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**Statewide Utility Codes and Standards Team Comments on Lighting Topics in 2019
Title 24, Part 6 Express Terms**

Additional submitted attachment is included below.

Comments on Lighting Topics in 2019 Title 24, Part 6 Express Terms

California Statewide Utility Codes and Standards Team

November 3, 2017

1. Introduction

The Statewide CASE Team appreciates the opportunity to participate in the rulemaking and the thoughtful feedback we have received from the California Energy Commission on the Codes and Standards Enhancement (CASE) proposals.

The CASE initiative presents recommendations to support the Energy Commission's efforts to update California's Building Energy Efficiency Standards (Title 24, Part 6) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor Owned Utilities – Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison and SoCalGas® – and several publicly Owned Utilities – Los Angeles Department of Water and Power, Sacramento Municipal Utility District, and Southern California Public Power Authority – sponsored this effort.

The California Statewide Utility Codes and Standards Team (Statewide CASE Team) actively supports the Energy Commission in developing revisions to Title 24, Part 6 by developing code change proposals that will result in feasible, enforceable, and cost-effective enhancements to the building energy efficiency standards. In developing these proposals, the Statewide CASE Team conducts research and market surveys, holds stakeholder meetings, and evaluates the energy savings and cost-effectiveness of considered measures. The CASE Reports, which present pertinent information that supports the code change proposals, are posted within each measure topic page on title24stakeholders.com.

The Statewide CASE Team encourages the Energy Commission to consider the following changes to the lighting measures.

Recommended revisions to the Express Terms are included in this document in purple. The Statewide CASE Team's recommended language insertions are single underlined and recommended language ~~deletions are single struck~~.

Recommended revisions to the Express Terms are summarized in Table 1.

Table 1: Summary of Recommended Revisions to the Express Terms

Measure Topic	Recommended Revision	Section of Standards
Lighting Alterations	<ul style="list-style-type: none"> • Clarify scope of the 70-luminaire exception so it only applies to component modifications. • Increase the stringency of the 70-luminaire exception by removing the per floor provision. <p>For the “Reduction of Existing Wattage” compliance option:</p> <ul style="list-style-type: none"> • Clarify that compliance must be demonstrated at the project level. • Eliminate the building size threshold. 	<p>EXCEPTION 6 to Section 141.0(b)2I</p> <p>Section 141.0(b)2I</p>
Outdoor Lighting Controls	<ul style="list-style-type: none"> • Require motion sensing controls for luminaires that are primarily providing parking lot general hardscape lighting, outdoor sales lot lighting, vehicle service station hardscape lighting, or vehicle service station canopy lighting. • Require that the controls reduce lighting power by at least 50 percent when vacant during normally occupied periods and that controls are <i>capable</i> of leaving at least 10 percent of power on when vacant. • Define a default normally unoccupied period of midnight to 6:00 am when the occupancy schedule is not known. • Require that the lighting system power be reduced by at least 75 percent power when unoccupied after-hours. 	<p>Section 130.2(c)</p>
Indoor Lighting Sources	<ul style="list-style-type: none"> • If included, limit the 0.75 multiplier to small aperture tunable white and dim-to-warm luminaires. • Clarify that color tuning credit of 0.1 watt per square foot applies to any size aperture color changing luminaires in healthcare facilities. 	<p>Section 140.6</p> <p>Table 140.6-C, footnote 10 for healthcare facility and hospitals</p>
Indoor Lighting Controls	<ul style="list-style-type: none"> • Maintain the code stringency by keeping 20-minute time delay that is currently in Section 110.9(b)4F. • Require automatic shutoff controls to turn the lighting OFF no longer than 20 minutes after the guest room has been vacated rather than 30 minutes, which is currently required. <p>For Daylighting controls:</p> <ul style="list-style-type: none"> • Require daylighting dimming with OFF step in primary sidelit daylit zones in concourses and skylit daylit zones in all spaces. • Require dimming to no greater than the minimum dimmed state of the luminaire or the lowest setpoint in accordance to Table 130.1-A. 	<p>Section 130.1(c)4 (formerly 130.1(c)3)</p> <p>Section 130.1(c)7 (formerly 130.1(c)6)</p> <p>Section 130.1(d)3</p>
Residential Lighting	<ul style="list-style-type: none"> • Maintain 2016 Title 24, Part 6 residential lighting requirements. <p>In Joint Appendix JA8:</p> <ul style="list-style-type: none"> • Use the more robust life test method that was designed for 2016 JA8 rather than the test methods described in Energy Star v2.1 Section 10. • Clarify the language for light sources with pre-programmed fade-in features. • Correct the error that exempts medium diameter (<2") ornamental lamps and small diameter (<1") other lamps. • Remove the option to use NEMA 77 as a test for flicker and retaining JA8 requirements and JA10 as the appropriate test method. 	<p>Section 150.0(k)</p> <p>Joint Appendix JA8</p>

2. Lighting Alterations

2.1 Clarifying Scope of the 70-luminaire Exception

2.1.1 Recommendation and Justification

The Statewide CASE Team applauds the Energy Commission's effort to simplify the sections of the standards that apply to lighting alterations. Overall, the proposed language in the Express Terms is significantly less complex compared to the 2016 and 2013 code cycles.

To prevent misinterpretation and missed opportunities for energy use reduction, the Statewide CASE Team recommends that the code language clearly state that the 70-luminaire exception only applies to what are called "component modifications" in the 2016 code. For projects known as "entire luminaire alterations" in the 2016 code, only the threshold of 10 percent of affected luminaires should apply. The language in the Express Terms could be interpreted that the 70-luminaire exception applies to component modifications and entire luminaire alterations. The Statewide CASE Team estimates that about 28-35 percent of lighting alterations that are currently regulated under 2016 Title 24, Part 6 would not be subject to code if the scope of the 70-luminaire exception is not clarified.

2.1.2 Recommended Revisions to the Express Terms

Section 141.0(b)2I:

EXCEPTION 6 to Section 141.0(b)2I. For each building or tenant space, alteration of [components in](#) up to 70 luminaires [per floor of the space](#), per annum [without replacing the luminaire housings, and without increasing lighting power](#).

2.2 The "Reduction of Existing Wattage" Compliance Option

2.2.1 Recommendation and Justification

The Statewide CASE Team recommends that the code language specify that the compliance under Option 3 must be demonstrated at a project level not at a luminaire level. This revision will simplify the code compliance process significantly.

Further, the Statewide CASE Team recommends eliminating the building size limit for Option 3 for the following reasons:

- Using building size as a prerequisite would complicate the compliance process by requiring the applicant to produce additional documentation indicating building/tenant size and by requiring building departments to review the additional documentation.
- Given the proposed 70-luminaire exception and assuming each luminaire is serving approximately 100 square feet, the spaces that are about 7,000 square feet in size will not be subject to the lighting alteration requirements. In this case, Option 3 that is available for buildings or tenant spaces that are less than 5,000 square feet becomes irrelevant.

Instead of introducing a building size limit for Option 3, the Statewide CASE Team recommends increasing the stringency of the 70-luminaire exception by removing the per floor provision in Exception 6 to Section 141.0(b)2I.

2.2.2 Recommended Revisions to the Express Terms

Section 141.0(b)2I:

I. Altered Indoor Lighting Systems.

[...]

iii. The alteration type shall be a luminaire-for-luminaire alteration ~~within a building or tenant space of 5,000 square feet or less, and the total wattage of the altered luminaires~~ shall have at least 40% lower total rated power wattage compared to ~~the system luminaires~~ prior to the alteration. The rated wattage shall be calculated in accordance with Section 130.0. ~~and~~ The alteration shall comply with the lighting control requirements specified in Table 141.0-E.

3. Outdoor Lighting Controls

3.1 Motion Sensing Controls

3.1.1 Recommendation and Justification

The Energy Commission's proposed changes to Section 130.2(c) would require a control to turn lights off during the day and a control to reduce power by at least 50 percent during normally unoccupied periods by either a timeclock control with a two-hour override or a motion control. If the standards are adopted as proposed in the Express Terms, the Statewide CASE Team expects a decrease in the use of motion controls in favor of less expensive timeclock controls. This decrease in stringency of the outdoor lighting control standards would result in a loss of approximately 15 GWh/yr of energy savings as compared to the existing 2016 Title 24, Part 6 Standards.

Consistent with the Draft and Final CASE Reports on Outdoor Lighting Controls, the Statewide CASE Team recommends code language that would do the following:

- Require motion sensing controls for luminaires that are primarily providing lighting for general hardscape parking lots, outdoor sales lots, vehicle service station hardscapes, or vehicle service station canopies.
- Require that the controls reduce lighting power by at least 50 percent when vacant during normally occupied periods and that controls are *capable* of leaving at least 10 percent of power on when vacant.
- Define a default normally unoccupied period of midnight to 6:00 am when the occupancy schedule is not known.
- Require that the lighting system power be reduced by at least 75 percent when unoccupied after-hours. This additional level of control has a benefit-to-cost ratio in excess of four-to-one and saves an additional 6 GWh/yr statewide for new construction and retrofit projects.

3.1.2 Recommended Revisions to the Express Terms

Section 130.2(c):

(c) **Controls for Outdoor Lighting.** Outdoor lighting controls shall be installed that meet the following requirements for reducing lighting when daylight is available and during normally scheduled unoccupied periods:

EXCEPTION 1 to Section 130.2(c): Outdoor lighting not permitted by a health or life safety statute, ordinance, or regulation to be turned OFF or dimmed.

EXCEPTION 2 to Section 130.2(c): Lighting in tunnels required to be illuminated 24 hours per day and 365 days per year.

1. **Daylight Availability.** All installed outdoor lighting shall be controlled by a photo control, astronomical time-switch control, automatic scheduling control, or other control capable of automatically shutting OFF the outdoor lighting when daylight is available.
2. **Unoccupied Periods.** All installed outdoor lighting shall be controlled by ~~a control capable of reducing the outdoor lighting by at least 50 percent, or turning the lighting OFF, during normally~~

~~scheduled unoccupied periods. This control shall be either~~ an automatic scheduling control or an occupant sensing control, and shall include the following features:

~~A. For a Automatic scheduling controls shall reduce lighting power by at least 50 percent during normally unoccupied scheduled periods the control shall provide an override function that turns the lighting ON during its scheduled dim or OFF period for no more than 2 hours when an override is initiated.~~

~~—B. For occupant sensing controls, no more than 800 watts of lighting shall be controlled by any single sensor, and the control shall return the lighting to its dim or OFF state no later than 15 minutes after the area has been vacated.~~

~~B. Motion Sensing controls shall comply with Section 130.2(c)3. A through C.~~

3. **Bi-Level Motion Sensing.** Luminaires that are primarily providing parking lot general hardscape lighting, outdoor sales lot lighting, vehicle service station hardscape lighting, or vehicle service station canopy lighting and where the bottom of the luminaire is mounted 24 feet or less above the ground, shall be controlled by automatic lighting controls that meet all of the following requirements:

A. During normally scheduled occupied periods, the lighting power of each luminaire shall be automatically reduced by at least 50 percent or OFF when no activity has been detected in the area illuminated by the controlled luminaires for a time no longer than 15 minutes.

B. During normally scheduled unoccupied periods, in addition to complying with the requirements of item A, total lighting power shall be automatically reduced by at least 75 percent including OFF when no activity has been detected in the area illuminated by the controlled luminaires for a time no longer than 60 minutes.

C. No more than 800 watts of lighting power shall be controlled together.

D. The lighting system shall be capable of being configured to automatically reduce power of each luminaire by at least 75 percent, but not exceeding 90 percent without turning the luminaires OFF if no activity is detected in the area illuminated by the controlled luminaires.

EXCEPTION to Section 130.2(c)3: Luminaires controlled in accordance with Section 130.2(c)2A and located where trees or other obstructions block motion sensing between the luminaire and the area illuminated by the luminaire.

4. **Timed Manual Override.** Timed manual overrides are not required, but shall be allowed to override motion or scheduling controls for a duration not to exceed two hours. No more than 1,800 watts may be controlled per manual override control.
5. **Default Schedules.** Acceptance tests of outdoor lighting controls shall be conducted in accordance with Section 130.4(a)6. When scheduled operating hours are known, the acceptance tests shall confirm the time schedules are correctly applied. When scheduled operating hours are not known, acceptance tests shall be conducted to confirm the use of a default normally occupied scheduled period of 6:00 am to midnight and a default normally unoccupied scheduled period of midnight to 6:00 am.

4. Indoor Lighting Sources

4.1 Adder for Small Aperture Tunable White and Dim-to-Warm Luminaires

4.1.1 Recommendation and Justification

The Statewide CASE Team supports the Energy Commission’s alignment with the Final CASE Report on Indoor Lighting Power Densities (LPDs) and supports the Energy Commission’s decision to include a 0.75 multiplier for small aperture tunable white and dim-to-warm luminaires. The Statewide CASE Team’s analysis in Appendix M of the Final CASE Report demonstrates that only small aperture color changing luminaires need a power adjustment factor. Large aperture tunable white systems do not need a power adjustment factor since those systems have efficacies that were within 10 percent of static lighting systems. The Statewide CASE Team is conducting additional research to compare a broader range of color tuning luminaires. The findings from this research will be added as an appendix to the posted Final CASE Report on <http://title24stakeholders.com>.

Pacific Northwest National Laboratory’s (PNNL) September 2017 study (“Tuning the Light in Classrooms: Evaluating Trial LED Lighting Systems in Three Classrooms at the Carrollton-Farmers Branch Independent Schools District in Carrollton, TX”) also supports the finding that the efficacies of large aperture tunable white lighting systems are comparable with static white lighting systems. PNNL’s demonstration project used Lithonia tunable white luminaires and had LPDs between 0.54 and 0.63 watts per square foot, which are less than the 0.7 watts per square foot proposed for classrooms.

If the Energy Commission decides not to limit the 0.75 multiplier to small aperture tunable white and dim-to-warm luminaires, then the Statewide CASE Team recommends eliminating the 0.75 multiplier. This recommendation aligns with the comment from the International Association of Lighting Designers who also expressed support to remove the multiplier.

After considering input from other stakeholders, the Final CASE Report recommended a modest additional credit (0.1 watt per square foot) for all color tuning applications (including large aperture) in health care occupancies to accommodate lighting strategies that may benefit patient wellbeing. The Energy Commission’s proposed language limits this additional credit to only small aperture luminaires. The Statewide CASE Team recommends updating this language to clarify that color tuning credit applies to any size aperture color changing luminaires in healthcare facilities.

4.1.2 *Recommended Revisions to the Express Terms*

Table 140.6-C, footnote 10 for healthcare facility and hospitals:

10. Tunable white or dim-to-warm luminaires as specified in Section 140.6(a)4Bii and iii. [Large aperture color tuning or dim-to-warm luminaires qualify for this additional lighting power.](#)

5. Indoor Lighting Controls

5.1 Delay Period for Occupant Sensing Controls

5.1.1 *Recommendation and Justification*

The Energy Commission suggested modifications to Section 110.9(b)4A of the code language that would require occupant sensing controls to turn OFF the lighting after 30 minutes. This change would increase energy usage from lighting applications where occupant sensing controls are required and, thus, result in a reduction of the stringency of the standards. The Statewide CASE Team recommends maintaining the code stringency by keeping 20-minute time delay that is currently in Section 110.9(b)4F. Keeping 20-minute time delay would be in alignment with ASHRAE 90.1-2016 requirements for occupancy sensing controls, in which all lighting must “automatically shut off within 20 minutes of all occupants leaving the space...” (ASHRAE 90.1-2016, Section 9.4.1(h)). Further, the Statewide CASE Team recommends including the 20-minute time out language for occupancy sensing controls in Section 130.1(c) for clarity.

The Statewide CASE Team supports the Energy Commission's intent stated during October 4, 2017, public workshop to include the language from 2016 Standards regarding manual ON or partial ON setting for occupant sensing controls in areas with multi-level controls.

5.1.2 *Recommended Revisions to the Express Terms*

Section 130.1(c)4 (formerly 130.1(c)3):

34. Occupant sensing is required in office areas 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms, conference rooms, and restrooms. Occupant sensing is also required in corridors, stairwells, aisle ways in warehouses, open areas in warehouses, parking garages, parking areas, loading and unloading areas, library book stack aisles 10 feet or longer that are accessible from only one end, and library book stack aisles 20 feet or longer that are accessible from both ends. These controls shall provide the following in addition to the requirements of 130.1(c)1:

[...]

D. Occupant sensing controls shall be programmed to turn OFF all or part of the lighting no longer than 20 minutes after the space is vacant of occupants.

E. Occupant sensing controls shall function either as a:

i. Partial-ON Occupant Sensor capable of automatically activating between 50-70 percent of controlled lighting power, or

ii. Manual-ON Vacancy Sensor where all lighting responds to a manual ON input only.

EXCEPTION to 130.1(c)3E: In areas not required by Section 130.1(b) to have multi-level lighting controls, lighting is permitted to be controlled by an occupancy sensor that automatically turns ON all lighting when the room is occupied.

5.2 Delay Period for Automatic Shutoff Controls in Hotel Motel Guest Rooms

5.2.1 *Recommendation and Justification*

The Statewide CASE Team recommends requiring automatic shutoff controls to turn the lighting OFF no longer than 20 minutes after the guest room has been vacated rather than 30 minutes, which is currently required. This revision will simplify the code by aligning the requirement for guest rooms with the general requirement for 20-minute time delay in Section 110.9, 2016 Title 24, Part 6 and with Section 9.4.1.3(b) of ASHRAE 90.1-2016.

5.2.2 *Recommended Revisions to the Express Terms*

Section 130.1(c)7 (formerly 130.1(c)6):

~~6. In hotel motel guest rooms providing transient lodging, the automatic shutoff controls shall automatically turn the lighting off no longer than 30 minutes after the guest room has been vacated.~~

7. Hotel motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 20 minutes after the guest room has been vacated, lighting power is switched off.

EXCEPTION to Section 130.1(c)7: For hotel-motel guest rooms, one luminaire that is switched separately and where the switch is located within 6 feet of the entry door.

5.3 Daylighting Controls – Dimming to the Minimum of Dimmed State or Minimum Step in Table 130.1-A in Addition or as an Alternative to Dimming Plus OFF Controls

5.3.1 Recommendation and Justification

Additional energy savings could be achieved by adopting dimming plus OFF controls as presented in the Final CASE Report on Indoor Lighting Controls. However, stakeholders expressed concern about implementing daylight dimming plus OFF controls in office buildings, classrooms, and other areas where users expect to have more control over their electric lighting. Thus, the Statewide CASE Team recommends the Energy Commission adopt the OFF step in large space types in which the primary task is circulation and the space is saturated with daylight for most of the day. This requirement would apply to spaces such as airport and mall concourses, exterior corridors, and lobbies. The Statewide CASE Team proposes the OFF step be required in primary sidelit daylit zones in concourses and skylit daylit zones in all spaces. The Statewide CASE Team does not propose the OFF step be required in the secondary sidelit daylit zone.

In addition, when daylight in the daylit areas reaches 125 percent design illuminance the Statewide CASE Team recommends requiring dimming to no greater than the minimum dimmed state of the luminaire or the lowest setpoint in accordance to Table 130.1-A. The 2016 code language requires reducing lighting power to 35 percent of total light lighting power. Table 130.1-A requires LED fixtures to have the capability to dim to 10 percent of lighting power. Many LED luminaires are capable of dimming to five percent of lighting power, with some luminaires having a low set point of 0.1 to one percent of lighting power. Adjusting the required minimum setpoint to the lowest setting of the specific fixture required by Section 130.1(b) allows energy savings with no additional first cost.

If the Energy Commission decides not to introduce any requirements for dimming plus OFF controls, the Statewide CASE Team, recommends requiring dimming to no greater than the minimum dimmed state of the luminaire or the lowest setpoint in accordance to Table 130.1-A, when daylight in the daylit areas reaches 150 (versus 125) percent design illuminance.

5.3.2 Recommended Revisions to the Express Terms

Section 130.1(d)3:

(d) Automatic Daylighting Controls.

3. The automatic daylighting controls shall:

[...]

C. For areas other than parking garages, ensure that when the daylight illuminance is greater than ~~150~~ 125 percent of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone shall be reduced ~~by a to no greater than the minimum of 65 percent dimmed state or minimum step in Table 130.1-A;~~

D. For the primary sidelit daylit zone in concourses and the skylit daylit zone in all spaces, when the daylight illuminance is greater than 150 percent of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone shall be automatically turned OFF.

6. Residential Lighting

6.1 Correlated Color Temperature (CCT) and Dimmability Requirements

The Statewide CASE Team agrees with Acuity Brands that the proposed changes in the residential standards were substantive and that there was no prior public review opportunity of the proposal.¹ The current requirements in Section 150.0(k) and in Joint Appendix 8 (JA8) were developed carefully during the 2016 Standards development cycle with outreach to many stakeholders and detailed research. The Statewide CASE Team recommends that the Energy Commission not make substantive changes to the residential lighting requirements in this code cycle as the Statewide CASE Team has not received any compelling feedback that the basic structure of the residential requirements needs fixing. The residential lighting changes were one of the largest energy efficiency measures of the 2016 Standards, and several of the proposed changes would be disruptive to enforcement and compliance processes.

The Energy Commission's proposed changes may affect the enforceability of this section of the Standards as requirements differ depending upon whether lighting is "general lighting" or not, and whether it is in "habitable spaces" or not. This may provoke debate about which fixtures are providing general illumination versus those that are providing lighting for "decorative effect," and therefore exempt fixtures from requirements for color temperature and dimming.

In addition, the Energy Commission's proposal has moved lamp characteristics from the JA8 approval process to the building inspection process. The Express Terms require building inspectors to take time away from other enforcement activities to discern between 3200 Kelvin and 3600 Kelvin, which may not be realistic. Acuity Brands comments have also highlighted the disruptive nature of these changes, *"...manufacturers like Acuity Brands have committed considerable resources to update residential portfolios with JA8-2016 inseparable SSL luminaires at 4000K, and ask that the Commission evaluate the cost-effectiveness of making the change from 4000K to 3500K."*

The 2016 JA8 color temperature requirements were intentionally structured to be more stringent for removable lamps than for inseparable luminaires. It is much easier for the occupant of the home to replace a "daylight" blue LED removable lamp with an incandescent lamp than it is to replace inseparable LED luminaire with an incandescent luminaire.

The rationale for the low CCT requirements for LED replacement lamps is portrayed in Table 2. The table examines the possible outcomes from different lamp CCT selections initially installed by the home builder. This table considers occupant options if the installed lamp selection does not match their CCT preference. The table assumes that the lamp is retained if the lamp CCT matches the home occupant's preference. Additionally, incandescent lamps are only available in low color temperatures. LEDs, CFLs and other high-efficacy sources can produce high correlated color temperatures because these sources do not rely on the heating of a filament to produce a given color temperature.

In the table, there is only one scenario that could result in the occupant installing a low-efficacy incandescent lamp; when the initial lamp installed by the builder is a high color temperature (bluish) LED, and the occupant prefers low color temperatures (reddish) for the lighting in their home. If the occupant prefers a high color temperature (bluish) but the builder installed a high quality, high efficacy low color temperature LED, the homeowner could replace this lamp with a high efficacy, higher color temperature lamp with energy efficiency objectives maintained.

¹ http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221581_20171023T083232_Acuity_Brands_Comments_On_Draft_Express_Terms.pdf

The intent of the 3000 Kelvin maximum color temperature and other quality requirements in JA8 for long-lived, efficacious LED screw-in lamps is that they have comparable amenities to the incandescent lamps they displace and will be less likely to be replaced by incandescent lamps.

Table 2: Logic Model for the Color Temperature Requirements in the 2016 Standards

Initial Lamp	Initial lamp: 3000 K LED (reddish)		Initial lamp: 4000 K LED (bluish)	
Homeowner Preference	Likes reddish color lamps	Likes bluish color lamps	Likes reddish color lamps	Likes bluish color lamps
Outcome	Keeps initial LED lamp	Purchases bluish LED, CFL or induction	Purchases inefficient incandescent or reddish LED	Keeps initial LED lamp

Some high efficacy lamps emit an audible buzz, fail early when they are operated on a dimmer or in enclosed luminaires, flicker, exhibit pinkish-green color shifts or have dissimilar colors from lamp to lamp. The JA8 lamp specification is designed to prevent consumer rejection of high efficacy lamps by providing a testing and certification procedure to help to prevent poor quality products from being installed as part of the compliance process. For example, a lamp marked “JA8-2016-E” has been life-tested at elevated temperature so that it will not fail early if installed in an enclosed or recessed luminaire.

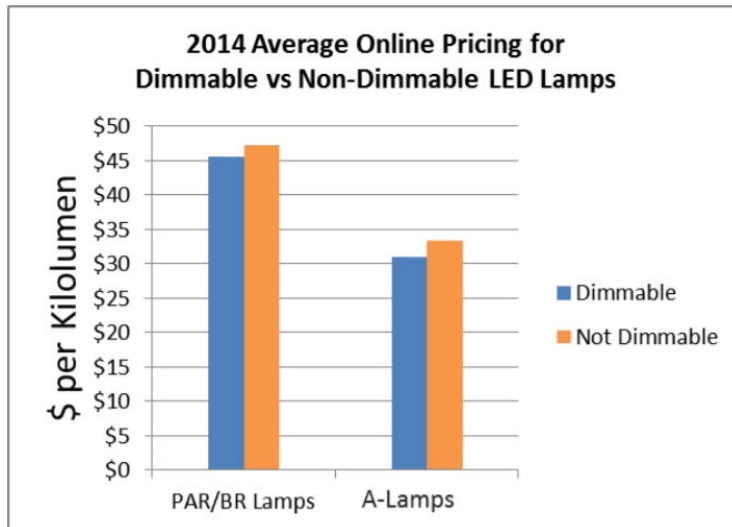


Figure 1: 2014 average online pricing for dimmable vs. non-dimmable LED lamps, based on hundreds of price points collected from nine online retailers.

Further, 2016 JA8 requires dimmability, a requirement which was demonstrated to be cost-effective when the 2016 Standards were adopted. Dimmability does not result in a cost adder for LED lamps, and most LED lamps are dimmable. This is consistent with comments the Statewide CASE Team has heard from industry contacts who are either in the driver manufacturer community or who have conducted research into dimming driver incremental costs. These stakeholders suggested that the incremental cost for an LED driver to be dimmable is small and shrinking. Estimates in 2014 ranged from \$0.15 to \$0.20 incremental manufacturer cost, but were expected to drop to \$0.05 or less within three years. To verify that the incremental manufacturer cost to add dimmability is indeed small, the Statewide CASE Team has conducted an analysis of thousands of retail prices collected from 9 online retailers. As shown in

Figure 1, online prices for dimmable LED replacement lamp products (based on price points from hundreds of products collected throughout 2014, and prices have dropped since then) are actually slightly lower on average 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 linear fluorescent / compact fluorescent lighting market, where historically few products were dimmable and they carried significant incremental retail prices.

2016 Title 24, Part 6 residential lighting standard is easy to enforce (simply need to look for the marking on the light source) and does not require having to define general lighting or asking the building inspector to determine CCT. The Statewide CASE Team agrees with Lutron Electronics that for Section 150.0(k) the preferred solution is to keep 2016 language without changes.²

6.2 Joint Appendix JA8 Updates

JA8.3.5 & 6: The Statewide CASE Team recommends using the more robust life test method that was designed for 2016 JA8 rather than the test methods described in Energy Star v2.1 Section 10. The test methods developed for 2016 JA8 were based on Energy Star, but expanded upon it. Specifically, the Energy Star elevated temperature test does not apply to luminaires or light engines, so the 2016 JA8 language provided guidance for testing ICAT luminaire and air leakage specification. The Statewide CASE Team also recommends that language is adjusted to explicitly state that products be tested at 6,000 hours.

JA8.3.3: The Statewide CASE Team supports the additional clarifying language for light sources with pre-programmed fade-in features.

Table JA-8: The Statewide CASE Team recommends correcting the error that exempts medium diameter (<2") ornamental lamps and small diameter (<1") other lamps. This exception was written in JA8.5 when the initial 2016 proposal included a requirement for multiple criteria marked on the lamp. When the marking was simplified to "JA8-2016" or "JA8-2016-E," this exception was no longer needed; it was removed from the body of JA8, but the compliance threshold criteria in Table JA-8 was accidentally left in. In addition, the requirements in Table 150.0-A required that lamps be marked as meeting "JA8" to be considered high efficacy. Thus, it is desirable to remove this conflicting language from Table JA-8.

6.3 NEMA 77 as Flicker Test for Light Sources (JA8)

In Section JA8.3.7, the Energy Commission is proposing to allow flicker testing to be done using either JA10 or NEMA77, and allowing sources to meet the flicker requirements in JA8 or NEMA77 (Pst and SVM of less than 1). The Statewide CASE Team recommends removing the option to use NEMA 77 as a test for flicker and retaining JA8 requirements and JA10 as the appropriate test method, for two reasons: 1) the Energy Commission's proposal is a weakening of the existing flicker requirements at a key frequency range, and 2) the Energy Commission's proposal would eliminate one of the primary benefits of the current requirements which is a data stream for all products in a format that can be compared to other flicker standards such as IEEE PAR1789 (i.e., percent amplitude modulation at specific cut-off frequencies). These two issues are explained in more detail below.

Weakening of current standards in the 120-200 Hz range

While the NEMA 77 flicker requirements are stricter in the low frequency (more visible) range, the proposed limit of SVM = 1 actually allows *more* flicker at higher frequencies (up to 35 percent at 200 Hz) than the existing Title 24, Part 6 limit, and it is therefore a weakening of the flicker requirements in

² http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221547_20171019T161544_Lutron_Electronics_Co_Inc_Comments_On_2019_Building_Energy_Effi.pdf

this range. Low frequency flicker is extremely noticeable and likely to inspire home builder and consumer rejection. Flicker occurring at frequencies in the range of 120-200 Hz can have serious negative impacts on specific segments of the population (such as migraines, headaches, and reduced visual performance) despite being less perceptible.

Products with flicker in this range could be designed, marketed, and installed by builders in new homes, without anyone immediately recognizing the problematic levels of flicker. This represents a significant risk for consumer dissatisfaction with high efficacy lighting. The role of standards may be even more important to prevent flicker from occurring in this frequency range.

Removing the benefit of data availability from current standards (test and list)

The ANSI standard for flicker, IEEE PAR 1789-2015, "Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers," is the best currently available standard for minimizing the health risks from flicker. The IEEE Standard has a recommended relationship of Percent Modulation (same as percent amplitude modulation, modulation depth or percent flicker) to frequency. The JA10 formatted test data summarizes its results with regards to modulation percentage and frequency, rendering it easy to compare the performance of light sources to the recommendations in the IEEE Standard. Since the NEMA 77 method does not require publishing the JA10 filtered amplitude modulation results, it cannot be directly applied to the IEEE recommendations. Thus, users would not have data in the format used by the IEEE standard, and California would not have the market benefits that result from test and list standards. This data will help maintain better-than-minimum flicker quality lamps as incandescent sources are phased out. The Statewide Team recommends that the flicker data for JA8 compliant products continue to be collected using the JA10 test method and recording of summary amplitude modulation data for the various cut-off frequencies specified in JA10 and continue to populate the JA8 database. This information could be used over the next several years to inform the discussions that determine the reasonable levels of directly perceptible and imperceptible flicker and associated costs.