NATURAL RESOURCES DEFENSE COUNCIL

July 29, 2013

California Energy Commission
1516 Ninth Street, Mail Station 4
Sacramento, CA 95814-5512

RE: Lighting Energy Efficiency Compliance Standards – **Docket #12-AAER-2B**

On behalf of the Natural Resources Defense Council and our more than 250,000 members and online activists in California, we respectfully submit this response to the Commission's Invitation to Submit Proposals dated June 13, 2013.

Enclosed are NRDC's proposals under Docket #12-AAER-2B for Lighting:

- Fluorescent Dimming Ballasts
- Light-emitting Diodes Quality
- Small Diameter Directional Lamps (Multifaceted Reflector Lamps)

We appreciate the opportunity to present our proposals. Please let me know if you have any questions.

Respectfully submitted,

Pierre Delforge
Director, High Tech Sector Energy Efficiency
pdelforge@nrdc.org

Proposal for Standards - Fluorescent Dimming Ballasts

Docket #12-AAER-2B

Appliance Efficiency Standards and Measures

for California Energy Commission's Invitation to Submit Proposals

Submitted By:

Pierre Delforge
Natural Resource Defense Council
pdelforge@nrdc.org
July 29, 2013

On behalf of the Natural Resources Defense Council and our more than 250,000 members and online activists in California, we respectfully submit this response to the Commission's Invitation to Submit Proposals dated June 13, 2013.

NRDC has reviewed the Investor Owned Utilities (IOUs) standards proposal for fluorescent dimming ballasts and is in agreement with their analysis, savings estimates and proposal. Rather than repeat much of their content, NRDC highlights below key considerations regarding the IOUs' proposal.

The market is expected to grow rapidly starting 2014 - While current sales and the existing stock of fluorescent dimming ballasts are modest, sales will greatly increase when the 2013 update to the California state building energy code (Title 24) goes into effect in January 2014 and requires dimming ballasts in most commercial fluorescent fixture installations. Given that no minimum efficiency standards exist for the vast majority of dimmable fluorescent ballasts, and that the efficiency gap between high efficiency and low efficiency dimmable ballasts is substantial, dimmable fluorescent ballasts efficiency standards present a significant savings opportunity.

Test procedure and metrics - The U.S. Department of Energy has recently finalized a new test method and metric called Ballast Luminous Efficiency (BLE) for fixed output ballasts. This test method and metric can be leveraged for use with dimming ballasts, by measuring ballast efficiency for intermediate input power levels as well as full power, which allows setting efficiency requirements at various dimming levels.

The efficiency gap between high efficiency and low efficiency dimmable ballasts is substantial - The IOUs testing of 34 unique dimming ballasts showed differences in efficiency of 5-10% between units of equivalent function.

Technological feasibility – There are multiple ways to improve ballast efficiency, from upgrading magnetic components, diodes, capacitors and transistors, to cutting out cathode heating and scaling it when dimming.

Proposed standards - Standard levels were selected based on IOU test results. They were chosen to allow tested products from at least two major manufacturers to qualify for most applications (1-, 2-, and 3-lamp ballasts). As they did not test all manufacturers' products for each application, the IOUs expect that products from more than two major manufacturers will meet the standard for all applications. In total, the proposed standard levels qualify 9 ballasts out of the 34 that were tested.

Cost-effectiveness - The IOU-proposed standards have no incremental cost and are very cost-effective for users, saving on average over $22 per unit over the lifetime of the product, at no or marginal additional cost.

CEC's adoption of the proposed standard would represent savings of 18.5 GWh/yr for first year sales and 300 GWh/yr savings after entire stock turnover. NRDC estimates that this would save Californians nearly $40 million annually, and reduce California's CO_2 emissions by over 100,000 metric tons annually, the equivalent of removing 25,000 passenger cars from the road continuously. NRDC encourages the Commission to adopt efficiency standards for fluorescent dimming ballasts as soon as possible.

Proposal for Standards – LED Lighting Quality Docket #12-AAER-2B

Appliance Efficiency Standards and Measures

for California Energy Commission's Invitation to Submit Proposals

Submitted By:

Noah Horowitz

Senior Scientist

Natural Resource Defense Council

nhorowitz@nrdc.org

July 29, 2013

1 Executive summary

The LED Lamp Quality standard is designed to ensure that all LED lamps sold in California deliver a minimum level of energy efficiency and performance. Our proposal does not however limit consumer choice just to LEDs; lamps of any kind including incandescent lamps and CFLs that meet the current efficacy requirements can continue to be sold in California.

Between now and roughly 2020, Californians will be able to choose between new incandescent light bulbs, compact fluorescents and Light Emitting Diode (LED) lamps. As CFLs only represent 30% or so socket share, a consumer who has a bad experience with LEDs will often revert back to the much less efficient incandescent lamps which use roughly three times more energy to deliver the same amount of light. This would result in an unfortunate and massive loss of energy savings for the State.

NRDC's proposal is designed to ensure that the LEDs offered for sale in California:

- Do not fail or degrade prematurely,
- Deliver good consumer experience – no noticeable delay in starting, give off acceptable light quality, do not have objectionable hum or flicker, etc
- Do not contain misleading product labeling claims, and
- If marketed as dimmable, then the lamp must meet basic dimming requirements.

NRDC has collaborated with the California Investor Owned Utilities (IOUs) during their development of their template for this product category and NRDC broadly agrees with the data and analysis they submitted. As such, the template we are submitting only highlights some of the key issues and few occasions where we recommend an alternate level/proposal, and does not attempt to include any of the energy use, market analysis, etc contained in the IOU template. Wherever possible, we tried to align with the definition and test method contained in ENERGY STAR's lamp specification and in many, but not all cases accepted their levels as well.

2 Product Description and Proposal Scope

2.1 Technical Description

See IOU proposal.

In lay language our proposal is intended to cover every day LED lamps that deliver light within a specified range of light output, regardless of their shape, base type or how they distribute the light. Linear tube LED lamps are not however covered by this proposal.

2.2 Technologies and Best Practices for Energy/Water Efficiency

While this proposal does include modest minimum efficiency requirement for LEDs, the main focus and strength of the proposal relate to the performance and quality elements contained in the proposal.

2.3 Design Life

See IOUs

2.4 Manufacturing Cycle

The LED lamp market is incredibly dynamic and companies are bringing to market new and improved models one to two times a year. Most illustrative are the 60W replacement lamps. This spring Cree introduced a 10.5W LED lamp at Home Depot that retailed for $12.97 and Philips has introduced multiple versions of their 60W over the past 6 months in both dimmable and non dimmable offerings, with prices as low as $10.97 in May 2013. These lamps are superior to most of the models that were previously offered for sale that recently cost $30 to $40.

2.5 Product Classes

We recommend establishment of three product classes – omni-directional, directional and decorative. Within each class, different efficacy levels may be warranted depending on light output or power use. For example, lamps that use < 15W might have a slightly lower efficacy requirement than those that use 15W or more.

3 Unit Energy/Water Usage

See IOUs

3.1 Duty Cycle

3.2 Efficiency Levels

See IOUs.

In addition it should be noted, that with certain designs lamp efficacy may go down 10 to 20% in order to achieve color rendering index (CRI) levels of 90 or higher and keep price constant. For some high CRI lamps, the efficacy can be maintained but the price of the lamp goes up due to the use of multiple colored LEDs.

3.3 Energy and/or Water Consumption

IOUs

4 Market Saturation and Sales

See IOUs.

Note this market is very dynamic and the CEC process should reflect any new products that enter the market during the proceeding, including but not limited to lamps with higher CRI, new dimming circuitry/designs, and pricing.

4.1 California Stock and Sales

4.2 Efficiency Options: Current Market and Future Market Adoption

5 Statewide Energy Usage

See IOUs. Note, the metric of greatest public interest is whether statewide lighting energy use for these sockets is going up or down. For example, consumer adoption of LEDs instead of today's incandescent lamps will result in higher LED lamp energy use statewide. However, overall lighting statewide energy use will go down as the LEDs will use 3 times less energy than the equivalent incandescent lamp.

6 Proposal

6.1 Summary of proposal

NRDC generally agrees with the proposal made by the IOUs, including the lamp efficacy levels they propose. Below we provide some additional text and highlight where we have an alternate approach.

Noise/Hum and Flicker – A big factor of dissatisfaction for consumers are lamps that produce objectionable levels of hum and flicker. We recommend CEC adopt the test methods and levels specified by ENERGY STAR for these metrics to help ensure consumers have a satisfactory experience with new LED lamps.

Color Consistency and Chromaticity – The EPA currently requires LED lamps to fall within 7 McAdam ellipses of each of the specified Correlated Color Temperature (CCT) bins. We also understand that ANSI has a voluntary standard that is tighter and requires products to fall with a 4-step MacAdam ellipse. This will result in greater color consistency between lamps marketed as operating at the same color temperature. The IOUs have recommended compliance with the 4-step requirement. We encourage the CEC during its workshop process to request additional data from stakeholders to better understand the cost implications of shifting toward a tighter specification.

Dimmability – As most LED lamps that will be purchased in the home will not go into a dimming circuit, we do not agree with portions of the IOUs proposal for dimming. We recommend CEC establish minimum dimming requirements for products marketed as dimmable, and for the non-dimmable lamps to be clearly marked on the front of package in sufficiently large font that the product is not dimmable.

We recommend the CEC seriously consider the dimming requirements specified by ENERGY STAR. ENERGY STAR requires dimmable lamps to dim down to 20% of initial light output. The IOUs have proposed dimming requirement down to 10%. We feel 20% will be sufficient for most users and is more readily achievable by manufacturers, especially due to the fact that the lamp will need to dim on a wide range of dimmers and that some lamps have a hard time dimming down to very low levels.

We took this approach, as removal of dimming circuitry reduces cost and can result in increased product reliability. If over the course of the rulemaking, dimmable products can be shown to not have any significant price increase or efficacy decrease relative to non-dimmable products, then NRDC would support mandatory dimming, or a tier 2 that would require dimming at a later date.

Premature failure/degradation – Due to the amount of time it takes for a manufacturer to test their lamp to full rated lifetime, or even 10,000 hours, we recommend the following combination of metrics to help ensure products do not fail or give off significantly less light prematurely. While we considered establishing a minimum lamp life requirement, we didn't think it was enforceable as it would take a few years of testing before actionable data would be available.

- Rapid Cycle Stress Test – Products that have inferior, low cost electronics will fail prematurely due to switching. This is a faster and easier failure mechanism to test for compared to the cumulative impacts of heat over the lamp's life. We recommend CEC adopt the rapid cycle stress test contained in ENERGY STAR and for 5 out of the 6 tested samples to survive at least one cycle per rated hour of life. For example a lamp rated 15,000 hours would need to survive 15,000 cycles of 5 minutes on/5 minutes off. This test also helps guard against manufacturer's overrating the lifetime of their products.
- Lumen Maintenance – must maintain 90%of initial light output after 1,000 hours of testing.
- Lamp survivability – all 10 of the tested samples shall be surviving at 1,000 hours of testing.

The lumen maintenance and lamp survivability testing for all lamps should be done at the elevated temperature of 45 degrees C that were initially required in Draft 3 of the ENERGY STAR specification. (The current version only requires testing at 45C for directional lamps, and 25C for omnidirectional and decorative lamps). Otherwise many LED lamps that are not designed or rated to withstand higher temperature operating environments will be placed in enclosed fixtures and consumers will often experience premature lamp failure and lost savings. While some might argue that only 25% or so of a home's omnidirectional sockets are within enclosed fixtures, very few consumers even know what an enclosed fixture is and will likely ignore the fine print buried on the side of the package that say "not for use in enclosed fixtures". One should also note that all but one of the LED omnidirectional lamps offered for sale at Home Depot in May had the warning "not for use with enclosed fixture" claim.

Color rendering – There are currently a scarcity of a) LED lamps models that have a CRI of 90 or higher and b) published studies that definitively document consumers' preference for models that offer CRI of 90 vs. 80 the typical level for today's products. As such we recommend the CEC: a) start with ENERGY STAR's color rendering requirements, and b) pending additional data during the proceeding on new products that achieve 90 CRI without a significant loss in efficiency or incremental cost, the CEC should consider establishing a minimum CRI of 90 and R9 requirements higher than those contained in ENERGY STAR.

Another approach would be for the CEC to set two tiers, the first tier would include a minimum CRI of 80, and R9 >0 and go into effect sooner, and a second tier that would include a higher CRI, again contingent upon the additional data that is gathered during this proceeding, that would go into effect later. The benefit of this approach is it does not delay the overall standard and provides industry with additional time that might be needed to redesign their products to meet the higher CRI levels.

Warranty – We agree with the IOUs that a warranty requirement is warranted and will help discourage manufacturers from producing product with inferior designs or with poor attention to quality control. CEC should consider the minimum warranty levels in ENERGY STAR of 2 years for lamps < 15,000 hours and 3 years for lamps >15,000 hours, and discuss with stakeholders if warranties of longer duration would make sense for lamps rated 25,000 hours or higher. The IOUs have proposed a minimum warranty of 5 years.

Equivalency Claims – As consumers have a long tradition of buying lamps based on the common wattages of 40, 60, 75, 100 and 150 Watts, as opposed to the amount of light, the lamp outputs, manufacturers market their products as 15W = 60W, or as bright as 60W. We recognize consumers will need this sort of comparison over the next several years, until they get to know that for their bedside table fixture they want 800 lumens, etc. Some manufacturers, especially when LED were first introduced, made grossly exaggerated claims. While some said 10W = 60W, the LED lamp gave off considerably less light than the 60W incandescent lamp that it was intended to replace.

To address this problem, we recommend CEC require those lamps that make this type of equivalency claim comply with the minimum light output levels as specified by ENERYG STAR and shown in the table below:

Equivalent Wattage Claim	Minimum Lumen Output
40	450
60	800
75	1100
100	1600
150	2550

6.2 Implementation Plan

6.3 Proposed Test Procedure(s)

See ENERGY STAR and IOU proposals. Note we recommend one significant change from ENERGY STAR – we propose lumen maintenance and lamp survivability testing be done at 45C for omni directional and decorative lamps, not 25C.

6.4 Proposed Regulatory Language

N/A

7 Technological Feasibility

See IOUs

8 Economic Analysis

See IOUs

9 Savings Potential

See IOUs. Note, estimates of incremental energy savings are highly dependent upon how future LED sales would vary if some of the models available for sale do not meet the minimum levels established by Title 20 and consumers have a bad experience.

10 Acceptance Issues

See IOUs.

11 Environmental and Societal Impacts

See IOUs

12 Federal Preemption or Other Regulatory or Legislative Considerations

None that we are aware of.

13 Methodology for Calculating Cost and Savings

See number 9.

14 Bibliography and Other Research

See IOUs.

Proposal for Standards – Small Diameter Directional Lamps

Docket #12-AAER-2B

Appliance Efficiency Standards and Measures

for California Energy Commission's Invitation to Submit Proposals

Submitted By:

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Natural Resource Defense Council
pdelforge@nrdc.org
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On behalf of the Natural Resources Defense Council and our more than 250,000 members and online activists in California, we respectfully submit this response to the Commission's Invitation to Submit Proposals dated June 13, 2013.

NRDC has reviewed the Investor Owned Utilities (IOUs) standards proposal for Small Diameter Directional Lamps (SDDL) and is in agreement with their analysis, savings estimates and proposal. Rather than repeat much of their content, NRDC highlights below key considerations regarding the IOU-proposal.

Why SDDLs matter – SDDL lamps that go into recessed cans or track lighting are becoming increasingly popular, especially in new construction and remodeled spaces, both in the residential and commercial sectors. It's not uncommon for a home remodel to include 25 to 50 small diameter recessed cans. As such, these lamps represent a rapidly growing category and source of energy use. Due to historical regulatory categories, only reflector lamps greater than 2 ½ inches are covered by federal minimum efficiency standards. There is a gaping regulatory hole which a CEC standard would fill to ensure the lamps that go into these smaller diameter openings are also energy efficient.

The proposed standards are technologically feasible - the very large majority (more than 90 percent) of the SDDL installed base in California is comprised of the most energy-consumptive lamp type available (i.e., conventional halogen). SDDL lamps offering energy savings of 30 to 80% compared to conventional halogen SDDL lamps exist. The IOUs propose two-tier minimum efficiency standards. The proposed standards are performance-based, not technologically prescriptive: they are achievable by specific technologies on the market today, but are not limited to these technologies.

The proposed Tier 1 standard, effective in 2015 would effectively require infrared coating on halogen lamps with lumen output exceeding 300 lumens sold in the California market. Already commercially available HIR 37W lamps would replace 50W conventional halogens, while 20 and 30W HIR lamps would replace 35W conventional halogen lamps. HIR technology provides equivalent utility in the small diameter market, is compatible in all use-cases to the conventional halogen technology, already has a

sizeable market presence, and serves as a cost-effective alternative without any technical feasibility concerns.

The Tier 2 standard, effective in 2018, would require an efficiency level on par with technically feasible HIR and the very large majority of LED lamps available today. The IOUs and NRDC expect that the cost of these lamps will decrease dramatically by the standard effective date, and that standard levels will also be achievable by improved, commercially available efficiency HIR lamps by then.

Cost-effectiveness - The IOU-proposed standards yield energy and avoided lamp-replacement cost savings over the lifetimes of the lamps that are between 6 and 20 times higher than their incremental upfront costs, making them very cost-effective for both the residential and commercial sectors.

Savings - The IOU-proposed standards will save Californians approximately 1,700 GWh annually after stock turnover. NRDC estimates that this would reduce Californians' electricity bills by $220 million annually and California's CO2 emissions by over 600,000 metric tons annually in 2020, the equivalent of removing 150,000 passenger cars from the road continuously.

In conclusion, given the large spread in energy use of available SDDL technologies, the magnitude of the potential savings, and the forecasted increased availability of more efficient products, NRDC strongly recommends CEC adopt the IOU-proposed minimum efficiency standards for small diameter directional lamps as soon as possible, to save Californians money while reducing electricity consumption and associated pollution.