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INITIAL STUDY AND PROPOSED NEGATIVE DECLARATION

AMENDMENTS TO APPLIANCE EFFICIENCY REGULATIONS

**Initial Study and Proposed Negative Declaration
for Small-Diameter Directional Lamps and
General Service Light-Emitting-
Diode (LED) Lamps**

**California Code of
Regulations
Title 20, Sections 1601 -
1609**

Docket # 15-AAER-6

California Energy Commission

Edmund G. Brown Jr., Governor



October 2015 | CEC-400-2015-036

CALIFORNIA ENERGY COMMISSION

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ABSTRACT

This initial study focuses on demonstrating that the proposed energy efficiency regulations for small-diameter directional lamps and general services LED lamps will not have any significant adverse effect on the environment. The initial study includes an environmental checklist support this finding. This report identifies and considers the potential environmental effects of adopting regulations for small diameter directional and general service lamps.

Implementation of the proposed regulations will result in an estimated reduction of 3,144 gigawatt-hours (GWh) per year in electricity consumption, in 2029 and after. It is estimated that the reduction in power plant operation in California would reduce criteria air pollutants (nitrous oxides (NO_x) by about 6,500 tons and sulfur oxides [SO_x] by about 113 tons, particulate matter less than 10 and 2.5 microns in diameter [PM₁₀, PM_{2.5}] by about 1,135 tons), and proposed regulations are estimated to avoid 10.3 million metric tons of carbon dioxide (CO₂) between 2017 and 2029. Savings of 3,144 GWh a year equates roughly to a 750-megawatt power plant.

In the case of SDDLs, the majority of the existing installed products are incandescent or halogen technologies. These products last about 4,000 hours. The new, more efficient SDDLs will last 25,000 hours or more. This long life will result in fewer lamps being disposed as more long-lasting products are installed.

Keywords: Appliance Efficiency Regulations, energy efficiency, Light-emitting diodes (LED), incandescent lamps, halogen lamps, halogen infra-red lamps, small diameter directional lamps, general service lamp.

Singh, Harinder, Ken Rider. 2015. Staff Analysis of Small Diameter Directional and General Service Lamps. California Energy Commission. CEC-400-2015-034.

NEGATIVE DECLARATION

2015 Amendments to the Appliance Efficiency Regulations, California Code of Regulations, Title 20 Sections 1601-1609

Public Resources Code § 25402, subdivision (c)(1), mandates that the California Energy Commission reduce wasteful, uneconomic, inefficient, or unnecessary energy use by prescribing, through regulation standards for minimum efficiency levels for appliances. The Energy Commission adopted appliance efficiency regulations in 1976 and periodically adopts new or revised standards. The Energy Commission proposes to adopt new *Appliance Efficiency Regulations* (Section 1601 - 1609 of Title 20 of the California Code of Regulations) establish efficiency standards for small-diameter directional lamps and general service light-emitting diode (LED) lamps.

The California Environmental Quality Act (CEQA), found in Public Resources Code Sections 21000 et seq., requires public agencies to identify and consider the potential environmental effects of their "projects," as that term is defined, and when feasible to mitigate any related adverse significant environmental consequences. The proposed adoption of these regulations is a discretionary action undertaken by a public agency and has the potential to result in a direct or indirect physical change in the environment. Thus, the proposed adoption constitutes a "project" under CEQA. (See Pub. Res. Code Section 21065.) The Energy Commission has prepared this initial study to assess the potential significant effects of the proposed regulations on the environment.

The proposed regulations are contained in the following document:

Proposed Amendments to Appliance Efficiency Regulations (Express Terms), California Code of Regulations, Title 20, Sections 1601 Through 1609, 2015 Appliance Efficiency Rulemaking, Small-Diameter Directional Lamps and General Services LED Lamps, October 2015, Docket Number 15-AAER-6.

The proposed regulations are summarized in the notice of proposed action and are available with the express terms at <http://www.energy.ca.gov/appliances/2015-AAER-06/rulemaking/>.

The potential environmental impacts of the proposed regulations are analyzed in the attached document:

Initial Study and Proposed Negative Declaration - Amendments to Appliance Efficiency Regulations, California Code of Regulations, Title 20, Sections 1601 - 1609, October 2015, Docket # 15-AAER-6.

All the documents listed above are available on the Energy Commission's website, <http://www.energy.ca.gov/appliances/2015-AAER-06/rulemaking/>, or by phone at

(916) 654-4147, or by electronic mail from the Energy Commission's Appliances and Existing Buildings Office, by submitting a request to Angelica.Romo@energy.ca.gov.

Finding of No Significant Impact

The initial study demonstrates, and the Energy Commission concludes, that the proposed energy efficiency regulations for small-diameter directional lamps and general services LED lamps will not have any significant adverse effect on the environment. The attached initial study and environmental checklist support this finding.

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CHAPTER 1:

Introduction

The California Energy Commission was established in 1974 by the Warren-Alquist Act to develop and implement energy policy for the State of California. One of the Energy Commission's mandates is to promote water and energy efficiency through a variety of means, including efficiency standards for appliances. (Pub. Res. Code Section 25402[c][1]). The Energy Commission adopted its first appliance efficiency standards in 1976, has periodically revised those, and adopted new regulations. The current regulations include provisions on testing of appliances to determine efficiency, reporting of data by manufacturers to the Energy Commission, establishing mandatory minimum efficiency levels, and compliance and enforcement procedures, as well as general provisions on the scope of the regulations and definitions.

The proposed amendments to the regulations include energy efficiency standards for small-diameter directional (SDDL) lamps and general service light-emitting diode (LED) lamps. The scope of the proposed regulations covers all SDDLs and general service LED lamps sold or offered for sale in California starting in 2017 for LEDs and 2018 for SDDLs.

The California Environmental Quality Act (CEQA), found in Public Resources Code Sections 21000 et seq., requires public agencies to identify and consider the potential environmental effects of their "projects," as that term is defined, and when feasible to reduce any related adverse environmental consequences. This proposed adoption is a discretionary decision undertaken by a public agency and has the potential to result in direct or indirect physical changes in the environment. Thus, it constitutes a "project" under CEQA. (See Pub. Resources Code Section 21065.) Therefore, the Energy Commission has prepared this initial study to assess the potential significant effects of the proposed regulations on the environment.

The term "lamp" refers to what commonly known as a "light bulb" and not the appliance that one would insert the light bulb. The technical term, "lamp" and not "light bulb" is used in this initial study for consistency with the staff report and other rulemaking materials. The correct term for the appliance that lights the lamp is a "luminaire"

Implementation of the proposed regulations will result in an estimated reduction of 3,145 gigawatt-hours (GWh) per year in electricity consumption, in 2029 and after. It is estimated that the concomitant reduction in power plant operation in California would reduce criteria air pollutants (nitrous oxides (NO_x) by about 6,500 tons and sulfur oxides [SO_x] by about 113 tons, particulate matter less than 10 and 2.5 microns in diameter [PM10, PM2.5] by about 1,135 tons), and proposed regulations are estimated to avoid 10.3 million metric tons of carbon dioxide (CO₂) between 2017 and 2029. Savings of 3,144 GWh a year equates roughly to a 750-megawatt power

plant.¹ 750 megawatts equates to a 48% capacity factor which is realistic for California where combined cycle plants don't operate at design intent levels but "industry standard" metric.

In the case of SDDLs, the majority of the existing installed products are incandescent or halogen technologies. These products last about 4,000 hours.² The new, more efficient SDDLs will last 25,000 hours or more. This long life will result in fewer lamps being disposed as more long-lasting products are installed.

Based on the initial study showing the regulations will result in a reduction in air pollution coupled with the decrease in waste, staff finds that the regulations will not have a significant impact on the environment but will benefit the environment. Therefore, a negative declaration is the appropriate environmental document.

1 Rider, Ken, Pierre duVair, Harinder Singh, Jared Babula, Michael Murza. 2015. Standardized Regulatory Impact Assessment of 2015 Proposed Appliance Efficiency Regulations. California Energy Commission. CEC-400-2015-028. Available at http://www.dof.ca.gov/research/economic_research_unit/SB617_regulation/Major_Regulations/documents/SRIA-CEC-LED-regs.pdf.

2 *Codes and Standards Enhancement (CASE) Initiative, Small-Diameter Directional Lamps, Addendum to July 2013 Submission*, p. 4, Table 2.1 (Aug. 6, 2014). Available at http://www.energy.ca.gov/appliances/2013rulemaking/documents/proposals/12-AAER-2B_Lighting/California_IOUs_Small_Diameter_Directional_Lamps_Addendum_to_CASE_Report_2014-08-06_TN-73551.pdf.

CHAPTER 2: Description of Proposed Project

Project Name

This project is a statewide rulemaking proceeding titled Small Diameter Directional and General Services LED Lamps Standards, Energy Commission Docket Number 15-AAER-6.

Project Description and Location

The project proposes statewide regulations to establish or amend the levels of efficiency required for small-diameter directional and general services LED lamps, which are not covered by federal appliance efficiency standards. The required new efficiency standards apply to newly manufactured products.

The proposed regulations for small diameter directional lamps will apply to residential and commercial products manufactured on or after January 1, 2018. These proposed regulations would require efficiency levels for small diameter directional lamps that can only be met by LED technologies thus requiring movement away from halogen and incandescent technologies. The proposed regulations for general services LED lamps will apply on or after January 1, 2017. These proposed regulations affect only LED technologies and so would not require a shift in the technologies or component parts used. This rulemaking also includes updates to portable luminaires, and minor clarifications and/or corrections to the existing Appliance Efficiency Regulations.

The proposed regulations relevant to this initial study are contained in:

Proposed Amendments to Appliance Efficiency Regulations (Express Terms), California Code of Regulations, Title 20, Sections 1601 Through 1609, September 2015 Appliance Efficiency Rulemaking, for Small-Diameter Directional and General Service LED Lamps, Docket Number 15-AAER-6.

More detailed description and analysis of the project is contained in:

Analysis of Small-Diameter Directional and General Service LED Lamps, CEC-400-2015-034.

All of the documents associated with this rulemaking are available at:

<http://www.energy.ca.gov/appliances/2015-AAER-06/rulemaking/> or by electronic mail from the Energy Commission's Appliances and Existing Buildings Office. The office can be reached by contacting Angelica Ramos at (916) 654-4147 or at Angelica.Romo@energy.ca.gov

CHAPTER 3: Energy and Environmental Impacts of the Proposed Project

Consultation

The CEQA guidelines require lead agencies to consult with any responsible or trustee agencies to assist in determining the appropriate type of environmental document to be issued. In this case, no other state or local agency has regulatory authority over any aspect of energy efficiency standards for lamps. Therefore, no responsible or trustee agency exists. Regardless, Commission staff sought the expertise on waste issues at the Department of Toxic Substances Control (DTSC) and the Department of Resources Recycling and Recovery (CalRecycle).

Staff determined that the regulations will substantially reduce the amount of lighting waste entering the waste stream, especially the number of SDDLs, because the efficient products required by the proposed regulations last much longer than the current halogen and incandescent products – more than 25,000 hours versus 4,000 hours. Thus, fewer lamps will need to be disposed of. While the total amount of waste will be reduced, the composition of the waste may change as LED technologies use different components than halogen or incandescent technologies. Staff's initial study focused on the potential changing composition of the lamps and whether the change has any environmental impacts.

To determine the impacts of the potential composition change, staff sought any information that either DTSC or CalRecycle had on electronic waste from general service LED lamps or SDDL LED products. Neither agency raised any concerns regarding the disposal of SDDL LED products or identified unique regulations covering the disposal of general service LED or SDDL lamps.

After discussing the potential waste issues with DTSC and CalRecycle, staff continued developing its initial study.

Energy Impacts

The energy efficiency standards being proposed will reduce the future demand for electricity in the state. The efficiency standard will reduce electricity consumption by 3,144 GWh per year after the stock turnover.³ Over a 10-year analysis period, from 2017 to 2029, in California the cumulative energy savings from switching to LED SDDLs and to higher-efficiency general service LED lamps are estimated to total about 32,792 gigawatt-hours and would save \$4.3 billion. Reduction in electricity

3 Rider, Ken, Pierre duVair, Harinder Singh, Jared Babula, Michael Murza. 2015. *Standardized Regulatory Impact Assessment of 2015 Proposed Appliance Efficiency Regulations*. California Energy Commission. CEC-400-2015-028, page 26. Available at http://www.dof.ca.gov/research/economic_research_unit/SB617_regulation/Major_Regulations/documents/SRIA-CEC-LED-regs.pdf.

would lead to a reduced need for new power plants, use of fossil fuels for those plants, and new transmission lines.

It is expected that LED technology will be the primary technology used to meet the SDDL standards. Products using LEDs for general illumination have recently demonstrated the potential to surpass conventional lighting technologies in terms of energy efficiency, longevity, versatility, and color quality. According to a recent forecast, LED lighting will represent 74 percent of lumen-hour sales in the U.S. general illumination market by 2030.⁴

Staff also compared LED lamp impacts with incandescent and halogen technologies. A U.S. Department of Energy (DOE) study found that a 15-watt CFL and a 12.5-watt LED lamp perform better than the 60-watt incandescent lamp. These three lamps all produce roughly the same light output (~850 lumens), but the environmental impacts associated with the incandescent are markedly more significant than the CFL and LED lamps because of the energy-in-use phase of the life cycle.⁵

Waste Impacts

Given the expectation that LED SDDLs will increase in sales with the adoption of the proposed standards, staff researched information on the composition of relevant LED lamps to assess the potential for significant impacts to the environment once the lamp was at the end of the useful life.

Staff compared LED lamp impacts with the existing impacts from non-LED lamps, such as incandescent and halogen. Staff analyzed the DOE study data collected on chemicals present in the LED, incandescent, and CFL lamps. The DOE study, *Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products*, analyzed the toxic and nontoxic chemicals present in LED, CFL, and incandescent lamps. The DOE study did not include small-diameter directional lamps, but small-diameter directional lamps use the same type of LED chips and associated electronics as used in general service LED lamps. The size of the directional lamps is smaller and has fewer LEDs in it than the general services LED lamp. Therefore, the quantity of chemicals in small-diameter directional lamps is slightly less than the chemicals found in general service lamps.

DOE conducted the study in 2013. The study included 22 samples, representing 11 models, which were tested to determine whether any of 17 key elements were present at levels exceeding California or federal regulatory thresholds for hazardous waste. Results of the DOE's exploratory study of medium screw base general service LED lamps are shown in the table below.

Table 1: LED Lamp Samples Exceeding TTLC, STLC, or FRL

4 Scholand, Michael J. and Heather E. Dillon, *Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products, Part 2: LED Manufacturing and Performance*, U.S. Department of Energy, page 6 (June 2012). Available at http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_led_lca-pt2.pdf.

5 Ibid.

Element	LED1		LED 2		LED 3		LED 4	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Antimony				TTLC	TTLC			
Arsenic*								
Barium*								
Beryllium								
Cadmium*								
Chromium*								TTLC
Cobalt								
Copper	TTLC	TTLC	TTLC	TTLC	TTLC	TTLC	TTLC	TTLC
Lead*				STLC				
Mercury*								
Molybdenum								
Nickel	STLC							TTLC
Selenium*							STLC	
Silver*								
Thallium								
Vanadium								
Zinc	TTLC			TTLC		TTLC		TTLC

Glossary: Soluble Threshold Limit Concentration (STLC), Total Threshold Limit Concentration (TTLC), Federal Regulatory Level (FRL)

*Federally regulated elements

Source: U.S. Department of Energy

Nearly all the lamps, regardless of technology, exceeded at least one California threshold—typically for copper, zinc, antimony, or nickel. The greatest contributors were the metal screw bases, drivers, ballasts, and wires or filaments. Internal LED light sources generally did not cause LED lamps to exceed thresholds.

There has been significant improvement in LED efficacy and quality since 2013, and these characteristics are expected to continue to improve. While in the past, LED technologies used different color LED lights to produce the desired colors, today’s small-diameter directional LED lamps and general service LED lamps use LEDs that produce white light. White LEDs are far less harmful than the predecessors - they contain regulated chemicals that are well below the total threshold limit concentrations (TTLC).⁶

A 2011 study conducted by the University of California, Irvine (UCI), *Potential Environmental Impacts of Light-Emitting Diodes (LEDs): Metallic Resources, Toxicity, and Hazardous Waste Classification*, verifies this finding.⁷ Test results are shown in Table 2 and 3 below, which show that the amount of chemicals found in the white LEDs are well below the TTLC, except for nickel and

⁶ Lim, Seong-Rin, Daniel Kang, Oladelea Ogunseitan, Julie M. Schoenung, “Potential Environmental Impacts of Light-Emitting Diodes (LEDs): Metallic Resources, Toxicity, and Hazardous Waste Classification,” *Environmental Science & Technology*, Vol. 45, No. 1, page 321 (2011). Available at <http://pubs.acs.org/doi/pdf/10.1021/es101052q>.

⁷ Lim, Seong-Rin, Daniel Kang, Oladelea Ogunseitan, Julie M. Schoenung, “Potential Environmental Impacts of Light-Emitting Diodes (LEDs): Metallic Resources, Toxicity, and Hazardous Waste Classification,” *Environmental Science & Technology*, Vol. 45, No. 1, page 321 (2011). Available at <http://pubs.acs.org/doi/pdf/10.1021/es101052q>.

silver. Allowable amount of silver is 500 mg/kg in California, whereas LEDs contained slightly more, at 520 mg/kg. However, Table 4 below shows that the amount of nickel found in LED lamps is less than the amount of nickel found in incandescent lamps that are being used. Moreover, because small-diameter directional LED replacement lamps last more than 25,000 hours compared to only 4,000 hours for halogen, the overall amount of nickel and silver waste from small-diameter directional lamps will be reduced.⁸

Table 2: Results of Total Threshold Limit Concentrations (TTL) Tests for LEDs

Substance	TTL Threshold	Red/Low	Red/High	Yellow/Low	Yellow/High	Green/Low	Green/High	Blue/Low	Blue/High	White
aluminum	N/A	97.0	158.0	104.0	156.0	79.6	156.0	153.0	73.4	84.5
antimony	500	15.4	2.0	2.8	1.9	3.6	2.5	1.3	1.5	25.9
arsenic	500	11.8	111.0	8.0	84.6	7.8	15.2	5.7	5.4	ND
barium	10000	ND	ND	ND	ND	ND	ND	ND	ND	ND
cerium	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
chromium	500(VI); 2500(III)	138.0	28.6	32.7	27.9	84.1	49.3	50.9	30.3	65.9
copper	2500	87.0	3818.0	956.0	2948.0	1697.0	3702.0	3892.0	2153.0	31.8
gadolinium	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
gallium	N/A	135.6	95.0	63.8	79.1	75.6	3.1	2.1	1.5	3.8
gold	N/A	39.8	45.8	30.5	30.1	40.2	176.3	32.5	118.6	115.9
indium	N/A	3.4	1.7	ND	ND	2.5	ND	ND	ND	ND
iron	N/A	285558	363890	300905	398630	310720	395652	339234	256499	311303
lead	1000	8103.0	8.9	7.7	ND	5.0	ND	ND	ND	ND
mercury	20	ND	ND	ND	ND	ND	ND	ND	ND	ND
nickel	2000	4797.0	2054.0	1541.0	2192.0	2442.0	2930.0	1564.0	1741.0	4083.0
phosphorus	N/A	114.2	ND	58.4	ND	78.5	91.8	79.1	84.3	110.8
silver	500	430.0	409.0	248.0	336.0	270.0	306.0	418.0	721.0	520.0
tungsten	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
yttrium	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
zinc	5000	48.2	66.2	36.5	63.6	41.8	62.5	42.6	36.7	49.2

The values in bold indicate that the TTL results exceed the regulatory limit. The unit of measurement is mg/kg. N/A: Not Applicable. ND: Not Detected.

Source: Seong-Rin Lim et al. (2011)

⁸ Seong-Rin Lim et al. (2011), *Potential Environmental Impacts of Light-Emitting Diodes (LEDs): Metallic Resources, Toxicity, and Hazardous Waste Classification*, available at <http://pubs.acs.org/doi/pdf/10.1021/es101052q>.

Table 3: Results of Toxicity Characteristics Leaching Procedure (TCLP) Tests for LEDs.

Substance	Threshold	Red/Low	Red/High	Yellow/Low	Yellow/High	Green/Low	Green/High	Blue/Low	Blue/High	White
iron	N/A	332.5	178.3	206.0	163.5	211.8	161.8	178.5	130.8	202.3
lead	5.0	186	ND	ND	ND	ND	ND	ND	ND	ND

The value in bold indicates that the TCLP result exceeds the regulatory limit. The unit of measurement is mg/L. N/A: Not Applicable. ND: Not Detected.

Source: Seong-Rin Lim et al. (2011)⁹

Staff has also reviewed a study paper on potential environmental impacts from the metals in incandescent, CFL, and LED bulbs published in *Environmental Science & Technology*.¹⁰ This study paper compares the chemical composition test result with the state-regulated TTLCs. This study applied life-cycle impact-based and hazard-based assessment methods. Results of the study are shown in Table 4 below.

Table 4: Results of Total Threshold Limit Concentrations (TTLC)

substance	TTLC threshold	Incandescent bulb	CFL bulb	LED bulb
aluminum	N/A	40,100	31,700	947,000
antimony	500	ND	117	123
arsenic	500	ND	2.6	ND
barium	10000	4.1	17.8	364
cerium	N/A	9.4	9.6	7.8
chromium	500 (VI);	5.8	1.1	120
copper	2500 (III), 2500	942	111,000	31,600
gadolinium	N/A	ND	0.6	0.1
gallium	N/A	7.9	6.0	108
gold	N/A	ND	ND	2.2
indium	N/A	ND	ND	ND
iron	N/A	372	12,800	12,300
lead	1000	6.9	3860	16.7
mercury	20	0.1	18.3	0.4
nickel	2000	188	120	151
phosphorus	N/A	ND	222	127
silver	500	16.2	12.2	159
tungsten	N/A	24.4	1.4	1.2
yttrium	N/A	0.6	2540	1.7
zinc	5000	320	34,500	4540

Values in bold indicate that the TTLC results exceed the regulatory limit. The unit of measurement is mg/kg. Note that mercury vapor in the CFL lamp can be released to the air during the grinding process. N/A: Not applicable. ND: Not detected.

Source: Seong-Rin Lim et al. (2013)

⁹ Seong-Rin Lim et al. (2011), *Potential Environmental Impacts of Light-Emitting Diodes (LEDs): Metallic Resources, Toxicity, and Hazardous Waste Classification*, available at <http://pubs.acs.org/doi/pdf/10.1021/es101052q>

¹⁰ Lim, Seong-Rin, Daniel Kang, Oladele A. Ogunseitan, and Julie M. Schoenung, "Potential Environmental Impacts From the Metals in Incandescent, Compact Fluorescent Lamp (CFL), and Light-Emitting Diode (LED) Bulbs," *Environmental Science & Technology*, Vol. 47, No. 2, pp. 1040-1047 (2013). Available at <http://pubs.acs.org/doi/abs/10.1021/es302886m>.

The LED chip is assembled into a pin-type device through the application of leads, wires, solders, glues, and adhesives, as well as heat sinks for thermal dissipation management. Efficacy of LED lighting and associated electronics is rapidly improving, resulting in fewer LEDs and electronic components within each lamp, thus reducing overall materials. Using high-efficacy components in LED lamps significantly reduced the size of heat sinks resulting in reduction in metal usage. The amount of the chemicals identified in Table 4 is smaller in the case of directional lamps because of the smaller size.

One of the greatest advantages in the use of LED lamps is they offer reduced life-cycle energy and environmental impacts when compared to CFLs, halogens, HIR, and incandescent lamps.

Environmental Impacts

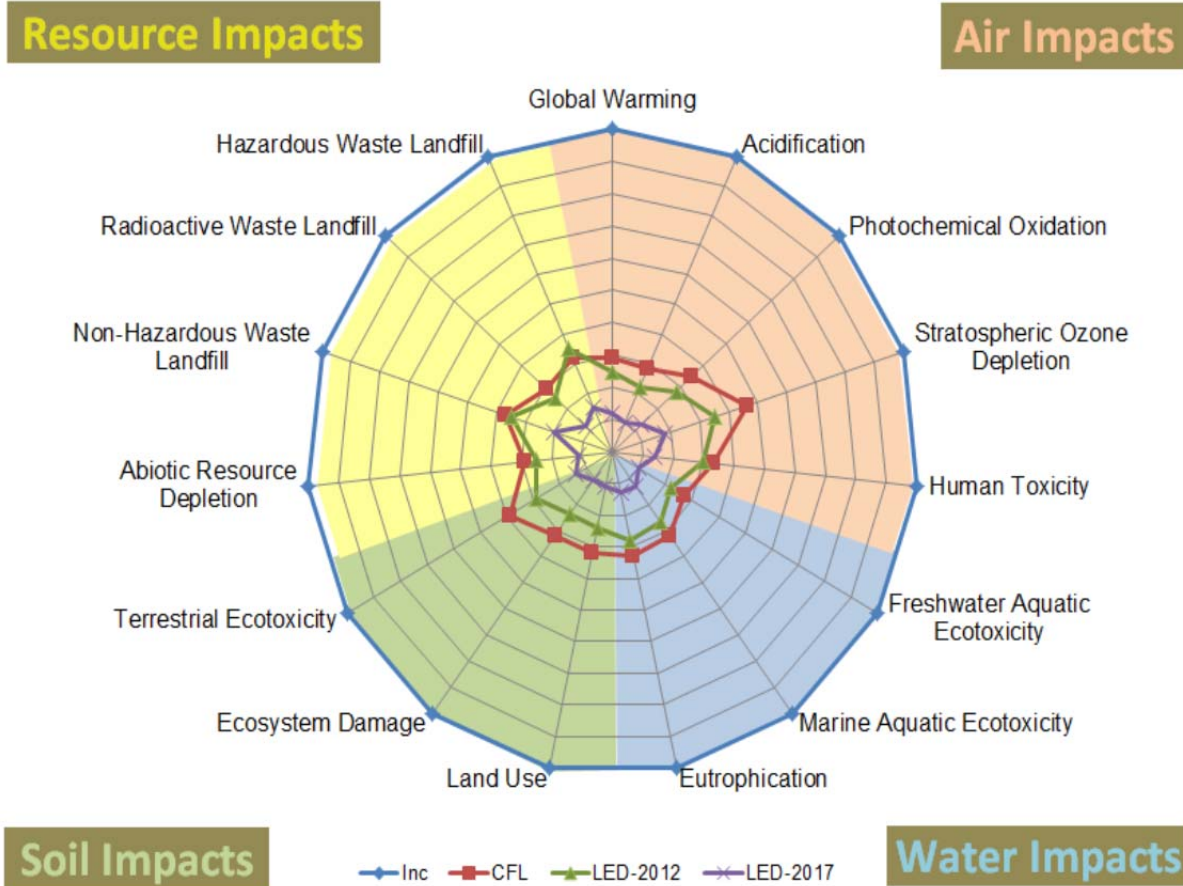
In a recent study, DOE performed a life-cycle assessment of energy and environmental impacts of LED lighting products compared to CFL and incandescent technologies. The results show that overall when looking at 15 major environmental parameters (see Figure 1), LED lamps have far less potential for overall environmental impacts and are superior to incandescent lamps.¹¹

The study included chemical analysis of a variety of LED, CFL, and incandescent lamps using standard testing procedures. The DOE study tested 22 samples of 11 lamp models, out of which 4 were LEDs. The testing was conducted to determine whether any of 17 elements identified as potentially harmful were present at levels exceeding California or federal regulatory thresholds for hazardous waste. Figure 1 shows life-cycle environmental impacts of LEDs from 2012 (represented by the green ring) far below incandescent (represented by the outer blue ring) in every category considered, including “hazardous waste landfill.” Furthermore, performance and material improvements projected for LEDs by 2017 suggest even greater life-cycle benefits from LEDs and further reduced hazardous waste impacts (as shown by the purple ring in the figure). Older studies from 2011 suggesting that LEDs had significant levels of toxic waste did not appear to consider the impacts of the much improved lifetime and efficacy of LED lamps over incandescent products. With an estimated lifetime that is 5 to 10 times longer than incandescent, far fewer LED lamps will be disposed of each year.¹²

11 Tuenge, Jason, Brad Hollomon, Heather Dillon, Lesley Snowden-Swan. *Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products Part 3: LED Environmental Testing*, U.S. Department of Energy, page 9 (March 2013). Available at http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2013_led_lca-pt3.pdf.

12 Ibid.

Figure 1: LED and CFL Life-Cycle Impacts Relative to Incandescent Lamps



Source: U.S. Department of Energy

The Energy Commission completed the environmental checklist that is contained in the CEQA Guidelines (California Code of Regulations, Title 14, Section 15000 et seq., Appendix G) to address the potential environmental effects of the proposed regulations. The impacts to California, which are outlined in Chapter 5, indicate that implementing the proposed amendments will have no adverse effect on the environment. In fact, the new standards will result in environmental benefits due to reductions in electricity use and related emissions reductions in California and the western United States.

The proposed regulations are estimated to avoid 10.3 million metric tons of carbon dioxide (CO₂) between 2017 and 2029. This emission reduction contributes to California’s AB 32 mandate to reduce greenhouse gas production.

Two types of benefits were estimated for the carbon dioxide emissions reductions. The first is an estimate of avoided global damages using a federal social cost of carbon value of \$47 per ton. Total avoided damages for the 10-year period under proposed standards equals \$373 million. A second value estimated is the avoided cost of purchasing CO₂ allowances for California’s Cap-and-Trade Program. The value for CO₂ allowance savings was estimated to be \$95 million, based upon an assumed allowance value of \$12 per ton.

For more detailed information on the economic benefits of the proposed energy efficiency standards, see *Standardized Regulatory Impact Assessment of 2015 Proposed Appliance Efficiency Regulations*, available at http://www.dof.ca.gov/research/economic_research_unit/SB617_regulation/Major_Regulations/documents/SRIA-CEC-LED-regs.pdf.

CHAPTER 4: No-Project Alternative

If the Energy Commission does not adopt energy efficiency standards for small-diameter directional lamps and general service LED lamps as proposed in this project, California would forego the electricity energy savings that would result from the proposed regulations, including about 32,792 gigawatt-hours (GWh) between 2017 and 2029 and consumer savings of \$4.3 billion over that period.

The annual release of criteria air pollutants (NO_x , SO_x , PM_{10} , $\text{PM}_{2.5}$, and CO) would continue from power plants that generate electricity, both in California and across the western United States, including 6,555 metric tons of carbon dioxide (CO_2) in 2017 and 984,070 metric tons in 2029.

Not adopting the standards will also prevent any reduction in waste, as shorter-lived SDDLs will not be replaced with longer-lived technologies.

The estimated savings from the proposed standards are cumulative. Small-diameter directional lamps and general service LED lamps sold in one year continue to provide energy savings in future years, while each future year also contains new sales of these products. The savings and benefits are calculated based on the life cycle of the compliant products.

CHAPTER 5: Environmental Checklist

Table 1: Lead and Responsible Agencies

Project Title	<i>Proposed Amendments to Appliance Efficiency Regulations (Express Terms), California Code of Regulations, Title 20, Sections 1601 Through 1609, October 16, 2015 Appliance Efficiency Rulemaking, Docket Number 15-AAER-6</i>
Lead agency name and address	California Energy Commission, 1516 Ninth Street–MS 25, Sacramento, California 95814
Contact person and phone number	Project Manager, Harinder Singh, Appliances and Existing Buildings Office, Efficiency Division, Harinder.Singh@energy.ca.gov (916) 654-4091
Project description	The project is a proposal for statewide regulations to establish the levels of efficiency required for small diameter directional lamps and general service LED lamps, which are not covered by federal appliance efficiency standards. The required new efficiency standards apply to newly manufactured products and are attainable through normal manufacturing processes.
Responsible agencies	None
Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement)	None

Environmental Factors Potentially Affected

For each of the environmental factors checked below, there is likely to be a positive environmental impact due to the decrease in power generation associated with reduced electrical demand by the use of more efficient appliances. The Energy Commission's analysis reveals no significant adverse impacts.

Table 2: Potentially Affected Areas

	I. Aesthetics	x	VII. Greenhouse Gas Emissions		XIII. Population/Housing
	II. Agriculture Resources	x	VIII. Hazards & Hazardous Materials		XIV. Public Services
x	III. Air Quality	x	IX. Hydrology/ Water Quality		XV. Recreation
x	IV. Biological Resources		X. Land Use/ Planning		XVI. Transportation/Traffic
	V. Cultural Resources		XI. Mineral Resources	x	XVII. Utilities/Service Systems
	VI. Geology/Soils		XII. Noise		XVIII. Mandatory Findings of Significance

Issues

Table 3: Specific Potential Issues

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
I. AESTHETICS -- Would the project:				
a) Have a substantial adverse effect on a scenic vista?				X
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?				X
c) Substantially degrade the existing visual character or quality of the site and its surroundings?				X
d) Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area?				X
COMMENT: Improvements in energy efficiency of small diameter directional lamps and general services LED lamps will have no impact to aesthetics and no impact on any of the specific concerns listed above.				
II. AGRICULTURE RESOURCES – In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state’s inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:				
a) Convert prime farmland, unique farmland, or farmland of statewide importance (farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?				X
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220[g]), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104[g])?				X
d) Result in the loss of forest land or conversion of forest land to non-forest use?				X
e) Involve other changes in the existing environment that, due to their location or nature, could result in conversion of farmland, to nonagricultural use or conversion of forest land to non-forest use?				X
COMMENT: Improvements in the energy efficiency of small diameter directional lamps and general services LED lamps will have no impact to agricultural resources and no impact on any of the specific concerns listed above. These regulations do not require land, including forest or agriculture land, to convert to other uses.				
III. AIR QUALITY -- Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?				X
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?				X
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors)?				X
d) Expose sensitive receptors to substantial pollutant concentrations?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
e) Create objectionable odors affecting a substantial number of people?				X
COMMENT: Improvements in the energy efficiency of small diameter directional lamps and general services LED lamps will have no adverse impact to the air quality concerns listed above. The proposed efficiency standards will result in reduced power plant operation and related facility emissions in California as compared to no standards.				
IV. BIOLOGICAL RESOURCES -- Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?				X
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?				X
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				X
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?				X
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?				X
COMMENT: Improvements in energy efficiency of small-diameter directional lamps and general service LED lamps will have no impact on biological resources and no impact on the specific concerns listed above. The proposed regulations do not require land, including wetlands or habitat, to convert to other uses.				
V. CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?				X
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?				X
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?				X
d) Disturb any human remains, including those interred outside formal cemeteries?				X
COMMENT: Improvements in energy efficiency of small-diameter directional lamps and general service LED lamps will have no impact on any cultural resources and no impact on any of the specific concerns listed above. The proposed regulations do not require land, including burial grounds or archaeological/paleontological sites, to convert to other uses.				
VI. GEOLOGY AND SOILS -- Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				X
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to <i>Division of Mines and Geology Special Publication 42</i> .				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
ii) Strong seismic ground shaking?				X
iii) Seismic-related ground failure, including liquefaction?				X
iv) Landslides?				X
b) Result in substantial soil erosion or the loss of topsoil?				X
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on-or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?				X
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?				X
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?				X
COMMENT: Improvements in the energy efficiency of small diameter directional lamps and general services LED lamps will have no impact to geology and soils and no impact on the specific concerns listed above. The proposed regulations do not require changes to land use that might affect its seismic or stability characteristics.				
VII. GREENHOUSE GAS EMISSIONS -- Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?				X
b) Conflict with an applicable plan, policy or regulation adopted for the services of reducing the emissions of greenhouse gases?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no adverse greenhouse gas emissions. The proposed regulations are part of state policy to reduce greenhouse gas emissions. The regulations will reduce greenhouse gas emissions by an estimated 984,000 MTCO ₂ e/yr.				

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
VIII. HAZARDS AND HAZARDOUS MATERIALS -- Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?				X
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?				X
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				X
d) Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				X
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				X
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
h) Expose people or structures to a significant risk of loss, injury; or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no impact on hazards and hazardous material. The proposed regulations also do not alter the way in which these materials are disposed. The standards will reduce overall waste by increasing the sales of lighting products that last 25,000 or more hours compared to the current 4,000 hours.				
IX. HYDROLOGY AND WATER QUALITY -- Would the project:				
a) Violate any water quality standards or waste discharge requirements?				X
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?				X
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on-or off-site?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on-or-off-site?				X
e) Create or contribute runoff water that would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?				X
f) Otherwise substantially degrade water quality?				X
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				X
h) Place within a 100-year flood hazard area structures that would impede or redirect flood flows?				X
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?				X
j) Inundation by seiche, tsunami, or mudflow?				X
COMMENT: Improvements in the small-diameter directional lamps and general service LED lamps will have no impact on hydrology and water quality and no impact on any of the specific concerns listed above. The proposed regulations do not require land, including flood zones and drainage, to be altered.				
X. LAND USE AND PLANNING -- Would the project:				
a) Physically divide an established community?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the services of avoiding or mitigating an environmental effect?				X
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no impact to land use and planning and no impact on to any of the specific concerns listed above. The proposed regulations do not require land, including habitat and community development sites, to convert to other uses.				
XI. MINERAL RESOURCES -- Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				X
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no adverse impact to mineral resources and no impact on any of the concerns listed above. The proposed regulations do not require land, including mineral-rich land, to convert to other uses.				
XII. NOISE -- Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?				X
b) Exposure of persons to or generation of excessive ground borne vibration or ground borne noise levels?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?				X
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				X
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no noise impact and no impact on the specific concerns listed above.				
XIII. POPULATION AND HOUSING -- Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				X
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?				X
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no impact on population and housing and no impact on any of the concerns listed above.				

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
XIV. PUBLIC SERVICES -- Would the project:				
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				X
Fire protection?				X
Police protection?				X
Schools?				X
Parks?				X
Other public facilities?				X
COMMENT: Improvements in energy efficiency of the small-diameter directional lamps and general service LED lamps will not require the construction or alteration of governmental buildings in a way that will cause significant negative environmental impact. This reduction in energy consumption will lead to environmental benefits by reducing greenhouse gas emissions, criteria pollutant production, and the need to site and construct new power plants.				
XV. RECREATION -- Would the project:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?				X
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no impact on recreation and no impact on any of the specific concerns listed above. The proposed regulations do not require park or recreational land to convert to other uses.				
XVI. TRANSPORTATION/TRAFFIC -- Would the project:				
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?				X
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the country congestion management agency for designated roads or highways?				X
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that result in substantial safety risks?				X
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?				X
e) Result in inadequate emergency access?				X
f) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities.				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no impact on transportation/traffic and no impact on any of the specific concerns listed above.				
XVII. UTILITIES AND SERVICE SYSTEMS -- Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				X
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				X
e) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the projects projected demand in addition to the providers' existing commitments?				X
f) Be served by a landfill with sufficient permitted capacity to accommodate the projects solid waste disposal needs?				X

	<i>Potentially Significant Impact</i>	<i>Less Than Significant With Mitigation Incorporation</i>	<i>Less Than Significant Impact</i>	<i>No Impact</i>
g) Comply with federal, state, and local statutes and regulations related to solid waste?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no adverse impact on any of the concerns listed above. By reducing electricity use, the proposed regulations will have beneficial effects on energy utilities by reducing the need to procure additional electricity generation and increased reliability.				
XIX. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?				X
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?				X
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?				X
COMMENT: Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps will have no adverse impact on any of the concerns listed in the above checklist. No potential exists for any adverse impacts on any animal or human populations, and none of the impacts are cumulatively considerable. Improvements in the energy efficiency of small-diameter directional lamps and general service LED lamps resulting from the proposed standards are likely to result in beneficial impacts including reduced electricity consumption, reduced power plant operation, and reduced need to build power plants and power lines in the future.				

CHAPTER 6: Determination

On the basis of this evaluation:

X	I find that the proposed project WILL NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.
	I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.
	I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.
	I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.
	I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.
<p>Signing Officer:</p> <p>ROBERT P. OGLESBY Executive Director</p> <p>Signature _____ Date _____</p>	

APPENDIX A: Matrix of Proposed Changes to Appliance Efficiency Standards and Resulting Energy and Environmental Effects

Table A-1: Matrix of Proposed Changes

	Appliance Type	Existing Standard	Proposed Standard or Description of Changes	Estimated Energy Effects	Potential Environmental Issues
1	Small-diameter directional lamps	Currently there are no federal or state standards for small-diameter directional lamps.	The proposed requirements establish a standard for small-diameter directional lamps, effective January 1, 2018 of ≥ 80 lumens per watt or a CRI+ <i>Efficiency</i> ≥ 165 and a minimum required <i>Efficiency</i> ≥ 70 LPW.	The regulations, by 2029, would result in annual savings of 2,285 gigawatt-hours (GWh) of electricity. This equates to roughly \$3.7 billion in savings to California businesses and individuals.	EMISSIONS: Emissions reductions in criteria pollutants from both standards are (NO _x , SO _x , CO, PM2.5) estimated to be 749 tons per year. Greenhouse gas emissions reduced by 0.984,000 metric tons of carbon dioxide equivalent (CO ₂ e) annually. ¹³ WASTE: Reduction in the quantity of lamps being disposed of.
2	General service LED lamps	There are no existing standards for general service LED lamps	The proposed requirements establish a standard for general service LED lamps as: $2.3 \times CRI + Efficacy \geq 298$	The regulations, by 2029, would result in annual savings of 859 gigawatt-hours (GWh) of electricity. This equates to roughly \$543 million in cumulative savings to California businesses and individuals.	EMISSIONS: Emissions reductions in criteria pollutants (NO _x , SO _x , CO, PM2.5) from both standards are estimated to be 749 tons per year. Greenhouse gas emissions reduced by 984,000 metric tons of carbon dioxide equivalent (CO ₂ e) annually.

¹³ Available at http://www.dof.ca.gov/research/economic_research_unit/SB617_regulation/Major_Regulations/documents/SRIA-CEC-LED-regs.pdf

APPENDIX B:

References

References

Order Instituting Rulemaking, Order # Order 12-0314-16, March 4, 2012; Docket # 12-AAER-, available at

http://www.energy.ca.gov/appliances/2012rulemaking/notices/prerulemaking/2012-03-14_Appliance_Efficiency_OIR.pdf

Staff Analysis of Small Diameter Directional Lamps and General Service LED Lamps, CEC-400-2015-0X, Docket # 15-AAER-6; available at

<http://www.energy.ca.gov/appliances/2015-AAER-06/rulemaking/>

Amendments to Appliance Efficiency Regulations (Express Terms), California Code of Regulations, Title 20, Sections 1601 through 1609. 2015 Appliance Efficiency Rulemaking for Small Diameter Directional Lamps and General Services LED lamps, Docket # 15-AAER-6; available at <http://www.energy.ca.gov/appliances/2015-AAER-06/rulemaking/>

Notice of Proposed Action, Proposed Amendments to Appliance Efficiency Regulations, California Code of Regulations, Title 20, Sections 1601 through 1607, October 16, 2015, Docket # 15-AAER-6; available at <http://www.energy.ca.gov/appliances/2015-AAER-06/rulemaking/>

Initial Statement of Reasons, Proposed Amendments to Appliance Efficiency Regulations, California Code of Regulations, Title 20, Sections 1601 through 1607, October 16, 2015, Docket # 15-AAER-6; available at

<https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=15-AAER-06>

“Standardized Regulatory Impact Assessment of 2015 Proposed Appliance Efficiency Regulations” available at

http://www.dof.ca.gov/research/economic_research_unit/SB617_regulation/Major_Regulations/documents/SRIA-CEC-LED-regs.pdf

Small Diameter Directional Lamps, Codes and Standards Enhancement (CASE) Initiative Docket #12-AAER-2B available at

http://www.energy.ca.gov/appliances/2013rulemaking/documents/proposals/12-AAER-2B_Lighting/California_IOUs_Small_Diameter_Directional_Lamps_Addendum_to_CASE_Report_2014-08-06_TN-73551.pdf

Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products Part 2: LED Manufacturing and Performance June 2012 Available at

http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_led_lca-pt2.pdf

Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products Part 3: LED Environmental Testing available at

http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2013_led_lca-pt3.pdf

Potential Environmental Impacts from the Metals in Incandescent, Compact Fluorescent Lamp (CFL), and Light-Emitting Diode (LED) Bulbs, Environmental Science & Technology, vol. 47, No. 2, (2013). Available at <http://pubs.acs.org/doi/abs/10.1021/es302886m>.

Potential Environmental Impacts of Light-Emitting Diodes (LEDs): Metallic Resources, Toxicity,

and Hazardous Waste Classification, Environmental Science & Technology, Vol. 45, No. 1 (2011). Available at <http://pubs.acs.org/doi/pdf/10.1021/es101052q>.

APPENDIX C: Glossary of Terms

CO – Carbon Monoxide, a gas generated from incomplete combustion processes including fossil fuel combustion. The primary concern is the effect of chronic low emission levels on local air quality, as contrasted with the potential acute health hazard posed by direct inhalation of concentrated CO.

CO₂ – Carbon Dioxide, a gas generated from normal combustion processes including fossil fuel combustion. Primary concern is its effect on global climate change.

General service light-emitting diode (LED) lamp – A lamp using LED technology that is intended for general illumination of an area.

Gigawatt-hour (GWh) – One thousand megawatt-hours, or one million kilowatt-hours, or one billion watt-hours of electrical energy.

Light-emitting diode (LED) – A p-n junction solid state device, the radiated output of which is a function of the physical construction, material used, and exciting current of the device.

Megawatt (MW) – One thousand kilowatts, or one million watts of power.

NO_x – Oxides of nitrogen, usually NO and NO₂, which are gases generated from incomplete combustion processes including fossil fuel combustion. Primary concern is as a chief component of air pollution, contributing specifically to ground-level ozone (O₃), smog, and acid rain (through formation of nitric acid).

PM₁₀ – Solid particulate matter defined as having a mean aerodynamic diameter of 10 microns or smaller. Generally considered pollutants, particulates are released from combustion processes in exhaust gases including those generated by fossil fuel plants, by mobile sources such as automobiles, and by other fugitive particle sources.

PM_{2.5} – Solid particulate matter defined as having a mean aerodynamic diameter of 2.5 microns or smaller. Similar in most respects to PM₁₀ but with somewhat different effects on biology and health.

Small diameter directional lamp (SDDL) – A directional lamp with a diameter of 2.25 inches or less.

SO_x – Sulfur oxides, a group of gases generated from the combustion of sulfur. Trace quantities of sulfur are found in virtually all fossil fuels, and are combusted when the fuels are burned. Primary concern is as the pollutant primarily responsible for acid rain (through formation of sulfuric acid).