. So, we transform the market to support a coming code change. And that's what we've been doing with these quality products, bringing them more and more in line with what will support the code change. And we do support the entire draft proposal.	
Westinghouse	So, in addition to our concern that products with a CRI lower than about 84 can't actually meet the 72 R-8 requirements, we believe that there are products in the analysis as meeting the efficacy requirements, and also meeting CRI and R-8, which have a CCT value above 3,000 K. We do agree and we also offer products that are above 3,000 K, and we understand consumers do want these products for certain applications, and many consumers prefer them for all applications. However, in the analysis, including items that don't meet the average consumer's expectation that a lamp will be 3,000 K or less, matching the incandescent equivalent that they're replacing, creates a concern that you're going to create the problem that you're trying to address. Which is that there will be products that will meet some of the requirements for color rendering in R-8, but will not meet the incandescent equivalent requirements and will not be at CCT	See RESPONSES 1 and 3. The regulations cover a wide range of lamps, including high CCT lamps, making it necessary for staff to include these lamps in the analysis and develop standards that would make sense regardless of the CCT of the lamp.

	acceptable to consumers. And I guess the other point that I would make is there's an unspoken assumption that comes up here a lot in commenters, including mine earlier, that 90 is high, so 80 must be poor or low-quality light. And that's not accurate. 80 CRI is good color quality. Below 80 is where you start to see issues with color emission that consumers would find objectionable, even in general applications. CFLs were a challenge. We did have issues.	
Professor Lorne Whitehead	Thank you very much. My name is Lorne Whitehead. I'm a Professor at the University of British Columbia. And I think, I had a remark prepared, but I'm going to change it a little bit just in response to some of the comments that we've already had. I think a really important point needs to be made about light and vision. We know it, but I think we should think about it, again. It's an extremely complex topic. It spans the realm from the generation of light to the method by which light gets to our eye, which lighting scientists are experts on. And then it involves the experience that occurs in our brains as a result of visual processing from the retina to the brain, which is a vision science question. A huge question. And, you know, the fact is, in today's world of science nobody can be an expert in all those areas. So, mistakes are going to happen. You know, you, for example, are considering issues here that span all of those areas and you'll hear things that really don't hang together, quite bluntly. And it's not because people aren't smart and it's not because	The comment supports the standards and does not ask for changes to the standards.

	they aren't well-intentioned. It's just too big a field. So, we have to constructively compare different points of view. And, of course, you have to try to sort it out. So, I think I would like to comment, again, on the efficiency question. It keeps coming up. You hear it again, and again, and again. There's a very simple fact when it comes to the use of power. If you use less power, you use less power. So, the fact that a particular product might be less efficient in some definition that has very little to do with human perception or human value is irrelevant. It's all about what's valuable to people. Now, it's simply true that higher CRI light provides more value per watt for people. If you want to see well, you spend money on electricity to see better. And high CRI light, even though that efficacy word that gets used is slightly lower, very slightly lower, the result is better light, so you get more. Let me turn that argument around a different way. Now, if you take the – if you accept the point of view that we have a moral obligation to have the highest possible efficacy of light, well, that takes you to low pressure sodium. Or, if you want to stay white, it takes you down to at least CRI 60 light, light that's been optimized for efficacy and not for adequate color vision. And nobody in this room, I believe, is suggesting that we do that. Why not? Because that more efficient light would not provide the value for people. So, if you want to know what provides the best value for people, you have to turn to scientific experts on that field. And you're hearing them	

	say, these standards, these improved CRI standards provide that value for consumers.	
Osram Sylvania	This standard will have Californians paying more for less efficacious lighting because of your insistence on color metrics that the consumer neither values, nor understands. Some applications require high color rendering lamps and we thank staff for recognizing that these special lamps need lower efficacy requirements. But to require that everyone purchase these higher costs, lower efficacy, specialty application lamps is wrong.	See RESPONSES 1 and 4.
California IOUs	Good afternoon. My name is Mike McGaraghan. I'm with Energy Solutions, a consulting company who supports the California Investor-Owned Utilities' Statewide Codes and Standards Team. And I've been supporting this process for the last several years. Thank you for the opportunity to speak today. I wanted to touch on a couple of points and the first one is just to remind folks in the room that what the CEC is proposing to do today is actually not atypical for a standards proceeding. It's really what happens with standards adoption. You don't just focus on energy reduction or wattage reduction. You have to couple that with performance and considerations with poor performance. And it's come up time and time again. But a couple of examples, including recent ones, the Commission passed toilet standards just last year. You can make a toilet use less water by reducing its capacity to flush things well. That's why there's also a	The comment supports the standards and does not ask for changes to the standards.

	map score that goes with toilet efficiency standards. So, it's not just the gallons per flush, there's also a performance score. And the same can be said of virtually any product that goes through a standards process. Clothes washers, dryers, dishwashers, refrigerators, you name it. You can make a refrigerator use less energy by keeping food at 41 degrees, instead of 38 degrees. Buy we know that's not good for people. We know consumers are not going to figure out which refrigerator they need to buy in the store, in the aisle. So, this is actually pretty consistent with standard-setting processes. And I've seen a number of them over the years, working here in California. So, the other thing I wanted to do was point out that there are a number of supporters of the standard that couldn't be here today. We've heard from a handful of very supportive manufacturers today and I'm appreciative that they could be here. But there are also a number of smaller manufacturers who don't have staff, they don't have government relations staff to make it out to meetings like this. Comments have been submitted from a handful of those and I'll just name them. OptiLight is a manufacturer based in California that was supportive of the standards in written comments. Sunrise Lighting is another one, based in Arizona. Green Creative, I don't think they're here today. They've managed to come to some of these in the past, but they are a small operation and I don't think they're here today. So, I just wanted to reiterate that there is a lot of support for this	

	and not all of those people could be here today. The last thing I wanted to touch on was just the fact that the proposed standards do not require 90 CRI. I can say that without a doubt because we've tested products that meet all the R-1 through R-8 scores and still have a CRI below 90. We've tested about 25 percent, actually, of the products that met all the R-1 through R-8 scores and actually had a CRI below 90. Some were 84, 85, 86. So, certainly technical feasible. With that, I'll wrap up my comments and just say I strongly support the path the Commission is taking today and urge the Commissioners to adopt. And thank you very much.	
Philips	The more efficient CRI 80 lamps are also available right now and will save consumers more energy than a CRI 90 of the same light output. The CRI 80 lamps will disappear in the California market in the next few years, however, if Item 3 is approved today. We also wish to point out that the Illuminating Engineering Society of North America, or IES, has docketed comments which indicate that CRI should not be used in regulations. Commissioners, we think that consumers should have choices and the best way to promote lamps with a CRI 90 is to incentivize them, not mandate them. We ask that you vote no on Item 3. Thank you.	See RESPONSES 1, 3, and 4. Staff also notes that the comments from IES merely state that IES does not endorse use of CRI (or any other measure) for regulations, but does not affirmatively state that the Commission should not use CRI as a metric in its regulations.
Data-related Comments		
LumiLEDs	Good morning, Alex Baker from Lumileds, in San Jose,	The comment provides background on the

	headquartered in San Jose. We make the LEDs that go into the LED bulbs that are proposed to be regulated. For five years, starting in 2007, I worked at the USEPA managing the Energy Star Lighting Program, and I have an appreciation for where you find yourselves because my job there was to make decisions wedged between manufacturer interest, utility interest, consumer interest, retail interest. So, in that role it was my responsibility to finalize a spec when everyone was equally angry with me. This is my first time with the CEC regulatory process. What I've observed is that the Commission and the electric utilities view the market data and see plentiful product already meeting the proposed regulation.	commenter and is not a comment on the proposed regulations.
LumiLEDs	On the other hand, manufacturers, including our customers, believe, when all the requirements are considered together, that maybe a handful of existing products will meet it. This is the reason why NEMA manufacturers are requesting a list of products that the CEC believes will meet the combined requirements. I think it's encumbent upon the Commission to gather all stakeholders together, in one forum, where these differences, and opinions, and perceptions can be ironed out, so the regulation can be based on one set of common facts, however imperfect that set is.	See RESPONSES 3 and 5.
Philips	Good afternoon, Commissioners. My name is Anthony Serres and I'm with Philips Lighting. Thank you for the opportunity to address the Commission, today. Despite	See RESPONSES 5 and 6.

	what staff presented earlier, most topics have had minimal open discussion between the experts, the IOUs and industry.	
Westinghouse	My name is Dave Gatto and I am with Westinghouse Lighting. First off, I'd like to thank Ken for providing information. I think it started on slide 16, early in the presentation, showing the analysis of available products that staff believes currently meet Tier 1 and Tier 2 proposals. As Mike McGaraghan noted, this analysis includes a limited number of actual product testing and it indicates that the R-8 value that was used is an estimated or assumed value, not something that's actually been confirmed. Which called into question whether those products are actually available? What I would say is that the products listed that do meet Tier 1 and 2, it's clear that they meet those where the testing is backing it up. Although, to Mike McGaraghan's point, there weren't any at 82. 84, I believe, was the lowest found. However, what's not clear is whether these products would meet the other requirements of the proposal or that they can meet other consumer preferences requirements, such as color texture.	See RESPONSES 1 and 3.
Downlight Retrofit Kits		
Eaton Lighting	On behalf of Eaton, first, I recommend – there are two things I want to recommend here. First, the CEC continue to include the recessed module retrofit kits as it's	Regarding the first comment, the Energy Commission appreciates the support for including retrofit kits in the efficiency standards.

	currently written in the 15-day language. It is among the first of what the future holds as, really, the next generation lamp. These solutions offer the highest energy savings, with color quality and reliability that minimizes snap back to provide sustained savings. Secondly, while it's logical that the Commissioner desires to take advantage of the most recent standards of LM 84 and TM 28, these standards are new and it will take time to implement these changes, potentially slowing down the process of innovation. We do request, as Eaton, on behalf of the industry, to delay the use of just LM 84 and TM 28, and include the capability of using LM 80 and TM 21 as an alternate to these testing procedures for reporting.	Regarding the second comment, the Energy Commission wrote its proposed regulatory language to match the then-proposed U.S. DOE test procedure for general service LED lamps. Ultimately, the Energy Commission will be preempted from using a different test procedure than DOE for those products covered under DOE's rule.[35]
Efficacy		
GE	And then, finally, just to echo the concerns about the very high LPW for MR-16 lamps. And we do not believe that that is necessary. Most of the savings are going to be achieved by wiping out the halogen MR-16 lamps, and that level doesn't have to need to be set at a level that will only allow a very limited number of specialty, very high-efficiency MR-16s. We believe it needs to be lower to allow a wider array of choice in this space.	See RESPONSES 10 and 11.
Osram Sylvania	And good morning, and thank you for the invitation to address the Commission. I'm Mark Lien. I'm the Director	See RESPONSES 1, 3, and 10.

35 http://energy.gov/sites/prod/files/2014/05/f15/led_tp_snopr.pdf

	of Government and Industry Relations for Osram. Osram is the second largest global producer of LEDs, with our Opto Semiconductor Division, located here, in Sunnyvale, California. We support strong energy efficiency goals for general service lamps. Your color preference requirements, however, as we've heard, are counterproductive to this end. What Ken presented sounds as if there are many products available now to meet your proposal. But despite repeated requests, we've never seen a list of these of these products and believe that most do meet some, but not all of the requirements, and at substantially higher costs. The Commission's proposal relies on economies of scale to bring the color performance up, the efficiency up and the price down. Performance is proportional to price. Raise performance and cost goes up.	
Osram Sylvania	What the proposal means for Californians is products that are more expensive, with color metrics that make them less efficient, meaning that they are more costly to use. And these products will be purchased in fewer numbers due to the higher prices or sourced online by consumers. The CEC has earned respect for intelligent and progressive energy standards. What is different about this proposal is that you are creating mandatory regulations for LED products, a first in this country. What is conspicuously absent is expertise in manufacturing processes and best practices. During the development of this version it appears that manufacturers, that have the	See RESPONSES 1, 3, and 5. To account for manufacturing processes and product development timing, the Energy Commission modified the effective dates for the tier 1 and tier 2 general service LED standards to provide additional time for manufacturers to ramp up production of compliant products. No additional changes are needed.

	expertise, are at best an inconvenience and, at worse, adversarial. We have shared efficiency goals –	
Westinghouse	I think what's being missed here is that the issues were not about CRI. CFL issues that caused the greatest consumer objections were things about warm-up time, start-up time, high color temperature in the early days, when we didn't have and 27 K available. In closing, I would respectfully ask the Commission to vote no on the current proposal and encourage staff and stakeholders to take the time necessary to find the best medium performance requirements that will make consumers happy and allow the greatest efficiency to be achieved in the State. Thank you.	See RESPONSE 1 regarding the need for CRI, RESPONSE 4 regarding consumer choice, and RESPONSE 8 regarding the CFL experience. Proposed standards are reasonable and feasible staff recommends no change.
Osram Sylvania	Susan Callahan, with Sylvania. I wish to share with you a quote from HL Mencken, which I believe reflects the 15-day language you are considering adopting today. "For every complex problem there is an answer that is clear, simple and wrong." And the 15-day language is the wrong answer. The answer that you -- this standard should be about energy efficiency and what can be done to increase the adoption rate of LED lamps and it is not. Omnidirectional LED lamps are not compact fluorescent lamps. They are transforming the market by themselves because of their efficacy and cost.	See RESPONSE 8. The regulations are precisely about energy efficiency and increasing the adoption rate of LEDs. No change is recommended.

PAR/BR Lamps		
Osram Sylvania	Regarding costs, a good example of one of the many lamp types not considered in your analysis is the PAR 38 spot and floodlight category, for which the only post adoption lamp today is a commercial grade product that costs $80. With popular LED PAR 38 lamps today selling for under $20. It defies precedent to expect a niche market to influence a drop in price of 75 percent in a maturing product design for California lamps to be close to competitive with the rest of the country.	See RESPONSE 3 and 4.
Small-diameter Directional Lamps		
Osram Sylvania	You complain that consumers are replacing their CFLs with LEDs, rather than replacing their even less efficient halogens. They aren't replacing their halogen lamps because of perceived color issues with LEDs. They aren't replacing them because of the initial cost. And increasing the cost of LEDs will slow adoption. With regard to small-diameter directional lamps, I ask that you reconsider the phrase, "capable of operating at". Exactly what does that mean? That you install the lamp, flip the switch and it will turn on, or that it will operate in the manner for which it was designed at nominal lumens and life.	Staff expects LEDs will replace both CFLs and halogens. The greater energy efficiency benefit would occur with the replacement of halogens with LED given how much energy halogens use. The change made in the 15 day language to clarify that the standards apply to any SDDL lamps that are capable of operation at 12V, 24V, or 120V is important given that products rated just off of these voltages could easily be operated at these voltages, with minimal impacts to light levels or lamp life. For example, as noted by the IOUs, 12.5V or 11.5V products can be operated on 12V transformers, so the proposed change is a critical improvement to the scope of the standards to

		prevent gaming and loophole products. No change is requested or needed.
GE	And then finally, with regard to small-diameter directional MR-16 lamps, we believe the proposed 80 lumen per watt minimum belies the market data, which indicates that the rate of efficiency gain is starting to flatten as the technology matures. An ambitious efficiency projection for 2018, for this lamp category, would be in the low 70 lumens per watt. Again, looking at the data, that's about 15 percent per year from where we are today, at roughly 55, 56 lumens per watt. Since today's MR-16 halogen lamps are going to be wiped out of the market by this regulation, we think it's encumbent on the Commission to ensure that there's sufficient product out there for various applications at the range of wattages, the color temperatures and beam spreads necessary to meet market demand. We think the standard should be set at 70 lumens per watt. And I'll end there. Appreciate that it's late in the process, but we would like another shot at 15-day amendments to address these and other concerns. So, we would encourage you not to adopt today. Thank	See RESPONSE 10.
Standby Power		
Philips	Okay. On standby point, while 0.2 watts is available in a few lamps and it may appear feasible for standby power limit, an 0.2 watt limit has unintended consequences. It	See RESPONSES 1, 2, and 9.

	will limit the development of lamps with features such as color changing, or occupancy sensing, and future lighting products that integrate functions other than lighting. We urge the adoption of the limit of a half a watt to leave flexibility for manufacturers in this early stage of the technology. On decorative lamps, efficacy is typically 10 lumens per watt lower than omnidirectional lamps, as clearly shown by Ken Rider's analysis. We request that CEC reduce the efficacy spec for decorative lamps by 10 lumens per watt. A too high spec for efficacy will effectively encourage greater use of halogen lamps. On this topic, we agree with Noah of NRDC. And I'd like to make a response to Michael McGaraghan's comments. We are not saying that there should be no performance specs. We're saying that they are set higher than they need to be for most applications. A CRI 80 lamp is not the same as a low-pressure sodium lamp.	
Feit Electric	On the matter of standby power, for connected lamps, we believe that a 0.2 maximum is overly restrictive for this emerging technology. We have tested many different types of connected smart lamps, and varying technologies, and do not find lamps that pass this requirement. The new Energy Star Version 2.0 sets the maximum standby power at 0.5 watts, and we believe this is an obtainable level. We are concerned that by setting a 0.2 maximum, California may hinder adoption of this dynamic and evolving technology within the State. We believe it is premature to establish such a low standby	See RESPONSE 2. A comment that identifies an unspecified theoretical future use which would require greater than .2 watts is not sufficient to warrant changing the regulatory language.

	power level. Thank you for your time and consideration of our comments.	
General/Miscellaneous		
Sierra Club	Good afternoon, Commissioners, thank you for the opportunity to comment today. Eddie Moreno, on behalf of Sierra Club California and its 380,000 members and supporters in the State. I urge the Commission to adopt the proposed standards for small-diameter directional LED lamps and general purpose LED lamps today. The Sierra Club has been working to improve air quality and to reduce the greenhouse gas emissions in the State by fighting the construction of new, dirty power plants and fighting to retire others. Over the next 13 years, these standards will support our efforts by avoiding the construction of one 500-megawatt power plant, one that will likely be built in one of the State's already over-burdened communities. The Club and its members have also been strong advocates for clean energy and worked very hard to ensure the passage of SB 350 last year. The standards will help Sierra Club and its efforts to help make solar available to all Californians by reducing home energy demand. Aside from all the important and critical environmental benefits, none of this can come to fruition without the help or the action of the consumers. Some are arguing that the CEC wants to promote LED lighting that is more expensive and less efficient. Specifically, opponents of the regulations are arguing that there	The comment supports the standards and does not ask for changes to the standards.

	shouldn't be strong emphasis on color quality in the regulations because the market will ensure that all Californians have access to those products. This is difficult to support as some of the performance metrics, like color rendering, are not apparent at the time of purchase. Customers may not be able to associate a color experience with a CRI score and that's understandable. To standardize the score at a level that will allow us to enjoy the quality of full color lighting, which we have with traditional lighting, is critical for adoption, and the CEC has done that. Opponents of the proposed regulations claim that they will harm low-income customers. This is not true as one of the major requirements of efficiency standards is that they be cost effective and are affordable to customers. Failing to meet this requirement, alone, would have halted the proposal in its infancy. Ironically, the opposition's proposal is to weaken the standard, which would create a two-tiered market, one for the poor and one for those who can afford to enjoy the quality lighting. By creating a two-tiered market, the producers are guaranteeing that their best lighting will never be available to low-income customers. A single standard for color quality will make for a more competitive market, which will ultimately decrease the cost of products with the desired performance, and the CEC has done that. The purpose of the general service LED lamps is to eliminate and to provide the ability to discern colors and efficiency, and	

	there's the ability of the lamp to perform both those functions. Opponents argue that weaker standards will produce a product that uses less energy, but will be at the cost of one of those functions. Let's not harm the reputation of LED lighting. I urge the Commission to adopt the proposed standards. Thank you.	
Feit Electric	Feit Electric was established in 1978, in California, and is a leading manufacturer of high quality, high efficiency lamps. We share and support the Commission's goal to save energy in the State of California. We have long supported the efforts of the CEC to tighten and strengthen regulations on lamps sold in the State. We participated in the development of California's Voluntary Quality LED Lamp Specification, and subsequently designed and produced lamps to meet it. Currently, we offer both 80 and 90 CRI lamps at comparable prices. Not only here, in California, but also throughout the United States. Feit Electric is generally supportive of the proposed 15-day language for general purpose LED lamps. We believe that setting a minimum CRI of 82 and the two-tiered implementation of efficacy requirements is obtainable in the established time frame	The comment supports the standards and does not ask for changes to the standards.
Pacific Gas & Electric	Good afternoon, Commissioners. Thank you for allowing us this opportunity to speak. PG&E is very supportive of the Commission's proposals to set minimum performance and quality requirements for LED lamps to help ensure consumer satisfaction and, therefore,	Staff appreciates the supporting comment from Ms. Mary Anderson and recommends no changes to the proposed standard.

	increase market transformation. We also want to commend the CEC for its work with all the parties at arriving to this point. The CEC has made several compromises throughout this rulemaking in response to stakeholder input and we believe the proposed standards represent a good middle ground that we are willing to support, and happy to support. The CEC has undertaken a data-driven process to establish the current 15-day language. This includes collecting product testing data and has depended on test data to support these standards, including products that meet the .2 watt standby requirement, using multiple communication protocols and product features. The results of this data collection show that there are many products that meet the CEC proposed standard, including affordable options. There's already a product that meets Tier 2 and is selling at less than $4. Projecting out recent LED pricing trends, the sub-five dollar products should be the norm by 2017 and many products will likely be lower, in the $2 to $3 range. This will be accessible for all consumers and this will ensure that all consumers have the opportunity to purchase high quality LED lamps for an affordable cost, rather than limiting a high quality CFL to the wealthy, due to the higher cost premium. And this will be an important step to fully transforming the market. CFLs were able to infiltrate 50 percent of the sockets in California due to the quality issues that have been defined, and they were always relegated to the secondary	

	sockets, with fewer run times, as per studies done by the CPUC. We've seen recently that these sockets, LEDs have replaced the CFLs. Even at the higher cost, people are putting them into the CFLs and not putting them into their primary locations. Consumers have maintained these incandescents or halogen fixtures in their primary living spaces to ensure that those areas are lit with high quality light sources.	
Pacific Gas & Electric	Dimmable, high CRI, with low flicker and long lives. To transform the market, California must ensure the LED product quality can be trusted by consumers at a reasonable cost. Consumers may not be able to articulate what they would like, in technical terms, but their installation decisions show that they understand a high quality product and do not settle for an inferior product. We believe that the steps that have been taken will go a long way towards preventing poor quality products and negative consumer experience, in reducing consumer confidence in LEDs. And we strongly support your adoption of the 15- day language.	Staff appreciates the supporting comment from Ms. Mary Anderson and recommends no changes to the proposed standard.
Southern California Edison	I'm Charles Kim of Southern California Edison Company. I'm here to support the 15-day language. But I want to make a comment about the process that CEC has taken. The 15-day language, it reflects a couple of things. First of all, it reflects the California's leadership in energy efficiency, environmental stewardship, and cost-effective solutions that brings benefits and values to Californians. This measure requires additional cost. Therefore,	Staff appreciates the supporting comment from Mr. Charles Kim and recommends no changes to the proposed standard.

	California demands high quality of their products. The 15-day language reflects and illuminates CEC's staff's extraordinary steps that have been taken since the year 2012CEC has listened to industries and lowered the CRI requirements. Since the year 2014, CEC has listened to industries and gave one additional year to be ready for Californians. Since the year 2014, CEC has listened to industry and added the extensions to SDLs. All of the process has been taken. It truly shows the CEC's leadership, reconciling all the issues and trying to balance what is the best for the Californians. And 15-day language also reflects the data-driven decisions that California deserves. So, once again, I'm here to highly commend the extraordinary steps that staff has been taken to make this 15-day language, and I'm very thankful to have an opportunity to support this effort. Thanks so much.	
Osram Sylvania	Multiple CEC and IOU studies confirm that price is the single greatest impediment to adoption. Even if higher rendering products can be delivered by 2018, at a price on par with today's most popular products, those popular products will also continue to innovate and will continue to be more efficient and less costly due to market forces. The economies of scale at work in the North American market have found a balance between cost and performance that, in 2015, spurred a 237 percent increase in LED sales. The curve for this rise in sales is exponential and rising, as you saw in the earlier	See RESPONSES 1, 4, and 8.

	slide. The problem of LED adoption has been solved. The market shift is well underway. And unlike CFLs, consumer acceptance of current LED products is already very strong.	
Osram Sylvania	California is 12 percent of the national market, but a single digit percentage of the North American market for these lamps. Global production standards will not change to accommodate this small market. California then becomes a niche market.	Global production standards do not need to change to accommodate the California market as existing compliant products are already produced. The only change is the removal of lower quality products from the market. No change is requested or necessary in response to this comment.
Green Creative	But name is Eric Bluevas. I'm the Utility Program Manager with Green Creative. And we're an LED lighting manufacturer based right here, in California. And I want to take this opportunity to express our support for both the small-diameter and the general service LED proposed standards here. As a California-based company, we do pride ourselves in supporting these kind of practical, progressive approaches from the Commission. As an example, our company was one of the first manufacturers to produce the voluntary spec line of products and we continue to do that today. We saw a similar debate when those standards were proposed, that we're seeing today. And, you know, several years now we see a mature, cost-competitive market for those products. So, one overall point we'd like to emphasize is we're not debating a snapshot of what's available on the market today, we're debating what's achievable once	The comment supports the standards and does not ask for changes to the standards.

	these proposed standards would go into place. And it's our belief that these are completely reasonable, technically feasible, and achievable as is, especially within the time frames for implementation. Green Creative, as a manufacturer, we're already there. We have a plethora of products that are becoming more and more cost competitive, that already meet these requirements, now. And as noted earlier, the rest of the market can more than adopt these given the time frames proposed. So, I just want to reiterate that we do support this language and thank you, again, for the opportunity to speak.	
British Columbia Ministry of Energy and Mines	My name is Voitek Gretka. I'm from the British Columbia Ministry of Energy and Mines. Thanks for the opportunity to comment to the Commission today. British Columbia, as well as the States of Washington, Oregon and California, as you may know, are part of the Pacific Coast Collaborative, who are poised to adopt leading edge codes and standards. Small-diameter directional lamps have been part of our -- on our agenda for about a few years, now. And we have actually done our own analysis, as well as reading the Commission staff's analysis, to date, and have concluded, similarly, that it represents a sizeable energy savings and that color rendering especially being one of the most important factors to consider. In British Columbia, in 2011, we looked at regulating incandescent, basically, effectively banning incandescent lamps. And there was a lot of outcry over	The comment supports the standards and does not ask for changes to the standards.

	the replacement product, CFLs, as we've heard today. And so, we believe it's very important to be able to set backstops on color rendering, as the Commission has done or has proposed here. Or, staff has proposed, I should say. So, I won't take too much time here, but I'll just say that we support the adoption of the proposal. Thank you.	
NRDC	Commissioners, staff and colleagues, good morning. I'm Noah Horowitz and I'm the Director of NRDC's Center for Energy Efficiency Standards. We urge the CEC to adopt the standard today, which will be the most stringent in the world and serve as a model for future adoption in other states and jurisdictions. We're also supportive of the CEC's proposal to set minimum energy efficiency and performance standards for the everyday LED light bulbs. This will ensure that the LEDs that California consumers buy will not only save energy, but perform well, too. The CEC standards include important requirements, besides just efficiency, for things like low standby power, light quality, and making sure that the lamps that are sold are not likely to fail prematurely. Throughout this proceeding we've urged the CEC to be careful not to set overly stringent requirements for color rendering, as consumers are very satisfied with today's offerings, which typically have a CRI with 80, and because the lamps with higher CRI will use more power and be more expensive to produce. Hopefully, the incremental cost in power penalty in the CEC's proposal will provide -- will be	The comment generally supports the standards and does not ask for changes to the standards. With respect to the CRI requirements, see RESPONSE 1.

	modest, as manufacturers modify their products to comply with the standards. In summary, we believe the CEC's proposed standards for general service LED lamps have a lot of merits and we support their adoption today, as well. Thank you very much.	
Osram Sylvania	And the very specialty halogen lamps that you will eliminate have no LED counterparts. These lamps are designed with particular focal lengths, for particular optical performance. They are not potential loopholes. In summary, I have a simple request. Please abandon this 15-day language. The haste with which it appears to have been thrown together, without data to substantiate your claims, the mathematical errors we've seen, the greater than/less than mix up, specious correlation of lighting parameters and, most importantly, your unwillingness or inability to provide industry the list of lamps you claim meet this standard indicates a lack of understanding of the technology, and a lack of respect for the people of California. Thank you.	See RESPONSES 3, 6, 10, and 11.
Francis Rubenstein	Secondly, California is not an economic island. If California consumers can't get the LEDs they want at the right price, they'll just turn right around and go online. I would hate to see this regulation effectively take money out of California retailers, like independent hardware stores, Ace, Home Depot, et cetera, and have it all go to Amazon, instead. I think Amazon makes enough money as it is, without profiting from our situation here.	This comment mischaracterizes the point of regulation as set forth in Title 20. Regulated products that do not meet efficiency standards cannot be sold or offered for sale in California. This would include online retailers such as Amazon or Home Depot's webpage. See RESPONSE 4 regarding consumer choice and cost.

Francis Rubenstein	The potential for possible harm due to blue light at night is going to become much more important, now. Apple has done a new operating system, 9.3, is going to have the ability to be able to change the amount of blue light that you get from your phone at nighttime, in order to reduce the amount of blue light that we have at nighttime. But if you think about what Apple is doing, Apple's giving their consumers a choice to implement a feature they didn't have before.	This comment is not relevant to this proceeding as the comment is about smart phones and not LED lamps. The regulations do not prohibit the development of a LED lamp that would allow the user to turn off a certain wave length of light being emitted. No change is needed.
NEMA	But to those who claim that LEDs are not being adopted, NEMA's sales figures, particularly for the last year, contradict that sharply. That is a geometric curve you see on that slide up there. The rate over the third quarter of 2014 and the third quarter of 2015 increased by 237 percent. That's not just a positive slope on a curve, but a geometric rate if you look at the curve overall.	Staff agrees with NEMA's comment that LEDs are being adopted by consumers and sales are growing. This makes it all the more important that the products being purchased are energy efficient and meet basic performance requirements. This is especially so given how long LEDs lamps can last.
NEMA	The Commission set out to address the adoption challenges they felt in the proposal -- in the market, in 2013, when this proposal development began. That problem is solved. That's what that slide says, that we've figured it out in the meanwhile. And so, to adopt a standard that causes a reset is potentially harmful. I personally believe it is harmful, will be harmful to the market. And as was mentioned, California is not an economic island. So, please disapprove the proposal. We know we can improve it. And you're not going to lose any energy because they're just as efficient. Thank you.	See RESPONSES 4 and 8.

Sacramento Municipal Utility District	Good morning, Chair, Commissioners. I'm here representing the Sacramento Municipal Utility District. And I just wanted to express support for the standards and, in particular, for your attention to high quality lighting in the standards process. I was here ten years ago, when we started the lighting revolution and it's been an exciting time. I know that in my house lighting quality apparently doesn't matter that much. Because I've gone and most of my house is either LEDs or compact fluorescents these days. I have a few pin halogen-based lamps that I can't replace, yet. But I did replace two MR-16s with LED puck lights. And I took all of my old incandescent bulbs that I still had around, and brought them into SMUD, recently, where we now have a display case of incandescent lamps that we're building as part of our customer service center. And you can bring your own in, if you wish, or send them over to SMUD. I do have one pin-based compact fluorescent in a bathroom that you guys forced me to put in when I remodeled my house ten years ago. And I'm excited, now, to see some LED pin-based products that I hope we will be able to replace that next time that compact fluorescent burns out. I just, again, wanted to express my support. Lighting quality may not matter in my house, but I talk to many people who say I will not – my house, my wife hates those compact fluorescents. It's important to get that right this time around so that we don't have those kinds of stories running around. I remember being in this room years	The comment supports the standards and does not ask for changes to the standards.

	ago, and Commissioner Geesman asking a stakeholder if he'd been able to get his wife to accept compact fluorescents in his house. And the man said, no, I haven't been able to do that, yet. But you know what they say, a man who says he's in charge at home will lie about other things, too. Thank you. (Laughter)	
LumiLEDs	I've also observed that in this process that manufacturers, who created the CRI metric and use it daily, seem to be vilified, viewed with contempt and made to look like we don't know what we're talking about. Sierra Club petitions are flooding the docket with statements that simply aren't scientifically true. For instance, that manufacturers want a specification that is less efficient, will cost more money, and generate more greenhouse gas emissions. This is nonsense.	Staff appreciates the participation by large number of stakeholders and California consumers in this proceeding.
LumiLEDs	In summary, Lumileds eagerly wishes to participate in a collaborative, transparent regulatory process. We do not support the adoption of this deeply flawed regulation and we reiterate our request for you to restart this process.	See RESPONSES 5 and 6. Based on substantial evidence in the record, the proposed standard is cost effective and feasible and will save significant energy statewide. There is no reason to restart the regulatory process.
Eaton Lighting	Good morning, ladies and gentlemen of the Energy Commission, as well as those that are visiting here, today. My name is Bob Smith. I'm the Director of Energy for Eaton. And on behalf of Eaton Lighting Solutions, formerly known as Cooper Lighting, we appreciate this opportunity to speak to you today. First of all, California is poised to take advantage of the advancements in solid	Commenter is making a general statement no change is requested and needed.

	state lighting due to the progressive nature of the energy code development. The definition of lighting systems is dramatically changing with the advent of solid state lighting. And this poses challenges on effective planning, as well as regulatory development. And we appreciate the situation that the Energy Commission is in today, with the rapid changes that are occurring. Give you a little background about Eaton. Eaton is a premier lighting provider globally, about $2 billion worth of revenue, annually. And in a simple statement, Eaton broadly supports the efforts of the CEC, its staff, and what it's doing on behalf of the State, our country, as well as the world. Eaton applauds the efforts that are being made to prepare for these advancements to save energy for their constituents, as well as reducing greenhouse gas emissions far in advance of the rest of the country. Due to the laws passed in the State of California, the Commission must strike a balance between market availability and predictive improvements that are fairly well understood by those that study the lighting technology and invest in the innovation that you can rely on. Eaton worked closely with the Commission supporting some combined color quality, energy savings and reliability for recessed modules that are currently, today, meeting the language that you see in the 15-day language. That's in every case.	
Eaton Lighting	In conclusion, as a NEMA member, we fully support the efforts of the California Energy Commission, driven to	The comment supports the standards and does not ask for changes to the standards.

	enable market transformation by combining energy savings, quality, and reliability requirements. And once again, on behalf of Eaton I thank you for this opportunity to speak to you, today.	
San Diego Gas & Electric	Hello, Commissioners, and thank you for the opportunity to comment on this topic. My name is Adrian Salas and I am with San Diego Gas & Electric. And we support the adoption of the proposed standards. I also want to support the color rendering requirements, which is important to our customers and to reaching California's lighting energy savings targets, laid out by AB 1109. Lastly, I want to applaud the Commission and staff for making great efforts to involve stakeholders and incorporate their input. The proposed standards are more lenient than the original proposal, submitted by the Investor-Owned Utilities' Statewide Codes and Standards Team. However, SDG&E values the CEC's process and respectfully recommends adoption of the proposed standards today. Thank you.	The comment supports the standards and does not ask for changes to the standards.