

Proposal Information Template for:

General Purpose Lighting

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Proposal Information– General Purpose Lighting

2008 Appliance Efficiency Standards

CONTENTS

Purpose	2
Methodology.....	3
Bibliography and Other Research.....	6

Purpose

This document is a report template to be used by researchers who are evaluating proposed changes to the California Energy Commission’s (Commission) appliance efficiency regulations (Title 20, Cal. Code Regs, §§ 1601 – 1608). This report specifically covers general purpose lighting.

Overview

Description of Standards Proposal	This brief report covers general purpose lighting options for CEC. Given that newly-adopted federal standards essentially pre-empt California’s Title 20 authority to regulate most general service lighting technologies, this document reviews potential energy savings and economic analysis of adopting the federal Tier 1 standards a year early and Tier 2 standards two years early—as permitted by EISA 2007.
California Stock	PG&E, through its sub-contractor, Ecos, has estimated that California has 437 million light sockets in residential dwellings in 2007.
Energy Savings and Demand Reduction	Federal standards call for increasing the number of lumens produced by 100, 75, 60, and 40 W light bulbs in 2012, 2013, 2014, and 2014 respectively. Potential cumulative energy savings from early implementation of federal standards are between 2,142 and 2,522 GWh for Tier 1 and approximately 3,755 GWh per year for Tier 2. Corresponding peak demand reduction between 61.14 and 78.71 MW for Tier 1 and 65.71 MW for Tier 2, as detailed in Tables 1 and 2 below.
Economic Analysis	Relative costs to consumers are between \$.80 and \$2.00 per bulb, incremental cost, net of present valued savings, with a cost of saved energy between \$0.026 and 0.045, as detailed below, in Tables 1 & 2. The standard is cost effective for all lumen ranges in both the optimistic and pessimistic scenarios. The lifecycle benefit/cost ratio ranges from 2.2 to 3.9 for Tier 1; and from 3.1 to 4.5 for Tier 2.
Non-Energy Benefits	Non-energy benefits are diverse and well-documented elsewhere, including reduced pollution, longer-life lighting technologies, and life cycle cost savings.

<p>Environmental Impacts</p>	<p>Adoption of efficient lighting technologies generally has positive impacts on landfill volume, but also some complex issues surrounding the mercury in CFLs. The mercury impact is more than offset by the reductions in mercury emissions from coal-fired power plants, even at California’s relatively low use of coal. However, these reductions are outside of California, whereas some increase in mercury due to adoption of CFLs will occur within California.</p>
<p>Acceptance Issues</p>	<p>Acceptance issues will likely include incremental first costs, potential consumer perceptions due to lower lumen output resulting from manufacturers’ offering of compliant bulbs at the lower ranges of each lumen bin.</p>
<p>AB 1109 (California Lighting Efficiency and Toxics Reduction Act)</p>	<p>Meeting AB1109 requirements for indoor, residential lighting will probably require 50% or higher market penetration by CFLs. This could possibly be accomplished by early-adoption of federal Tier 1 and 2 lighting standards, if consumer trends move purchasing and implementation beyond the standards.</p>
<p>Federal Pre-emption or other Regulatory or Legislative Considerations</p>	<p>Federal pre-emption largely eliminates California’s ability to adopt more stringent standards for lighting. However, early adoption of the federal standards would achieve significant savings of electricity.</p>

Methodology

PG&E’s sub-contractors Energy Solutions and Ecos analyzed the potential benefits to California of adopting the federal EISA Tier 1 standards a year early, and Tier 2 standards two years early. The numbers shown in Figures 1 and 2 (below) are for the residential lighting sector only.

Assumptions:**2011:**

- Base case wattages reflect impact of California Tier 2 standards and also accounts for non-compliant and modified spectrum bulbs on the market
- Standards wattages reflect impact of complying with federal Tier 1 standards one year early, but some lapses in compliance and continued sales of exempted lamp models
- Standards wattages rise in pessimistic scenario primarily to reflect bin jumping
- Lamp lifetimes go up in the pessimistic scenario, because dimmer lamps last longer
- Incremental costs are rough estimates, reflecting present cost of CFL and Halogena products and longer lifetimes of the efficient models than conventional incandescents, reducing the need to purchase more lamps in the future.
- Residential electricity costs based on CEC rate forecast for 2011-2014
- Previous Ecos modeling for PG&E yielded the estimate of 25% market share for CFLs in California, divided by lumen bin based on mfr-reported data at the CEC
- Unit % sales of incandescents in the future estimated from lumen bin shares remaining the same in optimistic scenario, but shifting toward brighter lamps in the pessimistic scenario
- Absolute unit sales estimated at 11% of national sales previously estimated for EPA based on internal Ecos model of lighting manufacturing and imports
- Demand reduction estimates based on 7% of lamps operating during peak periods.
- Note that only the 4th lumen bin's savings would occur in 2011, only the 3rd bin's savings would occur in 2012, and the 1st and 2nd bins savings would occur in 2013 from accelerating federal standards by one year.

2018:

- Base case wattages reflect impact of federal Tier 1 standards and assume full compliance by all technologies with no exempted products.
- Standards wattages reflect impact of complying with federal Tier 2 standards two years early.
- Standards wattages assume fixed 45 lm/W requirements across the full light output range and assumed light output levels as shown below:
- Average Standards Bulb Watts: 600 lm; 900 lm; 1300 lm; 2100 lm; in order to make compliance with fixed lm/W easier.
- Lamp lifetimes roughly double (to 4,000 hours) due to the prevalence of CFL and solid state lamps in the compliant mix.
- Incremental costs are merely an educated guess--it is impossible to forecast CFL and solid state lighting prices in 10 years.
- Residential electricity costs based on CEC rate forecast for 2018 and 2019.
- No attempt has been made to account for sales and installation over the course of the year 2018.
- Absolute unit sales estimated at 11% of national sales recognizing that as lamp life increases, total sales go down.
- Absolute Unit Sales: # of light bulbs purchased, adjusted for population and other growth factors, divided by average % increase in lifetime.

Table 1. Lifetime Energy Savings from One Year's Worth of Light Bulb Sales — 2011

Optimistic Scenario (Minimal Dimming, Bin Jumping, and Sales of Excluded Products)

Lumen Ranges	310 to 749	750 to 1049	1050 to 1489	1490 to 2600	TOTAL
Avg. Base Case Bulb Watts	38.5	58	72	96.5	65.9
Avg. Standards Bulb Watts	30	44	55	74	50.3
Net Wattage Savings per Bulb	8.5	14	17	22.5	15.6
Average Inc Lifetime (hours)	2,500	2,500	2,000	2,000	2296
Avg. Lifetime kWh Savings per Bulb	21.25	35	34	45	35
Incremental Cost	\$0.80	\$0.90	\$1.00	\$1.25	\$1.00
Cost of Saved Energy	\$0.038	\$0.026	\$0.029	\$0.028	\$0.028
Lifetime cost Savings @ \$0.010/kWh)	\$2.13	\$3.50	\$3.40	\$4.50	\$3.49
Lifecycle Benefit/Cost ratio	2.7	3.9	3.4	3.6	3.5
Unit Sales % Incandescent (2007)	9.7%	34.4%	16.3%	14.2%	75%
Unit Sales % Incandescent (2011-13)	9.1%	32.3%	15.3%	13.3%	70%
Absolute Unit Sales (millions/yr)	9.40	33.33	15.79	13.76	72.27
Total Lifetime GWh Savings	200	1,166	537	619	2,522
Total MW Demand Impact	5.59	32.66	18.79	21.67	78.71

Pessimistic Scenario (Extensive Dimming, Bin Jumping, and Sales of Excluded Products)

Lumen Ranges	310 to 749	750 to 1049	1050 to 1489	1490 to 2600	TOTAL
Avg. Base Case Bulb Watts	38.5	58	72	96.5	69.4
Avg. Standards Bulb Watts	32	48	60	79	57.3
Net Wattage Savings per Bulb	6.5	10	12	17.5	12.1
Average Inc Lifetime (hours)	2,750	2,750	2,250	2,250	2511
Avg. Lifetime kWh Savings per Bulb	17.9	27.5	27.0	39.4	29.6
Incremental Cost	\$0.80	\$0.90	\$1.00	\$1.25	\$1.04
Cost of Saved Energy	\$0.045	\$0.033	\$0.037	\$0.032	\$0.034
Lifetime cost Savings @ \$0.010/kWh)	\$1.79	\$2.75	\$2.70	\$3.94	\$2.96
Lifecycle Benefit/Cost ratio	2.2	3.1	2.7	3.2	2.9
Unit Sales % Incandescent (2007)	9.7%	34.4%	16.3%	14.2%	75%
Unit Sales % Incandescent (2011-13)	6.5%	30.0%	15.0%	18.5%	70%
Absolute Unit Sales (millions/yr)	6.71	30.97	15.49	19.10	72.27
Total Lifetime GWh Savings	120	852	418	752	2,142
Total MW Demand Impact	3.05	21.68	13.01	23.40	61.14

Table 2. Lifetime Energy Savings from One Year's Worth of Light Bulb Sales—2018

Lumen Ranges	310 to 749	750 to 1049	1050 to 1489	1490 to 2600	TOTAL (Wt. Avg.)
Avg. Base Case Bulb Watts	29	43	53	72	48.9
Avg. Standards Bulb Watts	13.3	20	28.9	46.7	26.2
Net Wattage Savings per Bulb	15.7	23	24.1	25.3	22.7
Average New Lamp Lifetime (hours)	4,000	4,000	4,000	4,000	4000
Avg. Lifetime kWh Savings per Bulb	62.8	92	96.4	101.2	91
Incremental Cost	\$2.00	\$2.00	\$2.00	\$2.00	\$2.00
Cost of Saved Energy	\$0.032	\$0.022	\$0.021	\$0.020	\$0.022
Lifetime cost Savings @ \$0.010/kWh)	\$6.28	\$9.20	\$9.64	\$10.12	\$9.09
Lifecycle Benefit/Cost ratio	3.1	4.6	4.8	5.1	4.5
Unit Sales % Incandescent (2007)	9.7%	34.4%	16.3%	14.2%	75%
Unit Sales % Incandescent (2011-13)	9.1%	32.3%	15.3%	13.3%	70%
Unit Sales % Qualifying Lamps (2018)	9.1%	32.3%	15.3%	13.3%	70%
Absolute Unit Sales (millions/yr)	5.37	19.04	9.02	7.86	41.3
Total Lifetime GWh Savings	337	1,752	870	796	3,755
Total MW Demand Impact	5.90	30.66	15.22	13.92	65.71

Recommendations

1. Adopt federal Tier 1 standards to take effect one year early, 1/1/2011.
2. Adopt federal Tier 2 standards to take effect two years early, 1/1/2018.

Bibliography and Other Research

http://energy.ca.gov/appliances/2008rulemaking/documents/2008-01-15_workshop/presentations/Calwell_Chris_Presentation.pdf