

DOCKETED

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Staff Workshop

Analysis of General Service Lamps (Expanded Scope)

2018 Appliance Efficiency Pre-Rulemaking

Docket Number 17-AAER-07



Patrick Saxton
August 28, 2018
California Energy Commission



Submitting Written Feedback

- Comments due by 5:00 p.m. September 17, 2018
- To submit electronically:
 - <http://www.energy.ca.gov/appliances/2017-AAER-07/>
 - Click on “Submit eComment”
- To send a hard copy:
 - California Energy Commission
 - Dockets Office, MS-4
 - Re: Docket No. 17-AAER-07
 - 1516 Ninth Street
 - Sacramento, CA 95814-5512
- To send a digital copy: e-mail docket@energy.ca.gov, include docket number 17-AAER-07



Purpose

- Align definitions related to General Service Lamps (GSLs) in the California Appliance Efficiency Regulations with the U.S. Department of Energy (DOE) definitions from two January 19, 2017, Final Rules
- California's existing GSL standard (45 lumens per watt) (lpw) would apply to these definitions for lamps sold on or after January 1, 2020
- New definition and standard (45 lpw) for low-lumen lamps manufactured on or after January 1, 2020



2006-2016

2004

CA adopts
GSIL
standards

2007

Energy
Independence and
Security Act defines
GSL and sets
2 tiers of lamp
standards

2008

CA adopts Tier 1
and Tier 2 of
EISA

2011

Tier 1 takes
effect in
California

2012

Tier 1 takes
effect
nationally

2012

Burgess Rider
prohibits DOE
from implementing
GSIL standards

2014

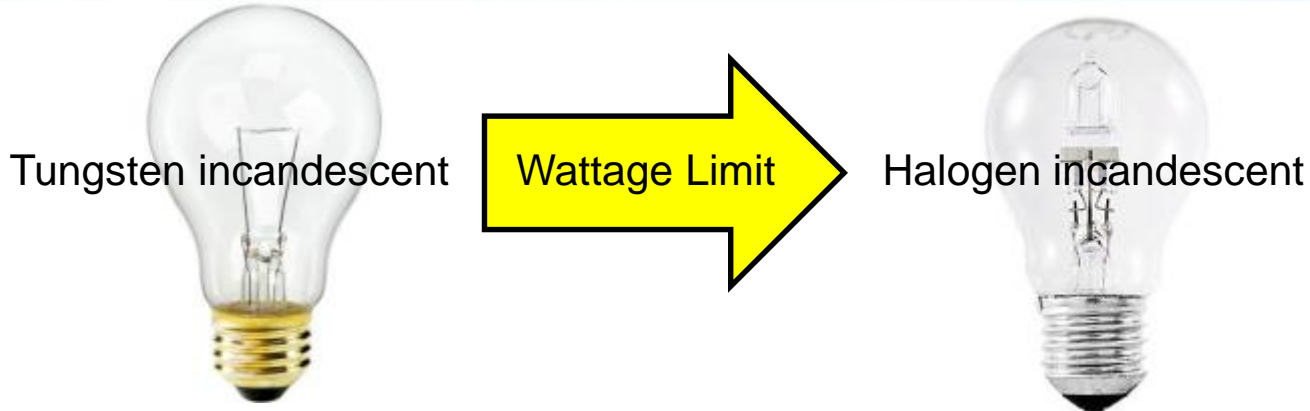
DOE begins GSL
rulemaking –
**Backstop
triggered**

2016

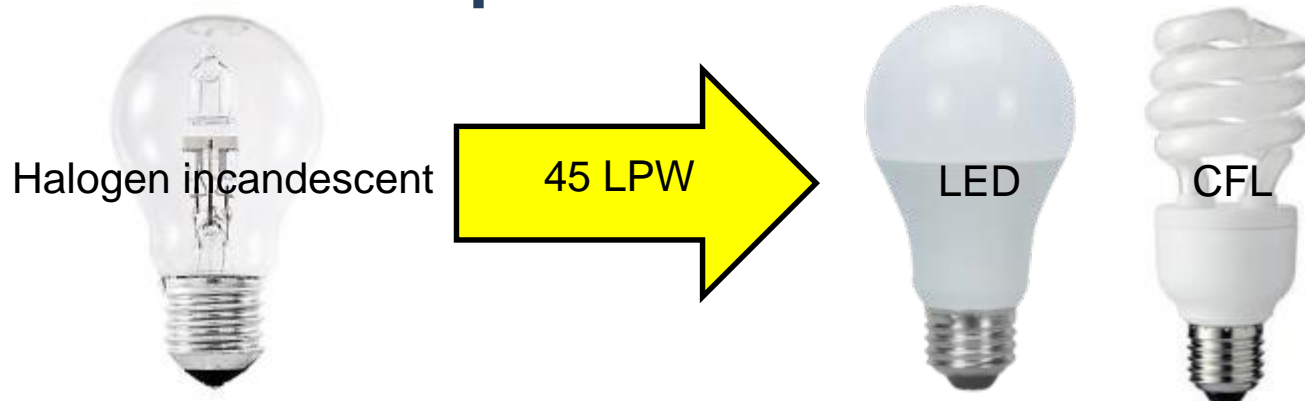
CA adopts
LED and SDDL
standards



EISA Tier 1: Wattage Limits on GSILs



EISA Tier 2: 45 lumens per watt for GSILs





2017

Jan 19

DOE amends
GSL definitions
(no standards)

Mar 15

NEMA sues
DOE

Apr 21

CEC begins
rulemaking on
GSLs scope

Jul 7

NEMA v.
DOE settles

Aug 4

NEMA sues
CEC

2018

Jan 1

CA LED, SDDL,
Tier 2 GSL
standards take
effect

Apr 10

NEMA withdraws
lawsuit against
CEC

Jul 13

DOE proposed
rule related to
GSLs at OMB

Aug 3

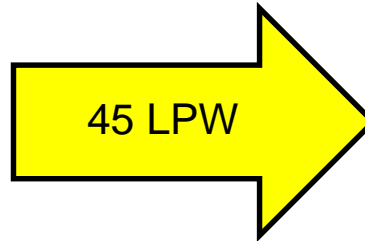
CEC publishes
staff report on
GSLs



DOE Definitions: Expanded GSL scope



Incandescent



Fluorescent or LED



California GSL Implementation



- GSL – only LED or CFL can meet 45 lpw
- Additional requirements for state-regulated LED lamps



- Not GSLs – no 45 lpw
- Federal standards apply to some lamps
- Additional requirements for state-regulated LED lamps



Staff Proposal

- Align state definitions with DOE Final Rules
 - Expands scope of existing state GSL 45 lpw standard
 - Align with EISA sales prohibition on January 1, 2020
- Low-lumen lamps defined
 - Lumen range 150 to 310
 - Otherwise meets definition of GSL (base, shape, etc.)
 - Minimum efficacy 45 lpw
 - Effective January 1, 2020
 - Based on date of manufacture



Staff Proposal

- State-regulated LED lamps
 - Maintain all requirements
 - Many are GSLs under expanded scope
 - Not LED downlight retrofit kits
- State-regulated small-diameter directional lamps
 - Maintain all requirements
 - Many are GSLs under expanded scope



Impact of Staff Proposal

- **Existing** 45 lpw standard applies to additional lamp types
- New 45 lpw standard applies to low-lumen lamps
- LED or fluorescent technologies only
- Examples of lamps subject to 45 lpw





Draft Proposed Regulatory Language – **1602(k)**

- Split section 1602(k) into two subsections
 - 1602(k)(1) for GSLs sold before January 1, 2020, and all other lamps
 - Move entire current section with no changes
 - 1602(k)(2) for GSLs sold on or after January 1, 2020, and low-lumen lamps
 - New and amended definitions from this rulemaking
 - Aligning amended definitions with DOE Final Rules
 - Only including most relevant in presentation
 - All can be found in staff report chapter 10



Draft Proposed Regulatory Language – **1602(k)(2)**

- “Designed and marketed” means exclusively designed to fulfill the indicated application and, when distributed in commerce, designated and marketed solely for that application, with the designation prominently displayed on the packaging and all publicly available documents (e.g., product literature, catalogs, and packaging labels). This definition is applicable to terms related to the following covered lighting products: Fluorescent lamp ballasts; fluorescent lamps; general service fluorescent lamps; general service incandescent lamps; general service lamps; incandescent lamps; incandescent reflector lamps; medium base compact fluorescent lamps; and specialty application mercury vapor lamp ballasts.



Draft Proposed Regulatory Language – **1602(k)(2)**

- “General service light-emitting diode (LED) lamp” means an integrated or non-integrated LED lamp designed for use in general lighting applications (as defined in this section) and that uses light-emitting diodes as the primary source of light.



Draft Proposed Regulatory Language – **1602(k)(2)**

- “General service incandescent lamp” means a standard incandescent or halogen type lamp that is intended for general service applications; has a medium screw base; has a lumen range of not less than 310 lumens and not more than 2,600 lumens or, in the case of a modified spectrum lamp, not less than 232 lumens and not more than 1,950 lumens; and is capable of being operated at a voltage range at least partially within 110 and 130 volts; however this definition does not apply to the following incandescent lamps—



Draft Proposed Regulatory Language – **1602(k)(2)**

- Amended GSIL definition (continued)
 - (1) An appliance lamp;
 - (2) A black light lamp;
 - (3) A bug lamp;
 - (4) A colored lamp;
 - (5) A G shape lamp with a diameter of 5 inches or more as defined in ANSI C79.1-2002 (incorporated by reference; see 10 CFR 430.3);
 - (6) An infrared lamp;
 - (7) A left-hand thread lamp;
 - (8) A marine lamp;
 - (9) A marine signal service lamp;



Draft Proposed Regulatory Language – **1602(k)(2)**

- Amended GSIL definition (continued)
 - (10) A mine service lamp;
 - (11) A plant light lamp;
 - (12) An R20 short lamp;
 - (13) A sign service lamp;
 - (14) A silver bowl lamp;
 - (15) A showcase lamp; and
 - (16) A traffic signal lamp.



Draft Proposed Regulatory Language – **1602(k)(2)**

- “General service lamp” means a lamp that has an ANSI base; is able to operate at a voltage of 12 volts or 24 volts, at or between 100 to 130 volts, at or between 220 to 240 volts, or of 277 volts for integrated lamps (as defined in this section), or is able to operate at any voltage for non-integrated lamps (as defined in this section); has an initial lumen output of greater than or equal to 310 lumens (or 232 lumens for modified spectrum general service incandescent lamps) and less than or equal to 3,300 lumens; is not a light fixture; is not an LED downlight retrofit kit; and is used in general lighting applications.



Draft Proposed Regulatory Language – **1602(k)(2)**

- Amended GSL definition (continued)
 - General service lamps include, but are not limited to, general service incandescent lamps, compact fluorescent lamps, general service light-emitting diode lamps, and general service organic light-emitting diode lamps. General service lamps do not include:
 - (1) Appliance lamps;
 - (2) Black light lamps;
 - (3) Bug lamps;
 - (4) Colored lamps;
 - (5) G shape lamps with a diameter of 5 inches or more as defined in ANSI C79.1-2002 (incorporated by reference; see 10 CFR 430.3);



Draft Proposed Regulatory Language – **1602(k)(2)**

- Amended GSL definition (continued)
 - (6) General service fluorescent lamps;
 - (7) High intensity discharge lamps;
 - (8) Infrared lamps;
 - (9) J, JC, JCD, JCS, JCV, JCX, JD, JS, and JT shape lamps that do not have Edison screw bases;
 - (10) Lamps that have a wedge base or prefocus base;
 - (11) Left-hand thread lamps;
 - (12) Marine lamps;
 - (13) Marine signal service lamps;
 - (14) Mine service lamps;



Draft Proposed Regulatory Language – **1602(k)(2)**

- Amended GSL definition (continued)
 - (15) MR shape lamps that have a first number symbol equal to 16 (diameter equal to 2 inches) as defined in ANSI C79.1-2002 (incorporated by reference; see 10 CFR 430.3), operate at 12 volts, and have a lumen output greater than or equal to 800;
 - (16) Other fluorescent lamps;
 - (17) Plant light lamps;
 - (18) R20 short lamps;



Draft Proposed Regulatory Language – **1602(k)(2)**

- Amended GSL definition (continued)
 - (19) Reflector lamps (as defined in this section) that have a first number symbol less than 16 (diameter less than 2 inches) as defined in ANSI C79.1-2002 (incorporated by reference; see 10 CFR 430.3) and that do not have E26/E24, E26d, E26/50x39, E26/53x39, E29/28, E29/53x39, E39, E39d, EP39, or EX39 bases;
 - (20) S shape or G shape lamps that have a first number symbol less than or equal to 12.5 (diameter less than or equal to 1.5625 inches) as defined in ANSI C79.1-2002 (incorporated by reference; see 10 CFR 430.3)



Draft Proposed Regulatory Language – **1602(k)(2)**

- Amended GSL definition (continued)
 - (21) Sign service lamps;
 - (22) Silver bowl lamps;
 - (23) Showcase lamps;
 - (24) Specialty MR lamps;
 - (25) T shape lamps that have a first number symbol less than or equal to 8 (diameter less than or equal to 1 inch) as defined in ANSI C79.1-2002 (incorporated by reference; see 10 CFR 430.3), nominal overall length less than 12 inches, and that are not compact fluorescent lamps (as defined in this section);
 - (26) Traffic signal lamps.



Draft Proposed Regulatory Language – **1602(k)(2)**

- “Low-lumen lamp” means a lamp that has a lumen output of 150 lumens or greater and less than 310 lumens and otherwise meets the definition of a general service lamp.



Draft Proposed Regulatory Language – **1604(k)**

- No substantive changes to test procedures
- Clarifying edits to ensure alignment with DOE
- Maintains optional testing for state-regulated LEDs
 - Flicker
 - Audible noise
 - California Building Efficiency Standards Joint Appendix 8 (T24 JA8)
- Low-lumen lamps use same test procedures as GSLs



Draft Proposed Regulatory Language – **1605.3(k)**

- State Standards – State-Regulated General Service Lamps - Tier II

| Lumen Ranges | Minimum Lamp Efficacy | Minimum Rated Lifetime | Effective Date |
|------------------------|----------------------------------|-------------------------------|--|
| 310-2600 | 45 lumens per watt | 1,000 Hours | Jan 1, 2018 |
| <u>310-3300</u> | <u>45 lumens per watt</u> | <u>1,000 Hours</u> | <u>Sold on or after Jan 1, 2020</u> |



Draft Proposed Regulatory Language – **1605.3(k)**

- State Standards – Low-Lumen Lamps

| Lumen Ranges | Minimum Lamp Efficacy | Minimum Rated Lifetime | Effective Date |
|---------------------------------|----------------------------------|-------------------------------|--|
| <u>150≤Lumens<310</u> | <u>45 lumens per watt</u> | <u>1,000 Hours</u> | <u>Manufactured on or after Jan 1, 2020</u> |



Draft Proposed Regulatory Language – **1606**

- Certification not currently required for GSLs
 - No certification requirements proposed
 - Most GSLs required to certify under different lighting type
 - State-regulated LED lamp
 - State-regulated small diameter directional lamp
 - Federally regulated medium screw base CFL



Draft Proposed Regulatory Language – **1607**

- No new marking requirements proposed
 - Existing requirements
 - Name, model number, date of manufacture
 - Exception for lamps allows information on product packaging
 - Maintain state-regulated LED lamp marking requirements



Discussion Questions & Feedback

1. Do the definitions, test procedures, and standards align with the DOE Final Rules?
2. How can the Energy Commission make the proposed regulations clearer?
3. Should the Energy Commission require certification of GSLs? If so, what data should the Energy Commission collect?
4. Should the Energy Commission expand the marking requirements for GSLs? If so, how?



BREAK



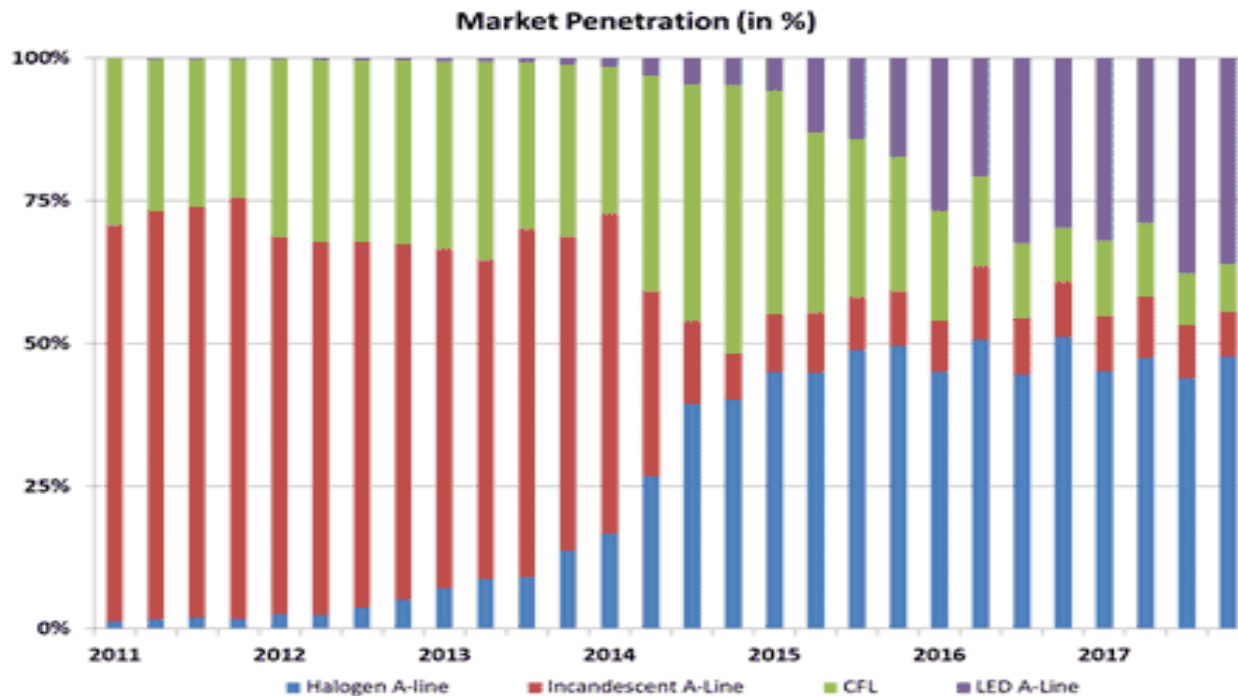
Technical Feasibility

- Four categories of lamps analyzed
 - Lamps with E12, E17, E26, or GU24 base
 - Small diameter directional lamps
 - Low-lumen lamps
 - All other GSLs
- 45 lpw standard can be met by LED or fluorescent
- Proposed newly covered lamp types either
 - High-efficiency replacements available
 - High-efficiency replacements not available but can be manufactured using existing technologies



Technical Feasibility

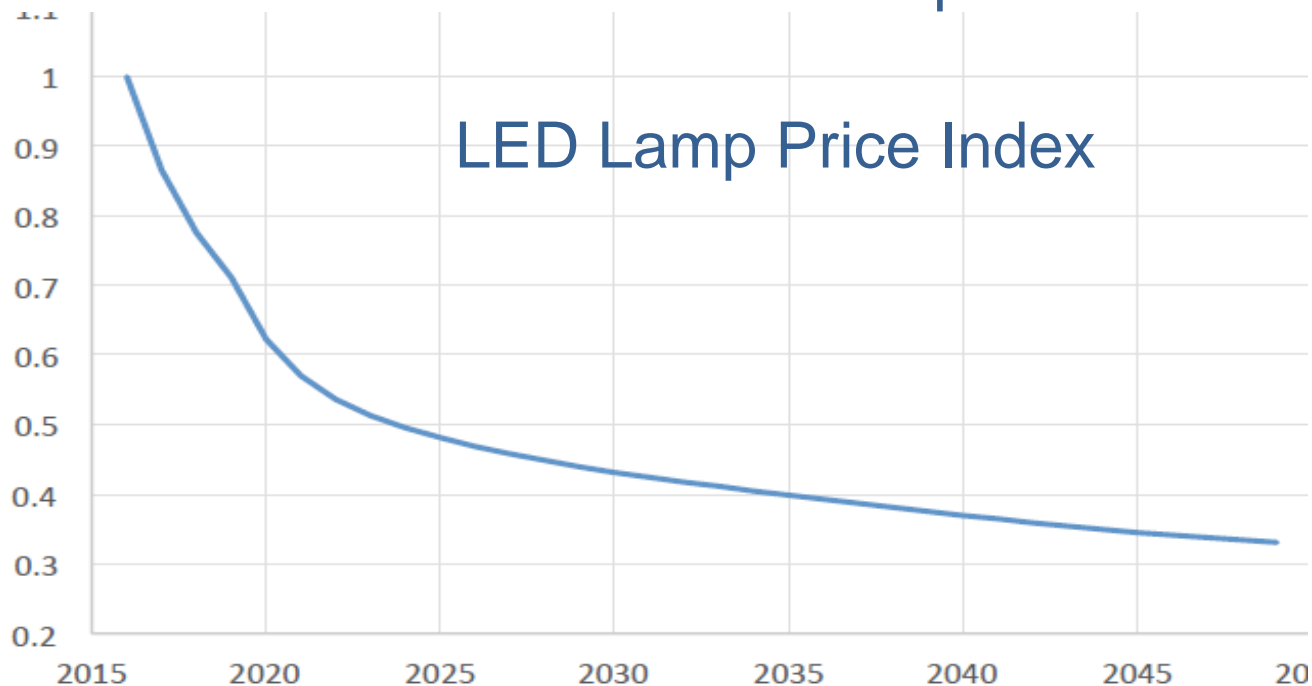
- LEDs broadly available and shipments increasing
 - 8,600+ on ENERGY STAR qualified products list (QPL)
- National shipments of A-shape lamps





Technical Feasibility

- LED cost and price declining
 - Different base or envelope shape not costly
- Thermal management and light distribution important
 - Manufacturers have abundant experience



Source: Impact of the EISA 2007 Energy Efficiency Standard on General Service Lamps (LBNL), January 2017



Technical Feasibility

- Lamps with E12, E17, E26, or GU24 base
 - LEDs found technically feasible in Commission's 2016 rulemaking
 - Many LEDs available on California retail shelves
 - CFLs available but market share declining



California Energy Commission
STAFF REPORT

Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode (LED) Lamp Efficiency Opportunities

2015 Appliance Efficiency Rulemaking
Docket Number 15-AAER-6

California Energy Commission
Edmund G. Brown Jr., Governor

October 2015 | CEC-400-2015-034





Technical Feasibility

- Small diameter directional lamps
 - LEDs found technically feasible in Commission's 2016 rulemaking
 - Many LEDs available on California retail shelves

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Technical Feasibility

- Low-lumen lamps
 - Lower light output versions of other screw base LEDs
 - Otherwise identical to GSLs
 - 440+ on ENERGY STAR QPL between 150-310 lumens





Technical Feasibility

- All other GSLs
 - Primarily distinguished by light output level, base type, form factor
 - DOE definitions explicitly exclude lamps that cannot be made with non-incandescent technology
 - High-efficacy lamps for types included in definition are inferred to be technically feasible
 - Exist in the market today
 - Clear technological pathway for manufacturing



Cost-effectiveness & Savings

- Analyzed five lamp types
 - Large-diameter reflector lamps
 - Decorative lamps
 - Globe lamps
 - EISA-exempt lamps
 - Low-lumen lamps



Cost-effectiveness & Savings

- EISA-exempt lamps
 - Rough service
 - Shatter-resistant
 - Vibration service
 - Three-way incandescent
 - 2,601-3,300 lumen GSIL
- Analysis for EISA-exempt based on three-way and 2,601-3,300 lumen
 - High incremental cost represents these two lamp types
 - Rough, vibration, shatter-resistant can be replaced with standard LED



Cost-effectiveness & Savings

| Lamp Type | Lumens | Noncompliant | | | Compliant | | |
|--------------------------|--------|-----------------|----------------|------------------|-----------------|----------------|------------------|
| | | Wattage (watts) | Efficacy (lpw) | Lifetime (hours) | Wattage (watts) | Efficacy (lpw) | Lifetime (hours) |
| Large-diameter reflector | 635 | 65 | 9.8 | 2,000 | 14.1 | 45 | 10,000 |
| Decorative | 417.5 | 50 | 8.4 | 3,000 | 9.3 | 45 | 10,000 |
| Globe | 320 | 40 | 8.0 | 3,000 | 7.1 | 45 | 10,000 |
| EISA-exempt | 1000 | 72 | 13.9 | 3,500 | 22.2 | 45 | 10,000 |
| Low-lumen | 50 | 7 | 7.1 | 3,000 | 1.1 | 45 | 10,000 |

Source: Impact of the EISA 2007 Energy Efficiency Standard on General Service Lamps and Energy Commission staff



Cost-effectiveness & Savings

| Lamp Type | Sector Share | | Daily Hours of Use | | Sector-Weighted Annual Hours of Use |
|--------------------------|--------------|------------|--------------------|------------|-------------------------------------|
| | Residential | Commercial | Residential | Commercial | |
| Large-diameter reflector | 96% | 4% | 2.9 | 10.7 | 1,172 |
| Decorative | 90% | 10% | 2.6 | 10.7 | 1,245 |
| Globe | 90% | 10% | 1.7 | 10.7 | 949 |
| EISA-exempt | 84% | 16% | 2.3 | 10.7 | 1,330 |
| Low-lumen | 100% | 0% | 8.0 | 8.0 | 2,920 |

Source: Impact of the EISA 2007 Energy Efficiency Standard on General Service Lamps, Energy Commission staff, and General Service Lamps (Expanded Scope) CASE Initiative



Cost-effectiveness & Savings

| Lamp Type | Annual Electricity Usage (kWh) | | Electricity Savings (kWh) | |
|--------------------------|--------------------------------|-----------|---------------------------|----------|
| | Noncompliant | Compliant | Annual | Lifetime |
| Large-diameter reflector | 76.2 | 16.5 | 59.7 | 509 |
| Decorative | 62.2 | 11.5 | 50.7 | 407 |
| Globe | 38.0 | 6.7 | 31.2 | 329 |
| EISA-exempt | 95.8 | 29.6 | 66.2 | 498 |
| Low-lumen | 20.4 | 3.2 | 17.2 | 59 |

Source: Energy Commission staff



Cost-effectiveness & Savings

| Lamp Type | Lamp Cost | | Incremental Cost of Compliant Lamp |
|--------------------------|--------------|-----------|------------------------------------|
| | Noncompliant | Compliant | |
| Large-diameter reflector | \$2.33 | \$3.33 | \$1.00 |
| Decorative | \$1.24 | \$5.82 | \$4.58 |
| Globe | \$2.32 | \$6.32 | \$4.00 |
| EISA-exempt | \$1.99 | \$16.97 | \$14.98* |
| Low-lumen | \$1.25 | \$2.50 | \$1.25 |

Source: Impact of the EISA 2007 Energy Efficiency Standard on General Service Lamps and Energy Commission staff

* Compliant EISA-exempt cost based on three-way 2,601-3,300 lumen lamps



Cost-effectiveness & Savings

| Lamp Type | Net Monetary Savings for Single Lamp | |
|--------------------------|--------------------------------------|-----------|
| | First-Year | Lifecycle |
| Large-diameter reflector | \$9.96 | \$90.90 |
| Decorative | \$4.60 | \$61.00 |
| Globe | \$1.65 | \$50.69 |
| EISA-exempt | -\$3.16 | \$54.64 |
| Low-lumen | \$1.94 | \$11.77 |

Source: Energy Commission staff

Residential \$0.1855 per kWh
Commercial \$0.1421 per kWh



Cost-effectiveness & Savings

- Statewide savings estimates dependent on existing stock and shipments assumptions
- LED shipments increased by 10 percent annually

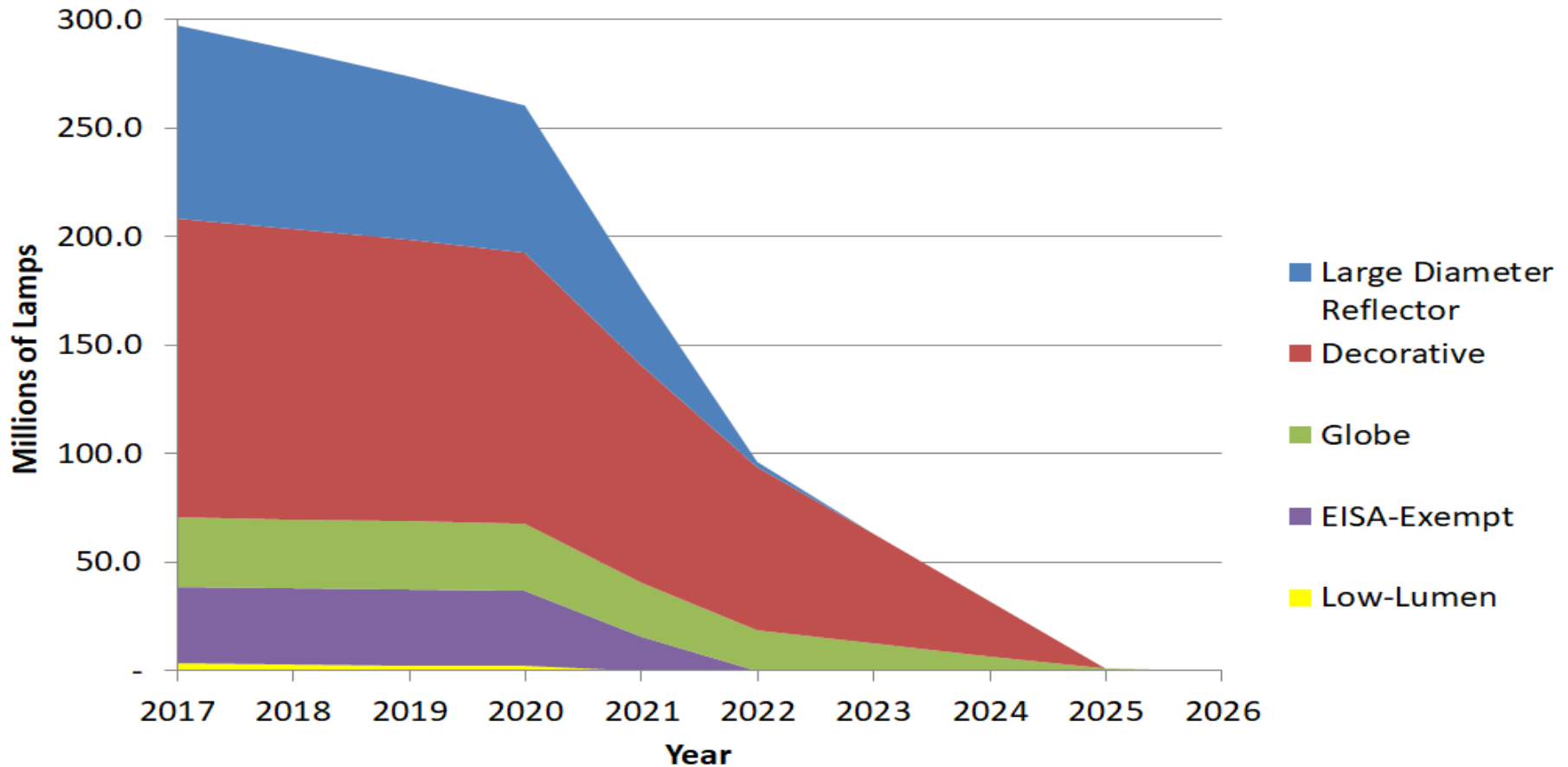
| Lamp Type | 2020 Low-Efficacy Stock | 2020 Shipments by Light Source | |
|--------------------------|-------------------------|--------------------------------|-----|
| | | Incandescent | LED |
| Large-diameter reflector | 67,400,000 | 80% | 20% |
| Decorative | 125,200,000 | 85% | 15% |
| Globe | 30,400,000 | 90% | 10% |
| EISA-exempt | 35,000,000 | 100% | 0% |
| Low-lumen | 2,000,000 | 85% | 15% |

Source: Energy Commission staff



Cost-effectiveness & Savings

- Existing stock of low-efficacy lamps

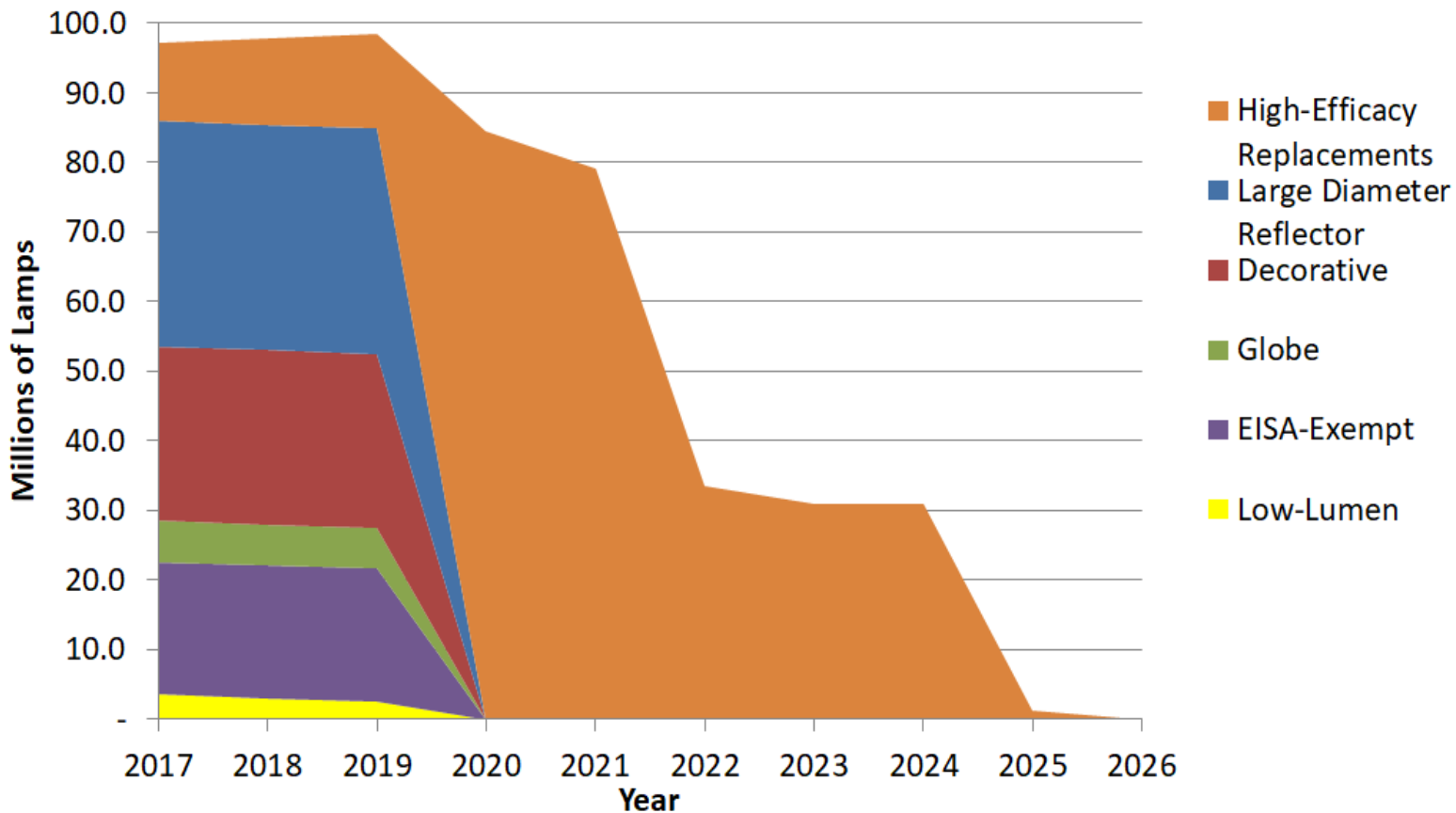


Source: Energy Commission staff



Cost-effectiveness & Savings

- Replacement low-efficacy lamp shipments only
- New construction and CFL/LED replacements not included



Source: Energy Commission staff



Cost-effectiveness & Savings

| Lamp Type | Statewide Annual Savings (GWh) | | Statewide Annual Net Monetary Savings (\$millions) | |
|--------------------------|--------------------------------|----------------------|--|----------------------|
| | First-Year | After Stock Turnover | First-Year | After Stock Turnover |
| Large-diameter reflector | 1,933 | 4,018 | \$323 | \$738 |
| Decorative | 1,267 | 6,345 | \$115 | \$1,149 |
| Globe | 184 | 950 | \$10 | \$172 |
| EISA-exempt | 1,265 | 2,317 | -\$60 | \$414 |
| Low-lumen | 35 | 35 | \$4 | \$6 |
| Total | 4,684 | 13,666 | \$391 | \$2,480 |

Source: Energy Commission staff



Data Request

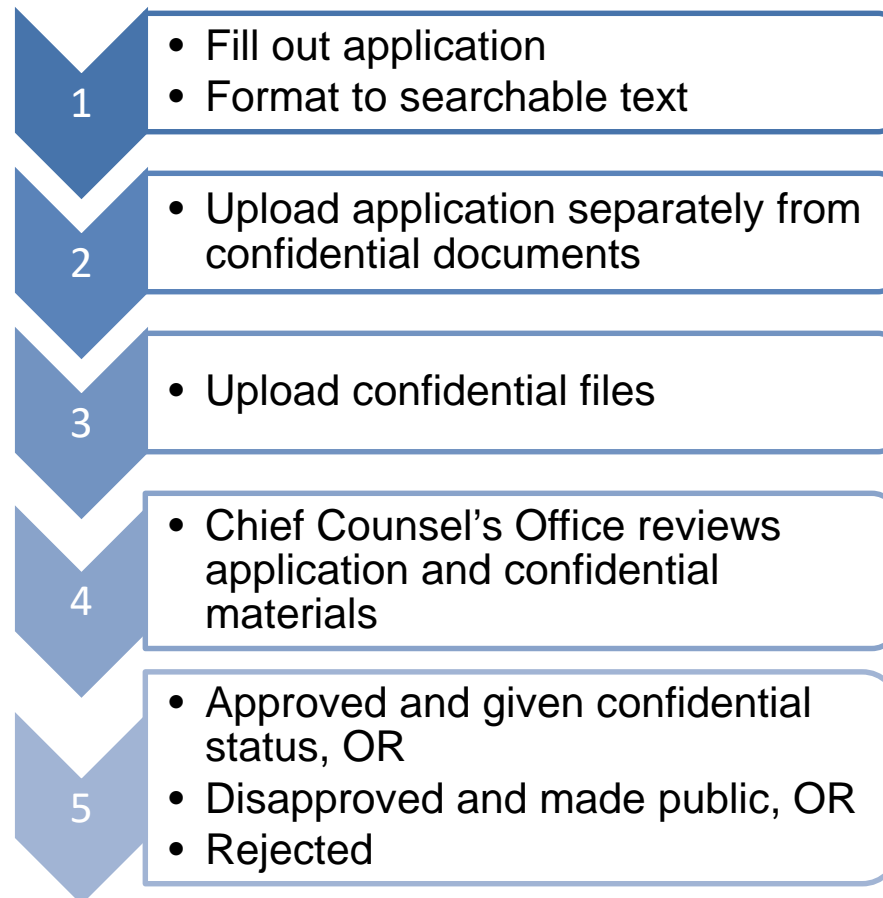
- National LED market share may not reflect California market share
 - California specific existing stock of low-efficacy lamps
 - California specific shipments of low-efficacy lamps
 - California specific shipments of LED lamps
- Updated LED pricing and availability in California



Submitting Confidential Data

Request a document or data be given confidential status

Method 1

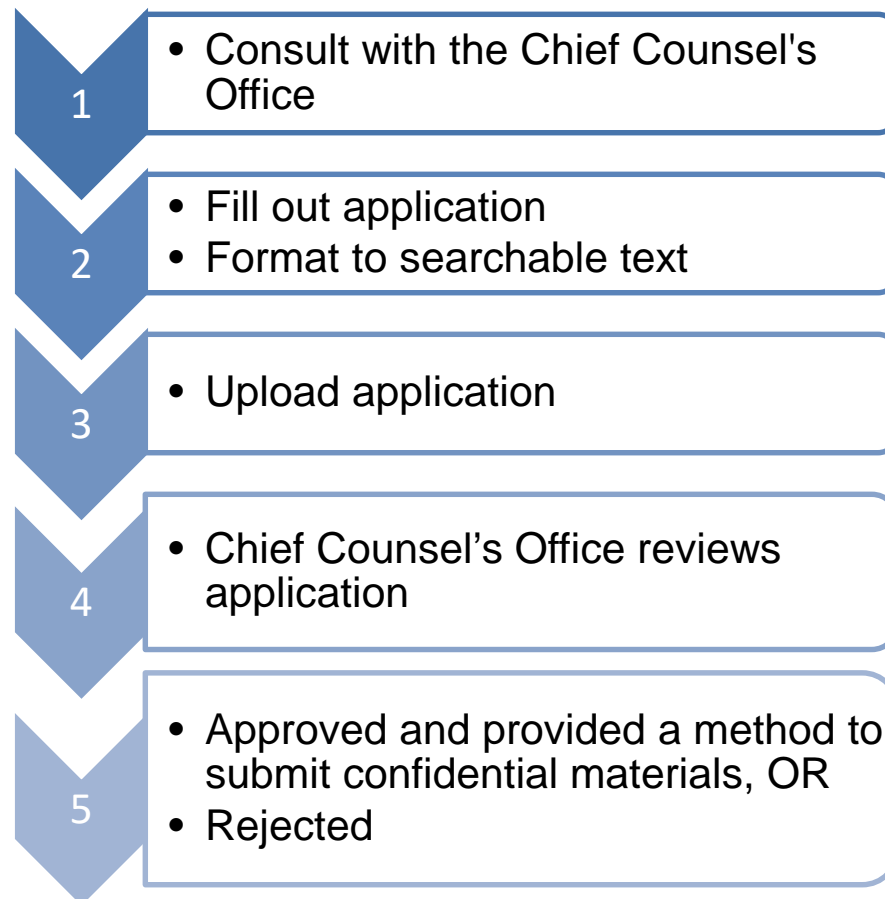




Submitting Confidential Data

Request a document or data be given confidential status

Method 2





Submitting Confidential Data

Jared Babula

Chief Counsel's Office

Jared.Babula@energy.ca.gov

(916) 651-1462

Application

http://www.energy.ca.gov/commission/chief_counsel/documents/CEC13.pdf

Submit feedback or comments

<https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=17-AAER-07>



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Conclusion

- Remaining low-efficacy lamps in California consume a significant amount of electricity on a statewide basis
- High-efficacy replacement lamps are technically feasible
- High-efficacy replacement lamps are cost-effective
- Significant statewide electricity savings would occur from implementing this proposal
- Significant statewide monetary savings for California consumers and businesses would occur from implementing this proposal



Discussion Topics & Feedback

- California savings may be over- or understated as a result of assumptions made about California's market in light of national trends. How can staff better reflect California market share?
 - California specific existing stock of low-efficacy lamps
 - California specific shipments of low-efficacy lamps
 - California specific shipments of LED lamps
- Do stakeholders have information on updated LED pricing and availability in California to improve the cost-effectiveness and technical-feasibility analyses?



BREAK



Stakeholder Presentations

- Joe Howley, GE Lighting
- Noah Horowitz, Natural Resources Defense Council
- Phi Nguyen and Mike McGaraghan, Energy Solutions representing the California Investor Owned Utilities



Final Discussion & Feedback



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THANK YOU

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