Rulemaking Framework Document for General Service Fluorescent Lamps, Incandescent Reflector Lamps, and General Service Incandescent Lamps

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Program

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

AEO	Annual Energy Outlook
ANOPR	advance notice of proposed rulemaking
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BT	Building Technologies Program
BR	bulged reflector (type of reflector lamp)
CCT	correlated color temperature
CFR	Code of Federal Regulations
CFL	compact fluorescent lamp
CIE	International Commission on Illumination
CO_2	carbon dioxide
CRI	color rendering index
CSL	candidate standard level
DOE	U.S. Department of Energy
DOJ	U.S. Department of Justice
EERE	Office of Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
E.O.	Executive Order
EPACT 1992	Energy Policy Act of 1992
EPACT 2005	Energy Policy Act of 2005
EPCA	Energy Policy and Conservation Act
ER	elliptical reflector (type of reflector lamp)
FR	Federal Register
FTC	Federal Trade Commission
GRIM	Government Regulatory Impact Model
HID	high intensity discharge lamp
IEC	International Electrotechnical Commission
IESNA	Illuminating Engineering Society of North America
ImSET	Impact of Sector Energy Technologies
IR	Infrared
LCC	life-cycle cost
LPW	lumens per watt
NECPA	National Energy Conservation Policy Act of 1978
NEMA	National Electrical Manufacturers Association
NEMS	National Energy Modeling System
NES	national energy savings
NOPR	notice of proposed rulemaking
NO_x	nitrogen oxides
NPV	net present value
OIRA	Office of Information and Regulatory Affairs
OMB	U.S. Office of Management and Budget
PAR	parabolic aluminized reflector (type of reflector lamp)
R&D	research and development
RIA	regulatory impact analysis

SG&A	selling, general, and administrative costs
SO_2	sulfur dioxide
T8, T10, T12	tubular fluorescent lamps, diameters of 1, 1.25 or 1.5 inches, respectively
TSD	technical support document
TSL	trial standard level
U.S.C.	United States Code
W	watts
WACC	weighted-average cost of capital

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1. INTRODUCTION

The U.S. Department of Energy (the Department or DOE) Appliances and Commercial Equipment Standards Program, of the Office of Energy Efficiency and Renewable Energy's (EERE's) Building Technologies Program (BT), develops and promulgates test procedures and energy conservation standards for consumer appliances and commercial equipment. The Department is committed to expeditiously completing overdue or "backlog" rulemakings. A DOE report submitted to Congress on January 31, 2006,[1] identifies the rulemakings the Department has scheduled for completion by June 2011 and explains many of the techniques the Department will be applying to the rulemaking process in order to meet this schedule. The Department will also continue to apply the procedures set forth in the Process Rule,[2] to the extent that they do not inhibit the completion of the rule by the scheduled dates.

The purpose of this document is to describe the procedural and analytical approaches the Department anticipates using to evaluate energy conservation standards for general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps. This document is intended to inform stakeholders of the process that DOE will follow for the standards rulemaking for these lamp types and to encourage and facilitate stakeholder input during the rulemaking. This document is merely the starting point for developing standards and is not a definitive statement with respect to any issue to be determined in the rulemaking.

Section 1 provides an overview of the rulemaking process. Sections 2 through 16 discuss analyses DOE intends to conduct to fulfill the statutory requirements and guidance for this standards rulemaking. Although DOE is bundling rulemaking activities for general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps into a single rulemaking, it will conduct separate analyses for each lamp type to determine whether amended energy conservation standards are technologically feasible and economically justified. In other words, for each of the lamp types examined in this rulemaking, the Department will perform a separate set of analyses, including an engineering analysis, a life-cycle cost (LCC) and payback period analysis, a national impact analysis, and a manufacturer impact analysis.

Information regarding this rulemaking will be maintained on the DOE website at: http://www.eere.energy.gov/buildings/appliance_standards/.

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[1] On January 31, 2006, the Department submitted to Congress the *Energy Conservation Standards Activities*, which was submitted pursuant to section 141 of the Energy Policy Act of 2005 (P.L. 109-58) and to the Conference Report (109-275) to the Fiscal Year 2006, Energy and Water Development Appropriations Act. The report is available as a PDF file on the DOE webpage at: http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

[2] *Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products* (the "Process Rule"), 61 FR 36974 (July 15, 1996); 10 CFR Part 430, Subpart C, Appendix A.

While the Department invites stakeholder comment on all aspects of the material presented in this document, several specific issues on which DOE seeks comment are set out in comment boxes like this one. These comment boxes are used to highlight issues and ask specific questions on the approaches the Department is proposing to follow to conduct the analyses required for the standards rulemaking. These comment boxes are numbered according to the section in which they appear.

1.1. The Appliances and Commercial Equipment Standards Program

The Energy Policy and Conservation Act (EPCA or the Act) of 1975 (42 U.S.C. 6291–6309) established an energy conservation program for major household appliances. The National Energy Conservation Policy Act of 1978 (NECPA) amended EPCA to add Part C of Title III (42 U.S.C. 6311-6317), which established an energy conservation program for certain industrial equipment. Additional amendments to EPCA have given DOE the authority to regulate the energy efficiency of several products, including certain fluorescent and incandescent lamps — the products that are the focus of this document. Amendments to EPCA in the Energy Policy Act of 1992 (EPACT 1992), P.L. 102-486, established energy conservation standards for residential, commercial and industrial general service fluorescent lamps and incandescent reflector lamps, as well as requirements to conduct two cycles of rulemakings for determining whether these standards should be amended.[3] (42 U.S.C. 6295(i)(1) and (3)-(4)) In addition, EPCA provides that within twenty-four months after Federal Trade Commission (FTC) labeling requirements have become effective for general service fluorescent lamps and general service incandescent lamps, DOE must initiate a rulemaking to determine if the standards in effect for such lamps should be amended so that they would be applicable to additional general service fluorescent and general service incandescent lamps. (42 U.S.C. 6295(i)(5)) Furthermore, according to EPCA, DOE must publish a rule within eighteen months of initiating the rulemaking. (42 U.S.C. 6295(i)(5)) The FTC published labeling requirements for covered lamps on May 13, 1994, which had an effective date of May 15, 1995. 59 FR 25176. Previously, the Department did not take action on the requirements of 42 U.S.C. 6295(i) because lamps were assigned low priority based on public comment and potential energy savings estimates in the priority setting process.[4]

Section 1.2 of this document provides detail on the distinction between fluorescent lamps and general service fluorescent lamps, and between incandescent lamps, incandescent reflector lamps and general service incandescent lamps. The following paragraphs discuss the statutory requirements and actions that DOE is taking for each of the lamp types covered in this rulemaking.

[3] Although EPACT 1992 places regulatory authority, standards, and definitions for fluorescent and incandescent lamps under the energy conservation program for consumer products (42 U.S.C. 6291–6309), these provisions also apply to general service fluorescent and incandescent reflector lamps distributed for commercial use. (42 U.S.C. 6291(1))

[4] See Appendix B to FY 2005 Preliminary Priority-Setting Summary Report on the DOE webpage at: http://www.eere.energy.gov/buildings/appliance_standards/priority_setting.html

EPCA establishes standards for **general service fluorescent lamps**, requiring that they meet prescribed minimum efficacy levels per given color rendering index (CRI) levels,[5] and further requires that DOE conduct two cycles of rulemakings to determine if the standards should be amended. (42 U.S.C. 6295(i)(1), (3)-(4)) In addition, the Act requires DOE to conduct a rulemaking to determine if the standards in effect for fluorescent lamps should be amended so that they would be applicable to additional general service fluorescent lamps. (42 U.S.C. 6295(i)(5)) In this rulemaking, DOE is conducting its first review to determine if the standards should be amended, while fulfilling the additional statutory requirement that DOE determine if the standards should be applicable to additional general service fluorescent lamps.

As with general service fluorescent lamps, EPCA also establishes energy conservation standards for **incandescent reflector lamps**, requiring that certain lamps meet prescribed efficacy levels, and directs DOE to conduct two cycles of rulemakings to determine if the standards should be amended. (42 U.S.C. 6295(i)(1), (3)-(4)) In addition, the Act requires DOE to conduct a rulemaking to determine if the standards for incandescent reflector lamps should be amended so that they would be applicable to **additional general service incandescent lamps**. (42 U.S.C. 6295(i)(5)) In this rulemaking, the Department is conducting its first review to determine if the standards for incandescent reflector lamps should be amended. The Department is also fulfilling the additional requirement that DOE determine whether the standards should cover additional general service incandescent lamps, including additional incandescent reflector lamps.

1.2. Overview of Sub-categories of Lamps Covered

This rulemaking covers certain types of fluorescent lamps and incandescent lamps. Section 321(30) of EPCA (42 U.S.C. 6291(30)) contains definitions for "fluorescent lamps" and "incandescent lamps" and the sub-categories of these lamps that are the subject of this rulemaking. These sub-categories are as follows:

1. General service fluorescent lamps;
2. Incandescent reflector lamps; and
3. General service incandescent lamps (which include incandescent reflector lamps and non-reflector lamps).

In addition to the statutory definitions, the Department published definitions for terms which supplement the statutory definitions for fluorescent and incandescent lamps.[6] 62 FR 29222 (May 29, 1997); 10 CFR section 430.2. These terms are listed and their definitions

[5] The Act defines "lamp efficacy" as "the lumen output of a lamp divided by its wattage, expressed in lumens per watt (LPW)." (42 U.S.C. 6291(30)(M)) It defines "color rendering index" (CRI) as "the measure of the degree of color shift objects undergo when illuminated by a light source as compared with the color of those same objects when illuminated by a reference source of comparable color temperature." (42 U.S.C. 6291(30)(J))

[6] These revised or additional terms include: "basic model," ''cold temperature fluorescent lamp,'' ''fluorescent lamp,'' and ''incandescent lamp,'' ''BR incandescent reflector lamp,'' ''colored fluorescent lamp,'' ''colored incandescent lamp,'' ''correlated color temperature,'' ''design voltage,'' ''ER incandescent reflector lamp,'' ''incandescent reflector lamp,'' ''rated voltage,'' ''rated wattage,'' ''residential straight-shaped lamp,'' ''rough or vibration service incandescent reflector lamp,'' and ''voltage range.''

provided in Appendix B. The following sections describe in more detail the definitions for fluorescent and incandescent lamps, as well as the three lamp types covered in this rulemaking.

1.2.1. Fluorescent Lamps

Section 321(30)(A) of EPCA (42 U.S.C. 6291(30)(A)) defines a fluorescent lamp as

a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including only the following:

- *(i) Any straight-shaped lamp (commonly referred to as 4-foot medium bi-pin lamps) with medium bi-pin bases of nominal overall length of 48 inches and rated wattage of 28 or more.*
- *(ii) Any U-shaped lamp (commonly referred to as 2-foot U-shaped lamps) with medium bi-pin bases of nominal overall length between 22 and 25 inches and rated wattage of 28 or more.*
- *(iii) Any rapid start lamp (commonly referred to as 8-foot high output lamps) with recessed double contact bases of nominal overall length of 96 inches and 0.800 nominal amperes, as defined in ANSI C78.1-1978 and related supplements.*
- *(iv) Any instant start lamp (commonly referred to as 8-foot slimline lamps) with single pin bases of nominal overall length of 96 inches and rated wattage of 52 or more, as defined in ANSI C78.3-1978 (R1984) and related supplement ANSI C78.3a-1985.*

The Act's definition of fluorescent lamps establishes the Department's scope of authority in this rulemaking. Given the above definition for fluorescent lamps, the Department will not be analyzing other types of lamps that might otherwise generally be considered fluorescent lamps. For example, the Department will not be evaluating circline lamps, T5 lamps, or any other lamps that fall outside the definition specified in the Act. In other words, for the purposes of defining DOE's regulatory authority over fluorescent lamps, Congress gave DOE authority only over a subset of fluorescent lamps.

In the category of 8-foot lamps, the Department updated the EPCA definition for fluorescent lamps in a final rule published May 29, 1997. 62 FR 29222. In that rulemaking, DOE updated the two American National Standards Institute (ANSI) documents cited in the statutory definition to ANSI C78.1-1991 and C78.3-1991.[7] In this rulemaking, the Department is inclined to limit the coverage of 8-foot linear recessed double contact lamps to 95W and 113W T12 lamps since these are the only lamps contained in ANSI C78.1-1991 that are rated at "0.800 nominal amperes." This amperage is an element of the above-quoted EPCA definition for a

[7] ANSI C78.3-1978 is an ANSI-published guide to standard characteristics for instant-start and cold-cathode fluorescent lamps. C78.1-1978 is the equivalent guide for rapid-start fluorescent lamps. Supplements to C78.3-1978 and C78.1-1978 update the guides over time. In 1991, ANSI combined the original standards with their supplements into C78.3-1991 and C78.1-1991, respectively. In 1997, DOE incorporated definitions for fluorescent lamps into the Code of Federal Regulations (CFR). 62 FR 29238. DOE used the statutory definition, but replaced 'ANSI C78.1-1978 and related supplements' with 'ANSI C78.1-1991'; and replaced 'ANSI C78.3-1978 (R1984) and related supplement C78.3a-1985' with 'C78.3-1991'.

"fluorescent lamp." (42 U.S.C. 6291(30)(A)(iii)) See Appendix C for an illustration of the lamp categories in each of the four types of fluorescent lamps established by the Act.

1.2.1.1. General Service Fluorescent Lamps

Section 321(30)(B) of EPCA (42 U.S.C. 6291(30)(B)) defines general service fluorescent lamps as

> *fluorescent lamps which can be used to satisfy the majority of fluorescent applications, but does not include any lamp designed and marketed for the following non-general lighting applications:*
>
> *(i) Fluorescent lamps designed to promote plant growth.*
> *(ii) Fluorescent lamps specifically designed for cold temperature installations.*
> *(iii) Colored fluorescent lamps.*
> *(iv) Impact-resistant fluorescent lamps.*
> *(v) Reflectorized or aperture lamps.*
> *(vi) Fluorescent lamps designed for use in reprographic equipment.*
> *(vii) Lamps primarily designed to produce radiation in the ultra-violet region of the spectrum.*
> *(viii) Lamps with a color rendering index of 82 or greater.*

This statutory definition further narrows those fluorescent lamps that DOE has authority to regulate. This definition is also important to this rulemaking because of the aforementioned EPCA requirement that DOE conduct a rulemaking to determine if the standards in effect for fluorescent lamps should be amended so that they would be applicable to additional general service fluorescent lamps. (42 U.S.C. 6295(i)(5)) EPCA set standards for general service fluorescent lamps according to those categories it uses for defining fluorescent lamps: (i) 4-foot linear medium bi-pin; (ii) 2-foot U-shaped medium bi-pin; (iii) 8-foot linear recessed double contact and (iv) 8-foot linear single pin. (42 U.S.C. 6295(i)(1)(A))

While this rulemaking is intended to comply with 42 U.S.C. 6295(i)(5), the Department is not aware of any additional general service fluorescent lamps which meet the EPCA definition and are not already regulated. Therefore, the Department does not have grounds for amending the standards for general service fluorescent lamps to include additional general service fluorescent lamps per 42 U.S.C. 6295(i)(5).[8]

Item 1 *The Department welcomes comment on the scope of this rulemaking, under the statutory requirement to consider additional general service fluorescent lamps. (42 U.S.C. 6295(i)(5))*

[8] The Department will still review and consider amending the existing standards for general service fluorescent lamps required by 42 U.S.C. 6295(i)(3).

1.2.2. Incandescent Lamps

Section 321(30)(C) of EPCA (42 U.S.C. 6291(30)(C)) defines an incandescent lamp as

a lamp in which light is produced by a filament heated to incandescence by an electric current, including only the following:

- *(i) Any lamp (commonly referred to as lower wattage nonreflector general service lamps, including any tungsten-halogen lamp) that has a rated wattage between 30 and 199 watts, has an E26 medium screw base, has a rated voltage or voltage range that lies at least partially within 115 and 130 volts, and is not a reflector lamp.*
- *(ii) Any lamp (commonly referred to as a reflector lamp) which is not colored or designed for rough or vibration service applications, that contains an inner reflective coating on the outer bulb to direct the light, an R, PAR, or similar bulb shapes (excluding ER [Elliptical Reflector] or BR [Bulged Reflector]) with E26 medium screw bases, a rated voltage or voltage range that lies at least partially within 115 and 130 volts, a diameter which exceeds 2.75 inches, and is either --*
  - *(I) a low(er) wattage reflector lamp which has a rated wattage between 40 and 205 watts; or*
  - *(II) a high(er) wattage reflector lamp which has a rated wattage above 205 watts.*
- *(iii) Any general service incandescent lamp (commonly referred to as a high- or higher-wattage lamp) that has a rated wattage above 199 watts (above 205 watts for a high wattage reflector lamp).*

Concerning E26 medium screw bases, the Department intends to use the definition of "medium screw base" as added to EPCA in section 135(a)(3) of the Energy Policy Act of 2005 (EPACT 2005), Public Law 109-58. (42 U.S.C. 6291(51)) This defines an Edison screw base with the prefix E26 as that appearing in the "American National Standard for Electric Lamp Bases," ANSI/IEC C81.61–2003, published by the American National Standards Institute. This version of C81.61 identifies four lamp base (cap) types with a prefix of E26, which are: single-contact medium screw (E26/24); double-contact medium screw (E26d); skirted medium screw for PAR lamps (E26/50x39); and extended skirted medium screw for R-lamps (E26/53x39). In other words, for the purposes of defining DOE's regulatory authority over incandescent lamps, Congress gave DOE authority only over a subset of incandescent lamps.

1.2.2.1. Incandescent Reflector Lamps

EPCA defines an incandescent reflector lamp in subparagraph (C)(ii) of the definition for incandescent lamps. (42 U.S.C. 6291(30)(C)(ii) and (30)(F)) In bullet form, the definition is:

Any incandescent lamp which:

- Is not colored or designed for rough or vibration service applications;
- Contains an inner reflective coating on the outer bulb to direct the light;
- Is an R, PAR or similar bulb shape (excluding ER or BR) with an E26 medium screw base;

- Has a rated voltage or voltage range that lies at least partially in the range of 115 and 130 volts;
- Has a diameter that exceeds 2.75 inches; and
- Is either (I) a low(er)-wattage reflector lamp that has a rated wattage between 40 and 205; or (II) a high(er)-wattage reflector lamp that has a rated wattage above 205.

This statutory definition of an incandescent reflector lamp specifically excludes ER and BR lamps. (See Appendix B for the DOE definitions of ER and BR lamps). For this reason, the Department will not consider ER and BR lamps in its review and possible amendment of the reflector lamp energy conservation standards. However, the Department is aware that shipments of these lamp shapes have increased significantly over the last decade. Therefore, the Department will consider how the exemption for ER and BR lamps affects the national energy savings analysis of the efficacy requirements for incandescent reflector lamps.

Item 2 *The Department welcomes comment on how a more stringent standard for incandescent reflector lamps might impact the market share of ER and BR lamps.*

1.2.2.2. General Service Incandescent Lamps

Section 321(30)(D) of EPCA (42 U.S.C. 6291(30)(D)) defines a general service incandescent lamp as

any incandescent lamp (other than a miniature or photographic lamp) that has an E26 medium screw base, a rated voltage range at least partially within 115 and 130 volts, and which can be used to satisfy the majority of lighting applications, but does not include any lamps specifically designed for --

(i) traffic signal, or street lighting service;
(ii) airway, airport, aircraft, or other aviation service;
(iii) marine or marine signal service;
(iv) photo, projection, sound reproduction, or film viewer service;
(v) stage, studio, or television service;
(vi) mill, saw mill, or other industrial process service;
(vii) mine service;
(viii) headlight, locomotive, street railway, or other transportation service;
(ix) heating service;
(x) code beacon, marine signal, lighthouse, reprographic, or other communication service;
(xi) medical or dental service;
(xii) microscope, map, microfilm, or other specialized equipment service;
(xiii) swimming pool or other underwater service;
(xiv) decorative or showcase service;
(xv) producing colored light;
(xvi) shatter resistance which has an external protective coating; or
(xvii) appliance service.

Under EPCA, the term "general service incandescent lamp" applies both to certain "incandescent reflector lamps" and to other non-reflector general service incandescent lamps. In common parlance, however, incandescent reflector lamps are generally not understood to be general service incandescent lamps. In considering whether to amend the EPCA standards to make them applicable to additional general service incandescent lamps (per 42 U.S.C. 6295(i)(5)), the Department will evaluate lamps that: 1) meet the EPCA definitions for general service incandescent lamps and incandescent reflector lamps, and 2) are not already regulated by the incandescent reflector lamp standards.[9] In addition, the Department will also consider non-reflector incandescent lamps that meet the EPCA definition for general service incandescent lamps. In considering whether to amend existing standards for incandescent reflector lamps (per 42 U.S.C. 6295(i)(3)), the Department will evaluate lamps that meet the EPCA definition of incandescent reflector lamps.

The majority of terms within the statutory definition for general service incandescent lamps remain undefined. For example, neither EPCA nor the DOE regulations define the term "decorative or showcase service." From the Department's initial assessment of available products, it appears that several models of incandescent lamps in manufacturer catalogues within the range of 40 to 100 watts could be classified as decorative. Given that the definitions determine coverage of standards, the Department intends to develop and provide clarification on the definition for general service incandescent lamps, where needed.

Item 3 *The Department welcomes comment on the issue of product coverage, specifically the requirement to consider additional general service incandescent lamps. (42 U.S.C. 6295(i)(5))*

Item 4 *The Department welcomes comment on which, if any, of the exemption categories in the statutory definition for general service incandescent lamps require clarification.*

1.3. Overview of the Rulemaking Process

1.3.1. Test Procedures

The Department established test procedures for fluorescent and incandescent lamps on May 29, 1997. 62 FR 29222. The test procedures incorporate by reference ANSI, Illuminating Engineering Society of North America (IESNA) and International Commission on Illumination (CIE) industry standards to measure lamp efficacy and CRI. Each CFR reference to an industry standard applies to a particular year of publication. Appendix D presents a list of the industry standards that are related to lamps covered under this rulemaking and that the Department incorporated by reference in 10 CFR section 430.22.

[9] This set of lamps includes high-wattage incandescent reflector lamps that are general service incandescent lamps. The EPCA definition for incandescent reflector lamps distinguishes low-wattage (40 to 205 watts) from high-wattage (above 205 watts) reflector lamps. (42 U.S.C. 6291(30)(C)(ii) and (30)(F)) The ECPA standards for incandescent reflector lamps apply to the low-wattage incandescent reflector lamps. (42 U.S.C. 6295(i)(1))

The test procedures provide detailed measurement instructions for measuring the performance of all lamps covered by this rulemaking: general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps. The Department does not intend to update the test procedures for these lamps as part of this rulemaking.

1.3.2. Rulemaking Process and Stakeholder Participation

When DOE evaluates new or amended standards for "covered products" under EPCA, it must consider seven factors, to the greatest extent practicable. These seven statutory factors are:

(1) The economic impact of the standard on the manufacturers and consumers of the affected product(s);
(2) The savings in operating costs throughout the estimated average life of the product(s) compared to any increases in the initial cost, or maintenance expense;
(3) The total projected amount of energy savings likely to result directly from the imposition of the standard;
(4) Any lessening of the utility or the performance of the product(s) likely to result from the imposition of the standard;
(5) The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard;
(6) The need for national energy conservation; and
(7) Other factors the Secretary considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i)) Additional statutory requirements for prescribing new or amended standards are set forth in 42 U.S.C. 6295(o)(1)-(2)(A), (2)(B)(ii)-(iii), and (3)-(4).

The process for developing standards involves analysis, public notice, and consultation with interested parties. Such parties, collectively referred to as stakeholders, include manufacturers, consumers, energy conservation and environmental advocates, State and Federal agencies, and any other groups or individuals with an interest in energy conservation standards and test procedures. The Department considers stakeholder participation to be a very important part of the rulemaking process. The Department actively encourages the participation and interaction of all stakeholders during the comment period of each rulemaking stage. The broad array of stakeholders who provide comments promotes a balanced discussion of critical information required to conduct the standards rulemaking, beginning with the public comment on the Framework Document and during subsequent comment periods.

In conducting the test procedure rulemakings and the energy conservation standards rulemakings, DOE involves stakeholders through a variety of means, including formal public notifications (i.e., Federal Register notices). The standards rulemaking process involves three formal, major public notices, which are published in the Federal Register. The first of the rulemaking notices is an advance notice of proposed rulemaking (ANOPR, see section 1.4). The ANOPR is designed to publicly vet the models and tools to be used in the rulemaking, and to facilitate public participation before the proposed-rule stage. The second notice is a notice of proposed rulemaking (NOPR, see section 1.4), which presents: a discussion of comments received in response to the ANOPR; the analysis of the impacts of standards on consumers,

manufacturers and the nation; the Department's weighting of the impacts; and the proposed standards. The third notice is the final rule (see section 1.5), which presents: a discussion of comments received in response to the NOPR; the revised analysis of the impacts of standards; the Department's weighting of the impacts; the standards adopted by DOE; and the effective dates of the standards.

1.4. Advance Notice of Proposed Rulemaking

As part of its initial rulemaking activity, the Department typically identifies product design options or efficiency levels that it will analyze in detail and those it should eliminate from further consideration. This process includes a market and technology assessment (see section 3) and a screening analysis (see section 4). These activities include consultations with stakeholders and independent technical experts who can assist with identifying the key issues and design options to be considered by the Department in the rulemaking. This Framework Document, the public meeting and the opportunity for comment on this Framework Document are all intended to initiate dialogue with stakeholders, and provide an opportunity for comment and input into the structure and analytical approach proposed for this energy conservation standards rulemaking.

At the ANOPR stage, in addition to the market and technology assessment and screening analysis, the other principal analyses the Department will be presenting include: the engineering analysis (see section 5); the consumer LCC impact and payback period results (see section 8); the national energy savings (NES) and consumer net present value (NPV) results (see section 10); and a preliminary manufacturer impact analysis (see section 12). In addition, in the ANOPR Federal Register notice, the Department will publish the Secretary's determination whether to amend current standards to make them applicable to additional general service fluorescent and general service incandescent lamps.[10] (42 U.S.C. 6295(i)(5))

The ANOPR analysis will include candidate standard levels (efficiency levels) to facilitate the stakeholder review of the spreadsheet models that underpin the analyses presented. Stakeholder comments on the models will be used to refine them for the next stage of the rulemaking analyses, where the Department will propose efficiency levels for comment. In the ANOPR, the Department's range of candidate standard levels for analysis will include the maximum improvement in energy efficiency that is technologically feasible ("max tech") and the efficiency corresponding to the minimum LCC point. DOE generally selects efficiency levels or design options for consideration that span the full range of technologically achievable efficiencies.

Relative to a baseline model (see section 3.4 which discusses baseline models), the range of levels analyzed typically includes:

- The highest energy efficiency level or lowest energy consumption level that is technologically feasible (the "max tech" level);

[10] As noted above, the Department is not aware of any additional general service fluorescent lamps which meet the EPCA definition and are not already regulated. Therefore, the Department does not intend to amend the standards for general service fluorescent lamps to include additional general service fluorescent lamps per 42 U.S.C. 6295(i)(5)

- The level with the lowest LCC; and
- Levels that incorporate noteworthy technologies or fill in large gaps between efficiency levels of other levels considered.

The Department will make the spreadsheet tools and results from the ANOPR analyses available on its website for review and will consider comments on them after the publication of the ANOPR. When the Department publishes the ANOPR, the Department will also make available a technical support document (TSD) containing the details of all the analyses performed to date. Following publication of the ANOPR, the Department provides a 75-day public comment period and holds one public meeting. At this point the Department encourages stakeholders to develop joint recommendations for standard levels.

1.5. Notice of Proposed Rulemaking

For the NOPR, the Department starts by carefully reviewing and considering all the comments received after the publication of the ANOPR. This process may result in revisions or refinements to the ANOPR analyses, including the engineering analysis and life-cycle cost analysis. DOE also conducts additional economic impact analyses. These analyses generally include a consumer LCC sub-group analysis (see section 11), a complete manufacturer impact analysis (see section 12), a utility impact analysis (see section 13), an employment impact analysis (see section 14), an environmental assessment (see section 15), and a regulatory impact analysis (see section 16).

The NOPR analytical process ends with the selection of proposed standard levels that will be published in the NOPR. The Department selects these proposed standard levels from the trial standard levels (TSLs) analyzed during the NOPR phase of the rulemaking. The NOPR Federal Register notice will document the evaluation and selection of the proposed standard level(s) (if any). The proposed standard levels would apply to both lamps covered under existing standards as well as any additional lamps that the Secretary determined to regulate at the ANOPR stage.

For each product class, the Department will identify the max tech efficiency level. If the Department proposes a level lower than that, it will sequentially explain the reasons for eliminating higher levels beginning with the highest level considered. The Department will present the analysis results in the NOPR and the analysis details in an accompanying TSD.

The Department considers many factors in selecting proposed standards, as described above in section 1.3.2. These factors and criteria are contained in the EPCA and take into consideration the benefits, costs, and impacts of energy conservation standards. In addition, the Department encourages stakeholders to develop joint recommendations for standard levels. The Department will carefully consider such recommendations in its decision process.

When the Department publishes the NOPR, it will provide the Department of Justice (DOJ) with a copy of the NOPR and TSD and will solicit feedback on the impact of the proposed standard level on competition. DOJ will review these standard levels in light of any lessening of competition that is likely to result from the imposition of standards. The Department will consider the DOJ determination on the impacts of the proposed standard on competition in

preparing the final rule. The NOPR is followed by a 75-day public comment period that includes one public meeting.

1.6. Final Rule

DOE may revise its analyses after considering public comments on the NOPR. On the basis of the public comments, DOE will review the engineering and economic impact analyses and proposed standards and consider modifications where necessary.

After the publication of the NOPR, the Department will conduct a thorough review of all analyses performed, and of the TSLs. Final revisions to the analyses and trial standard levels will be made as appropriate.

Before the final rule is issued, the Department will consider DOJ comments on the NOPR relating to the impacts of the proposed standard levels on competition to determine whether changes to these standard levels are needed.

The standards rulemaking will conclude with the publication of the final rule. The Department will select the final standard levels based on the complete record of the standards rulemaking. The final rule will promulgate the final standard levels and their effective date and explain the basis for their selection. The final rule will be accompanied by a final TSD.

2. ANALYSES FOR RULEMAKING

Ultimately, the Department intends to select energy conservation standards that achieve the maximum improvement in energy efficiency that is technologically feasible, economically justified, and will result in significant energy savings. The selection of such standards is expected to achieve the maximum energy savings that are economically justified without putting an unjust financial burden on any particular party. Economic justification includes the consideration of economic impacts on domestic manufacturers and consumers, national benefits including environmental impacts, issues of consumer utility, and impacts from any lessening of competition. The purpose of the analyses conducted in support of the standards rulemaking is to ensure that the final standards are technologically feasible, economically justified, and will result in significant energy savings.

This section offers an overview of the DOE analytical methodology and discusses the major components of the analyses DOE will conduct. A consistent approach to analysis throughout the rulemaking will be ensured through the consideration of each analysis as a part of the overall standards-setting framework.

Figure 1 summarizes the analytical components of the standards-setting process. The analyses are presented in the center column. Each analysis has a set of key inputs, which are data and information required for the analysis. "Approaches" are the methods that will be used to obtain key inputs. For example, some key inputs exist in public databases, some will be collected from stakeholders or experts with special knowledge, and some will be developed by the project team in support of the rulemaking. The results of each analysis are key outputs,

which feed directly into the rulemaking. Dotted lines indicate the flow of information between the various analyses.

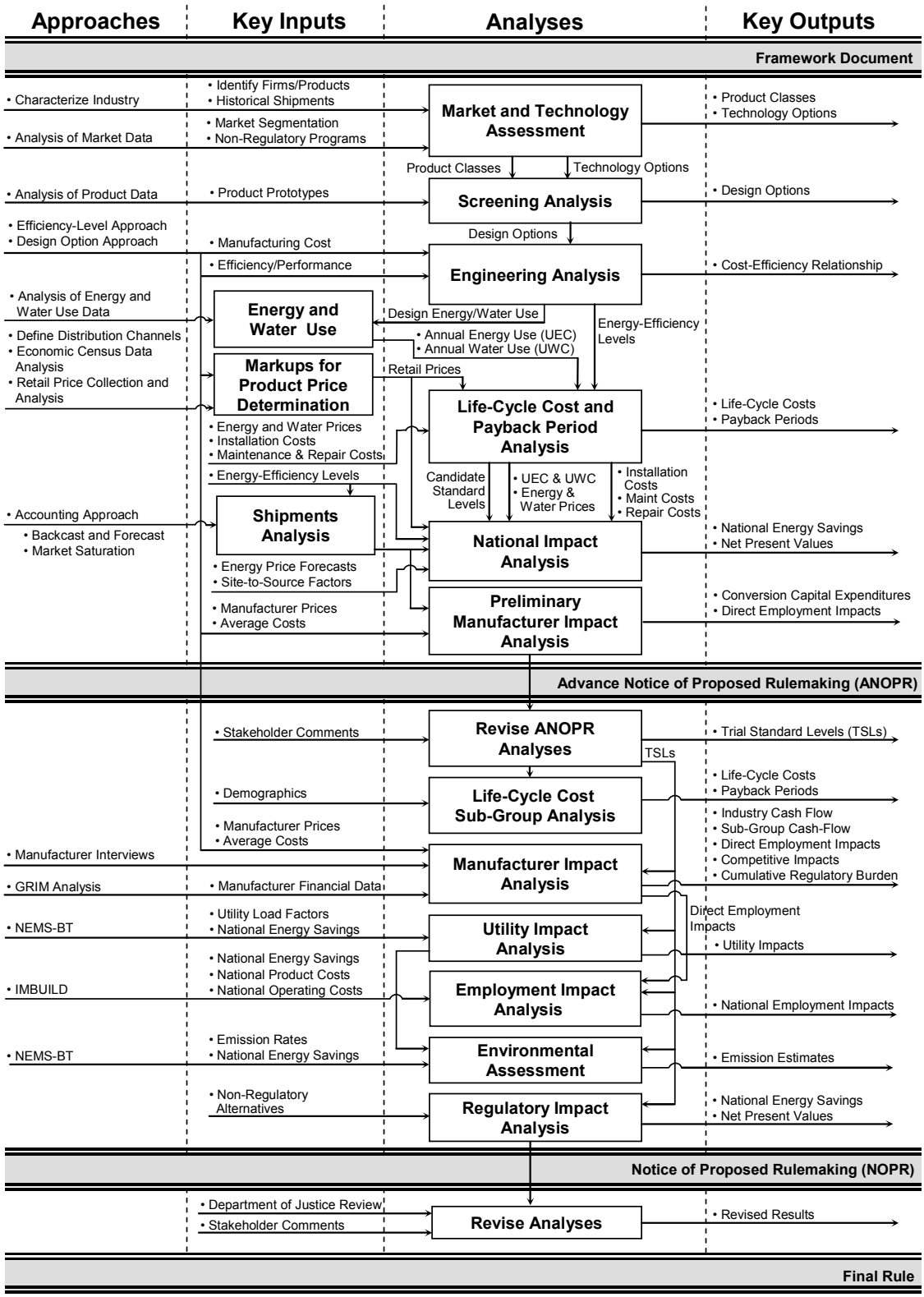


Figure 1. Flow Diagram of Analyses for the General Service Fluorescent Lamps, Incandescent Reflector Lamps and General Service Incandescent Lamps Energy Conservation Standard Rulemaking Process

3. MARKET AND TECHNOLOGY ASSESSMENT

The market and technology assessment will provide information about the manufacturers of general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps, and specifics about the performance attributes of these lamps. This assessment is used throughout the rulemaking. However, it is particularly important at the outset for developing product classes, and identifying technology design options to improve efficacy (i.e., efficiency) for each of the lamp types.

3.1. Market Assessment

The Department will qualitatively and quantitatively characterize the structure of the markets for general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps. In the market assessment, the Department will characterize the manufacturers, estimate market shares and trends, and address regulatory and non-regulatory initiatives intended to improve the efficacy or reduce the energy consumption of covered lamps.

This market assessment will establish the context for this rulemaking, and serve as a resource to guide the analyses that will follow. For example, the Department may use historical shipments and prices as an indicator of future shipments and prices. Similarly, DOE will use market structure data for the manufacturer impact analysis.

The Department recognizes that there is limited public information on national lamp shipments, manufacturing costs, channels of distribution and manufacturers' market shares. This type of data would be extremely valuable for conducting analyses to determine if energy conservation standards are economically justified and will result in significant energy savings. Therefore, the Department encourages stakeholders to submit any available, applicable data to the Department that pertains to these areas of interest and would assist the Department in gaining a better understanding of the market and manufacturers of these lamp types.

Item 5 *The Department welcomes information on shipments, manufacturing costs, distribution channels and estimates of market shares for the lamps considered in this rulemaking. In order for the data to be used to conduct energy savings calculations, a degree of disaggregation (e.g., by product class and wattage) is desirable.*

The Department is creating a database of commonly available products based on the most recent manufacturer catalogues from lamp manufacturers (e.g., GE Lighting, Osram/Sylvania, Philips Lighting and others), as well as some of the smaller market participants. This model database enables the Department to understand what is available in the market and compare available products to statutory definitions. Subsequent knowledge about product availability will be used to evaluate how the market may respond to various standard levels (e.g., consumers substituting lamps that are not subject to regulation), as well as performance attributes of the various commercially available lamp technologies (e.g., halogen).

3.2. Product Classes

The Department divides covered products into classes by: (a) the type of energy used; and (b) capacity of the product or any other performance-related feature that justifies different standard levels, such as features affecting consumer utility. (42 U.S.C. 6295(q)) For this rulemaking on lamps, the Department intends to analyze general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps separately, where appropriate.

For **general service fluorescent lamps**, the Act contains eight product classes (42 U.S.C. 6295(i)(1)(A)), shown below in Table 1.

Table 1. EPCA Product Classes for General Service Fluorescent Lamps

Lamp Type	Nominal Lamp Wattage
4-foot medium bi-pin	> 35 W
	≤ 35 W
2-foot U-shaped	> 35 W
	≤ 35 W
8-foot slimline	> 65 W
	≤ 65 W
8-foot high output	> 100 W
	≤ 100 W

The Department recognizes that following the establishment of these eight product classes in EPACT 1992, the fluorescent lamp market has diversified and several new fluorescent lamp diameters have gained market share.[11] In particular, T8 lamps are much more prevalent today than the T12 lamps which dominated when Congress passed EPACT 1992. In recognition of this trend toward smaller diameter fluorescent lamps for certain lamp types, ANSI promulgated industry standards for T8 and T10 lamps, some of which are covered products under the Department's definition of a fluorescent lamp (see Appendix C). The Department's review of manufacturer catalogues confirmed that 4-foot medium bi-pin and the 2-foot U-shape both have covered products available in multiple diameters.

The Department recognizes that lamps with different diameters most often require ballasts specifically designed to operate those lamps. Therefore, T8, T10 and T12 lamps are not interchangeable with each other. While there are some ballasts on the market that can operate a T8, T10 and T12 lamp, the majority of those sold operate just one of these lamps. In other words, a T8 lamp cannot be retrofitted into a T12 socket without changing the ballast because of the operational requirements of the T8 lamp. The need to retrofit a ballast if changing to a

[11] Fluorescent lamp diameters are defined in eighths of an inch and the letter "T" designates a tubular shape. Thus, industry nomenclature would refer to"T8" lamps as tubular fluorescent lamps having a diameter of one inch. Similarly, "T12" lamps are fluorescent lamps with a diameter of one and a half inches.

different lamp type (e.g., from T12 to T8), compels the Department to differentiate product classes according to lamp diameter. The Department believes this is in accordance with EPCA requirements for developing product classes where "performance-related features" justify different standard levels, such as features affecting consumer utility. (42 U.S.C. 6295(q)) These differentiating performance-related features necessitate that the Department subdivide product classes for these products.

Therefore, the Department is proposing to modify the product classification structure for general service fluorescent lamps to one that specifically takes into account the diversity in lamp diameters for 4-foot medium bi-pin and 2-foot U-shaped fluorescent lamps. These modified product classes will allow for separate consideration of appropriate standard levels of these different products. Table 2 presents product classes broken down by wattage and by ranges of lamp diameters: "≤T8" and ">T8." As an alternative to these (or other) lamp diameter ranges, the Department could establish product classes according to specific lamp diameters (e.g., T8, T10 and T12). Under this approach, the Department would also ensure that fluorescent lamp energy conservation standards would be applicable to any other fluorescent lamp diameters that may become available in the future. The Department would associate this "other fluorescent lamps" category with one of the specific lamp diameters.

Table 2. Proposed Product Class Modifications for General Service Fluorescent Lamps[12]

Lamp Type	Lamp Diameter	Nominal Lamp Wattage	Minimum CRI	Product Class #
4-foot medium bi-pin	>T8	> 35 W	69	1
		≤ 35 W	45	2
	≤T8	> 35 W	69	3
		≤ 35 W	45	4
2-foot U-shaped	>T8	> 35 W	69	5
		≤ 35 W	45	6
	≤T8	> 35 W	69	7
		≤ 35 W	45	8
8-foot slimline	T12	> 65 W	69	9
		≤ 65 W	45	10
8-foot high output	T12	> 100 W	69	11
		≤ 100 W	45	12

While new lamp diameters such as T8 have also been introduced into the 8-foot slimline and 8-foot high output lamp type classifications, these lamp types are not listed in ANSI C78.3-1991 and C78.1-1991, respectively. As these ANSI standards are an element of the EPCA definition for 8-foot fluorescent lamps, 8-foot T8 lamps are outside of the Department's scope of coverage (see definition of a general service fluorescent lamp, section 1.2.1).

[12] To facilitate stakeholder comment on this proposal, the Department has labeled each of the product classes with a number.

Finally, relating to fluorescent lamps, the Department is currently considering whether any amendment is warranted to the minimum CRI levels for the proposed fluorescent lamp product classes.

For **incandescent reflector lamps**, EPCA establishes six product classes shown below in Table 3 (42 U.S.C. 6295(i)(1)(A)). The Department understands that while the scope of covered products extends beyond the wattage range depicted in Table 3 – incandescent reflector lamps with wattages exceeding 205 watts are a covered product (42 U.S.C. 6291(30)(C)(ii) and (F) and 6292(a)(14)) – this range of wattages still represents the bulk of market shipments and, therefore, energy savings potential. The Department is considering using these product classes, or perhaps modifying them slightly if the Department determines that the wattages common today might be better classified in different wattage ranges. The Department is also considering whether spot reflector lamps should be classified separately from flood reflector lamps, as they provide a different utility and this characteristic of light beam spread is a performance-related feature that may impact the efficacy of the lamp.

Table 3. EPCA Product Classes for Incandescent Reflector Lamps[13]

Nominal Lamp Wattage	Product Class #
40-50 watts	13
51-66 watts	14
67-85 watts	15
86-115 watts	16
116-155 watts	17
156-205 watts	18

For **additional general service incandescent lamps** (including high-wattage incandescent reflector lamps and non-reflector lamps), the Act does not prescribe standards or establish product classes. As part of the standards rulemaking analysis outlined in this document, the Department will evaluate whether to develop standards for additional general service incandescent lamps.

Should the Secretary determine to consider high-wattage incandescent reflector lamps for energy conservation standards, the Department would need to establish product classes for these lamps. To this end, the Department will consider establishing product classes for high-wattage incandescent reflector lamps according to wattage to be consistent with existing (low-wattage) incandescent reflector lamp standards. The Department's initial review of manufacturer catalogues indicates that lamps which meet both the general service incandescent lamp definition and the incandescent reflector lamp definition extend up to 300 watts.

[13] To facilitate stakeholder comment on this proposal, the Department has labeled each of the product classes with a number.

For non-reflector general service incandescent lamps, the Department will evaluate whether capacities or performance-related features warrant creation of product classes. Some of the capacities and features being considered include: type of lamp coating, wattage bins (i.e., similar to the wattage bins as used for incandescent reflector lamps), lamp design voltage and lumen output. In addition, the Department is considering creating a separate product class for 3-way lamps, which function differently than conventional general service incandescent lamps and which require unique sockets in order to operate with multiple settings.

Item 6 *The Department welcomes comment on the modified product classes it is considering for general service fluorescent lamps. This includes whether specific lamp diameters or lamp diameter ranges would be more appropriate.*

Item 7 *The Department welcomes comment on the product classes it is considering for incandescent reflector lamps. This includes whether the wattage ranges need to be refined and whether spot and flood reflector lamps should be treated separately.*

Item 8 *The Department welcomes comment on what, if any, product classes the Department should consider for additional general service incandescent lamps. This includes, for non-reflector lamps, whether the classes should be based on lamp coatings, wattage ranges, lamp design voltages and/or lumen ranges, and whether 3-way lamps should be treated as a separate product class. For high-wattage incandescent reflector lamps, the Department welcomes comment on any appropriate product class(es).*

3.3. Technology Assessment

The technology assessment centers on understanding how energy is used by the product or equipment, and what changes are possible that would reduce that energy consumption. The measures that improve the energy efficiency of the equipment are called "design options," and are often based on existing technology options, as well as prototype designs and concepts. In consultation with stakeholders, the Department will develop a list of design options that can and should be considered in this rulemaking. Initially, this list will include all those technologies considered to be technologically feasible and will serve to establish the max tech design. In the screening analysis, the Department will eliminate from consideration any design options that fail to meet one of the four screening criteria, as discussed in section 4 of this document.

The Department is collecting information on design options that could be employed to improve the efficacy of general service fluorescent lamps and general service incandescent lamps, including incandescent reflector lamps. The Department will review manufacturer catalogues, recent trade publications and technical journals, as well as consult with technical experts. Presently, the Department is aware of a limited set of design options that could improve the efficacy of these lamps. These design options are listed below.

The Department intends to evaluate the following design options for **general service fluorescent lamps**:

- Electrode materials and coatings
- Lamp fill gas composition
- Phosphor materials (halophosphor versus triphosphor)

The Department is aware that some attempts to improve fluorescent lamp efficacy may also modify lamp performance or other lamp characteristics. For example, electrode improvements to increase efficacy may also affect the operating life of the lamp.

The Department intends to evaluate the following design options for **incandescent reflector lamps**:

- Higher temperature incandescent light sources
- Filament materials and coatings
- Reflector materials and coatings
- Lamp-fill gas

Incandescent reflector lamp design options involving gas-fill improvements include halogen, krypton and xenon lamps. Design options involving reflector coatings include infrared (IR) reflective coatings. Higher temperature incandescent light sources could trade off higher efficacy for lower-rated lamp life, a factor the Department will consider.

The following technologies and design options are relevant to other **general service incandescent lamps**:

- Higher temperature incandescent light sources
- Filament materials and coatings
- Lamp-fill gas

General service incandescent lamps that make use of the gas-fill improvements include halogen, krypton and xenon lamps. Again, higher temperature incandescent light sources could trade off higher efficacy for lower rated lamp life, which the Department will consider.

Item 9 *The Department welcomes comment on the preliminary design options identified in this section for each of the three lamp types. More specifically, the Department welcomes comment on whether there are other technologies or design features that it should consider and what, if any, impacts they might have on safety, performance, and consumer utility.*

3.4. Baseline Models

Once the Department establishes product classes, it will select baseline models as reference points against which the Department can measure changes resulting from energy conservation standards. The baseline model represents the characteristics of equipment in a given product class. Typically, the baseline model would be a model that just meets current required energy conservation standards. If no existing standards apply to a product, as is the case

with general service incandescent lamps (other than incandescent reflector lamps), the Department will select baseline models that are typical of what is sold in the market today. A baseline model encompasses lamp features and performance characteristics such as lamp shape, wattage, correlated color temperature, color rending index, operating life, et cetera. Below, the Department proposes certain characteristics for baseline models. However, the Department is not defining all the detailed characteristics about the proposed baseline models until it receives comment from stakeholders and can conduct further analysis.

The baseline models are used to conduct the engineering analysis and the LCC and payback-period analyses. To determine energy savings and changes in manufacturer selling price, the Department will compare each of the more efficacious lamps (i.e., lamps that incorporate the design options to improve efficacy) with the baseline model.

In section 3.2, the Department identified twelve product classes for fluorescent lamps, six product classes for incandescent reflector lamps (which could become twelve if spot and flood reflector lamps are treated separately), and asked for stakeholder comment on how it should classify general service incandescent lamps. The Department believes that for certain lamp types, it may be possible to extrapolate the analyses of one class to another (e.g., extrapolate minimum efficacy from one wattage to other wattages, and from one diameter to other diameters). Furthermore, the Department believes that it may be redundant to conduct an engineering analysis (see section 5) and a LCC analysis (see section 8) on a baseline model for each product class. Once the Department determines which product classes to select as representative of other product classes, it will need to select a lamp as a baseline model. DOE will study these baseline models in the engineering analysis and LCC analysis.

For **general service fluorescent lamps**, the Department selected six representative product classes from the twelve proposed in section 3.2, as shown in Table 4. To facilitate stakeholder comment on this proposal, the Department will refer to product classes by number as shown in the table. The Department proposes to select product class numbers 2 and 4 as the representative product classes for analysis for 4-foot medium bi-pin lamps because these two product classes represent the majority of the 4-foot medium bi-pin lamp sales. In addition, this selection represents two distinct lamp types that frequently operate on two different ballasts because the operational requirements of the lamps are different. Similarly, the Department proposes to select product class numbers 5 and 8 for the 2-foot U-shaped lamps, thereby capturing any variability between lamp types that require different ballasts to operate. DOE would scale the results from these two representative product classes to all the other medium bi-pin and U-shaped lamp type product classes. For 4-foot medium bi-pin lamps, the Department is proposing to use a 34W T12 baseline model for product class 4 and a 32W T8 baseline model for product class 2. For the 2-foot U-shaped lamps, the Department is proposing to use a 40W T12 baseline model for product class 5 and a 31W T8 baseline model for product class 8. In the ANOPR, the Department will define the baseline models in much more detail by specifying additional lamp features and performance characteristics (e.g., correlated color temperature, color rending index, operating life). However, the Department will wait to define the detailed characteristics about these baseline models until it receives comments from stakeholders and can conduct further market and technology analysis on fluorescent lamps.

For 8-foot slimline fluorescent lamps, the statutory definition specifies two categories of lamps that the Department can cover: 60W T12 lamps and 75W T12 lamps (see "linear 96-inch single-pin lamps" in Appendix C).[14] The Department proposes to select product class number 10 as the representative product class for 8-foot slimline fluorescent lamps because this group of lamps is more prevalent in the market. Within this representative product class, the Department is proposing to select a 60W T12 baseline model for its analysis. The Department will define this baseline model in more detail by specifying additional lamp features and performance characteristics based on stakeholder comments and further market and technology analysis.

For 8-foot high output fluorescent lamps, ANSI C78.1-1991 specifies two categories of lamps that fall within the Department's scope: 95W T12 lamps and 113W T12 lamps (see "linear, 96-inch recessed double-contact" in Appendix C). The Department proposes to select product class number 12 as the representative product class for 8-foot high output fluorescent lamps because this group is more prevalent in the market. Within this representative product class, the Department is proposing to select a 95W T12 baseline model for its analysis. As with the lamps described above, the Department will define this baseline model in more detail by specifying additional lamp features and performance characteristics based on stakeholder comments and further market and technology analysis.

Table 4. Proposed Representative Product Classes for General Service Fluorescent Lamps

Lamp Type	Lamp Diameter	Nominal Lamp Wattage	Minimum CRI	Product Class #	Baseline Model / Extrapolation
4-foot medium bi-pin	> **T8**	> 35 W	69	1	(scale from 34W/48T12/RS)
		≤ 35 W	**45**	**2**	**34W/48T12/RS**
	≤ T8	> 35 W	69	3	(scale from 32W/48T8/RS)
		≤ 35 W	**45**	**4**	**32W/48T8/RS**
2-foot U-shaped	> **T8**	**> 35 W**	**69**	**5**	**40W/23T12/U6/RS**
		≤ 35 W	45	6	(scale from 40W/23T12/U6/RS)
	≤ T8	> 35 W	69	7	(scale from31W/23T8/U1/RS)
		≤ 35 W	**45**	**8**	**31W/23T8/U1/RS**
8-foot slimline	**T12**	> 65 W	69	9	(scale from 60W/96T12/SP)
		≤ 65 W	**45**	**10**	**60W/96T12/SP**
8-foot high output	**T12**	> 100 W	69	11	(scale from 95W/96T12/HO)
		≤ 100 W	**45**	**12**	**95W/96T12/HO**

As discussed in section 3.2, EPCA establishes six product classes for **incandescent reflector lamps**. Of these six product classes, the Department proposes to use product class numbers 15 and 17 as the representative product classes for incandescent reflector lamps because these two classes encompass high-volume wattage ratings and are well-bounded (i.e., not on either extreme) within the range of wattages currently regulated (see Table 5). Furthermore, the

[14] According to the ECPA definition, 8-foot slimline fluorescent lamps refer to those included in ANSI 78.3-1991.

Department is proposing to select parabolic aluminized reflector (PAR) lamps as the baseline models for both of these product classes, as PAR lamps represent the majority of covered incandescent reflector lamps available in the market. Within the two proposed representative product classes, the Department proposes to select a 75W PAR lamp and a 150W PAR lamp as the baseline models because these wattages are common in the market and they would adequately represent the full range of covered lamp wattages. The Department will define the baseline models in more detail once it has received comment on this proposal and completed its market and technology assessment.

Table 5. Proposed Product Classes for Incandescent Reflector Lamps

Nominal Lamp Wattage	Product Class #	Baseline Model / Extrapolation
40-50	13	(scale from 75W)
51-66	14	(scale from 75W)
67-85	**15**	**75W PAR**
86-115	16	(interpolate between 75W and 150W)
116-155	**17**	**150W PAR**
156-205	18	(scale from 150W)

For **additional general service incandescent lamps**, neither EPCA nor DOE has established product classes or any other classification structure since there are no energy conservation standards. As discussed earlier, the Department is considering product classes for non-reflector general service incandescent lamps based on wattage (consistent with incandescent reflector lamps), lamp coatings, design voltages and/or lumen output. From information published in late 2005, the Department understands that there are three A-line lamp wattages sold today which dominate the general service incandescent lamp market: 60W, 75W and 100W.[15] The Department will take this information into consideration, along with stakeholder comments, when establishing product class(es) and selecting representative baseline model(s). As with general service fluorescent lamps and incandescent reflector lamps, the Department will examine if it is possible to extrapolate the analyses of one baseline model within a representative product class to other (similar) product classes.

For high-wattage incandescent reflector lamps, the Department intends to establish product classes based on wattage ratings for any additional lamps the Secretary determines to consider for energy conservation standards. The Department intends to extrapolate its analysis from incandescent reflector lamp representative product classes to these additional product classes, where appropriate.

[15] According to a 2004 National Electrical Manufacturers Association (NEMA) survey of its manufacturers, 60W, 75W and 100W lamps constitute over eighty percent of market sales for A-line lamps. Source: Pitsor, K. Letter to Tim Tutt, John Wilson and Gary Flamm. December 14, 2005. Online at: http://www.energy.ca.gov/appliances/2006rulemaking1/documents/2006-03-10_NEMA_A-LINE_SURVEY_REPONSE_12-14-2005.PDF.

Item 10 *The Department welcomes comment on the representative product classes proposed in section 3.4. Additionally, the Department welcomes comment on the scaling of findings from the representative product classes to other product classes that are not analyzed.*

Item 11 *The Department welcomes comment on the baseline models identified for each of the representative product classes. This includes specific technological information such as lamp size, wattage rating, CRI, CCT (correlated color temperature), operating life, etc.*

4. SCREENING ANALYSIS

The purpose of the screening analysis is to screen out technology design options that will not be considered in the rulemaking for general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps. DOE will screen out technology design options according to four criteria, as noted below.

Through its own research and in consultation with interested parties, the Department will develop a list of design options for consideration. Initially, the candidate design options or best available technologies will encompass all those technologies that may be technologically feasible. Following development of this initial list of design options, the Department will review each design option or best available technology based on the following four criteria, as addressed in sections 4(a)(4) and 5(b) of the Process Rule:

1. *Technological feasibility.* Design options that are not incorporated in commercially available lamps or in working prototypes will not be considered further.

2. *Practicability to manufacture, install, and service.* If it is determined that mass production of a design option or reliable installation and servicing of a design option could not be achieved on the scale necessary to serve the relevant market by the time of the effective date of the energy conservation standard, then that design option will not be considered further.

3. *Impacts on lamp utility to consumers.* If a design option is determined to have significant adverse impact on the utility of the lamp to significant subgroups of consumers, or result in the unavailability of any covered lamp type with performance characteristics (including reliability), features, size, capacities, and volumes that are substantially the same as lamps generally available in the United States at the time, it will not be considered further.

4. *Safety of technologies.* If it is determined that a design option will have significant adverse impacts on health or safety, it will not be considered further.

As discussed in the Technology Assessment section (see section 3.3), the Department understands that for incandescent lamps, improvements in lamp efficacy are possible through increasing the operating temperature of the filament, which can cause a reduction in operating life. The Department may limit variation in incandescent lamp lifetime in order not to significantly reduce lamp utility.

The reasons for eliminating any design options during the screening analysis will be fully documented and published for stakeholder review and comment as part of the ANOPR.

Item 12 *The Department welcomes comment on whether the Department's analysis should allow incandescent (both reflector and additional general service incandescent) lamp life to vary in order to increase (or decrease) efficacy? If so, what would be a reasonable amount of variance (i.e., not a 'significant adverse impact') for reflector lamps and for general service incandescent lamps?*

5. ENGINEERING ANALYSIS

After conducting the screening analysis, the Department performs an engineering analysis based on the remaining design options that improve lamp efficacy. This section provides an overview of the engineering analysis (section 5.1), discusses the Department's proposed approach (section 5.2), and addresses manufacturer prices (section 5.3), proprietary designs (section 5.4), and regulatory burdens that might affect the engineering analysis (section 5.5).

5.1. Engineering Analysis Overview

The purpose of the engineering analysis is to determine the relationship between the manufacturer's selling price and efficacy for general service fluorescent lamps and incandescent reflector lamps. In addition, the Department will develop an engineering analysis for additional general service incandescent lamps as part of its determination whether energy conservation standards should be considered for these lamp types. In determining the price-efficacy relationship, the Department will estimate the increase in the manufacturer selling price associated with technological changes that increase the efficacy of the baseline models.

The Department will develop cost estimates for the engineering analysis (which it will also use in the manufacturer impact analysis, see section 12) from detailed data on the cost of incremental material, labor, and overhead. The Department will develop separate engineering analyses for each of the baseline models identified in section 3.4. The Department intends to develop industry-average, cost-efficacy relationships for these lamps based primarily on manufacturer-supplied data. If needed, the Department may supplement this analysis with its own cost estimates of specific design options.

Therefore, the Department seeks design, efficacy, and cost information to develop a detailed understanding of the cost of improving the efficacy of the various baseline model lamps. In addition, the Department must identify the model with the highest efficacy that is technologically feasible within each product class (i.e., the "max tech" model).

Item 13 *For each product class, the Department welcomes information on design options and incremental manufacturing costs for five lamp efficacy levels above the baseline, one of which would be max tech. Detailed information on the lamp performance (e.g., energy consumption, light output, operating life, etc.) and the incremental manufacturing costs (e.g., material costs,[16] labor costs,[17] overhead costs[18] (excluding depreciation), building conversion capital expenditures, tooling/equipment conversion capital expenditures, research and development (R&D) expenses, marketing expenses, etc.) would be welcome.*

5.2. Engineering Analysis Approach

For the engineering analysis, the Department will examine aggregated incremental increases in the manufacturer production cost at specified efficiency levels (or efficacy levels in the case of lamps). In support of this analysis, the Department intends to collect incremental cost data from manufacturers. The cost data would represent the average incremental production cost to improve the efficacy of a baseline model. The Department may supplement the manufacturer-provided cost data with its own cost estimates of particular design options. DOE would develop design-option cost estimates via consultation with lighting experts and industry representatives and/or further review of any available cost and performance information. The Department would also use the cost data collected for the engineering analysis in the manufacturer impact analysis (see section 12). If possible, the Department would then aggregate the cost numbers by weighting each individual data point by company-level sales volumes for each product class.

To be useful in the manufacturer impact analysis, manufacturer cost information should reflect the variability in baseline models, design strategies, and cost structures that exist among manufacturers. If necessary, the Department will qualify any aggregated cost-efficacy data. Information obtained through follow-up with manufacturers would assist this effort. These

[16] Costs of raw materials including scrap that can be traced to final or end products. Direct material costs do not include indirect material costs which are attributed to supplies that may be used in the production process but are not assigned to final products (e.g., lubricating oil for production machinery).

[17] The earnings of workers who assemble parts into a finished good or operate machines in the production process. Direct labor includes the fringe benefits of direct laborers such as group health care, as well as overtime pay. Direct labor does not include indirect labor which is defined as the earnings of employees who do not work directly in assembling a product such as supervisors, janitors, stockroom personnel, inspectors, and forklift operators.

[18] Factory overhead excluding depreciation. Factory overhead includes indirect labor, downtime, set-up costs, indirect material, expendable tools, maintenance, property taxes, insurance on assets, and utility costs. Factory overhead does not include selling, general, and administrative costs (SG&A); research and development (R&D); interest; or profit (accounted for by the Department separately).

confidential interviews will provide a deeper understanding of the various combinations of technologies used to increase lamp efficacy, and their associated manufacturing costs.

The Department will estimate the contribution of the depreciation of conversion capital expenditures to the incremental overhead. During the interviews, the Department will gather information about the capital expenditures needed to increase the efficacy of the baseline models to various efficacy levels (i.e., conversion expenditures by efficacy). The Department will also gather information about the depreciation method(s) used to expense the conversion expenditures.

For the cost-efficacy curves, the Department intends to hold the lamp lumen output constant at the level of the baseline model. Thus, as the lamps become more efficacious, they will consume less electricity rather than produce more light. Holding lumen output constant across the engineering analysis cost-efficacy curves is necessary to ensure that end-users are supplied with an equivalent service under the base case and standards case scenarios.

The approach proposed above will enable the Department to characterize the cost-efficacy relationship for lamps across the entire efficacy range without relying solely on simulation modeling. The Department will maintain the confidentiality of proprietary data, while allowing the public to examine the cost and design assumptions that underlie the cost-efficacy estimates.

Item 14 *The Department welcomes comment on the above-described approach to determining the relationship between manufacturer selling price and lamp efficacy.*

Item 15 *The Department welcomes feedback on its proposal to normalize its engineering analysis around the lumen output of each baseline lamp.*

5.3. Manufacturer Prices

The Department plans to apply markups to convert manufacturer production costs to manufacturer selling prices. The Department intends to estimate manufacturer markups from publicly available financial information (e.g., Securities and Exchange Commission 10-K reports).

Item 16 *The Department welcomes comment on the markup approach proposed for developing estimates of manufacturer selling prices.*

5.4. Proprietary Designs

The Department will consider in its engineering and economic analyses all design options that are commercially available or present in a working prototype, including proprietary designs. The Department will consider a proprietary design in the subsequent analyses only if it is not a

unique path to a given lamp efficacy level. If the proprietary design is the only approach available to achieve a given efficacy level, then DOE will reject the efficacy level (that can only be achieved by a proprietary design) from further analysis. Furthermore, the Department is sensitive to manufacturer concerns regarding proprietary designs and will make provisions to maintain the confidentiality of any proprietary data submitted by manufacturers. This information will provide input to the competitive impacts assessment and other economic analyses.

Item 17 *The Department welcomes comment on whether there are proprietary designs that the Department should consider for any of the lamps under consideration by this rulemaking, and if so, how the Department should acquire the cost data necessary for evaluating these designs.*

5.5. Outside Regulatory Changes Affecting the Engineering Analysis

In conducting an engineering analysis, the Department must consider the effects of regulatory changes outside the Department's statutory energy conservation standards rulemaking process that can impact the manufacturers of the covered equipment. Some of these changes can also affect the efficacy or energy consumption of the covered lamps. The Department will attempt to identify all such outside engineering issues that could impact the engineering analysis. The consideration of these issues is closely related to the cumulative regulatory burden assessment that the Department will carry out as part of the manufacturer impact analysis.

Item 18 *The Department welcomes comment on whether there are outside issues that the Department should consider in its analysis of general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps.*

6. ENERGY-USE AND END-USE LOAD CHARACTERIZATION

The purpose of the energy-use and end-use load characterization is to identify the way in which products are used by consumers, and thereby determine the energy-savings potential of energy-efficiency improvements. For the lamps in this rulemaking, this analysis will focus on how end-users install and operate these lamps.

This analysis, which is an input to the LCC assessment and the national impact analysis, is intended to capture and represent the typical energy consumption in the field. This usage profile enables DOE to conduct a calculation to determine the LCC and the payback period of more efficacious lamp technologies relative to the baseline lamp.

For incandescent lamps, the energy consumption is often simply the lamp wattage multiplied by the number of operating hours in a given year. For general service fluorescent

lamps, the Department is aware that there are low-frequency and high-frequency ballasts in the field, and that the same lamp type would have different performance characteristics depending on the ballast used. Thus, in the energy-use and end-use load characterization that the Department performs in this rulemaking, it will consider both types of ballasts.

The Department seeks to identify and obtain detailed data on the typical applications and end-use profiles for the lamps considered in this rulemaking. If the range of energy use determined for each lamp type is large enough, DOE will conduct a sensitivity analysis to determine how high and low estimates of energy use might impact the economic feasibility of any amended energy conservation standards.

Item 19 *The Department welcomes recommendations on sources of data that would provide end-use operating profiles for each of the lamp types covered under this rulemaking.*

Item 20 *The Department welcomes comment on whether the end-use operating profiles are different for each of the lamp types covered under this rulemaking, and if so, how.*

Item 21 *The Department welcomes comment on other engineering issues that could impact the engineering analysis.*

7. MARKUPS FOR EQUIPMENT PRICE DETERMINATION

The Department uses manufacturer-to-consumer markups to convert the manufacturer selling price estimates from the engineering analysis to consumer prices. It then uses these markups in the LCC analysis, consumer payback period analysis, and national impact analysis. Retail prices are needed for the baseline efficacy level and all other efficacy levels under consideration. The Department will obtain these retail prices by applying manufacturer-to-consumer markups to manufacturer-selling-price estimates. To validate these markups, the Department will attempt to collect data on existing prices in the market either by purchasing large data sets or by downloading data from distributor internet sites.

Before it can develop markups, DOE must identify distribution channels (i.e., how a lamp is distributed from the manufacturer to the consumer). Once it establishes proper distribution channels for each of the lamp types, DOE will rely on economic census data from the U.S. Census Bureau, as well as input from the lighting industry and subject matter experts to develop an understanding of the markups applied as a lamp moves from the manufacturer to the consumer. To the extent possible, the Department also will use collected retail price data to determine overall manufacturer-to-consumer markups.

This analysis will generate retail prices based on the marked-up manufacturing prices from the engineering analysis. Because the Department expects to generate a range of price

estimates, it plans to describe new retail prices within a range of uncertainty. If the range of retail prices for each lamp type is large enough, the Department will conduct a sensitivity analysis to determine how high and low estimates of retail price might impact the economic feasibility of any potential amended energy conservation standard.

Item 22 *The Department welcomes comment on the distribution chain for lamps, the key stakeholders in those distribution chains, the typical markups applied by those stakeholders, and the overall markup from manufacturer selling price to retail shelf.*

8. LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS

The effects of increased energy conservation standards on consumers include a change in operating expense (usually decreased) and a change in purchase price (usually increased). In carrying out rulemakings for other products, the Department has analyzed the net effect on consumers by calculating the LCC and payback period analyses using the engineering performance data (section 5), the energy-use and end-use load characterization data (section 6), and the equipment retail prices (section 7). Inputs to the LCC calculation include the installed cost to the consumer (purchase price plus installation cost), operating expenses (energy expenses, and, if applicable, repair costs, and maintenance costs), the lifetime of the product or other defined period of analysis, and a discount rate.

For the ANOPR, DOE will conduct the LCC analysis using typical values to reflect conditions in the field for product retail price and life, energy costs, energy usage, and discount rates. If the Department determines that there is significant variability in any of the above inputs, it will conduct sensitivity analyses to determine how the LCC and payback period are impacted by high and low estimates for each of the inputs. For any sensitivity analyses that it conducts, the Department will account for correlations that may exist between inputs (e.g., energy usage may be correlated to energy prices). The detailed impact calculation, which DOE will conduct after the ANOPR, may include an assessment of impacts on subgroups of consumers, as described in section 11.

Based on the results of the LCC analysis, DOE will select candidate standard levels (CSLs) for the ANOPR analysis. The range of CSLs typically will include the lamp efficacy level with the lowest LCC, the highest efficacy level that is technologically feasible, and other levels DOE has not yet determined.

For the NOPR, the Department will carefully review all of the comments it received on the ANOPR LCC analysis, make any necessary revisions to the analysis, and evaluate additional parameters not included in the ANOPR analysis, if necessary.

For general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps, DOE will need to determine input values for several variables. The

following sections discuss the methodologies DOE plans to use to develop: energy prices; discount rates; maintenance, repair, and installation costs; and lamp lifetimes.

8.1. Energy Prices

For consumers of general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps, the Department will review residential and commercial energy price data from the Energy Information Administration (EIA) as a means for establishing electricity prices. If the EIA data demonstrate a large variability in electricity prices, DOE will conduct a sensitivity analysis to determine how high and low electricity price estimates might impact the economic feasibility of any amended energy conservation standards. The Department will use projections of national-average energy prices for residential, commercial and industrial consumers to estimate future energy prices in its LCC analysis. The Department will use EIA's *Annual Energy Outlook* (*AEO*) as the principal source of projections for future electricity prices.

Item 23 *The Department welcomes input on the proposed methodology for estimating current and future electricity prices.*

8.2. LCC Discount Rates

The calculation of consumer LCC requires the use of an appropriate discount rate. For residential consumers of general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps, the Department plans to use the same approach that it relied on to develop discount rates for residential furnaces and boilers—i.e., derive the discount rates from estimates of the interest or "finance cost" to purchase residential products. By applying the financial theory, the finance cost of raising funds to purchase residential products can be interpreted as: (1) the financial cost of any debt incurred to purchase residential products, principally interest charges on debt, or (2) the opportunity cost of any equity used to purchase residential products, principally interest earnings on household equity. Household equity is represented by holdings in assets such as stocks and bonds, as well as the return on homeowner equity. The Department would obtain much of the data required to determine the cost of debt and equity from the Federal Reserve Board's triennial *Survey of Consumer Finances*.

For commercial and industrial consumers of general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps, the Department plans to use the same approach it relied on for developing discount rates for commercial unitary air conditioners and commercial consumers of distribution transformers. This approach involves deriving the discount rates for commercial consumers by estimating the cost of capital of companies that purchase commercial equipment. The cost of capital is commonly used to estimate the present value of cash flows to be derived from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so the cost of capital is the weighted-average cost of equity and debt financing. This corporate finance approach is referred to as the weighted-average cost of capital (WACC). For instance, the set of commercial or industrial companies purchasing lamps may differ from those who purchase large

unitary air conditioners or distribution transformers, which would result in different discount rates being developed for this rulemaking.

The Department will publish the discount rates and associated documentation on the derivation of these discount rates at the time of the ANOPR publication. Stakeholders will be invited to comment specifically on the issue of consumer discount rates during the ANOPR comment period.

Item 24 *The Department welcomes input on the proposed approaches for estimating discount rates for residential and commercial consumers of lamps covered under this rulemaking.*

8.3. Maintenance, Repair, and Installation Costs

Typically, the Department will take into consideration any expected changes to maintenance, repair, and installation costs for the products covered in a rulemaking. Often, small incremental changes in product efficiency would incur little or no change in repair and maintenance costs over baseline products. For products with significant energy efficiency improvements over the baseline, there may be increased repair and maintenance costs since those products are more likely to incorporate technologies that are not widely available. For lamps, the Department expects that maintenance and repair costs will be negligible, given that lamps typically do not have replaceable parts. With regard to installation costs, the Department is aware that there would be variability in the costs for commercial and industrial sector lamp installations (both fluorescent and incandescent) depending on whether the re-lamping practices are based on group re-lamping (i.e., changing all lamps in a section at the same time, before the end of the average lamp lifetime) or spot re-lamping (i.e., changing only those lamps which have failed). However, the Department does not believe that existing re-lamping practices would necessarily change under an energy conservation standard. In addition, because the product being considered under this rulemaking is a lamp, the Department is not intending to consider ballast replacements in its analysis (i.e., the Department intends to only consider interchangeable lamps as direct substitutes).

Item 25 *The Department welcomes comment on whether and how to develop maintenance, repair and installation costs for all three lamp types. In particular, will policies of group re-lamping versus spot re-lamping impact the installation costs differentially with standard levels?*

8.4. Lamp Lifetimes

The Department will use information from catalogues, various literature sources and input from manufacturers and other stakeholders to establish lamp lifetimes for use in the LCC and subsequent analyses.

For incandescent lamp technologies, as discussed in section 5, the Department recognizes that one of the methods by which a lamp can be made more efficacious is by increasing the operating temperature of the filament, which increases the evaporation rate of tungsten and shortens the life of the lamp. Impacts such as these will be taken into account in the LCC analysis through a clear understanding of the various lamp lifetimes relative to the baseline model.

For commercial sector installations, as discussed in section 8.3, commercial entities may employ policies of either group re-lamping or spot re-lamping. The apportionment of commercial-sector floor-space to group and spot re-lamping is important, as it will impact the practical lamp lifetime, meaning the period over which the LCC of a given lamp is captured.

Based on consideration of the comments received for the ANOPR, the Department will make necessary changes to the analysis. These changes will be reflected in the documentation of the NOPR.

Item 26 *The Department welcomes comment on appropriate lamp lifetimes for the three lamps types covered in this rulemaking. For the commercial and industrial sectors, should group re-lamping be taken into consideration, and if so, how should the Department characterize its impact on lamp lifetimes?*

9. SHIPMENTS ANALYSIS

Shipment forecasts are required in order to calculate the national impacts of standards on energy, net present value (NPV), and future manufacturer cash flows. The Department plans to develop shipments forecasts based on an analysis of key market drivers for the covered lamps.

9.1. Base-Case Forecast

To evaluate the various impacts of standards, the Department must develop a base-case forecast against which to compare forecasts for higher efficiency levels. The base-case forecast is designed to depict what will happen to energy consumption and energy costs over time if the Department does not adopt new or amended energy conservation standards for the lamps covered under this rulemaking. In determining the base-case forecast, the Department will consider historical shipments, the mix of lamp efficacies sold under existing regulation (or, in the case of general service incandescent lamps, absence of regulation), and how that mix might change over time. For these purposes, the Department needs data on historical product shipments and the market shares of the different efficiency levels offered in each product class.

The Department seeks data on historical lamp shipments for general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps. The Department is considering manufacturers and industry organizations as potential sources of such information. Alternatively, to arrive at this information the Department is considering purchasing national

market reports, extrapolating from shipment data received by the California Energy Commission in its State rulemaking on general service incandescent lamps, or extrapolating historical sales data from the United States Bureau of Census. The United States Bureau of Census publishes limited information on the quantity and dollar-value of product shipments. Census data for the value of product shipments are available for years 1994-2004. Data for product shipment quantities, for those companies with a shipment value of $100,000 or more, are available from 1997 to 2002. However, neither dataset disaggregates the lamps according to lamp type or energy conservation standard product class. For fluorescent lamps, the Department may calibrate its fluorescent lamp shipment estimates against shipment data for fluorescent lamp ballasts, which specifies shipment quantities and values by ballast type; this data is available from 2002 to 2005.

The Department hopes to collect shipment data within each product class, as well as market share efficiency data (i.e., data on the distribution of product shipments by lamp efficacy), if applicable, for each product class. The Department recognizes that this information may be difficult to collect, and may, therefore, consider other methods to estimate the efficiency distribution in the market. For instance, if market share efficiency data are not available, the Department may develop, as a proxy, efficiency distributions based on available models and information from subject matter experts.

9.2. Accounting Methodology

The Department proposes to determine annual shipments in the base case by accounting for new building construction, lamp replacements due to failure and luminaire retrofits (i.e., major remodeling where the fixture is replaced). Each of these three impacts on the accounting methodology is discussed below:

- *New Construction* – the new fixtures that are installed each year due to floor space growth in a particular sector. The Department proposes to determine this by using the NEMS growth projection for the residential and commercial sectors.

- *Replacements* – the lamps that have burned out. This calculation is based on a comparison of the operating hours of the lighting technologies and the lamps servicing an end-use application. To the extent that the Department uses a group re-lamping as opposed to spot re-lamping in the commercial sector lamp installations (see section 8.3), the lamp replacement rate may increase.

- *Retrofits* – the lamps and fixtures replacing existing lamps and fixtures during renovation or remodeling. This replacement generally occurs before a lamp has burned out.

Item 27 *The Department welcomes comment on the accounting methodology described above for new construction, replacements and retrofits for each of the lamp types covered in this rulemaking.*

9.3. Standards Impacts on Lamp Shipments

For each lamp type, the Department will develop a set of shipment forecasts for the covered lamps for each set of standards analyzed. These standards-case forecasts will be used to evaluate the impacts of standards on lamp shipments. Standards-case forecasts are derived using the same data sets as base-case forecasts. However, because the standards-case forecasts take into account the increase in purchase price and the decrease in operating costs caused by standards, forecasted shipments typically deviate from the base case. The magnitude of the difference between the standards-case and base-case shipment forecasts depend on the estimated purchase-price-increase, as well as the operating-cost savings from the standard. In addition, for lamps considered in this rulemaking, the Department will take into consideration substitute lamps that may become more popular under various standards scenarios. In other words, if DOE increased the standard for incandescent reflector lamps, there might be a migration away from regulated lamps toward un-regulated substitutes such as ER, BR or other lamp shapes. Because the purchase price tends to have a larger impact than operating cost on equipment purchase decisions, standards-case forecasts typically do show an elasticity of demand, manifested as a drop in shipments relative to the base case. For this rulemaking, changes in the elasticity of demand will most likely result from the substitution of non-regulated technologies for regulated technologies rather than from unused sockets.

Market-pull programs, such as consumer rebate programs that encourage the purchase of more efficacious lamps and manufacturer tax credits that encourage the production of more efficacious lamps, also affect standards-case forecasts. When such programs exist, the Department considers their impact on the forecast of both standards-case and base-case shipments.

Item 28 *The Department welcomes comment on how any amended standard for general service fluorescent lamps and incandescent reflector lamps, as well as a standard on general service incandescent lamps, might impact lamp shipments. The Department also invites input on market-pull programs that promote the adoption of more-efficacious lamps.*

10. NATIONAL IMPACT ANALYSIS

Section 8 discusses methods for estimating the LCC savings and payback period for individual consumers. This section discusses the Department's assessment of the aggregate impacts at the national level. Measures of impact to be reported include the NPV of total consumer LCC and national energy savings.

10.1. Inputs to Forecasts

Analyzing impacts of Federal energy conservation standards requires a comparison of projected United States energy consumption with, and without, new or amended energy conservation standards. The forecasts contain projections of unit energy consumption of new

lamps, annual equipment shipments, and the price of purchased equipment. The derivations of the base-case shipments forecasts are discussed in section 9. Approaches to determine retail prices for products are described in section 7, while approaches to determine unit energy consumption are described in section 6.

10.2. Calculation of Energy Savings

The Department intends to calculate national energy consumption for each year beginning with the expected effective date of the standards. It will calculate national electricity consumption for the base case and each standard level analyzed. The Department plans to perform this calculation through the use of a spreadsheet model that effectively multiplies annual shipment forecasts by unit energy savings, thereby accounting for the stock of appliances affected by standards.

In response to comments by stakeholders who asked for a simple, transparent model, the Department developed NES spreadsheet models for its standards rulemakings starting in 1996. The Department's NES spreadsheet model will provide a credible, stand-alone forecast of national energy savings and NPV for general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps.

In other rulemakings, the Department prepared NES spreadsheet models to project energy savings and to demonstrate how the growth in efficiency can be accounted for over time.[19] Although these models are specific to each product, their general framework is applicable to the lighting market, and, specifically, to the general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps.

Item 29 *The Department welcomes comment on the NES spreadsheet models used for estimating national impacts of amended energy conservation standards.*

10.3. Net Present Value

The Department calculates the national NPV of the energy conservation standards in conjunction with the NES. It calculates annual energy expenditures from annual energy consumption by incorporating forecasted energy prices, using the shipment and average energy efficiency forecasts described in section 9. The Department calculates annual equipment expenditures by multiplying the price per unit times the forecasted shipments. The difference between a base-case and a standards-case scenario typically contributes to a national energy savings off-set against increased expenditures on lamps. The difference each year between energy bill savings and increased equipment expenditures is the net savings (if positive) or net costs (if negative). The Department discounts these annual values to the present time and sums them to give a net present value. According to U.S. Office of Management and Budget (OMB) requirements, the Department will conduct two NPV calculations, one using a real discount rate of three percent and the other using a real discount rate of seven percent (OMB, Circular A-4:

[19] Several NES spreadsheet models from previous rulemakings, including fluorescent lamp ballasts, can be found on the Department of Energy's website at www.eere.energy.gov/buildings/appliance_standards/.

Regulatory Analysis. 2003). Based on consideration of the comments received for the ANOPR, the Department will make any necessary changes to the analysis and candidate standard levels (CSLs).

11. LIFE-CYCLE COST SUBGROUP ANALYSIS

This section describes how DOE analyzes consumer impacts by dividing consumers into subgroups and accounting for variations in key inputs to the LCC analysis. A consumer subgroup comprises a subset of the population that is likely, for one reason or another, to be impacted disproportionately by new or revised energy conservation standards. The purpose of a subgroup analysis is to determine the extent of this disproportional impact. The Department will work with stakeholders early in the rulemaking process to identify any subgroups for this consideration. However, it will not analyze the consumer subgroups until the NOPR stage of the analysis.

In comparing potential impacts on the different consumer subgroups, the Department will evaluate variations in regional electricity prices, variations in usage profiles, and variations in installation costs that might affect the NPV of an energy conservation standard to certain consumer subgroups. To the extent possible, DOE may obtain estimates of the variability in each input variable and consider this variability in its calculation of consumer impacts. It will discuss with stakeholders the variability in each input variable and likely sources of information.

The Department intends to consider the impact of any new standards on consumer subgroups.

> ***Item 30*** *The Department welcomes comment on what, if any, consumer subgroups are appropriate in considering standards for general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps.*

12. MANUFACTURER IMPACT ANALYSIS

Recently, the Department announced changes to the manufacturer impact analysis format in a report issued to Congress on January 31, 2006 (as required by section 141 of EPACT 2005). This report, entitled "Energy Conservation Standards Activities," (Standards Activities) is available on the DOE website at: http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

Previously, DOE did not report any manufacturer impact analysis results during the ANOPR phase; however, under this new format, DOE will collect, evaluate, and report preliminary information and data in the ANOPR. (See Standards Activities, page 48) Such preliminary information includes the anticipated conversion capital expenditures by efficiency level and the corresponding, anticipated impacts on employment. The Department will invite input on these issues during its ANOPR manufacturer interviews.

The analysis of impacts on manufacturers is intended to provide the Department with an assessment of the potential impacts of energy conservation standards on manufacturers of general service fluorescent lamps, incandescent reflector lamps and additional general service incandescent lamps. The Department intends to conduct a separate manufacturer impact analysis for each of the lamp types covered under this rulemaking. In addition to financial impacts, a wide range of quantitative and qualitative effects may occur following adoption of a standard that may require changes to the manufacturing practices for these lamps. The Department will identify these effects through interviews with manufacturers and other experts.

12.1. Sources of Information for the Manufacturer Impact Analysis

Many of the analyses described earlier provide important information that the Department uses as inputs for the manufacturer impact analysis. Such information includes financial parameters developed in the market assessment (section 3.1), manufacturing costs and prices from the engineering analysis (sections 5.2 and 5.3), retail price forecasts (section 7), and shipments forecasts (section 9). The Department supplements this information with information gathered during manufacturer interviews. The interview process plays a key role in the manufacturer impact analysis, since it provides an opportunity for interested parties to express their views on important issues.

The Department will conduct detailed interviews with manufacturers to gain insight into the range of potential impacts from standards. During the interviews, the Department will take note of information on the possible impacts on manufacturing costs, equipment prices, sales, direct employment, capital assets, and industry competitiveness. Both qualitative and quantitative information are valuable. The Department will schedule interviews well in advance to provide every opportunity for key individuals to be available.

The Department will ask interview participants to identify all confidential information provided in writing or orally. It will consider the information gathered, as appropriate, in the energy conservation standard decision-making process. The Department will also ask participants to identify any information that they wish to have included in the public record, but that they do not want to have associated with their interview. The Department will incorporate this information into the public record, but will report it without attribution.

The Department will collate the interview results and prepare a summary of the major issues and outcomes. This summary will become part of the technical support document for this rulemaking.

Item 31 *The Department welcomes comment on interviewing companies to assess manufacturer impacts, and the procedures that the Department should follow when scheduling interviews and requesting information.*

12.2. Industry Cash Flow Analysis

The industry cash flow analysis relies primarily on the Government Regulatory Impact Model (GRIM). The Department uses the GRIM to analyze the financial impacts of more stringent energy conservation standards on the industry that produces the products covered by the standard.

The GRIM analysis uses a number of factors—annual expected revenues; manufacturer costs such as costs of goods sold; selling, general, and administrative costs; taxes; and capital expenditures (both ordinary capital expenditures and those related to standards)—to arrive at a series of annual cash flows beginning from the announcement of the new standard and continuing for several years after its implementation. The Department compares the results against base-case projections that involve no new standards. The financial impact of new standards is then the difference between the two sets of discounted annual cash flows. Other performance metrics, such as return on invested capital, are also available from the GRIM.

The Department will gather this information from two primary sources: the analyses conducted to this point, and interviews with manufacturers and other stakeholders. Information gathered from previous analyses will include financial parameters, manufacturing costs, price forecasts, and shipments forecasts. Interviews with manufacturers and other stakeholders will be essential in supplementing this information.

12.3. Manufacturer Subgroup Analysis

It is possible that the use of average industry cost values will not adequately assess differential impacts among subgroups of lamp manufacturers. The Department recognizes that smaller manufacturers, niche players, and manufacturers exhibiting a cost structure that differs largely from the industry average may be impacted differently by the imposition of standards. Ideally, the Department would consider the impact on every firm individually. In highly concentrated industries, this may be possible. In industries having numerous participants, however, the Department will use the results of the market and technology assessment to group manufacturers into subgroups, as appropriate.

Item 32 *If appropriate, what are potential subgroups of lamp manufacturers that should be considered in a manufacturer subgroup analysis?*

12.4. Competitive Impacts Assessment

EPCA directs the Department to consider any lessening of competition that is likely to result from an imposition of standards. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It further directs the Attorney General to determine in writing the impacts, if any, of any lessening of competition. (42 U.S.C. 6295(o)(2)(B)(ii)) The Department will make a determined effort to gather firm-specific financial information and impacts. The Department will then report the aggregated impact of the standard on manufacturers. The competitive analysis will focus on assessing the impacts to smaller, yet significant, manufacturers. DOE will provide the Attorney General with a copy of the NOPR for consideration in his evaluation of the impact of standards on the

lessening of competition. The Department will base the assessment on manufacturing cost data and on information collected from interviews with manufacturers. The manufacturer interviews will focus on gathering information that would help in assessing asymmetrical cost increases to some manufacturers, increased proportion of fixed costs potentially increasing business risks, and potential barriers to market entry (e.g., proprietary technologies).

12.5. Cumulative Regulatory Burden

The Department is aware that other regulations may apply to products covered under this rulemaking, as well as to other equipment produced by the same manufacturers of products covered under this rulemaking. Multiple regulations may result in a cumulative regulatory burden on these manufacturers. The Department will seek to limit the overlapping effects on manufacturers of DOE standards and other regulatory actions affecting the three types of covered lamps and manufacturers of these lamps.

Regulations that could affect the industry impacted by this rulemaking include:

- New EPCA standards, prescribed in EPACT 2005, for medium-base compact fluorescent lamps (CFL's), mercury vapor lamp ballasts, torchiere fixtures and ceiling fan light kits;
- Standards EPCA prescribes for fluorescent lamp ballasts, FTC labelling requirements, and a determination on a standard for high intensity discharge (HID) lamps;
- Existing and/or proposed State standards for reflector lamps (i.e., ER and BR lamps), general service incandescent lamps, enhanced spectrum incandescent lamps, metal halide lamp fixtures, HID ballasts, and/or under-cabinet luminaires;
- State building energy codes lighting requirements (e.g. ASHRAE 90.1);
- Federal and State requirements regarding fluorescent and HID lamp disposal; and
- International standards, including Canada's regulation of general service fluorescent lamps, fluorescent lamp ballasts and incandescent reflector lamps.

Item 33 *The Department welcomes comment on what other regulations or pending regulations the Department should consider in its examination of cumulative regulatory burden.*

13. UTILITY IMPACT ANALYSIS

To perform the utility impact analysis, which will include an analysis of the electric utility industry, the Department plans to use a variant of the EIA's National Energy Modeling System (NEMS), called NEMS-BT (BT is DOE's Building Technologies Program). NEMS is a large, multi-sectoral partial equilibrium model of the U.S. energy sector, used primarily for the purpose of preparing the *Annual Energy Outlook* (AEO). NEMS-BT produces a widely recognized reference case forecast for the United States through 2030 and is available in the public domain. Outputs of the utility analysis can parallel results that appear in the latest AEO, with some additions. Typical outputs include forecasts of sales, price, and avoided capacity. The Department plans on conducting the utility impact analysis as a scenario departing from the

latest AEO reference case. In other words, the energy savings impacts from amended energy conservation standards will be modeled using NEMS-BT to generate forecasts that deviate from the AEO reference case.[20]

Item 34 *The Department welcomes input from stakeholders on its proposed use of NEMS-BT to conduct the utility impact analysis.*

14. EMPLOYMENT IMPACT ANALYSIS

The imposition of standards can impact employment both directly and indirectly. Direct employment impacts are changes in the number of employees at the factories that produce the covered lamp types, along with the affiliated distribution and service companies. The Department will evaluate direct employment impacts in the manufacturer impact analysis, as described in section 12. Indirect employment impacts may result from expenditures shifting between goods (the substitution effect) and changes in income and overall expenditure levels (the income effect) that occur due to the imposition of standards. The combined direct and indirect employment impacts will be investigated in the employment impact analysis using the Pacific Northwest National Laboratory's 'Impact of Sector Energy Technologies' (ImSET) model. ImSET was developed for the Department's Office of Planning, Budget, and Analysis, and estimates the employment and income effects of energy-saving technologies in buildings, industry, and transportation. In comparison with simple economic multiplier approaches, ImSET allows for more complete and automated analysis of the economic impacts of energy-efficiency investments.

Item 35 *The Department welcomes feedback on its proposed approach to assessing national employment impacts, both direct and indirect.*

15. ENVIRONMENTAL ASSESSMENT

The primary environmental effects of energy conservation standards for general service fluorescent lamps and incandescent reflector lamps, and additional general service incandescent lamps, are likely to be reduced emissions resulting from reduced electricity consumption. The environmental impact analysis will track the impact of possible standards on three types of energy-related emissions: carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulfur dioxide (SO_2). The Department intends to base these calculations on the NEMS-BT modeling work proposed for the utility impact analysis. This approach has the advantage of examining the marginal impact of standards for general service fluorescent lamps and incandescent reflector

[20] Several NEMS-BT models from previous rulemakings can be found on the Department of Energy's website at www.eere.energy.gov/buildings/appliance_standards/.

lamps, and additional general service incandescent lamps, on the utility generation mix and the subsequent environmental emissions.

Carbon emissions are tracked in NEMS-BT by a detailed module that produces robust results because of its broad coverage of all sectors and inclusion of interactive effects. NEMS-BT also includes a module for SO_2-allowance trading and delivers a forecast of SO_2-allowance prices. It is important to note, however, that simulation of SO_2 trading tends to imply that physical emissions effects will be zero. However, there is an SO_2 benefit from conservation in the form of a lower emission permit price and, if big enough to be calculable by NEMS, this value can be reported. NEMS-BT also has an algorithm for estimating NO_x emissions from power generation.

Item 36 *The Department welcomes feedback on its proposed approach to assessing national environmental impacts, both direct and indirect.*

16. REGULATORY IMPACT ANALYSIS

Under the Process Rule, the Department is committed to exploring non-regulatory alternatives to mandatory standards. In the NOPR stage, the Department will prepare a regulatory impact analysis (RIA) pursuant to Executive Order (E.O.) 12866, "Regulatory Planning and Review," 58 FR 51735 (October 4, 1993), which is subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) at the Office of Management and Budget. The regulatory impact analysis will address the potential for non-regulatory approaches to supplant or augment energy conservation standards to improve the efficacy of general service fluorescent lamps and incandescent reflector lamps, and additional general service incandescent lamps, on the market.

The Department recognizes that voluntary or other non-regulatory efforts by manufacturers, utilities, and other interested parties can result in substantial efficacy improvements. The Department intends to consider the likely effects of non-regulatory initiatives on lamp energy use, consumer utility, and life-cycle costs. The Department will take into account the actual impacts of any such initiatives to date, but also will consider information presented regarding the impacts that any existing initiative might have in the future.

APPENDIX A – EPCA DIRECTIVES REGARDING FLUORESCENT AND INCANDESCENT LAMPS

This appendix provides a copy of the current requirements the Act sets forth for the Department regarding fluorescent and incandescent lamps under 42 U.S.C. 6295(i).

(i) General service fluorescent lamps and incandescent reflector lamps

(1) (A) Each of the following general service fluorescent lamps and incandescent reflector lamps manufactured after the effective date specified in the tables listed in this paragraph shall meet or exceed the following lamp efficacy and CRI standards:

Fluorescent Lamps

Lamp Type	*Nominal Lamp Wattage*	*Minimum CRI*	*Min Avg. Lamp Efficacy (LPW)*	*Effective Date (Months)*
4-foot medium bi-pin	*> 35 W*	*69*	*75*	*36*
	≤ 35 W	*45*	*75*	
2-foot U-shaped	*> 35 W*	*69*	*68*	*36*
	≤ 35 W	*45*	*64*	
8-foot slimline	*> 65 W*	*69*	*80*	*18*
	≤ 65 W	*45*	*80*	
8-foot high output	*> 100 W*	*69*	*80*	*18*
	≤ 100 W	*45*	*80*	

Incandescent Reflector Lamps

Nominal Lamp Wattage	*Min. Avg. Lamp Efficacy (LPW)*	*Effective Date (Months)*
40-50	*10.5*	*36*
51-66	*11.0*	*36*
67-85	*12.5*	*36*
86-115	*14.0*	*36*
116-155	*14.5*	*36*
156-205	*15.0*	*36*

(B) For the purposes of the tables set forth in subparagraph (A), the term ``effective date'' means the last day of the month set forth in the table which follows October 24, 1992.

(2) Notwithstanding section 6302(a)(5) of this title and section 6302(b) of this title, it shall not be unlawful for a manufacturer to sell a lamp which is in compliance with the law at the time such lamp was manufactured.

(3) Not less than 36 months after October 24, 1992, the Secretary shall initiate a rulemaking procedure and shall publish a final rule not later than the end of the 54-month period beginning on October 24, 1992, to determine if the standards established under paragraph (1) should be amended. Such rule shall contain such amendment, if any, and provide that the amendment shall apply to products manufactured on or after the 36-month period beginning on the date such final rule is published.

(4) Not less than eight years after October 24, 1992, the Secretary shall initiate a rulemaking procedure and shall publish a final rule not later than nine years and six months after October 24, 1992, to determine if the standards in effect for fluorescent lamps and incandescent lamps should be amended. Such rule shall contain such amendment, if any, and provide that the amendment shall apply to products manufactured on or after the 36-month period beginning on the date such final rule is published.

(5) Not later than the end of the 24-month period beginning on the date labeling requirements under section 6294(a)(2)(C) of this title become effective, the Secretary shall initiate a rulemaking procedure to determine if the standards in effect for fluorescent lamps and incandescent lamps should be amended so that they would be applicable to additional general service fluorescent and general service incandescent lamps and shall publish, not later than 18 months after initiating such rulemaking, a final rule including such amended standards, if any. Such rule shall provide that the amendment shall apply to products manufactured after a date which is 36 months after the date such rule is published.

(6) (A) With respect to any lamp to which standards are applicable under this subsection or any lamp specified in section 6317 of this title, the Secretary shall inform any Federal entity proposing actions which would adversely impact the energy consumption or energy efficiency of such lamp of the energy conservation consequences of such action. It shall be the responsibility of such Federal entity to carefully consider the Secretary's comments.

(B) Notwithstanding subsection (n)(1) of this section, the Secretary shall not be prohibited from amending any standard, by rule, to permit increased energy use or to decrease the minimum required energy efficiency of any lamp to which standards are applicable under this subsection if such action is warranted as a result of other Federal action (including restrictions on materials or processes) which would have the effect of either increasing the energy use or decreasing the energy efficiency of such product.

(7) Not later than the date on which standards established pursuant to this subsection become effective, or, with respect to high-intensity discharge lamps covered under section 6317 of this title, the effective date of standards established pursuant to such section, each manufacturer of a product to which such standards are applicable shall file with the Secretary a laboratory report

certifying compliance with the applicable standard for each lamp type. Such report shall include the lumen output and wattage consumption for each lamp type as an average of measurements taken over the preceding 12-month period. With respect to lamp types which are not manufactured during the 12-month period preceding the date such standards become effective, such report shall be filed with the Secretary not later than the date which is 12 months after the date manufacturing is commenced and shall include the lumen output and wattage consumption for each such lamp type as an average of measurements taken during such 12-month period.

APPENDIX B - DEFINITIONS

This appendix provides the CFR (10 CFR section 430.2) and USC (statutory) (42 U.S.C. 6291(30)) definitions for the lamp products covered under this rulemaking. These definitions do not include fluorescent lamp definitions associated with fluorescent ballast standards.

Fluorescent Lamps

42 U.S.C. 6291(30)(A)

Except as provided in subparagraph (E), the term "fluorescent lamp" means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including only the following:

- *(i) Any straight-shaped lamp (commonly referred to as 4-foot medium bi-pin lamps) with medium bi-pin bases of nominal overall length of 48 inches and rated wattage of 28 or more.*
- *(ii) Any U-shaped lamp (commonly referred to as 2-foot U-shaped lamps) with medium bi-pin bases of nominal overall length between 22 and 25 inches and rated wattage of 28 or more.*
- *(iii) Any rapid start lamp (commonly referred to as 8-foot high output lamps) with recessed double contact bases of nominal overall length of 96 inches and 0.800 nominal amperes, as defined in ANSI C78.1-1978 and related supplements.*
- *(iv) Any instant start lamp (commonly referred to as 8-foot slimline lamps) with single pin bases of nominal overall length of 96 inches and rated wattage of 52 or more, as defined in ANSI C78.3-1978 (R1984) and related supplement ANSI C78.3a-1985.*

10 CFR 430.2

Fluorescent lamp means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including only the following:

- *(1) Any straight-shaped lamp (commonly referred to as 4-foot medium bi-pin lamps) with medium bi-pin bases of nominal overall length of 48 inches and rated wattage of 28 or more.*
- *(2) Any U-shaped lamp (commonly referred to as 2-foot U-shaped lamps) with medium bi-pin bases of nominal overall length between 22 and 25 inches and rated wattage of 28 or more.*
- *(3) Any rapid start lamp (commonly referred to as 8-foot high output lamps) with recessed double contact bases of nominal overall length of 96 inches and 0.800 nominal amperes, as defined in ANSI C78.1-1991.*
- *(4) Any instant start lamp (commonly referred to as 8-foot slimline lamps) with single pin bases of nominal overall length of 96 inches and rated wattage of 52 or more, as defined in ANSI C78.3-1991.*

10 CFR 430.2

Residential straight-shaped lamp means a low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into light, including a straight-shaped fluorescent lamp with medium bi-pin bases of nominal overall length of 48 inches and is either designed exclusively for residential applications; or designed primarily and marketed exclusively for residential applications.

(1) A lamp is designed exclusively for residential applications if it will not function for more than 100 hours with a commercial high-power-factor ballast.

(2) A lamp is designed primarily and marketed exclusively for residential applications if it:

(i) Is permanently and clearly marked as being for residential use only;

(ii) Has a life of 6,000 hours or less when used with a commercial high-power-factor ballast;

(iii) Is not labeled or represented as a replacement for a fluorescent lamp that is a covered product; and

(iv) Is marketed and distributed in a manner designed to minimize use of the lamp with commercial high-power-factor ballasts.

(3) A manufacturer may market and distribute a lamp in a manner designed to minimize use of the lamp with commercial high-power-factor ballasts by:

(i) Packaging and labeling the lamp in a manner that clearly indicates the lamp is for residential use only and includes appropriate instructions concerning proper and improper use; if the lamp is included in a catalog or price list that also includes commercial/industrial lamps, listing the lamp in a separate residential section accompanied by notes about proper use on the same page; and providing as part of any express warranty accompanying the lamp that improper use voids such warranty; or

(ii) Using other comparably effective measures to minimize use with commercial high-power-factor ballasts.

10 CFR 430.2

Rated wattage, with respect to 4-foot medium bi-pin T8, T10 or T12 lamps, means:

(1) If the lamp is listed in ANSI C78.1-1991, the nominal wattage of a lamp determined by the lamp designation in Annex A.2 of ANSI C78.1-1991; or

(2) If the lamp is a residential straight-shaped lamp, the wattage a lamp consumes when operated on a reference ballast for which the lamp is designed; or

(3) If the lamp is neither listed in ANSI C78.1-1991 nor a residential straight-shaped lamp, the wattage a lamp consumes when using reference ballast characteristics of 236 volts, 0.43 amps and 439 ohms for T10 or T12 lamps or reference ballast characteristics of 300 volts, 0.265 amps and 910 ohms for T8 lamps.

General Service Fluorescent Lamps

42 U.S.C. 6291(30)(B)

The term "general service fluorescent lamp" means fluorescent lamps which can be used to satisfy the majority of fluorescent applications, but does not include any lamp designed and marketed for the following non-general lighting applications:

(i) Fluorescent lamps designed to promote plant growth.

(ii) Fluorescent lamps specifically designed for cold temperature installations.

(iii) Colored fluorescent lamps.

(iv) Impact-resistant fluorescent lamps.

(v) Reflectorized or aperture lamps.

(vi) Fluorescent lamps designed for use in reprographic equipment.

(vii) Lamps primarily designed to produce radiation in the ultra-violet region of the spectrum.

(viii) Lamps with a color rendering index of 82 or greater.

10 CFR 430.2

Basic model means all units of a given type of covered product (or class thereof) manufactured by one manufacturer and—

* * * * *

(15) with respect to general service fluorescent lamps, means lamps that have essentially identical light output and electrical characteristics – including lumens per watt and color rendering index (CRI) – and that do not have any differing physical or functional characteristics that affect energy consumption or efficacy.

10 CFR 430.2

Cold temperature fluorescent lamp means a fluorescent lamp specifically designed to start at −20 [deg]F when used with a ballast conforming to the requirements of ANSI Standard C78.1–1991, and is expressly designated as a cold temperature lamp both in markings on the lamp and in marketing materials, including but not limited to catalogs, sales literature, and promotional material.

10 CFR 430.2

Colored fluorescent lamp means a fluorescent lamp designated and marketed as a colored lamp, and with either of the following characteristics: a CRI less than 40, as determined according to the method given in CIE Publication 13.2 (see 10 CFR 430.22), or a lamp correlated color temperature less than 2,500K or greater than 6,600K.

Incandescent Lamp

42 U.S.C. 6291(30)(C)

Except as provided in subparagraph (E), the term "incandescent lamp" means a lamp in which light is produced by a filament heated to incandescence by an electric current, including only the following:

(i) Any lamp (commonly referred to as lower wattage nonreflector general service lamps, including any tungsten-halogen lamp) that has a rated wattage between 30 and 199 watts, has an E26 medium screw base, has a rated voltage or voltage range that lies at least partially within 115 and 130 volts, and is not a reflector lamp.

(ii) Any lamp (commonly referred to as a reflector lamp) which is not colored or designed for rough or vibration service applications, that contains an inner reflective coating on the outer bulb to direct the light, an R, PAR, or similar bulb shapes (excluding ER or BR) with E26 medium screw bases, a rated voltage or voltage range that lies at least partially within 115 and 130 volts, a diameter which exceeds 2.75 inches, and is either–

(I) a low(er) wattage reflector lamp which has a rated wattage between 40 and 205 watts; or

(II) a high(er) wattage reflector lamp which has a rated wattage above 205 watts.

(iii) Any general service incandescent lamp (commonly referred to as a high- or higher-wattage lamp) that has a rated wattage above 199 watts (above 205 watts for a high wattage reflector lamp).

10 CFR 430.2

Incandescent lamp means a lamp in which light is produced by a filament heated to incandescence by an electric current, including only the following:

(1) Any lamp (commonly referred to as lower wattage non-reflector general service lamps, including any tungsten halogen lamp) that has a rated wattage between 30 and 199, has an E26 medium screw base, has a rated voltage or voltage range that lies at least partially in the range of 115 and 130 volts, and is not a reflector lamp.

***(2) Any incandescent reflector lamp.** [Emphasis added]*

(3) Any general service incandescent lamp (commonly referred to as a high-or higher-wattage lamp) that has a rated wattage above 199 (above 205 for a high wattage reflector lamp).

42 U.S.C. 6291(30)(R)

The term "tungsten-halogen lamp" means a gas-filled tungsten filament incandescent lamp containing a certain proportion of halogens in an inert gas.

42 U.S.C. 6291(51)[21]

The term "medium screw base" means an Edison screw base identified with the prefix E-26 in the "American National Standard for Electric Lamp Bases", ANSI–IEC C81.61-2003, published by the American National Standards Institute.

10 CFR 430.2

Voltage range means a band of operating voltages as marked on an incandescent lamp, indicating that the lamp is designed to operate at any voltage within the band.

[21] Section 135(a)(3) of EPACT 2005 (Public Law 109-58) adds 42 U.S.C. 6291(51).

10 CFR 430.2

Rated voltage with respect to incandescent lamps means:

(1) The design voltage if the design voltage is 115V, 130V or between 115V and 130V:

(2) 115V if the design voltage is less than 115V and greater than or equal to 100V and the lamp can operate at 115V; and

(3) 130V if the design voltage is greater than 130 V and less than or equal to 150 V and the lamp can operate at 130V.

10 CFR 430.2

Design voltage with respect to an incandescent lamp means:

(1) The voltage marked as the intended operating voltage;

(2) The mid-point of the voltage range if the lamp is marked with a voltage range; or

(3) 120V if the lamp is not marked with a voltage or voltage range.

Incandescent Reflector Lamps

42 U.S.C. 6291(30)(F)

The term ``incandescent reflector lamp'' means a lamp described in subparagraph (C)(ii).

Subparagraph (30)(C)(ii).

(ii) Any lamp (commonly referred to as a reflector lamp) which is not colored or designed for rough or vibration service applications, that contains an inner reflective coating on the outer bulb to direct the light, an R, PAR, or similar bulb shapes (excluding ER or BR) with E26 medium screw bases, a rated voltage or voltage range that lies at least partially within 115 and 130 volts, a diameter which exceeds 2.75 inches, and is either–

(I) a low(er) wattage reflector lamp which has a rated wattage between 40 and 205 watts; or

(II) a high(er) wattage reflector lamp which has a rated wattage above 205 watts.

10 CFR 430.2

Incandescent reflector lamp (commonly referred to as a reflector lamp) means any lamp in which light is produced by a filament heated to incandescence by an electric current, which: is not colored or designed for rough or vibration service applications that contains an inner reflective coating on the outer bulb to direct the light; has an R, PAR or similar bulb shape (excluding ER or BR) with an E26 medium screw base; has a rated voltage or voltage range that lies at least partially in the range of 115 and 130 volts; has a diameter that exceeds 2.75 inches; and is either a low(er)-wattage reflector lamp that has a rated wattage between 40 and 205; or a high(er)-wattage reflector lamp that has a rated wattage above 205.

10 CFR 430.2

Colored incandescent lamp means an incandescent lamp designated and marketed as a colored lamp that has a CRI less than 50, as determined according to the method given in CIE Publication 13.2 (see 10 CFR 430.22); has a correlated color temperature less than 2,500K or greater than 4,600K; has a lens containing 5 percent or more neodymium oxide; or contains a filter to suppress yellow and green portions of the spectrum and is specifically designed, designated and marketed as a plant light.

10 CFR 430.2

Rough or vibration service incandescent reflector lamp means a reflector lamp: in which a C-11 (5 support), C-17 (8 support), or C-22 (16 support) filament is mounted (the number of support excludes lead wires); in which the filament configuration is as shown in Chapter 6 of the 1993 Illuminating Engineering Society of North America Lighting Handbook, 8th Edition (see 10 CFR 430.22); and that is designated and marketed specifically for rough or vibration service applications.

42 U.S.C. 6291(30)(I)

The term "bulb shape" means the shape of lamp, especially the glass bulb with designations for bulb shapes found in ANSI C79.1-1980 (R1984).

10 CFR 430.2

BR incandescent reflector lamp means a reflector lamp that has a bulged section below the bulb's major diameter and above its approximate base line as shown in Figure 1 (RB) on page 7 of ANSI C79.1-1994. A BR30 lamp has a lamp wattage of 85 or less than 66 and a BR40 lamp has a lamp wattage of 120 or less.

10 CFR 430.2

ER incandescent reflector lamp means a reflector lamp with an elliptical section below the bulb's major diameter and above its approximate baseline as shown in Figure 1 (RE) on page 7 of ANSI C79.1-1994 (see 10 CFR 430.22) and a finished size and shape shown in ANSI C78.21-1989 including the referenced reflective characteristics in part 7 of ANSI C78.21-1989 (see 10 CFR 430.22).

10 CFR 430.2

Basic model means all units of a given type of covered product (or class thereof) manufactured by one manufacturer and—

* * * * *

(16) With respect to incandescent reflector lamps, means lamps that have essentially identical light output and electrical characteristics – including lumens per watt – and that do not have any differing physical or functional characteristics that affect energy consumption or efficacy.

General Service Incandescent Lamps

42 U.S.C. 6291(30)(D)

The term "general service incandescent lamp" means any incandescent lamp (other than a miniature or photographic lamp) that has an E26 medium screw base, a rated voltage range at least partially within 115 and 130 volts, and which can be used to satisfy the majority of lighting applications, but does not include any lamps specifically designed for--

- *(i) traffic signal, or street lighting service;*
- *(ii) airway, airport, aircraft, or other aviation service;*
- *(iii) marine or marine signal service;*
- *(iv) photo, projection, sound reproduction, or film viewer service;*
- *(v) stage, studio, or television service;*
- *(vi) mill, saw mill, or other industrial process service;*
- *(vii) mine service;*
- *(viii) headlight, locomotive, street railway, or other transportation service;*
- *(ix) heating service;*
- *(x) code beacon, marine signal, lighthouse, reprographic, or other communication service;*
- *(xi) medical or dental service;*
- *(xii) microscope, map, microfilm, or other specialized equipment service;*
- *(xiii) swimming pool or other underwater service;*
- *(xiv) decorative or showcase service;*
- *(xv) producing colored light;*
- *(xvi) shatter resistance which has an external protective coating; or*
- *(xvii) appliance service.*

All Covered Lamps

42 U.S.C. 6291(30)(G)

The term "average lamp efficacy" means the lamp efficacy readings taken over a statistically significant period of manufacture with the readings averaged over that period.

42 U.S.C. 6291(30)(H)

The term "base" means the portion of the lamp which connects with the socket as described in ANSI C81.61-1990.

42 U.S.C. 6291(30)(J)

The term "color rendering index" or "CRI" means the measure of the degree of color shift objects undergo when illuminated by a light source as compared with the color of those same objects when illuminated by a reference source of comparable color temperature.

42 U.S.C. 6291(30)(K)

The term "correlated color temperature" means the absolute temperature of a blackbody whose chromaticity most nearly resembles that of the light source.

42 U.S.C. 6291(30)(M)

The term "lamp efficacy" means the lumen output of a lamp divided by its wattage, expressed in lumens per watt (LPW).

10 CFR 430.2

Lamp Efficacy (LE) means the measured lumen output of a lamp in lumens divided by the measured lamp electrical power input in watts expressed in units of lumens per watt (LPW).

42 U.S.C. 6291(30)(N)

The term "lamp type" means all lamps designated as having the same electrical and lighting characteristics and made by one manufacturer.

42 U.S.C. 6291(30)(O)

The term "lamp wattage" means the total electrical power consumed by a lamp in watts, after the initial seasoning period referenced in the appropriate IES standard test procedure and including, for fluorescent, arc watts plus cathode watts.

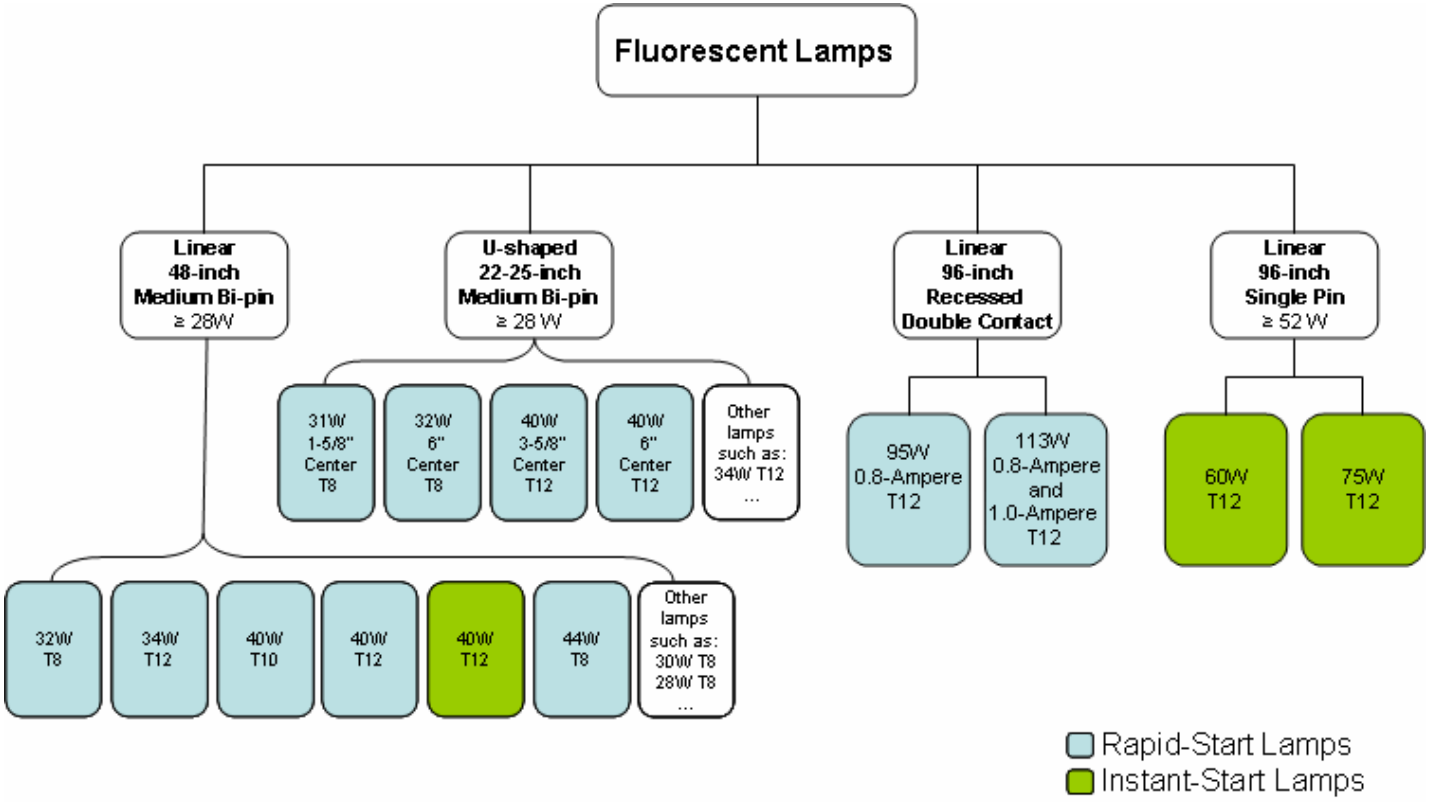
42 U.S.C. 6291(30)(P)

The terms "life" and "lifetime" mean length of operating time of a statistically large group of lamps between first use and failure of 50 percent of the group in accordance with test procedures described in the IES Lighting Handbook-Reference Volume.

42 U.S.C. 6291(30)(Q)

The terms "lumen output" means total luminous flux (power) of a lamp in lumens, as measured in accordance with applicable IES standards as determined by the Secretary.

APPENDIX C – LAMP CATEGORIES IN EACH OF THE DEPARTMENT'S FOUR FLUORESCENT LAMP TYPES



Notes: Per the statute's definition of 8-foot fluorescent lamps, the Department has listed only those lamp types specified in ANSI C78.1-1991 and ANSI C78.3-1991. To provide a sense of what 4-foot lamps and 2-foot lamps with a rated wattage of 28 or more are currently available, the Department has listed those products specified in current ANSI publications with a rated wattage of 28 or more. The most current publications include ANSI 78.81-2005 and ANSI C78.901-2006. The Department's energy standards will also apply to EPCA-defined products on the market (including those specified and those not specified in current ANSI publications). This would include any future products that may be introduced into the market, as noted by the icon labeled "other lamps such as…"

APPENDIX D – TEST PROCEDURE DETAILS

This appendix lists the industry standards which the Department incorporated by reference to test general service fluorescent lamps, incandescent reflector lamps and general service incandescent lamps. Figures D.1-D.3 detail how to use industry standards to measure lamp efficacy.

The industry standards incorporated by reference in the DOE test procedures include:

- ANSI C78.1–1991, "for Fluorescent Lamps—Rapid-Start Types—Dimensional and Electrical Characteristics",
- ANSI C78.2–1991, "for Fluorescent Lamps—Preheat-Start Types—Dimensional and Electrical Characteristics of Fluorescent Lamps",
- ANSI C78.3–1991, "for Fluorescent Lamps—Instant-Start and Cold-Cathode Types—Dimensional and Electrical Characteristics",
- ANSI C78.375–1991, "for Fluorescent Lamps—Guide for Electrical Measurements",
- ANSI C82.3–1983 "for Reference Ballasts for Fluorescent Lamps",
- Illuminating Engineering Society LM–9–88, "IES Approved Method for the Electrical and Photometric Measurements of Fluorescent Lamps",
- Illuminating Engineering Society of North America LM–16–1993, "IESNA Practical Guide to Colorimetry of Light Sources",
- Illuminating Engineering Society of North America LM–20–1994, "IESNA Approved Method for Photometric Testing of Reflector-Type Lamps",
- Illuminating Engineering Society of North America LM–45–91, "IES Approved Method for Electrical and Photometric Measurements of General Service Incandescent Filament Lamps",
- Illuminating Engineering Society of North America LM–58–1994, "IESNA Guide to Spectroradiometric Measurements",
- International Commission on Illumination (CIE) Publication No. 13.2 1974, corrected reprint 1993, "Method of Measuring and Specifying Color Rendering Properties of Light Sources," ISBN 3 900 734 39 9.

Figure D. 1 Fluorescent Lamps

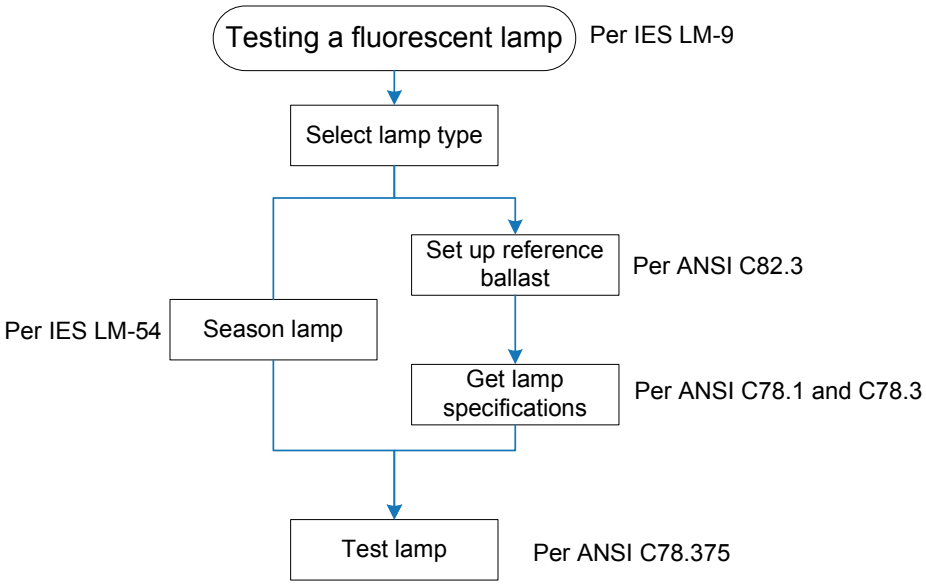


Figure D. 2 General Service Incandescent Lamps

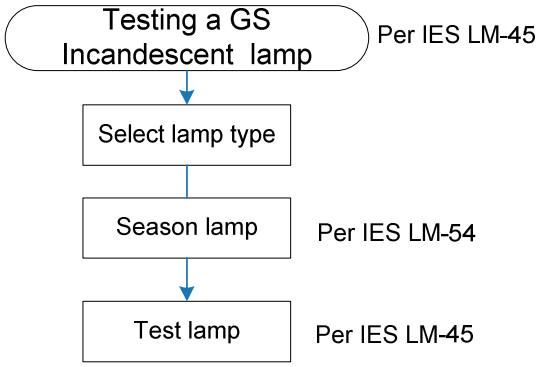


Figure D. 3 Incandescent Reflector Lamp Test Methods