
DRAFT Proposal Information Template for:
Candelabra Base, Three-way and High Lumen Lamps

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Please note: all savings estimates and information in this document are preliminary and are based on data available to the authors at the time of the report. PG&E plans to submit an updated template with greater detail for the Energy Commission's consideration within the next few weeks.

Proposal Information Template – Candelabra Base, Three-way and High Lumen Lamps

2011 Appliance Efficiency Standards

Prepared for: Pacific Gas and Electric Company,

This is a draft information template with preliminary findings on the energy savings opportunity associated with candelabra base, three-way and high lumen lamps. A final template will be submitted to the Energy Commission before the end of October to further document the standards opportunity.

CONTENTS

Purpose	2
Background	2
Overview	2
Methodology and Modeling used in the Development of the proposal	4
Data, Analysis, and Results	6
Proposed Standards and Recommendations	6
Bibliography and Other Research	6
References and Appendices	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 Regulations,, §§ 1601 – 1608) This report specifically covers three lamp types: candelabra base, high lumen (2601-3300 lumens) and three-way.

Background

The Energy Independence and Security Act (EISA) of 2007 created federal mandatory efficiency standards for general service incandescent lamps. Some types of incandescent lamps were excluded from immediate federal regulation. Three lamps found in residential buildings, candelabra base, high lumen and three-way lamps, present an attractive savings opportunity for California because higher-efficiency incandescent technologies already employed in general service can likely be employed in these lamp types. Candelabra base lamps have smaller than typical general service lamp bases and are often employed in chandelier and decorative applications. High lumen lamps are “high brightness” and are often employed in applications where a relatively lower density of sockets are present to illuminate large areas. Three-way lamps have three “brightness” settings and are common in table top lamps where multiple levels of light are desired.

We propose that California consider mandatory incandescent lamp standards to increase efficiency of candelabra base, high lumen and three-way lamps. The standard focuses on increasing the efficiency of the incandescent technology, and does not require a move to alternative technologies, such as CFL (compact fluorescent lamp) or LED (light-emitting diode). Each lamp type is subject to a different EISA-like efficiency requirement.

Overview

Description of Standards Proposal	Three unique EISA-like efficiency standards for the three incandescent lamp types: candelabra base, high lumen (2601-3300 Lumens) and three-way. The stringency level is chosen to encourage higher efficiency incandescent technology. CFL and LED technology would not be required to meet the levels proposed.
California Stock and Sales	We estimate current stock in California for all three types of lamps to be 57.4 million in total. Candelabra base: 53.7 million, three-way: 3.0 million, and high-brightness: 0.7 million
Energy Savings and Demand Reduction	<i>Per unit annual energy savings:</i> candelabra base: 9.2 kWh/yr to 11.5 kWh/yr, three-way: 11 kWh/yr to 31 kWh/yr, high lumen: 60 kWh/yr <i>Annual energy savings after stock turnover:</i> 622 GWh/yr to 806 GWh/yr in total; candelabra base: 514 GWh/yr to 642 GWh/yr, three-way: 40 GWh/yr to 116 GWh/yr, high lumen: 48 GWh/yr. Collective peak demand reduction is approximately 70 – 100 MW, using the applicable multiplier from Brown and Koomey (2002).
Economic Analysis	[To be completed in final version.]
Non-Energy Benefits	[To be completed in final version.]
Environmental Impacts	[To be completed in final version.]
Acceptance Issues	[To be completed in final version.]
Federal Preemption or other Regulatory or Legislative Considerations	These three lamps are not immediately covered by federal standards created in EISA 2007, and thus may be covered by the state of California. Three-way and high-brightness could be covered in the future by EISA 2007 if the numbers of these types of lamps increase. The DOE recently opened a rulemaking for “luminaires”, whose scope is not yet decided upon, but could include candelabra base. The earliest that this DOE standard would go into effect would be 2017/2018.

Methodology and Modeling used in the Development of the proposal

The values used to create an estimate of savings potential are summarized below. Notes below the table give rationale, methods and sources for the values presented.

Lamp Type	Estimated CA Installed Stock (in millions)	Duty Cycle (hrs/yr)	Baseline Power (W)	Replacement Wattage	% Stock Incandescent (after turnover)	Stock Turnover Savings Estimate (GWh/yr)
Candelabra base	53.7	1095	30-37.5*	21.6-27*	85%	514-642
Three-way	3.0	1095*	30-70-100	20-53-72	90%	40-116
High lumen	0.7	1095	150	95	95%	48

*A range of values is used for this parameter. Please see notes below.

Candelabra base lamp sources and methods

Estimated California Installed Stock – NEMA sales data on this lamp type is unavailable; however, KEMA (KEMA, 2010) recently published a California-based residential lighting survey that determined that approximately 11% of household sockets are “mini screw-based” which we assumed to be candelabra base lamps. We assumed that each household has a total of 41 sockets (RLW Analytics, 2005), giving us ~ 4 lamps per household. We then multiplied this by the number of households in California (2009 Census).

Duty Cycle – 3 hrs/day, 365 days a year. Due to the prevalence of this lamp type being used on dimmer circuits, we assumed that the lamps operate 1.5 hours/day at full power, and 1.5 hours/day dimmed at equivalent of 50% power.

Installed Stock Baseline Wattage – We used two different baselines to represent a range of energy savings. The most common wattages of candelabra base lamps are 25, 40, and 60 W. For the first baseline scenario, we assumed that 50% of current stock is 25 W, 25% are 40 W, and 25% are 60 W in (CALiPER 2008). The weighted average of this comes out to 37.5 W, which is what we used as the first baseline. For the second baseline, we used 30.0 W as the weighted average power per lamp. This scenario assumes more than 50% of the stock is 25 W lamps, the lowest common lamp wattage.

Replacement Wattage – We used 27 W and 22 W as the replacement lamp for the two baseline scenarios, which was calculated using the same weighted average above with 18, 29, 43 W as EISA replacements (note that the 18 W replacement comes from reducing 25 W by 28%, which is the average power reduction of the EISA general service requirements).

% Stock Incandescent (after turnover) – LEDs are starting to make inroads in this product category, so we assumed that 85% of the current stock would remain incandescent after the standard.

Three-way lamp data sources and methods

Estimated California Installed Stock - The estimated installed stock in California was derived from NEMA U.S. three-way lamp sales data (EERE, 2010) scaled to California by the number of households (2009 census). This resulted in approximately one three-way lamp per every 5 households.

Duty Cycle – We were unable to locate any data on the duty cycle of three-way lamp types by wattage setting, so we employed a range for the savings estimate. We first calculated the annual energy if the lamp operates 3 hrs/day, 365 days/yr at the lowest wattage (30 W) setting and then the same calculation for the highest wattage setting. We then multiplied these values by the estimated installed stock to develop an estimated range for the savings potential for three-way lamps.

Installed Stock Baseline Wattage - For the current baseline wattage there are a few different lamps available with the most common being; 30 – 70 – 100 W, 50 – 100 – 150 W, 100 – 200 – 300 W. For the purposes of this analysis we chose the 30 – 70 – 100 W types as the current baseline to provide a conservative preliminary savings estimate. Further research into the existing baseline of three-way lamps will be conducted prior to submission of a complete proposal.

Replacement Wattage – We assumed that a 20 – 53 – 72 W lamp would replace the existing baseline lamp. This aligns with the general service incandescent lamp requirements of EISA.

% Stock Incandescent (after turnover) – Since many efficiency programs are promoting three-way CFLs, we assumed that 90% of the existing stock would remain incandescent and 10% would go to CFLs.

High lumen lamps data sources and methods

Estimated California Installed Stock – This was performed similarly to three-way above. NEMA sales data was scaled to California by number of households. This resulted in approximately one high lumen lamp per 20 households.

Duty Cycle – We assumed that high lumen output lamps are used 3 hrs/day, 365 days a year.

Installed Stock Baseline Wattage - We assumed that the baseline wattage is 150 W. Currently available incandescent lamps in this lumen range span from 140 to 170 W.

Replacement Wattage – We used the backstop requirement for this lamp type in EISA which is a maximum of 95 W.

% Stock Incandescent (after turnover) – We assumed that a small percentage (5%) of this lamp type would migrate to CFLs. Low transition to CFL due to the large sizes of CFLs currently in this lumen range.

Data, Analysis, and Results

[To be completed in final version.]

Proposed Standards and Recommendations

[To be completed in final version.]

Bibliography and Other Research

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References and Appendices

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