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Part II

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10 CFR Part 430
Energy Conservation Program: Energy Conservation Standards for Ceiling Fan Light Kits; Proposed Rules

DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EERE–2012–BT–STD–0045]

RIN 1904–AC87

Energy Conservation Program: Energy Conservation Standards for Ceiling Fan Light Kits

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Notice of proposed rulemaking (NOPR) and announcement of public meeting.

SUMMARY: The Energy Policy and Conservation Act of 1975 (EPCA), as amended, prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including ceiling fan light kits (CFLKs). EPCA also requires the U.S. Department of Energy (DOE) to periodically determine whether more-stringent, amended standards would be technologically feasible and economically justified, and would save a significant amount of energy. In this notice, DOE proposes amended energy conservation standards for CFLKs, and also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES: *Meeting:* DOE will hold a public meeting on Tuesday, August 18, 2015 from 9:00 a.m. to 4:00 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section VII, ''Public Participation,'' for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

Comments: DOE will accept comments, data, and information regarding this NOPR before and after the public meeting, but no later than October 13, 2015. See section VII, ''Public Participation,'' for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 4A–104, 1000 Independence Avenue SW., Washington, DC 20585. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting *regina.washington@ee.doe.gov* to initiate the necessary procedures. Please also note that any person wishing to bring a laptop into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons may also attend the public meeting via webinar.

Instructions: Any comments submitted must identify the NOPR on Energy Conservation Standards for ceiling fan light kits, and provide docket number EE–2012–BT–STD–0045 and/or regulatory information number (RIN) 1904–AC87. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov.* Follow the instructions for submitting comments.

2. *Email: CeilingFanLightKits2012STD0045@ee.doe.gov.* Include the docket number and/or RIN in the subject line of the message. Submit electronic comments in WordPerfect, Microsoft Word, PDF, or ASCII file format, and avoid the use of special characters or any form of encryption.

3. *Postal Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Office, Mailstop EE–5B, 1000 Independence Avenue SW., Washington, DC 20585–0121. If possible, please submit all items on a compact disc (CD), in which case it is not necessary to include printed copies.

4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this proposed rule may be submitted to Office of Energy Efficiency and Renewable Energy through the methods listed above and by email to *Chad_S_Whiteman@omb.eop.gov.*

No telefacsimilies (faxes) will be accepted. For detailed instructions on submitting comments and additional information on the rulemaking process, see section VII of this document (''Public Participation'').

Docket: The docket, which includes **Federal Register** notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at *www.regulations.gov.* All documents in the docket are listed in the *www.regulations.gov* index. However, some documents listed in the index may not be publicly available, such as those containing information that is exempt from public disclosure.

A link to the docket Web page can be found at: *www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/66.* This Web page contains a link to the docket for this notice on the *www.regulations.gov* site. The *www.regulations.gov* Web page contains simple instructions on how to access all documents, including public comments, in the docket. See section VII, ''Public Participation,'' for further information on how to submit comments through *www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Ms. Lucy deButts, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE–5B, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 287–1604. Email: *ceiling_fan_light_kits@ee.doe.gov.*

Ms. Elizabeth Kohl, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW., Washington, DC 20585–0121. Telephone: (202) 586–7796. Email: *Elizabeth.Kohl@hq.doe.gov.*

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov.*

SUPPLEMENTARY INFORMATION:

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I. Synopsis of the Proposed Rule

Title III, Part B [1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act) (42 U.S.C. 6291, *et. seq.*), established the Energy Conservation Program for Consumer Products Other Than Automobiles.[2] These products include CFLKs, the subject of this document.

Pursuant to EPCA, any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B)) EPCA also provides that not later than 6 years after issuance of any final rule establishing or amending a standard, DOE must publish either a notice of determination that standards for the product do not need to be amended, or a notice of proposed rulemaking including new proposed energy conservation standards. (42 U.S.C. 6295(m)(1))

In accordance with these and other statutory provisions discussed in this document, DOE proposes amended energy conservation standards for CFLKs. The proposed standards, which are expressed in minimum lumen output per watt (lm/W) of a lamp, or lamp efficacy, are shown in Table I.1. These proposed standards, if adopted, would apply to all CFLKs listed in Table I.1 and manufactured in, or imported into, the United States on and after the date three years after the publication of any final rule for this rulemaking.

TABLE I.1—PROPOSED ENERGY CONSERVATION STANDARDS FOR CEILING FAN LIGHT KITS

Product type	Lumens	Proposed level (lm/W)
All CFLKs	<120 >120	50 $74 - 29.42 \times 0.9983^{lumens}$

[1] For editorial reasons, upon codification in the U.S. Code, Part B was re-designated Part A.

[2] All references to EPCA in this document refer to the statute as amended through the Energy Efficiency Improvement Act of 2015, Pub. L. 114–11 (Apr. 30, 2015).

A. Benefits and Costs to Consumers

Table I.2 presents DOE's evaluation of the economic impacts of the proposed standards on consumers of CFLKs, as measured by the average life-cycle cost (LCC) savings and the simple payback period (PBP).[3] The average LCC savings are positive for the product class, and the PBP is less than the average lifetime of CFLKs, which is estimated to be 13.8 years (see section IV.F).

TABLE I.2—IMPACTS OF PROPOSED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF CFLKS (TSL 2)

Product class	Average LCC savings (2014$)	Simple payback period (years)
Residential Sector		
All CFLKs	24.3	1.2
Commercial Sector		
All CFLKs	53.4	0.3

DOE's analysis of the impacts of the proposed standards on consumers is described in section IV.F of this notice.

B. Impact on Manufacturers

The industry net present value (INPV) is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2015 to 2048). Using a real discount rate of 7.4 percent, DOE estimates that the INPV for manufacturers of CFLKs in the no-standards case is $94.8 million in 2014$. Under the proposed standards, DOE expects that manufacturers may lose up to 8.4 percent of this INPV, which is approximately $7.9 million. Additionally, based on DOE's interviews with the manufacturers of CFLKs, DOE does not expect significant impacts on manufacturing capacity or loss of employment for the industry as a whole to result from the proposed standards for CFLKs.

DOE's analysis of the impacts of the amended standards on manufacturers is described in section IV.J of this notice.

C. National Benefits and Costs [4]

DOE's analyses indicate that the proposed energy conservation standards for CFLKs would save a significant amount of energy. Relative to the case where no amended energy conservation standard is set (hereinafter referred to as the ''no-standards case''), the lifetime energy savings for CFLKs purchased in the 30-year period that begins in the anticipated year of compliance with the amended standards (2019–2048) amount to 0.047 quadrillion Btu (quads).[5] This represents a savings of 3.6 percent relative to the energy use of these products in the no-standards case.

The cumulative net present value (NPV) of total consumer costs and savings of the proposed standards for CFLKs ranges from $0.65 billion (at a 7-percent discount rate) to $0.82 billion (at a 3-percent discount rate). This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product costs for CFLKs purchased in 2019–2048.

In addition, the proposed standards for CFLKs would have significant environmental benefits. DOE estimates that the proposed standards would result in cumulative emission reductions of 3.3 million metric tons (Mt) [6] of carbon dioxide (CO_2), 3.5 thousand tons of sulfur dioxide (SO_2), 4.7 thousand tons of nitrogen oxides (NO_X), 11.2 thousand tons of methane (CH_4), 0.037 thousand tons of nitrous oxide (N_2O), and 0.011 tons of mercury (Hg).[7] The cumulative reduction in CO_2 emissions through 2030 amounts to 3.08 Mt, which is equivalent to the emissions resulting from the annual electricity use of almost 400 thousand homes.

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by a recent Federal interagency process.[8] The derivation of the SCC values is discussed in section IV.L. Using discount rates appropriate for each set of SCC values (see Table I.3), DOE estimates the present monetary value of the CO_2 emissions reduction (not including CO_2 equivalent emissions of other gases with global warming potential) is between $0.03 billion and $0.40 billion, with a value of $0.13 billion using the central SCC case represented by $41.2/t in 2015. DOE also estimates the present monetary value of the NO_X emissions reduction to be $0.02 billion at a 7-percent discount rate and $0.03 billion at a 3-percent discount rate.[9]

Table I.3 summarizes the national economic benefits and costs expected to result from the proposed standards for CFLKs.

TABLE I.3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CFLKS (TSL 2) *

Category	Present value (billion 2014$)	Discount rate (%)
Benefits		
Consumer Operating-Cost Savings	0.56	7
	0.73	3
CO_2 Reduction Monetized Value ($12.2/t case) **	0.03	5
CO_2 Reduction Monetized Value ($41.2/t case) **	0.13	3
CO_2 Reduction Monetized Value ($63.4/t case) **	0.21	2.5
CO_2 Reduction Monetized Value ($121/t case) **	0.40	3

[3] The average LCC savings are measured relative to the no-standards case efficacy distribution, which depicts the market in the compliance year in the absence of standards (see section IV.F.9). The simple PBP, designed to compare specific efficacy levels, is measured relative to the least efficient model on the market (see section IV.F).

[4] All monetary values in this section are expressed in 2014 dollars and, where appropriate, are discounted to 2015 unless explicitly stated otherwise. Energy savings in this section refer to the full-fuel-cycle savings (see section IV.H for discussion).

[5] A quad is equal to 10^{15} British thermal units (Btu).

[6] A metric ton is equivalent to 1.1 short tons. Results for emissions other than CO_2 are presented in short tons.

[7] DOE calculated emissions reductions relative to the no-standards case, which reflects key assumptions in the *Annual Energy Outlook 2014* (*AEO 2014*) Reference case. *AEO 2014* generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2013.

[8] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* Interagency Working Group on Social Cost of Carbon, U.S. Government (May 2013; revised November 2013) (Available at: *http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf).*

[9] DOE is currently investigating valuation of avoided SO_2 and Hg emissions.

TABLE I.3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CFLKS (TSL 2) *—Continued

Category	Present value (billion 2014$)	Discount rate (%)
NO_X Reduction Monetized Value	0.02 0.02	7 3
Total Benefits †	0.71 0.89	7 3
Costs		
Consumer Incremental Installed Costs	0.06 0.07	7 3
Total Net Benefits: Including Emissions Reduction Monetized Value †	0.65 0.82	7 3

* This table presents the costs and benefits associated with CFLKs shipped in 2019–2048. These results include benefits to consumers which accrue after 2048 from the products purchased in 2019–2048. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule.

** The CO_2 values represent global monetized values of the SCC, in 2014$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to average SCC with 3-percent discount rate ($41.2/t case).

The benefits and costs of the proposed standards, for CFLKs sold in 2019–2048, can also be expressed in terms of annualized values. The annualized monetary values are the sum of: (1) The annualized national economic value of the benefits from consumer operation of products that meet the new or amended standards (consisting primarily of operating-cost savings from using less energy, minus increases in product purchase prices and installation costs, which is another way of representing consumer NPV), and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[10]

Although combining the values of operating savings and CO_2 emission reductions is relevant to DOE's determination, two issues should be considered. First, the national operating savings are domestic U.S. consumer monetary savings that occur as a result of market transactions, whereas the value of CO_2 reductions is based on a global value. Second, the assessments of operating-cost savings and CO_2 savings are performed with different methods that use different time frames for analysis. The national operating-cost savings is measured for the lifetime of CFLKs shipped in 2019–2048. Because CO_2 emissions have a very long residence time in the atmosphere,[11] the SCC values after 2050 reflect future climate-related impacts resulting from the emission of CO_2 that continue beyond 2100.

Estimates of annualized benefits and costs of the proposed standards are shown in Table I.4. The results under the Primary Estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction (for which DOE used a 3-percent discount rate along with the average SCC series that has a value of $41.2/t in 2015), the estimated cost of the standards proposed in this rule is $6.0 million per year in increased equipment costs, while the estimated annual benefits are $55 million in reduced equipment operating costs, $7.5 million in CO_2 reductions, and $1.6 million in reduced NO_X emissions. In this case, the net benefit amounts to $59 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that has a value of $41.2/t in 2015, the estimated cost of the proposed CFLK standards is $4.0 million per year in increased equipment costs, while the estimated annual benefits are $41 million in reduced operating costs, $7.5 million in CO_2 reductions, and $1.3 million in reduced NO_X emissions. In this case, the net benefit amounts to $46 million per year.

[10] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2015, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (*e.g.,* 2020 or 2030), and then discounted the present value from each year to 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates, as shown in Table I.3. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, that yields the same present value.

[11] The atmospheric lifetime of CO_2 is estimated of the order of 30–95 years. Jacobson, MZ (2005), ''Correction to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming,' '' *J. Geophys. Res.* 110. pp. D14105.

TABLE I.4—ANNUALIZED BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CFLKS (TSL 2)

	Discount rate	(million 2014$/year)		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits				
Consumer Operating-Cost Savings	7%	55	36	59
	3%	41	24	43
CO_2 Reduction Monetized Value ($12.2/t case) *	5%	2.6	1.4	2.7
CO_2 Reduction Monetized Value ($41.2/t case) *	3%	7.5	3.9	7.9
CO_2 Reduction Monetized Value ($63.4/t case) *	2.5%	11	5	11
CO_2 Reduction Monetized Value ($112.1/t case) *	3%	22	12	24
NO_X Reduction Monetized Value	7%	1.6	0.90	1.6
	3%	1.3	0.65	1.3
Total Benefits †	7% plus CO_2 range	60 to 79	38 to 48	63 to 85
	7%	65	40	69
	3% plus CO_2 range	45 to 64	26 to 36	47 to 68
	3%	49	28	53
Costs				
Consumer Incremental Installed Product Costs	7%	6.0	3.5	6.4
	3%	4.0	2.3	4.2
Net Benefits				
Total †	7% plus CO_2 range	54 to 73	34 to 44	57 to 78
	7%	59	37	62
	3% plus CO_2 range	41 to 60	24 to 34	43 to 64
	3%	46	26	48

* This table presents the annualized costs and benefits associated with CFLKs shipped in 2019–2048. These results include benefits to consumers which accrue after 2048 from the products purchased in 2019–2048. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule. The Primary Estimate assumes the reference case electricity prices and housing starts from *AEO 2015* and decreasing product prices for LED CFLKs, due to price learning. The Low Benefits Estimate uses the Low Economic Growth electricity prices and housing starts from *AEO 2015* and a faster decrease in product prices for LED CFLKs. The High Benefits Estimate uses the High Economic Growth electricity prices and housing starts from *AEO 2015* and the same product price decrease for LED CFLKs as in the Primary Estimate.

** The CO_2 values represent global monetized values of the SCC, in 2014$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with a 3-percent discount rate ($41.2/t case). In the rows labeled "7% plus CO_2 range" and "3% plus CO_2 range," the operating-cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

DOE's analysis of the national impacts of the proposed standards is described in sections IV.H, IV.K and IV.L of this notice.

D. Conclusion

DOE has tentatively concluded that the proposed standards represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. DOE further notes that products achieving these standard levels are already commercially available for all product classes covered by this proposal. Based on the analyses described above, DOE has tentatively concluded that the benefits of the proposed standards to the nation (energy savings, positive NPV of consumer benefits, consumer LCC savings, and emission reductions) would outweigh the burdens (loss of INPV for manufacturers and LCC increases for some consumers).

DOE also considered more- and less-stringent efficacy levels (EL)s as trial standard levels, and is still considering them in this rulemaking. However, DOE has tentatively concluded that the potential burdens of the more-stringent ELs would outweigh the projected benefits. Based on consideration of the public comments DOE receives in response to this notice and related information collected and analyzed during the course of this rulemaking effort, DOE may adopt ELs presented in this notice that are either higher or lower than the proposed standards, or some combination of level(s) that incorporate the proposed standards in part.

II. Introduction

The following section briefly discusses the statutory authority underlying this proposed rule, as well as some of the relevant historical background related to the establishment of standards for CFLKs.

A. Authority

Title III, Part B of EPCA, Public Law 94–163 (42 U.S.C. 6291–6309, as codified) established the Energy Conservation Program for Consumer Products Other Than Automobiles, a program covering most major household appliances (collectively referred to as "covered products"), which includes the CFLKs that are the subject of this rulemaking. (42 U.S.C. 6295(ff)) EPCA, as amended, authorized DOE to conduct future rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(ff)(5)–(6)) Under 42 U.S.C. 6295(m), DOE must also periodically review its already established energy conservation standards for a covered product.

Pursuant to EPCA, DOE's energy conservation program for covered products consists essentially of four parts: (1) Testing; (2) labeling; (3) the establishment of Federal energy conservation standards; and (4) certification and enforcement procedures. The Federal Trade Commission (FTC) is primarily responsible for labeling, and DOE implements the remainder of the program. Subject to certain criteria and conditions, DOE is required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6295(o)(3)(A) and (r)) Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those products. (42 U.S.C. 6293(c) and 6295(s)) Similarly, DOE must use these test procedures to determine whether the products comply with standards adopted pursuant to EPCA. (42 U.S.C. 6295(s)) The DOE test procedures for CFLKs appear at title 10 of the Code of Federal Regulations (CFR) part 430, subpart B, appendix V.

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including CFLKs. Any new or amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A) and (3)(B)) Furthermore, DOE may not adopt any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3)) Moreover, DOE may not prescribe a standard: (1) For certain products, including CFLKs, if no test procedure has been established for the product, or (2) if DOE determines by rule that the standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B)) In deciding whether a proposed standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must make this determination after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven statutory factors:

(1) The economic impact of the standard on manufacturers and consumers of the products subject to the standard;

(2) The savings in operating costs throughout the estimated average life of the covered products in the type (or class) compared to any increase in the price, initial charges, or maintenance expenses for the covered products that are likely to result from the standard;

(3) The total projected amount of energy (or as applicable, water) savings likely to result directly from the standard;

(4) Any lessening of the utility or the performance of the covered products likely to result from 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 standard;

(6) The need for national energy and water conservation; and

(7) Other factors the Secretary of Energy (Secretary) considers relevant. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

EPCA, as codified, also contains what is known as an ''anti-backsliding'' provision, which prevents the Secretary from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. (42 U.S.C. 6295(o)(1)) Also, the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States of any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4))

Further, EPCA, as codified, establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. (42 U.S.C. 6295(o)(2)(B)(iii))

Additionally, 42 U.S.C. 6295(q)(1) specifies requirements when promulgating an energy conservation standard for a covered product that has two or more subcategories. DOE must specify a different standard level for a type or class of product that has the same function or intended use, if DOE determines that products within such group: (A) Consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) have a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard. (42 U.S.C. 6295(q)(1)) In determining whether a performance-related feature justifies a different standard for a group of products, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE deems appropriate. *Id.* Any rule prescribing such a standard must include an explanation of the basis on which such higher or lower level was established. (42 U.S.C. 6295(q)(2))

Federal energy conservation requirements generally supersede state laws or regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c)) DOE may, however, grant waivers of Federal preemption for particular state laws or regulations, in accordance with the procedures and other provisions set forth under 42 U.S.C. 6297(d)).

EPCA also requires that any final rule for new or amended energy conservation standards promulgated after July 1, 2010, is required to address standby mode and off-mode energy use. (42 U.S.C. 6295(gg)(3)) Specifically, when DOE adopts a standard for a covered product after that date, it must, if justified by the criteria for adoption of standards under EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off-mode energy use into a single standard, or, if that is not feasible, adopt a separate standard for such energy use for that product. (42 U.S.C. 6295(gg)(3)(A)–(B)) In a test procedure NOPR for ceiling fan light kits (hereafter ''CFLK TP NOPR''), DOE proposed that the energy use from standby mode and off mode associated with CFLKs be attributed to the ceiling fan to which they are attached, and thus any standby mode energy use is accounted for in the ceiling fan test procedure. Therefore, the CFLK metric accounts for energy consumption only in active mode. 79 FR 64688 (October 31, 2014). DOE will account for active mode energy use in any final amended energy conservation standards.

B. Background

1. Current Standards

The current energy conservation standards apply to CFLKs with medium screw base and pin-based sockets manufactured on and after January 1, 2007, and CFLKs with all other socket types manufactured on or after January 1, 2009. 70 FR 60407, 60413 (October 18, 2005). These standards are set forth in DOE's regulations at 10 CFR 430.32(s) as follows:

(2)(i) Ceiling fan light kits with medium screw base sockets manufactured on or after January 1, 2007, must be packaged with screw-based lamps to fill all screw base sockets.

(ii) The screw-based lamps required under paragraph (2)(i) of this section must—

(A) Be compact fluorescent lamps that meet or exceed the following requirements or be as described in paragraph (2)(ii)(B) of this section:

Factor	Requirements
Rated Wattage (Watts) & Configuration [1]	Minimum Initial Lamp Efficacy (lumens per watt).[2]
Bare Lamp:	
Lamp Power <15	45.0.
Lamp Power ≥15	60.0.
Covered Lamp (no reflector):	
Lamp Power <15	40.0.
15 ≤ Lamp Power <19	48.0.
19 ≤ Lamp Power <25	50.0.
Lamp Power ≥25	55.0.
With Reflector:	
Lamp Power <20	33.0.
Lamp Power ≥20	40.0.
Lumen Maintenance at 1,000 hours	≥90.0%.
Lumen Maintenance at 40 Percent of Lifetime	≥80.0%.
Rapid Cycle Stress Test	At least 5 lamps must meet or exceed the minimum number of cycles.
Lifetime	≥6,000 hours for the sample of lamps.

[1] Use rated wattage to determine the appropriate minimum efficacy requirements in this table.
[2] Calculate efficacy using measured wattage, rather than rated wattage, and measured lumens to determine product compliance. Wattage and lumen values indicated on products or packaging may not be used in calculation.

(B) Light sources other than compact fluorescent lamps that have lumens per watt performance at least equivalent to comparably configured compact fluorescent lamps meeting the energy conservation standards in paragraph (2)(ii)(A) of this section.

(3) Ceiling fan light kits manufactured on or after January 1, 2007, with pin-based sockets for fluorescent lamps must use an electronic ballast and be packaged with lamps to fill all sockets. These lamp ballast platforms must meet the following requirements:

Factor	Requirement
System Efficacy per Lamp Ballast Platform in Lumens per Watt (lm/w)	≥50 lm/w for all lamps below 30 total listed lamp watts. ≥60 lm/w for all lamps that are ≤24 inches and ≥30 total listed lamp watts. ≥70 lm/w for all lamps that are >24 inches and ≥30 total listed lamp watts.

(4) Ceiling fan light kits with socket types other than those covered in paragraphs (2) and (3) of this section, including candelabra screw base sockets, manufactured on or after January 1, 2009—

(i) Shall not be capable of operating with lamps that total more than 190 watts; and

(ii) Shall be packaged to include the lamps described in clause (i) with the ceiling fan light kits. 10 CFR 430.32(s)

2. History of Standards Rulemaking for CFLKs

Current energy conservation standards for CFLKs (42 U.S.C. 6295(ff)) were established by the Energy Policy Act of 2005 (EPAct 2005) (Title I, Subtitle C, section 135(c)), which were later amended by EPCA. Specifically, EPAct 2005 established individual energy conservation standards for three groups of CFLKs: (1) Those having medium screw base sockets (hereafter ''Medium Screw Base product class''); (2) those having pin-based sockets for fluorescent lamps (hereafter ''Pin-Based product class''); and (3) any CFLKs other than those included in the Medium Screw Base product class or the Pin-Based product class (hereafter ''Other Base Type product class''). (42 U.S.C. 6295(ff)(2)–(4)) In a technical amendment published on October 18, 2005, DOE codified the statute's requirements for the Medium Screw Base and Pin-Based product classes. 70 FR 60413. EPAct 2005 also specified that if DOE failed to issue a final rule on energy conservation standards for Other Base Type product class CFLKs by January 1, 2007, a 190 W limit would apply to those products. (42 U.S.C. 6295(ff)(4)(C)) Because DOE did not issue a final rule on standards for CFLKs by that date, on January 11, 2007, DOE published a technical amendment that codified the statute's requirements for Other Base Type product class CFLKs, which applied to Other Base Type product class CFLKs manufactured on or after January 1, 2009. 72 FR 1270. Another technical amendment final rule published on March 3, 2009 (74 FR 12058), added a provision that CFLKs with sockets for pin-based fluorescent lamps must be packaged with lamps to fill all sockets. (42 U.S.C. 6295(ff)(4)(C)(ii)) These standards for CFLKs are codified in 10 CFR 430.32(s)(2)–(4).

To initiate the rulemaking cycle to consider amended energy conservation standards for ceiling fans and CFLKs, on March 15, 2013, DOE published a notice announcing the availability of the framework document, ''Energy Conservation Standards Rulemaking Framework Document for Ceiling Fans and Ceiling Fan Light Kits,'' and a public meeting to discuss the proposed analytical framework for the rulemaking. 76 FR 56678. DOE also posted the framework document on its Web site, in which DOE described the procedural and analytical approaches DOE anticipated using to evaluate the establishment of energy conservation standards for ceiling fans and CFLKs.

DOE held the public meeting for the framework document on March 22, 2013,[12] to present the framework document, describe the analyses DOE planned to conduct during the rulemaking, seek comments from stakeholders on these subjects, and inform stakeholders about and facilitate their involvement in the rulemaking. At the public meeting, and during the comment period, DOE received many comments that both addressed issues raised in the framework document and identified additional issues relevant to this rulemaking.

DOE issued the preliminary analysis for the CFLK energy conservation standards rulemaking on October 27, 2014, and published it in the **Federal Register** on October 31, 2014. 78 FR 13563. DOE posted the preliminary analysis, as well as the complete preliminary technical support document (TSD), on its Web site.[13] The preliminary TSD includes the results of the following DOE preliminary analyses: (1) Market and technology assessment; (2) screening analysis; (3) engineering analysis; (4) energy use analysis; (5) product price determination; (6) LCC and PBP analyses; (7) shipments analysis; (8) national impact analysis (NIA); and (9) preliminary manufacturer impact analysis (MIA).

III. General Discussion

DOE developed this proposal after considering comments, data, and information from interested parties that represent a variety of interests. The following discussion addresses issues raised by these commenters.

A. Product Classes and Scope of Coverage

EPCA defines a ''ceiling fan light kit'' as ''equipment designed to provide light from a ceiling fan that can be: (1) Integral, such that the equipment is attached to the ceiling fan prior to the time of retail sale; or (2) attachable, such that at the time of retail sale the equipment is not physically attached to the ceiling fan, but may be included inside the ceiling fan at the time of sale or sold separately for subsequent attachment to the fan.'' [14] (42 U.S.C. 6291(50)(A), (B)) In the CFLK TP NOPR, DOE proposed to withdraw the current guidance [15] on accent lighting and to consider all lighting packaged with any CFLK to be subject to energy conservation requirements. 79 FR 64688, 64692 (October 31, 2014). Additionally, in the ceiling fan test procedure NOPR published on October 17, 2014, DOE proposed to reinterpret the definition of a ceiling fan to include hugger fans. 79 FR 62521, 62525–26 (October 17, 2014). For additional details on DOE's reasoning for proposing these changes, please see the proposed rulemaking documents.

When evaluating and establishing energy conservation standards, DOE divides covered products into product classes by the type of energy used or by capacity or other performance-related features that justifies a different standard. In making a determination whether a performance-related feature justifies a different standard, DOE must consider such factors as the utility of the feature to the consumer and other factors DOE determines are appropriate. (42 U.S.C. 6295(q)) For further details on product classes, see section IV.A.1 and chapter 3 of the NOPR TSD.

B. Test Procedure

EPCA sets forth generally applicable criteria and procedures for DOE's adoption and amendment of test procedures. (42 U.S.C. 6293) Manufacturers of covered products must use these test procedures to certify to DOE that their product complies with energy conservation standards and to quantify the efficiency of their product. As noted, the test procedures for CFLKs are provided in appendix V. As noted, DOE published a NOPR to amend these test procedures on October 31, 2014. 79 FR 64688.

With respect to the process of establishing test procedures and standards for a given product, DOE notes that, while not legally obligated to do so, it generally follows the approach laid out in guidance found in 10 CFR part 430, subpart C, Appendix A (Procedures, Interpretations and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products). That guidance provides, among other things, that, when necessary, DOE will issue final, modified test procedures for a given product prior to publication of the NOPR proposing energy conservation standards for that product. While DOE strives to follow the procedural steps outlined in its guidance, there may be circumstances in which it may be necessary or appropriate to deviate from it. In such instances, the guidance indicates that DOE will provide notice and an explanation for the deviation. Accordingly, DOE is providing notice that it continues to develop the final test procedure for CFLKs. DOE received comment on the proposed test procedure regarding the applicability of the CFLK test procedures and energy conservation standards to accent lighting. DOE also received comments on the appropriate metric for CFLKs with integrated SSL circuitry. DOE continues to consider those comments in the development of the final test procedure rule. DOE will attempt to issue the final test procedure within the comment period provided for this proposed standards rule. In the event that additional time to comment on the proposed standards in light of the final test procedure rule is desired, interested parties can seek an extension or reopening of the comment period upon issuance of the final test procedure.

1. Standby and Off-Mode Energy Consumption

EPCA directs DOE to update its test procedures to account for standby mode and off-mode energy consumption, with such energy consumption integrated into the overall energy efficiency, energy consumption, or other energy descriptor, unless the current test procedure already accounts for standby mode and off-mode energy use. (42 U.S.C. 6295(gg)(2)(A)) Furthermore, if an integrated test procedure is technically infeasible, DOE must prescribe a separate standby mode and off-mode test procedure for the covered product, if technically feasible.

In the preliminary analysis, DOE determined that energy use from standby mode and off mode associated with CFLKs be attributed to the ceiling fan to which they are attached. DOE's research indicates that standby power is relevant only to combined ceiling fan and light kit systems operated by remote control. The remote control receiver, which is almost always installed in the ceiling fan housing and used to receive signals for both the ceiling fan and the CFLK, is the component that constitutes the standby power consumption in the ceiling fan and light kit system. DOE therefore proposed to account for standby power in the ceiling fan test procedures. 79 FR 64688, 64690 (October 31, 2014). DOE further notes if standby mode were included into a single metric for CFLKs with remote controls, the CFLK would have a different efficacy than its lamps. Therefore, DOE has proposed to only include active mode energy

[12] The framework document and public meeting information are available at regulations.gov under docket number EERE–2012–BT–STD–0045–0001.

[13] The preliminary analysis, preliminary TSD, and preliminary analysis public meeting information are available at regulations.gov under docket number EERE–2012–BT–STD–0045–0072.

[14] Ceiling fan is defined as ''a nonportable device that is suspended from a ceiling for circulating air via the rotation of fan blades.'' (42 U.S.C. 6291(49))

[15] Guidance on accent lighting is available at *www1.eere.energy.gov/guidance/detail_search.aspx?IDQuestion=470&pid=2&spid=1.*

consumption in the CFLK test procedure. Id. See the preliminary analysis TSD or the CFLK TP NOPR for further details.

Based on its review of products currently on the market, DOE concludes that CFLKs do not consume power in off mode. Therefore DOE did not propose to measure off-mode power consumption in the ceiling fan light kit test procedure rulemaking.

C. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that could improve the efficiency of the products or equipment that are the subject of the rulemaking. As the first step in such an analysis, DOE develops a list of technology options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of those means for improving efficiency are technologically feasible. DOE considers technologies incorporated in commercially available products or in working prototypes to be technologically feasible. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(i).

After DOE has determined that particular technology options are technologically feasible, it further evaluates each technology option in light of the following additional screening criteria: (1) Practicability to manufacture, install, and service; (2) adverse impacts on product utility or availability; and (3) adverse impacts on health or safety. 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(ii)–(iv). Additionally, it is DOE policy not to include in its analysis any proprietary technology that is a unique pathway to achieving a certain EL. Section IV.B of this notice discusses the results of the screening analysis for CFLKs, particularly the designs DOE considered, those it screened out, and those that are the basis for the trial standard levels (TSLs) in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4 of the NOPR TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt an amended standard for a type or class of covered product, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such product. (42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (''max-tech'') improvements in energy efficiency for CFLKs, using the design parameters for the most efficient products available on the market or in working prototypes. The max-tech levels that DOE determined for this rulemaking are described in section IV.C.5 of this proposed rule and in chapter 5 of the NOPR TSD.

D. Energy Savings

1. Determination of Savings

For each TSL, DOE projected energy savings from the CFLKs that are the subject of this rulemaking purchased in the 30-year period that begins in the year of compliance with any amended standards (2019–2048).[16] The savings are measured over the entire lifetime of CFLKs purchased in the above 30-year period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the no-standards case. The no-standards case represents a projection of energy consumption in the absence of amended energy conservation standards, and it considers market forces and policies that may affect future demand for more-efficient products.

DOE used its NIA spreadsheet model to estimate energy savings from potential amended standards for CFLKs. The NIA spreadsheet model (described in section IV.H of this notice) calculates energy savings in site energy, which is the energy directly consumed by products at the locations where they are used. For electricity, DOE calculates national energy savings on an annual basis in terms of primary energy savings, which is the savings in the energy that is used to generate and transmit the site electricity. To calculate primary energy savings from site electricity savings, DOE derives annual conversion factors from data provided in the Energy Information Administration's (EIA) most recent *Annual Energy Outlook* (*AEO*).

In addition to primary energy savings, DOE also calculates full-fuel-cycle (FFC) energy savings. As discussed in DOE's statement of policy, the FFC metric includes the energy consumed in extracting, processing, and transporting primary fuels (*i.e.,* coal, natural gas, petroleum fuels), and thus presents a more complete picture of the impacts of energy conservation standards. 76 FR 51282 (August 18, 2011), as amended at 77 FR 49701 (August 17, 2012). DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered products or equipment. For more information, see section IV.H.1.

[16] DOE also presents a sensitivity analysis that considers impacts for products shipped in a 9-year period.

2. Significance of Savings

To adopt any new or amended standards for a covered product, DOE must determine that such action would result in ''significant'' energy savings. (42 U.S.C. 6295(o)(3)(B)) Although the term ''significant'' is not defined in the Act, the U.S. Court of Appeals for the District of Columbia Circuit, in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), opined that Congress intended ''significant'' energy savings in the context of EPCA to be savings that were not ''genuinely trivial.'' The energy savings for all of the TSLs considered in this rulemaking, including the proposed standards (presented in section IV.H.1), are nontrivial, and, therefore, DOE considers them ''significant'' within the meaning of section 325 of EPCA.

E. Economic Justification

1. Specific Criteria

EPCA provides seven factors to be evaluated in determining whether a potential energy conservation standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII)) The following sections discuss how DOE has addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of a potential amended standard on manufacturers, DOE conducts an MIA, as discussed in section IV.J. DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include: (1) INPV, which values the industry on the basis of expected future cash flows; (2) cash flows by year; (3) changes in revenue and income; and (4) other measures of impact, as appropriate. Second, DOE analyzes and reports the impacts on different types of manufacturers, including impacts on small manufacturers. Third, DOE considers the impact of standards on domestic manufacturer employment and manufacturing capacity, as well as the potential for standards to result in plant closures and loss of capital investment. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

For individual consumers, measures of economic impact include the changes in LCC and payback period (PBP) associated with new or amended standards. These measures are discussed further in the following section. For consumers in the aggregate, DOE also calculates the national NPV of the consumer costs and benefits expected to result from particular standards. DOE also evaluates the impacts of potential standards on identifiable subgroups of consumers that may be affected disproportionately by a standard.

b. Savings in Operating Costs Compared to Increase in Price (LCC and PBP)

EPCA requires DOE to consider the savings in operating costs throughout the estimated average life of the covered product in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the covered product that are likely to result from a standard. (42 U.S.C. 6295(o)(2)(B)(i)(II)) DOE conducts this comparison in its LCC and PBP analysis.

The LCC is the sum of the purchase price of a product (including its installation) and the operating expense (including energy, maintenance, and repair expenditures) discounted over the lifetime of the product. The LCC analysis requires a variety of inputs, such as product prices, product energy consumption, energy prices, maintenance and repair costs, product lifetime, and consumer discount rates. To account for uncertainty and variability in specific inputs, such as product lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value. The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost of a more-efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost by the initial change in annual operating cost for the year that standards are assumed to take effect.

For its LCC and PBP analysis, DOE assumes that consumers will purchase the covered products in the first year of compliance with amended standards. The LCC savings for the considered ELs are calculated relative to a no-standards case that reflects projected market trends in the absence of amended standards. DOE's LCC and PBP analysis is discussed in further detail in section IV.F.

c. Energy Savings

Although significant conservation of energy is a separate statutory requirement for adopting an energy conservation standard, EPCA requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6295(o)(2)(B)(i)(III)) As discussed in section III.D.1, DOE uses the NIA spreadsheet models to project national energy savings.

d. Lessening of Utility or Performance of Products

In establishing product classes and in evaluating design options and the impact of potential standard levels, DOE evaluates potential standards that would not lessen the utility or performance of the considered products. (42 U.S.C. 6295(o)(2)(B)(i)(IV)) Based on data available to DOE, the standards proposed in this notice would not reduce the utility or performance of the products under consideration in this rulemaking.

e. Impact of Any Lessening of Competition

EPCA directs DOE to consider the impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from a proposed standard. (42 U.S.C. 6295(o)(2)(B)(i)(V)) It also directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and to transmit such determination to the Secretary within 60 days of the publication of a proposed rule, together with an analysis of the nature and extent of the impact. (42 U.S.C. 6295(o)(2)(B)(ii)) DOE will transmit a copy of this proposed rule to the Attorney General with a request that the Department of Justice (DOJ) provide its determination on this issue. DOE will publish and respond to the Attorney General's determination in the final rule.

f. Need for National Energy Conservation

DOE also considers the need for national energy conservation in determining whether a new or amended standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)(VI)) The energy savings from the proposed standards are likely to provide improvements to the security and reliability of the nation's energy system. Reductions in the demand for electricity also may result in reduced costs for maintaining the reliability of the nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the nation's needed power generation capacity, as discussed in section IV.M.

The proposed standards also are likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases (GHGs) associated with energy production and use. DOE conducts an emissions analysis to estimate how potential standards may affect these emissions, as discussed in section IV.K; the emissions impacts are reported in section V.C.2 of this notice. DOE also estimates the economic value of emissions reductions resulting from the considered TSLs, as discussed in section IV.L.

g. Other Factors

EPCA allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) To the extent interested parties submit any relevant information regarding economic justification that does not fit into the other categories described above, DOE could consider such information under ''other factors.''

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values used to calculate the effects that proposed energy conservation standards would have on the payback period for consumers. These analyses include, but are not limited to, the 3-year payback period contemplated under the rebuttable-presumption test. In addition, DOE routinely conducts an economic analysis that considers the full range of impacts to consumers, manufacturers, the nation, and the environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE's evaluation of the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable-presumption payback calculation is discussed in section IV.F of this proposed rule.

IV. Methodology and Discussion of Related Comments

This section addresses the analyses DOE has performed for this rulemaking with regard to CFLKs. Separate subsections address each component of DOE's analyses.

DOE used several analytical tools to estimate the impact of the standards proposed in this document. The first tool is a spreadsheet that calculates the LCC and PBP of potential amended or new energy conservation standards. The NIA uses a second spreadsheet set that provides shipments forecasts and calculates national energy savings and NPV resulting from potential energy conservation standards. DOE uses the third spreadsheet tool, the Government Regulatory Impact Model (GRIM), to assess manufacturer impacts of potential standards. These three spreadsheet tools are available on the DOE Web site for this rulemaking: *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/66.* Additionally, DOE used output from the latest version of EIA's *AEO,* a widely known energy forecast for the United States, for the emissions and utility impact analyses.

A. Market and Technology Assessment

DOE develops information in the market and technology assessment that provides an overall picture of the market for the products concerned, including the purpose of the products, the industry structure, manufacturers, market characteristics, and technologies used in the products. This activity includes both quantitative and qualitative assessments, based primarily on publicly available information. (See chapter 3 of the NOPR TSD for further discussion of the market and technology assessment.) DOE received comments regarding product classes, the metric to determine the energy efficiency of CFLKs, and technology options identified that can improve the efficiency of CFLKs. Responses to these comments are discussed in the following sections.

1. Product Classes

DOE divides covered products into classes by: (a) The type of energy used; (b) the capacity of the product; or (c) other performance-related features that justify different standard levels, considering the consumer utility of the feature and other relevant factors. (42 U.S.C. 6295(q)) The current product class structure for CFLKs, which was established by EPACT 2005, divides CFLKs into three product classes: CFLKs with medium screw base (E26) sockets (Medium Screw Base product class), CFLKs with pin-based sockets for fluorescent lamps (Pin-Based product class), and any CFLKs other than those in the Medium Screw Base or Pin-Based product classes (Other Base Type product class). In the preliminary analysis, DOE restructured the current three CFLK product classes to the following two product classes: (1) CFLKs with Externally Ballasted or Driven Lamps and (2) All Other CFLKs. DOE received several comments related to the restructuring of product classes.

ASAP noted that they support DOE's proposed adjustments to the product class structure. (ASAP, Public Meeting Transcript, No. 82 at p. 85) [17] In a joint comment, ASAP, the American Council for an Energy-Efficient Economy, the National Resources Defense Council, and the Northwest Energy Efficiency Alliance (hereafter the ''Joint Comment'') specified that changing the product class structure in this way would correct unintended market distortions caused by the original CFLK standards. The Joint Comment continued that as CFLKs all use the same type of energy, do not have different capabilities requiring different energy conservation standards, and can provide a full range of illumination with different socket types equipped with light-emitting diode (LED) lamps or compact fluorescent lamps (CFLs), they support DOE's redefinition of product classes. (Joint Comment, No. 95 at pp. 1–2) Available information indicates that all CFLKs use the same type of energy and different socket types do not represent dissimilar capacities or require different standard levels. Therefore, as in the preliminary analysis, DOE proposes not to define CFLK product classes by socket type.

The Joint Comment did recommend, however, that DOE reconsider establishing a separate product class for externally ballasted or driven CFLKs. The Joint Comment noted that the market share of these products is small and is unlikely to grow due to the difficulty for consumers in diagnosing ballast or driver failure and finding the correct replacements. (Joint Comment, No. 95 at p. 2) The Minka Group and Lamps Plus agreed that with externally driven CFLKs, consumers will replace the entire CFLK rather than change a failed ballast. (The Minka Group, Public Meeting Transcript, No. 82 at p. 155; Lamps Plus, Public Meeting Transcript, No. 82 at p. 156) Emerson Electric noted that consumers are often unable to replace a ballast because the model is no longer available from the manufacturer, and thus consumers select a new CFLK instead. (Emerson Electric, Public Meeting Transcript, No. 82 at p. 156)

DOE also received comments that externally driven solid-state lighting (SSL) CFLKs (*i.e.,* with LED module and driver systems) typically do not come with consumer replaceable parts. Emerson Electric commented that they offer an LED array with an integrated driver and heat sink as a repair part. (Emerson Electric, Public Meeting Transcript, No. 82 at pp. 105–106) Hunter Fans commented that only the serviceable driver can be replaced in the SSL CFLKs that they offer. (Hunter Fans, Public Meeting Transcript, No. 82 at p. 219) Westinghouse Lighting (Westinghouse) commented that their limited offerings of integrated SSL CFLKs did not include consumer replaceable parts. Westinghouse noted that in the commercial marketplace, while there is interest in replaceable drivers and modules, it is unclear if manufacturers are planning to offer drivers and modules as consumer replaceable parts instead of repair parts. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 106; 218–219) Further, Westinghouse noted that replacing an externally driven fluorescent lamp with an externally driven LED lamp would require an entire CFLK change, as they were unaware of any retrofit LED lamps for pin-based lamps. (Westinghouse, No. 82 at p. 157) Westinghouse added that this product class is only 1 percent or less of the market. (Westinghouse, No. 82 at p. 157) As a result of the market's reluctance to embrace externally ballasted or driven products, The Joint Comment questioned whether this product group provides a distinct utility. (Joint Comment, No. 95 at p. 2)

In the preliminary analysis, DOE placed externally ballasted or driven lamps in a separate product class based on their unique utility in that they allow consumers to replace the lamp, and potentially the ballast or driver, separately if one fails independently of the other. However, feedback from stakeholders and interviews with manufacturers indicated that most consumers of CFLKs will typically replace both the lamp and ballast/driver

[17] A notation in this form provides a reference for information that is in the docket of DOE's rulemaking to develop energy conservation standards for CFLKs (Docket No. EERE–2012–BT–STD–0045), which is maintained at *www.regulations.gov.* This notation indicates that the statement preceding the reference was made by ASAP, is included in a public meeting transcript, is from document number 82 in the docket, and appears at page 85 of that document.

system or the entire CFLK rather than a failed component. Thus, DOE no longer identified the externally ballasted or driven lamps as providing a unique utility to consumers, and is not proposing a separate product class for these lamp types in the NOPR.

DOE received comments regarding maintaining a separate product class for CFLKs with sockets other than medium screw base lamps and pin-based fluorescent lamps. The Joint Comment noted that most CFLKs used medium screw base lamps prior to the previous CFLK standards, but once the existing standard set separate product classes and thereby different requirements for CFLKs with medium screw base sockets, those with pin-based sockets, and those with all other sockets, manufacturers switched to producing CFLKs with all other sockets, specifically candelabra and intermediate-base sockets. The Joint Comment stated that the switch to these small bases has decreased the anticipated savings of the previous CFLK standards, and also the impact of the previous general service lamp (GSL) standards. The Joint Comment noted that current CFLK sales are 80 percent intermediate and candelabra based sockets, even though there is no utility advantage over medium screw base sockets. (Joint Comment, No. 95 at p. 1)

Westinghouse disagreed, stating that the two product classes considered in the preliminary analysis make sense from the lamp manufacturer perspective, but limit design options for fan manufacturers. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 117, 129) Westinghouse asserted that consumers look for fashion and style in CFLKs and therefore design is a utility that is met by different types of CFLKs. Westinghouse reported that medium screw base lamps are usually A-shape lamps and physically larger, whereas candelabra-base lamps are typically bullet, flame, or B-shape lamps, which fulfill a decorative purpose rather than providing improved efficacy or light output. Westinghouse also noted that halogen lamps with specialty bases, such as E11 and bipin, are able to provide a lot of light in very small spaces. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 121–123)

Finally, American Lighting Association (ALA) commented that the All Other CFLKs product class would eliminate incandescent and halogen lamps in CFLKs. ALA and Westinghouse asserted that more efficacious substitutes, such as CFLs and LED lamps, currently do not serve as adequate replacements for the halogen lamps, especially those with smaller or specialty bases. Specifically, ALA and Westinghouse noted that it is difficult for LED lamps to have the same lumen package and lifetime as existing candelabra based lamps in CFLKs in the same small space without issues such as heat dissipation, especially while also meeting proposed efficacy standards. (ALA, No. 93 at p. 8; Westinghouse, Public Meeting Transcript, No. 82 at p. 100) Westinghouse noted that to use the LED lamps currently on the market, an entire luminaire design would be required to adequately dissipate heat. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 121–123)

While Westinghouse noted that LED lamps will soon be able to meet these challenges, they expressed concern about finalizing a rulemaking that requires products that are not yet equivalent to existing lamps. (Westinghouse, Public Meeting Transcript, No. 82 at p. 100) Hunter Fans commented that they agree with Westinghouse's concerns with design utility being adversely affected by the use of more efficacious light sources in CFLKs. (Hunter Fans, Public Meeting Transcript, No. 82 at p. 124) ALA noted that CFLK manufacturers have no control over the rate of LED technology advancement. (ALA, No. 93 at p. 8) NEMA stated that there can be a predilection towards moving to solely LED technology due to ELs, but while LED technology is feasible in the smaller lamp sizes, the market is very small and few manufacturers have moved to supply LED options. NEMA continued that this may be the same issue with the ceiling fan industry. (NEMA, Public Meeting Transcript, No. 82 at pp. 115–116) Westinghouse commented that DOE needs to make sure that less efficient candelabra bases and small profile SSL options are viable for manufacturers and priced at an acceptable level for consumers if DOE stays with a two product class system. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 116–177, 138)

Based on an evaluation of lamp efficacies reported in manufacturer catalogs, DOE has determined that small base LED lamps are currently available at the highest ELs proposed. (See section IV.C.4 for further details on this analysis.) DOE has found that these small base lamps have lifetimes at or above that of the baseline lamp selected in the engineering analysis. (See section IV.C.3 for further details on the baseline lamp selected.) While the lumen package of these small base LED lamps may not be comparable to small base halogen lamps, modifications in the CFLK design (*e.g.,* number of sockets) can achieve the targeted light output regardless of the lamp used. DOE also confirmed, based on information in manufacturer catalogs and product specifications, that there are commercially available small base lamps available at the highest proposed efficacy level and these lamps are marketed as being suitable for use in enclosed spaces. Thus, issues such as heat dissipation should not be a concern.

In this NOPR, DOE is proposing one product class for CFLKs, including CFLKs packaged with all lamp types, regardless of socket type, and CFLKs with consumer replaceable or non-consumer-replaceable LED modules and drivers.

Summary of CFLK Product Classes

In summary, DOE is no longer considering a separate product class for externally ballasted or driven lamps in CFLKs, as the ability to change the ballast/driver or lamp when one of these components fail rather than replacing the entire system is not a utility to consumers. Upon further analysis, DOE did not identify any class setting factors for CFLKs that use a different type of energy, offer a different capacity of the product, or provide unique performance-related features to consumers, and thereby warrant a separate product class. Therefore, in this NOPR analysis, DOE is proposing a single ''All CFLKs'' product class. (See chapter 3 of the NOPR TSD for further details on the CFLK product class.) DOE requests comment on the product class structure proposed in this document.

2. Metrics

In the preliminary analysis, DOE indicated that it is considering using luminous efficacy as the efficiency metric for all CFLKs. DOE considered using lamp efficacy where possible, and using luminaire efficacy where the lamp component in the CFLK is not designed to be consumer replaceable from the CFLK (*i.e.,* for CFLKs with SSL circuitry, such as those with inseparable LED lighting).

ASAP expressed support for the use of lamp efficacy as the primary metric. (ASAP, Public Meeting Transcript, No. 82 at p. 85) Westinghouse initially agreed with using lamp efficacy as the efficiency metric for CFLKs and luminaire efficacy for CFLKs with integrated SSLs. Specifically, Westinghouse approved of the method for this rulemaking, given current practices and test procedures, and suggested that DOE wait until industry or ENERGY STAR developed an alternative to adopt something else. (Westinghouse, Public Meeting Transcript, No. 82 at p. 59) However, upon further reflection, Westinghouse remarked that integrated SSLs should use the system efficacy, or ''light engine efficacy,'' based on IES LM–79. Westinghouse noted that this method would be less expensive and burdensome for manufacturers. Westinghouse added that products without existing test procedures would still use luminaire efficacy. (Westinghouse, No. 82 at pp. 81–82)

In the NOPR, DOE continued to base its analysis on luminous efficacy as the efficiency metric for CFLKs. DOE used lamp efficacy where possible and luminaire efficacy where the lamp component in the CFLK is not designed to be consumer replaceable from the CFLK. As proposed in the CFLK TP NOPR (79 FR 64688, 64694 [October 31, 2014]), IES LM–79–08 would be used to test the luminaire efficacy of CFLKs with integrated SSL circuitry (*i.e.,* light sources, drivers, or intermediate circuitry that is not consumer replaceable). DOE determined that for CFLKs with integrated SSL circuitry, luminaire efficacy was an appropriate metric because either destructive disassembly would be required to determine the lamp efficacy or, where non-destructive disassembly was possible, lamp efficacy measurements may not be consistent or accurate. 79 FR 64688, 64693, 64703–64704 (October 31, 2014).

Westinghouse noted that while an efficacy metric was acceptable, due to the combination of the existing product classes, the proposed standards may need to allow for more flexibility. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 58–59) The proposed standards account for the effects of the product class combination. DOE established the baseline level as discussed in section IV.C.3. DOE then evaluated each efficacy level to determine if it is technologically feasible and economically justified.

ALA stated that DOE's position to not include the energy savings potential of lighting controls might not be valid. ALA noted that lighting controls can be as powerful as efficacy in generating energy savings. ALA followed that DOE should be open to new test procedures for incorporating the energy savings of lighting controls. (ALA, Public Meeting Transcript, No. 82 at pp. 118–119)

DOE notes that CFLKs are not typically integrated with and/or sold with all components necessary to utilize lighting controls. Further, when a CFLK is set up to function with lighting controls, the use of controls is dependent on various factors, thereby making it difficult to generate consistent and repeatable results across product types that can be measured to a single standard. Therefore, DOE is not proposing to include lighting controls in the efficacy metric for CFLKs. However, DOE did assess various factors related to the use of controls and conducted an analysis to determine potential energy savings from controls. See section IV.E.3 for further information on energy savings from lighting controls.

Westinghouse commented that lifetime testing is burdensome for CFLK manufacturers because of the time associated with the testing, especially because product development of CFLKs trails the development of lamps. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 141–142) Additionally, ALA remarked that lifetime should not be a metric because CFLK manufacturers have limited control over lamp performance, but that if it is included, the standard should be 10,000 hours. ALA added that DOE can harmonize with ENERGY STAR Program Requirements for Lamps version 1.1, which specifies 10,000 hours for all CFLs and 15,000 hours for decorative LED lamps. (ALA, No. 93 at pp. 9, 12)

Current standards specify that CFLKs packaged with medium screw base CFLs must also meet the ENERGY STAR Program requirements for Compact Fluorescent Lamps, version 3.0. The additional requirements specify a minimum lifetime of 6,000 hours. DOE is proposing to maintain this requirement for medium screw base CFLs packaged with CFLKs.

3. 190 W Limitation

Current standards require that CFLKs with medium screw base sockets, or pin-based sockets for fluorescent lamps, be packaged with lamps that meet certain efficiency requirements. All other CFLKs must not be capable of operating with lamps that exceed 190 W. In the final rule for energy conservation standards for certain CFLKs published on January 11, 2007, DOE interpreted this 190 W limitation requirement as a statutory requirement to incorporate an electrical device or measure that ensures the light kit is not capable of operating with a lamp or lamps that draw more than a total of 190 W. 72 FR 1270, 1271 (Jan. 11, 2007).

Westinghouse questioned whether the 190 W limitation was needed in CFLKs with candelabra or intermediate-base lamps, noting that EPACT limits candelabra lamps to 60 W and intermediate-base lamps to 40 W, and thus a CFLK with three or fewer sockets would never have a total wattage exceeding 190 W. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 50–51) CFLKs, however, can have more than three sockets, and there are socket adapters available that can enable the use of medium base lamps in sockets intended for candelabra lamps. As a result, DOE has determined that the EPACT wattage restrictions on candelabra and intermediate-base lamps provides an insufficient basis for DOE to remove the 190 W limit requirement.

ALA stated that DOE should eliminate the 190 W limit for CFLKs with SSL technology or recognize that as such CFLKs use a fixed number of LEDs and a current-limiting device, they meet the 190 W limitation requirement by design. (ALA, Public Meeting Transcript, No. 82 at pp. 16, 42) The Minka Group asked for clarification on whether an LED driver counts as a wattage limiting device. (The Minka Group, Public Meeting Transcript, No. 82 at p. 39) ALA requested that DOE clarify that the design of a CFLK, with such an SSL system that (1) has an SSL driver and/or SSL light source that is not designed to be consumer replaceable; (2) has a rated wattage of 190 W or fewer; and (3) does not use any other light source, meets the requirement of an electrical device or measure that renders the CFLK incapable of operating lamps that total more than 190 W. (ALA, No. 93 at pp. 1–2, 4; ALA, No. 102 at pp. 1–4)

ALA provided several arguments supporting its recommendation. Noting that SSL technology is highly efficient, ALA stated that a 190 W SSL system in a CFLK would provide too much light for a typical consumer and manufacturers generally offer CFLKs with SSL systems rated at no more than 50 W. ALA also stated that the SSL driver, light source, and thermal management system are designed to operate together at the rated wattage and attempts to operate the system at a higher wattage would result in failure of these parts. Specifically, ALA commented that the thermal management system cannot be modified to handle the additional heat from operating at higher wattages. Thus, ALA concluded the SSL electrical and thermal system design acts as an electrical device or measure that limits the power the CFLK can draw, and the systems inherently limit the power that can be consumed during operation. (ALA, No. 93 at pp. 1–2, 4; ALA, No. 102 at p. 2)

ALA also argued that as long as either the SSL driver and/or light source are not consumer replaceable, the CFLK cannot be operated at a wattage higher than the rated wattage. ALA explained that the SSL light source and driver must match in terms of the design wattage or the system will fail.

Therefore, if the consumer replaceable part is replaced to operate the system above the rated wattage, the non-consumer replaceable part must also be replaced, which would require destructive disassembly. ALA stated that this would be beyond the capability of a typical consumer and would invalidate the CFLK's manufacturer warranty and Underwriters Laboratories (UL) listing. (ALA, No. 93 at pp. 1–2; ALA, No. 102 at p. 3) ALA also provided figures of a CFLK with SSL technology that consumes fewer than 20 W. In these figures, ALA noted that the CFLK has a non-consumer replaceable thermal management system that is customized for the CFLK and a consumer replaceable LED driver that is customized for the CFLK. (ALA, No. 93 at pp. 2–3; ALA, No. 102 at pp. 3–4)

Available information indicates that in some scenarios, CFLKs with only SSL technology could be considered to be inherently current limiting. These scenarios are (1) neither SSL drivers and nor SSL light sources are consumer replaceable, (2) SSL drivers are non-replaceable but SSL light sources are replaceable, and (3) SSL light sources are non-replaceable but SSL drivers are replaceable. In the scenario where the CFLK has a consumer replaceable SSL light source, once the light source is replaced with one that can operate at a higher wattage, the non-replaceable SSL driver would act as a limiting device and not allow the system to operate higher than the rated wattage. In the scenario where the consumer replaceable SSL driver is replaced with a driver that can operate at a higher wattage, rapid failure of the SSL light source would likely occur as it would be operated beyond the current, voltage, and/or temperature design limits. Moreover, significant increases in the rated wattage of drivers result in significant size increases in the drivers and the physical constraints of CFLK designs would not allow for such modification. Further, requiring that no other light source besides the SSL system be included in the CFLK would prevent any other means of operating the CFLK at a wattage higher than the rated wattage. Therefore, DOE proposes that CFLKs with SSL circuitry that (1) have SSL drivers and/or light sources that are not consumer replaceable, (2) do not have both an SSL driver and light source that are consumer replaceable, (3) do not include any other light source, and (4) include SSL drivers with a maximum operating wattage of no more than 190 W are considered to incorporate some electrical device or measure that ensures they do not exceed the 190 W limit. DOE proposes to incorporate this clarification in this rulemaking.

DOE is also considering whether all CFLKs with SSL circuitry should be determined to not exceed the 190 W limit. DOE seeks comment on this approach.

4. Technology Options

The technology assessment identifies technology options that improve CFLK efficacy. This assessment provides the technical background and structure on which DOE bases its screening and engineering analyses. The technology assessment begins with a description of the basic structure and operation of CFLKs and then develops a list of technology options considered in the screening analysis.

In the preliminary analysis, DOE identified more efficacious light sources as the technology option that could increase CFLK efficacy. In the preliminary analysis, DOE considered but decided not to include lighting controls and luminaire designs as technology options. Regarding lighting controls, DOE determined that CFLK controls are mostly manual (dimming or multi-level) that can be operated by remote control or at the wall switch and are usually combined with those of the ceiling fan into a single device. The CFLK TP does not provide test procedures for measuring energy savings from controls used on CFLKs, nor is such data available at a comprehensive level for the residential sector. DOE decided not to consider luminaire designs as a technology option because the metric of efficiency for CFLKs proposed in this rulemaking is lamp efficacy, and only in certain cases where lamp efficacy test procedures cannot be used is luminaire efficacy required (see section IV.A.2 for further details.) ALA and Westinghouse agreed with DOE's decision to consider more efficacious lamps as a technology option, and not to include lighting controls. (ALA, No. 93 at p. 8; Westinghouse, Public Meeting Transcript, No. 82 at pp. 113–115) ALA also agreed with DOE's decision not to include luminaire design as a technology option. (ALA, No. 93 at p. 8)

In the NOPR analysis, DOE broke down the more efficacious light sources technology option into specific technology options to identify the different mechanisms for increasing the efficacy of lamps packaged with CFLKs. DOE reviewed manufacturer catalogs, recent trade publications, technical journals, and patent filings to identify these technology options.

For CFLs, DOE is considering technology options related to improvements in electrode coatings, fill gas, phosphors, glass coatings, cold spot optimization, and ballast components. For LED lamps, DOE is considering technology options related to improvements in down converters, package architectures, emitter materials, substrate materials, thermal interface materials, heat sink design, thermal management, device-level optics, light utilization, driver design, and electric current.

Summary of CFLK Technology Options

In summary, DOE has developed the list of technology options shown in Table IV.1 to increase efficacy of CFLKs. See chapter 3 of the NOPR TSD for more information on the proposed CFLK technology options. DOE requests comment on the CFL and LED technology options being proposed for CFLKs and any additional options that should be included.

TABLE IV.1—CFLK TECHNOLOGY OPTIONS

Lamp type	Name of technology option	Description
CFL	Highly Emissive Electrode Coatings.	Improved electrode coatings allow electrons to be more easily removed from electrodes, reducing lamp power and increasing overall efficacy.
	Higher-Efficiency Lamp Fill Gas Composition.	Fill gas compositions improve cathode thermionic emission or increase mobility of ions and electrons in the lamp plasma.
	Higher-Efficiency Phosphors	Techniques to increase the conversion of ultraviolet (UV) light into visible light.
	Glass Coatings	Coatings on inside of bulb enable the phosphors to absorb more UV energy, so that they emit more visible light.
	Multi-Photon Phosphors	Emitting more than one visible photon for each incident UV photon.
	Cold Spot Optimization	Improve cold spot design to maintain optimal temperature and improve light output.
	Improved Ballast Components	Use of higher-grade components to improve efficiency of integrated ballasts.

TABLE IV.1—CFLK TECHNOLOGY OPTIONS—Continued

Lamp type	Name of technology option	Description
	Improved Ballast Circuit Design.	Better circuit design to improve efficiency of integrated ballasts.
	Change in Technology	Replace CFL with LED technology.
LED	Efficient Down Converters	New high-efficiency wavelength conversion materials, including optimized phosphor conversion, quantum-dots and nano-phosphors, have the potential for creating warm-white LED emitters with improved spectral efficiency, high color quality, and improved thermal stability.
	Improved Package Architectures.	Novel package architectures such as RGB+, system-in-package, hybrid color, and chip-on-heat-sink have the potential to improve thermal management, color-efficiency, and optical distribution, as well as electrical integration to greatly improve overall lamp and luminaire efficacy.
	Improved Emitter Materials	The development of efficient red, green, or amber LED emitters, will allow for optimization of spectral efficiency with high color quality over a range of CCT and which also exhibit color and efficiency stability with respect to operating temperature.
	Alternative Substrate Materials	Alternative substrates such as gallium nitride (GaN), silicon (Si), GaN-on-Si, and silicon carbide to enable high-quality epitaxy for improved device quality and efficacy.
	Improved Thermal Interface Materials (TIM).	Develop TIMs that enable high-efficiency thermal transfer for long-term reliability and performance optimization of the LED device and overall lamp product.
	Optimized Heat Sink Design	Improve thermal conductivity and heat dissipation from the LED chip, thus reducing efficacy loss from rises in junction temperature.
	Active Thermal Management Systems.	Devices such as internal fans, vibrating membranes, and circulated liquid cooling systems to improve thermal dissipation from the LED chip.
	Device-Level Optics	Enhancements to the primary optic of the LED package that would simplify or remove entirely the secondary optic, and thereby reduce losses due to absorption at interfaces.
	Increased Light Utilization	Reduce optical losses from the lamp housing, diffusion, beam shaping and color-mixing to increase the efficacy of the LED lamp.
	Improved Driver Design	Increase driver efficiency through novel and intelligent circuit design.
	AC LEDs	Reduce or eliminate the requirements of a driver and therefore the effect of driver efficiency on lamp efficacy.
	Reduced Current Density	Increase the number of LEDs in a lamp to reduce current density while maintaining lumen output. This reduces the efficiency losses associated with higher current density.

B. Screening Analysis

DOE uses the following four screening criteria to determine which technology options are suitable for further consideration in an energy conservation standards rulemaking:

1. *Technological feasibility.* Technologies that are not incorporated in commercial products or in working prototypes will not be considered further.

2. *Practicability to manufacture, install, and service.* If it is determined that mass production and reliable installation and servicing of a technology in commercial products could not be achieved on the scale necessary to serve the relevant market at the time of the projected compliance date of the standard, then that technology will not be considered further.

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

4. *Adverse impacts on health or safety.* If it is determined that a technology would have significant adverse impacts on health or safety, it will not be considered further.

10 CFR part 430, subpart C, appendix A, 4(a)(4) and 5(b).

If DOE determines that a technology, or a combination of technologies, fails to meet one or more of the above four criteria, it will be excluded from further consideration in the engineering analysis.

1. Screened-Out Technologies

In the preliminary analysis, DOE did not screen out more efficacious light sources as a technology option because more efficacious light sources were found to be commercially available products that met the four screening criteria. ALA stated that they agreed with the screening analysis, and DOE did not receive any further comments on retaining more efficacious light sources as a design option. (ALA, No. 93 at p. 9)

In the NOPR, as noted, DOE identified the specific technologies underlying more efficacious light sources. Of these technology options, several technology options were screened out based on the four screening criteria. Table IV.2 summarizes the technology options DOE is proposing to screen out and the associated screening criteria.

TABLE IV.2—CFLK TECHNOLOGY OPTIONS SCREENED OUT OF THE ANALYSIS

Technology	Design option excluded	Screening criteria
CFL	Multi-Photon Phosphors	Technological feasibility.
LED	Colloidal Quantum Dot Phosphors	Technological feasibility.
	Improved Emitter Materials	Technological feasibility.

2. Remaining Technologies

Through a review of each technology, DOE tentatively concludes that all of the other identified technologies listed in section IV.A.3 meet all four screening criteria to be examined further as design options in DOE's NOPR analysis. In summary, DOE did not screen out the following technology options:

CFL Design Options

- Highly Emissive Electrode Coatings
- Higher-Efficiency Lamp Fill Gas Composition
- Higher-Efficiency Phosphors
- Glass Coatings
- Cold Spot Optimization
- Improved Ballast Components
- Improved Ballast Circuit Design

LED Design Options

- Efficient Down Converters (with the exception of colloidal quantum-dots phosphors)
- Improved Package Architectures
- Alternative Substrate Materials
- Improved Thermal Interface Materials
- Optimized Heat Sink Design
- Active Thermal Management Systems
- Device-Level Optics
- Increased Light Utilization
- Improved Driver Design
- AC LEDs
- Reduced Current Density

DOE determined that these technology options are technologically feasible because they are being used in commercially available products or working prototypes. DOE also finds that all of the remaining technology options meet the other screening criteria (*i.e.,* practicable to manufacture, install, and service and do not result in adverse impacts on consumer utility, product availability, health, or safety). (See chapter 4 of the NOPR TSD for further details on the CFLK screening analysis.)

C. Engineering Analysis

DOE derives ELs in the engineering analysis and consumer prices in the product price determination. By combining the results of the engineering analysis and the product price determination, DOE derives typical inputs for use in the LCC and NIA.

1. General Approach

The engineering analysis is generally based on commercially available lamps that incorporate the design options identified in the technology assessment and screening analysis. (See chapters 3 and 4 of the NOPR TSD for further information on technology and design options.) The methodology consists of the following steps: (1) Selecting representative product classes, (2) selecting baseline lamps, (3) identifying more efficacious substitutes, and (4) developing ELs by directly analyzing representative product classes and then scaling those ELs to non-representative product classes. The details of the engineering analysis are discussed in chapter 5 of the NOPR TSD. The following discussion summarizes the general steps of the engineering analysis:

Representative product classes: DOE first reviews CFLKs covered under the scope of the rulemaking and the associated product classes. When a product has multiple product classes, DOE selects certain classes as ''representative'' and concentrates its analytical effort on these classes. DOE selects representative product classes primarily because of their high market volumes and/or distinct characteristics.

Baseline lamps: For each representative product class, DOE selects a baseline lamp as a reference point against which to measure changes resulting from energy conservation standards. Typically, a baseline lamp is the most common, least efficacious lamp in a CFLK sold in a given product class. DOE also considers other lamp characteristics in choosing the most appropriate baseline for each product class, such as wattage, lumen output, and lifetime.

More efficacious substitutes: DOE selects higher efficacy lamps as replacements for each of the baseline lamps considered. When selecting higher efficacy lamps, DOE considers only design options that meet the criteria outlined in the screening analysis (see section IV.B or chapter 4 of the NOPR TSD).

Efficacy levels: After identifying the more efficacious substitutes for each baseline lamp, DOE develops ELs. DOE bases its analysis on three factors: (1) The design options associated with the specific lamps studied; (2) the ability of lamps across wattages (or lumen outputs) to comply with the standard level of a given product class;[18] and (3) the max-tech EL. DOE then scales the ELs of representative product classes to any classes not directly analyzed.

2. Representative Product Classes

In the preliminary analysis, DOE established two product classes and identified both the CFLKs with Externally Ballasted or Driven Lamps and the All Other CFLKs product classes as representative. Although the All Other CFLKs product class constituted the majority of CFLKs sold, DOE also considered the CFLKs with Externally Ballasted or Driven Lamps product class as representative because the CFLKs in this class offered a unique utility in their ability to allow the consumer to replace the lamp or ballast/driver. DOE did not receive any comments on the representative product classes identified in the preliminary analysis.

As discussed in section IV.A.1, DOE is no longer establishing a separate product class for products that are externally ballasted or driven and proposes to include all CFLKs in one product class. Therefore, in this NOPR DOE analyzes one product class as representative.

3. Baseline Lamps

Once DOE identifies the representative product classes for analysis, it selects baseline lamps to analyze in each product class. DOE selects baseline lamps that are typically the most common, least efficacious lamps in a CFLK that meet existing energy conservation standards. Specific lamp characteristics are used to characterize the most common lamps packaged with CFLKs today (*e.g.,* wattage and light output). To identify baseline lamps, DOE reviews product offerings in catalogs and manufacturer feedback obtained during interviews.

In the preliminary analysis, DOE selected lamps representative of the most common, least efficacious lamps packaged with CFLKs that just meet existing CFLK standards. To calculate efficacy for lamps in the All Other CFLKs product class, DOE used the catalog lumens and the catalog wattage of the lamp. DOE used the catalog lumens and the American National Standards Institute (ANSI) rated wattage, or the catalog wattage if the ANSI rated wattage was not available, to calculate the efficacy for externally ballasted or driven lamps. (For further detail on the baseline lamps selected in the preliminary analysis, see chapter 5 of the preliminary TSD.) DOE received several comments regarding these baseline selections.

For the CFLKs with Externally Ballasted or Driven Lamps product class, Westinghouse commented that the selected circline fluorescent baseline lamp is accurate because it represents the only product used in externally ballasted or driven CFLKs. (Westinghouse, Public Meeting Transcript, No. 82 at p. 175) For the All Other CFLKs product class, Westinghouse remarked that the baseline lamp DOE selected is not the least efficacious lamp used in CFLKs because the least efficacious lamp is not currently subject to an efficiency standard. (Westinghouse, Public

[18] ELs span multiple lamps of different wattages. In selecting ELs, DOE considered whether these multiple lamps can meet the standard levels.

Meeting Transcript, No. 82 at pp. 134–135)

DOE notes that incandescent lamps, such as those that have candelabra bases, are commonly used in CFLKs, and are subject to a maximum wattage standard rather than an efficacy standard. As stated by Westinghouse, these lamps have lower efficacy values than the CFL used as the baseline lamp in DOE's analysis. As explained in the paragraphs that follow, DOE selected the baseline lamps consistent with the revised product class structure for the NOPR.

In the product class structure analyzed in the preliminary analysis, DOE determined that lamps in the All Other CFLKs product class, such as the candelabra-base lamps, must comply with a minimum standard of 45.0 lm/W for lamps less than 15 W and 60.0 lm/W for lamps greater than or equal to 15 W. The Joint Comment agreed with DOE's determination of the 45 lm/W minimum efficacy for the All Other CFLKs product class. (Joint Comment, No. 95 at p. 2).

DOE revised the product class structure in the NOPR and determined that, consistent with 42 U.S.C. 6295(o)(1) lamps packaged with CFLKs must comply with a minimum standard of 50.0 lm/W for lamps less than 15 W, 60.0 lm/W for lamps greater than or equal to 15 W and less than 30 W, and 70.0 lm/W for lamps greater than or equal to 30 W. The following discussion provides further detail on this change.

Existing standards for CFLKs, codified at 10 CFR 430.32(s), are currently divided into three product classes: (1) Ceiling fan light kits with medium screw base sockets (Medium Screw Base product class); (2) Ceiling fan light kits with pin-based sockets for fluorescent lamps (Pin-Based product class); and, (3) Ceiling fan light kits with socket types other than those covered in the previous two product classes, including candelabra screw base sockets (Other Base Type product class). In the preliminary analysis, DOE combined these three product classes for CFLKs and conducted a product class analysis that identified the following two product classes for consideration: CFLKs with Externally Ballasted or Driven Lamps product class and All Other CFLKs product class. See section IV.A.1 for further details.

Current standards require lamps in the Medium Screw Base product class to ''meet the ENERGY STAR Program requirements for Compact Fluorescent Lamps, version 3.'' 10 CFR 430.32(s). In the preliminary analysis, DOE determined that the products in the All Other CFLKs product class are subject to the same efficacy standards as the existing Medium Screw Base product class. These minimum efficacy standards are specific to wattage bins and whether the lamp is bare or covered. Because DOE determined that lamp cover was not a class setting factor in the preliminary analysis product class structure, the minimum efficacy requirements for this product class were determined by lamp wattage. Therefore, for products less than 15 W, DOE determined that the minimum efficacy for products in the All Other CFLKs product class is 45 lm/W, the highest of the existing standards for that wattage bin. For products greater than or equal to 15 W, DOE determined that the minimum efficacy is 60 lm/W, the highest of the existing standards for that wattage bin.

Current standards require lamps in the Pin-Based product class to ''meet the ENERGY STAR Program Requirements for Residential Light Fixtures version 4.0.'' 10 CFR 430.32(s) In the preliminary analysis, DOE determined that the products in the CFLKs with Externally Ballasted or Driven Lamps product class are subject to the same efficacy standards as the existing Pin-Based product class. These minimum efficacy standards are specific to wattage bins and lamp length. Because DOE determined that lamp length was not a class setting factor in the preliminary analysis product class structure, the minimum efficacy requirements for this product class were determined by lamp wattage. DOE determined that lamps in the CFLKs with Externally Ballasted or Driven Lamps product class must comply with a minimum standard of 50 lm/W for lamps less than 30 W and 70 lm/W for lamps greater than or equal to 30 W.

In the NOPR, DOE is proposing a single product class, and thus re-evaluated the minimum standard efficacy. Products in the All CFLKs product class are subject to either ENERGY STAR Program Requirements for Residential Light Fixtures version 4.0 (10 CFR 430.32(s)) or ENERGY STAR Program requirements for Compact Fluorescent Lamps, version 3. (10 CFR 430.32(s)). ENERGY STAR Program Requirements for Residential Light Fixtures version 4.0 minimum efficacy requirements are specific to wattage and length and ENERGY STAR Program requirements for Compact Fluorescent Lamps version 3 are specific to wattage and whether the lamp is bare or covered. Because DOE is not proposing length or lamp cover as product class setting factors, minimum efficacy requirements for this product class were determined by lamp wattage. Consistent with 42 U.S.C. 6295(o)(1), DOE determined that products in the All CFLKs product class are subject to the highest of the existing standards for each wattage bin. Therefore, for products less than 15 W, DOE set the minimum baseline efficacy at 50 lm/W. For products greater than or equal to 15 W and less than 30 W, DOE set the baseline efficacy at 60 lm/W. For products greater than or equal to 30 W, DOE set the baseline efficacy at 70 lm/W. The combined minimum efficacy requirements based on wattage are shown in Table IV.3.

TABLE IV.3—ALL CFLKS PRODUCT CLASS CURRENT STANDARD EFFICACY REQUIREMENTS

Lamp power (W)	Minimum efficacy (lm/W)
<15	50.0
≥15 and <30	60.0
≥30	70.0

In the preliminary analysis, DOE identified a 14 W spiral CFL with 730 lumens as the baseline lamp. However, DOE found product literature indicating that the lamp is marketed for rough service applications, a feature DOE did not find to be utilized in CFLKs. DOE also received feedback that CFLK manufacturers typically purchase the least expensive lamp available and a rough service lamp would command a premium. Further, market information indicated that many 14 W CFLs with low lumen outputs typically had an additional feature (*e.g.,* a cover or a coating for rough service operation) that was not used for lamps packaged in CFLKs. Thus, in the NOPR analysis, DOE modeled a 14 W CFL as the baseline lamp without these additional features and a light output of 800 lumens, which is a common lumen output for this lamp. DOE assumed the modeled baseline lamp would have the same characteristics (spiral shape, 82 Color Rendering Index [CRI], 2,700 kelvin [K] correlated color temperature [CCT], and 10,000-hour lifetime) as the most common commercially available lamps. The modeled baseline that DOE is proposing for the All CFLKs product class is specified in Table IV.4. (See chapter 5 of the NOPR TSD for further details.) DOE requests comment on the baseline lamp analyzed in the NOPR analysis.

TABLE IV.4—ALL CFLKS PRODUCT CLASS BASELINE LAMP

Bulb shape	Base type	Lamp type	Lamp wattage (W)	Initial light output (lm)	Efficacy (lm/W)	Lamp lifetime (hr)	CRI	CCT (K)
Spiral	E26	CFL	14	800	57.1	10,000	80	2,700

4. More Efficacious Substitutes

After choosing a baseline lamp, DOE identifies commercially available lamps that can serve as more efficacious substitutes. DOE utilized a database of commercially available lamps and selected substitute lamps that both save energy and maintain comparable light output to the baseline lamp. Specifically, in the preliminary analysis, DOE ensured that potential substitutions maintained light output within 10 percent of the baseline lamp lumen output for the lamp replacement scenario and within 10 percent of the baseline fixture lumen output for the light kit replacement scenario. Further, DOE considered only technologies that met all four criteria in the screening analysis. Regarding the lamp characteristics of the substitutes, DOE selected replacement lamp units with lifetimes greater than or equal to that of the lifetime of the baseline lamp. DOE also selected replacement lamp units with a CRI, CCT, and bulb shape comparable to that of the baseline representative lamp unit. (For further detail on the more efficacious substitutes selected in the preliminary analysis, see chapter 5 of the preliminary TSD.)

In the preliminary analysis, DOE considered more efficacious lamps under two different substitution scenarios: (1) A lamp replacement scenario and (2) a light kit replacement scenario. DOE selected the baseline light kit for both scenarios as a two-socket medium base light kit because it was representative of the most common basic CFLK product. In the lamp replacement scenario, DOE assumed that manufacturers would maintain the original fixture design, including the number of sockets, and only replace the lamp. Thus, DOE selected the base types of the more efficacious substitutes to be the same as that of the baseline lamp. In the light kit replacement scenario, DOE accounted for the possibility that manufacturers may change fixture designs. Thus, the base types of the more efficacious substitutes were not required to be the same as that of the baseline lamp and the number of sockets could be changed. Specifically, DOE considered replacement light kits with between one and four sockets and non-medium screw base types. For example, the candidate standard level (CSL) 1 light kit replacement option utilized one medium screw base 23 W CFL, and the CSL 3 light kit replacement option included four medium screw base 5 W LED lamps in the preliminary analysis.

DOE received several comments on the two substitution scenarios. Westinghouse and Hunter Fans commented that the lamp replacement scenario is preferred to the light kit replacement scenario because it is less cumbersome in terms of design changes and product cost. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 132–133; Hunter Fans, Public Meeting Transcript, No. 82 at p. 173) Further, Westinghouse commented that the lamp replacement scenario is the primary method used by manufacturers, but that an increase in integrated SSL CFLKs might make the light kit replacement scenario more popular. In the short term, however, Westinghouse stated that the split between manufacturers replacing lamps versus changing light kits to meet standards is unlikely to be equal. (Westinghouse, Public Meeting Transcript, No. 82 at p. 173) When it was clarified that the light kit replacement scenario referred to a change in the number of sockets, and not replacement with integrated LED CFLKs, however, Westinghouse indicated that an even split between the lamp replacement and light kit replacement scenarios would be a reasonable estimate. (Westinghouse, Public Meeting Transcript, No. 82 at p. 175)

While comments from some stakeholders indicated that the light kit replacement scenario may not be the likely choice taken by manufacturers, it remains an option and one that may become more common in the future. A change in the number of sockets allows for a wider variety of lamp types, wattages, and lumen packages to be considered, including CFLKs that utilize integrated LEDs. Therefore, DOE retained the light kit replacement scenario for the NOPR because changing the light kit is a path that manufacturers may take to comply with standards. For further discussion of the percentage allocated to the likelihood of manufacturers choosing each scenario, see section IV.G.

DOE also received several comments from stakeholders on the more efficacious substitute lamps selected for CFLKs in the preliminary analysis. ALA agreed with the criteria used to select more efficacious substitute lamps, and with the proposed substitute lamps that DOE selected. (ALA, No. 93 at p. 9) The Joint Comment noted that many CFLKs on the market already exceed the minimum standard of 45 lm/W, and that there are ample CFL and LED CFLK options already offered by retailers. (Joint Comment, No. 95 at p. 2)

Westinghouse noted that the medium base, 800 lumen, 60 W equivalent product used as the basis for DOE's analysis is not used in 70 percent of CFLKs. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 231–232) DOE acknowledges that the majority of CFLKs currently reside in the existing Other Base Type product class, typically using lamps with candelabra bases. However, as a result of the revised product class structure discussed in section IV.C.3, DOE selected an 800-lumen baseline lamp because it was the most common lamp with an efficacy near the baseline level of the revised product class structure. DOE selects more efficacious substitutes with lumens within 10 percent of the baseline, but does not limit these substitutes to products found in CFLKs.

The Minka Group commented that the LED representative lamp units are not omnidirectional. (The Minka Group, Public Meeting Transcript, No. 82 at pp. 149–150) ALA stated that it is not currently aware of an LED lamp that offers the omnidirectional lighting of halogen lamps at a comparable size to halogens. (ALA, No. 93 at pp. 8) DOE performed a review of lamp catalog data and confirmed that the A-shape general service LED lamps used as more efficacious substitutes are marketed as omnidirectional.

Westinghouse commented that medium base A19 LED lamps are more efficacious than LED lamps with other base types and sizes, noting that candelabra-base LED lamps are about 10 percent lower in efficacy than medium base A-shape LED lamps. Further, Westinghouse stated that medium base

A-shape LED lamps would not fit in CFLKs with candelabra sockets or be aesthetically pleasing. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 137–140) Westinghouse recommended that DOE ensure that the standard would allow products with small bases to comply. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 145–147) The Minka Group commented that LED lamps are not suitable replacements from a decorative perspective. (The Minka Group, Public Meeting Transcript, No. 82 at pp. 149–150) The Minka Group specifically recommended that DOE analyze G9 bases in the analysis and Westinghouse urged DOE to include base types smaller than G9 bases. (The Minka Group, Public Meeting Transcript, No. 82 at p. 140; Westinghouse, Public Meeting Transcript, No. 82 at p. 140) The Joint Comment, however, remarked that LED lamps provide the same amenities as incandescent lamps, and that LED lamps will only improve by the 2019 compliance date of this rulemaking. (Joint Comment, No. 95 at p. 2) Hunter Fans noted that it is not possible to estimate the efficacies of future LED lamps, especially externally driven LED CFLKs, but the market does have potential. (Hunter Fans, Public Meeting Transcript, No. 82 at pp. 158, 207–208)

DOE performed a survey of lamps with small bases (*e.g.,* E12, E17, and G9) and small form factors (*e.g.,* candle, flame tip, torpedo) based on catalog data and concluded that these lamp types are available at all ELs. For example, DOE identified a 3 W LED with a G9 base, a light output of 275 lm, and an efficacy of 91.7 lm/W, and also a 2 W LED with an E12 base, a light output of 200 lm, and an efficacy of 100 lm/W, with T4 and B11 shapes, respectively. These lamps meet the max-tech level, EL 4, which is discussed further in section IV.C.5.

Further, DOE notes that CFLKs with LED modules and driver systems can offer similar modular design options as CFLKs that use lamps with small bases. DOE applied thermal and driver losses estimated from the DOE Multi-Year Program Plan for Solid-State Lighting Research and Development [19] to commercially available LED modules and drivers to determine their lamp efficacy if they were incorporated as a consumer replaceable system in a CFLK. Per the CFLK test procedure NOPR, lamp efficacy is used to measure the efficiency of SSL CFLKs unless a CFLK has any light sources, drivers, or intermediate circuitry, such as wiring between a replaceable driver and a replaceable light source, that are not consumer replaceable. 79 FR 64688, 64693 (October 31, 2014). DOE determined that these CFLKs would meet EL 4, the max-tech level.

The Minka Group commented that the warranty of LED lamps labeled as 50,000 hours is actually 25,000 hours, which is an industry standard. (The Minka Group, Public Meeting Transcript, No. 82 at p. 142) ALA agreed, remarking that the 50,000 hour lifetimes for LED lamps are very optimistic and do not hold in the field. ALA noted that ENERGY STAR life ratings would be more appropriate. (ALA, Public Meeting Transcript, No. 82 at pp. 140–141)

In the preliminary analysis, LED replacement lamps selected at higher CSLs had lifetimes of 50,000 hours. DOE revised its selection of more efficacious substitutes for the NOPR analysis. DOE performed a review of data from lamp catalogs and the ENERGY STAR database of certified products [20] and determined that the lifetime of the LED lamps selected as representative lamp units in the NOPR is between 25,000 and 30,000 hours.

Several stakeholders commented on dimming. ALA commented that dimmable CFLs are unacceptable for CFLKs because they have a larger form factor, a slower startup time, and poor dimming performance. (ALA, No. 93 at p. 7) Westinghouse agreed, commenting that CFLs usually do not dim well, and the ones that do are more expensive. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 110–111) ALA added that CFLK controls are not typically designed for use with dimmable CFLs. (ALA, No. 93 at p. 7) DOE notes that although dimmable CFLs are not available at all levels, dimmable LED lamps are available at higher ELs; thus this functionality is maintained in the analysis.

ALA remarked that there are issues with dimmable LED compatibility with controls, but it expects this to change over time. ALA projected that LED CFLKs will increase to 15 percent of the market in five years, and that 25–50 percent of these CFLKs will be dimmable, with 7.5 percent having acceptable dimming functionality. (ALA, No. 93 at p. 8) Fanimation also commented that a high percentage of LED lamps will have dimming functionality. (Fanimation, Public Meeting Transcript, No. 82 at p. 112) Westinghouse commented that dimmable LED lamps are more functional than dimmable CFLs, but noted that their cost is very high compared to incandescent and halogen technologies, which represent 80 percent of the CFLK market. Westinghouse added that dimmable LED lamps may be unsatisfactory to the consumer compared to incandescent lamps. Westinghouse opined that if a rule is promulgated that creates consumer dissatisfaction, the consumer will switch to less efficient products that are not currently regulated. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 110–111)

In response to these comments, DOE reviewed catalog data and feedback from stakeholders. Through this research, DOE confirmed that dimmable lamps are available at all of the analyzed levels, and that the ability to dim has a negligible impact on efficacy. Based on feedback from manufacturers and DOE's research, DOE has found that current issues regarding dimming mainly relate to compatibility with controls originally intended to be used with incandescent lamps. Further, NEMA is actively addressing the issue with SSL 7A–2013,[21] which seeks to minimize compatibility issues by providing design and testing guidelines for both LED dimmers and lamps. Therefore, DOE agrees that issues with dimming LED lamps in conjunction with controls will be minimal at the time of compliance with any amended standards, and that the proposed ELs will not result in a loss of dimming functionality in CFLKs. Further, because all of the representative lamp units analyzed are dimmable, the consumer prices determined for these representative lamp units include the cost of dimming functionality and are used as inputs to determine the first cost of these lamps in the LCC analysis and NIA. Hence, the results of these analyses incorporate any additional costs due to dimming functionality.

DOE made several key changes in the NOPR analysis that impacted the selection of more efficacious substitutes. First, using the baseline updated for the NOPR, DOE selected more efficacious substitute lamps that have a light output within 10 percent of 800 lumens, the light output of the new baseline lamp. Second, at EL 2, DOE analyzed two

[19] U.S. Department of Energy. Solid-State Lighting Research and Development Multi-Year Program Plan. April 2013. <*http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2013_web.pdf*>.

[20] ENERGY STAR. *ENERGY STAR Certified Bulbs.* Last accessed February 20, 2015. <*http://www.energystar.gov/productfinder/product/certified-light-bulbs/*>.

[21] National Electrical Manufacturers Association. *Phase Cut Dimming for Solid State Lighting—Basic Compatibility.* April 22, 2013. <*http://www.nema.org/Standards/Pages/Phase-Cut-Dimming-for-Solid-State-Lighting-Basic-Compatibility.aspx*>.

representative lamp units (a CFL and LED lamp) because DOE found that efficacies meeting this level were common for both CFLs and LED lamps, but there was a difference in price between the two options. Third, using updated catalog information, DOE found commercially available lamps at levels of efficacy higher than the max-tech level identified in the preliminary analysis. DOE also found that for representative lamp units above EL 2 (which are LED lamps), the end-user price decreased as efficacy increased. Therefore, DOE analyzed the most efficient commercially available LED lamp as a more efficacious substitute because it was at the lowest incremental first cost for an available product above EL 2: an 8.5 W LED lamp with 94.1 lm/W at EL 3. Finally, as described in the paragraph that follows, DOE also modeled an 8 W LED lamp with 102.5 lm/W at the max-tech level, EL 4.

At the time of this NOPR analysis, DOE has determined that a commercially available 3-way LED lamp when operated at its middle setting is more efficacious than any other commercially available lamp that could be considered an adequate replacement for the baseline lamp (*i.e.,* has a non-reflector shape, a lumen output within 10 percent of the baseline lamp, a CCT around 2,700 K, a CRI greater than or equal to 80, a lifetime greater than or equal to that of the baseline, and a medium screw base). Specifically, the 3-way lamp is 8 W at its middle setting, and has a light output of 820 lumens, an efficacy of 102.5 lm/W, and a lifetime of 25,000 hours. DOE concluded that the higher efficacy level achieved by the middle setting demonstrated the potential for a standard, non-3-way, 8 W LED lamp to achieve this efficacy level. Therefore, DOE modeled an 8 W lamp with 820 lumens and an efficacy of 102.5 lm/W. DOE assumed the modeled lamp would have similar characteristics to the most common commercially available LED lamps in the 800-lumen range. Hence, DOE modeled the lamp to have an A19 shape, medium base type, 25,000-hour lifetime, 2,700 K CCT, 80 CRI, and dimming functionality. DOE requests comment on the 3-way lamp used as a basis for the modeled max-tech LED lamp and information on whether such a lamp would meet DOE's screening criteria and should be maintained for the final rule analysis.

As EL 4 is based on a modeled product, a lamp suitable for direct replacement that complies with EL 4 is not currently commercially available. DOE learned through interviews that most CFLK manufacturers do not manufacture lamps, but rather purchase lamps from another supplier or manufacturer to package in CFLKs. As lamp manufacturers are not required to comply with standards promulgated by this rulemaking, DOE is uncertain as to whether such a lamp meeting EL 4 would be commercially available at the time CFLK manufacturers would need to comply with any amended standards.

DOE has determined that EL 4 can be met by other methods available to CFLK manufacturers; however, most of these options require redesigns of existing fixtures. Some commercially available lamps with smaller base types meet EL 4, but these are available with low lumen outputs and would therefore require several lamps to be incorporated into a new CFLK to provide the same amount of light. Some commercially available lamps with the same base type as the baseline lamp are available at EL 4, but these have higher lumen outputs such that a CFLK would have to be redesigned with fewer sockets to maintain the same light output. Alternatively, a few LED modules and drivers with a similar lumen output as the baseline lamp could be incorporated as consumer replaceable parts in CFLKs. However, all of these methods of meeting EL 4 reflect the fact that, for most situations, direct lamp replacement would not be a means of meeting the efficacy level.

The representative lamp unit at EL 3 is the most efficacious commercially available LED lamp that could be considered an adequate substitute for the baseline lamp (*i.e.,* has a non-reflector shape, a lumen output within 10 percent of the baseline lamp, a CCT around 2,700 K, a CRI greater than or equal to 80, a lifetime greater than or equal to that of the baseline, and a medium screw base). Small base lamps are only available with low lumen outputs at EL 3 and LED modules and drivers are only available in a limited lumen range.

The representative lamp units at EL 2 are a commercially available LED lamp and CFL and the representative lamp unit at EL 1 is a commercially available CFL, all of which are considered adequate substitutes for the baseline lamp (*i.e.,* have a non-reflector shape, a lumen output within 10 percent of the baseline lamp, a CCT around 2,700 K, a CRI greater than or equal to 80, a lifetime greater than or equal to that of the baseline, and a medium screw base). At EL 2 and EL 1, CFLK manufacturers can choose from a large number of suitable options for direct lamp replacements, as well as fixture redesigns to meet this level. In particular, LED modules and drivers are available with lumen outputs that are not an option at higher ELs.

The CFLK representative lamp units that DOE analyzed in the NOPR are shown in Table IV.5 for the lamp replacement scenario and in Table IV.6 for the light kit replacement scenario. DOE requests comment on the criteria used in selecting more efficacious substitute lamps, as well as the characteristics of the lamps selected.

TABLE IV.5—ALL CFLKS PRODUCT CLASS DESIGN OPTIONS: LAMP REPLACEMENT SCENARIO

Efficacy level	Lamp type	Base type	Bulb shape	Wattage (W)	Initial light output (lm)	Efficacy (lm/W)	CRI	CCT (K)	Lamp lifetime (hr)
Baseline	CFL	E26	Spiral	14	800	57.1	80	2,700	10,000
EL 1	CFL	E26	Spiral	13	800	61.5	80	2,700	10,000
EL 2	CFL	E26	Spiral	11	730	66.4	82	2,700	10,000
	LED	E26	A19	12	800	66.7	82	2,700	25,000
EL 3	LED	E26	A19	8.5	800	94.1	81	2,700	25,000
EL 4	LED	E26	A19	8	820	102.5	80	2,700	25,000

TABLE IV.6—ALL CFLKS PRODUCT CLASS DESIGN OPTIONS: LIGHT KIT REPLACEMENT SCENARIO

Efficacy level	Lamp type	Base type	Bulb shape	Fixture sockets	Lamp wattage (W)	Fixture wattage (W)	Lamp initial light output (lm)	Fixture initial light output (lm)	Efficacy (lm/W)	CRI	CCT (K)	Lamp life (hr)
Baseline	CFL	E26	Spiral	2	14	28	800	1,600	57.1	80	2,700	10,000
EL 1	CFL	E26	Spiral	3	9	27	520	1,560	57.8	80	2,700	10,000
EL 2	LED	E26	G25	3	8	24	500	1,500	62.5	82	2,700	25,000
EL 3	LED	E26	A21	1	16	16	1,600	1,600	100.0	80	2,700	25,000
EL 4	LED	E26	A21	1	15	15	1,600	1,600	106.7	82	2,700	25,000

5. Efficacy Levels

DOE adopted an equation-based approach to establish ELs for CFLKs. In the preliminary analysis, DOE developed the general form of the equation by evaluating lamps with similar characteristics, such as technology, bulb shape, and lifetime, across a range of wattages. The continuous equations specified a minimum lamp efficacy requirement across wattages and represented the efficacy a lamp achieves. DOE received several comments regarding the EL equations.

The Joint Comment agreed with the equation-based lm/W standard, remarking that it is the most effective metric for establishing lighting standards for CFLKs. (Joint Comment, No. 95 at pp. 2–3) The Joint Comment opposed the use of lumen bins, and remarked that for general service incandescent lamps (GSILs), lumen bins have resulted in manufacturers selecting the lowest allowable light output within a bin. (Joint Comment, No. 95 at p. 3) However, Westinghouse commented that wattage-based efficacy equations would be confusing for CFLK manufacturers because they do not manufacture lamps. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 144–145) The Joint Comment suggested that, similar to the European Union, DOE should use an equation-based approach to establish minimum ELs as a function of light output. (Joint Comment, No. 95 at p. 3)

DOE analyzed commercially available lamps and found that a continuous equation best describes the relationship between efficacy and lamp wattage rather than bins. In the NOPR analysis, DOE altered its approach to base ELs on continuous equations as a function of light output rather than wattage. Available information indicates that the primary utility provided by a lamp is lumen output, which can be achieved through a range of wattages depending on the lamp technology. Further, fixed losses in lamps, such as power consumed by the integrated ballast/driver, become proportionally smaller at higher lumen outputs, thereby increasing efficacy proportionally to light output. For these reasons, DOE believes that lamps providing equivalent lumen output should be subject to the same minimum efficacy requirements.

Westinghouse commented that while DOE is setting an energy conservation standard, consumers value utility, and price points have been set for certain aspects, such as lamp size, dimmability, and lifetime. If the standard is too high, CFLK manufacturers trying to balance efficacy and utility at a consumer price point may not have any suitable products. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 148–149) DOE analyzed each EL to maintain the products' existing utility to the consumer including lifetime, dimming functionality, and availability of CFLK design options. DOE then analyzed the cost associated with each EL in the LCC analysis; see section IV.F for discussion on the cost effectiveness to consumers.

ALA suggested that DOE use minimum LCC as a criterion in developing its TSLs and selecting its proposed standard, and that DOE propose a standard that is no more stringent than CSL 2. (ALA, No. 93 at p. 11) ALA recommended that DOE propose a standard level that permits both CFLs and LED lamps, allowing CFLK manufacturers to select the best lighting technology to meet necessary utilities. (ALA, No. 93 at pp. 9–10, 12) DOE developed TSLs as described in section V.A. When proposing a standard, DOE weighs a variety of factors, including the maximum energy savings and NPV to the nation, as well as product availability and the costs and benefits to the individual consumer. See section V.C.1 for more information on the rationale used in selecting the proposed level.

As mentioned previously, DOE considered two scenarios: A lamp replacement scenario and a light kit replacement scenario. DOE selected ELs that could be met by the more efficacious substitutes identified in the lamp replacement scenario. DOE also identified more efficacious lamp substitutes for the light kit replacement scenario that had efficacies equal to or greater than the efficacies of the corresponding EL based on the lamp replacement scenario.

In the preliminary analysis, DOE had considered one CSL for the CFLKs with Externally Ballasted or Driven Lamps product class and five CSLs for the All Other CFLKs product class. (For further details, see chapter 5 of the preliminary TSD.) In the NOPR analysis, DOE analyzed all covered CFLKs in one product class. DOE surveyed the market, analyzed product catalogs, and took into account feedback from manufacturers to develop ELs. Based on this assessment, DOE identified varying levels of efficacy that reflected technology changes and met the criteria for developing ELs previously outlined. In the NOPR, DOE is considering four ELs.

Table IV.7 presents the ELs for CFLKs. See chapter 5 of the NOPR TSD for additional information on the methodology and results of the engineering analysis.

TABLE IV.7—SUMMARY OF EFFICACY LEVELS FOR ALL CFLKS

Representative product class	Efficacy level	Light output (lm)	Minimum required efficacy (lm/W)
All CFLKs	EL 1	<260	50
		≥ 260 and ≤ 2040	$69 - 29.42 \times 0.9983^{lumens}$
		>2040 and <2100	$>(1/30) \times$ lumens
		≥ 2100	70

TABLE IV.7—SUMMARY OF EFFICACY LEVELS FOR ALL CFLKS—Continued

Representative product class	Efficacy level	Light output (lm)	Minimum required efficacy (lm/W)
	EL 2	<120	50
		≥120	$74 - 29.42 \times 0.9983^{lumens}$
	EL 3	All	$101 - 29.42 \times 0.9983^{lumens}$
	EL 4	All	$106 - 29.42 \times 0.9983^{lumens}$

As shown in Table IV.7, DOE made adjustments to EL 1 and EL 2 to ensure that, consistent with 42 U.S.C. 6295(o), the efficacy remains above the current minimum standards summarized in Table IV.3. See Sections II.A and IV.C.3 for further discussion of this issue. For lamps less than 15 W, the minimum efficacy is 50 lm/W. For a light output of less than 260 lumens, DOE found that the EL 1 equation could potentially allow lamps that are less than 50 lm/W to meet standards and therefore set the minimum efficacy requirement at 50 lm/W for lamps in this lumen range. For a light output of less than 120 lumens, DOE found that the EL 2 equation could potentially allow lamps that are less than 50 lm/W to meet standards and therefore set the minimum efficacy requirement at 50 lm/W for lamps in this lumen range. DOE determined that no adjustments to any ELs were necessary to meet the 60 lm/W current standard applicable to lamps *greater than* 15 W and less than 30 W.

For lamps *greater than* 30 W, DOE determined that the minimum efficacy is 70 lm/W. DOE found that the equation for EL 1 could potentially allow lamps that are less than 70 lm/W to meet standards. Therefore, for lumens greater than 2040 and less than 2100, DOE set the minimum efficacy requirement at greater than (1/30) × lumens for EL 1. For lumens greater than or equal to 2100, DOE set the minimum efficacy requirement at 70 lm/W. DOE requests comment on the equations used to define the efficacy requirements at each EL. See chapter 5 of the NOPR TSD for further information on the anti-backsliding adjustments that DOE made to the ELs.

6. Scaling to Other Product Classes

Typically DOE determines ELs for product classes that were not directly analyzed (''non-representative product classes'') by scaling from the ELs of the representative product classes. As DOE only identified one product class for CFLKs, no scaling was required.

D. Product Price Determination

Because the efficiency of a CFLK is based on the efficacy of the lamps with which it is packaged, DOE developed a product price determination for the lamp component of the CFLK. Typically, DOE develops manufacturer selling prices (MSPs) for covered products and applies markups to create consumer prices to use as inputs to the LCC analysis and NIA. Because lamps are difficult to reverse-engineer (*i.e.,* not easily disassembled), DOE directly derives consumer prices for the lamps in this rulemaking.

In the preliminary analysis, DOE determined premiums on CFLKs by comparing distributor net prices [22] to the retail prices of these products in each distribution channel. DOE identified three main distribution channels for CFLKs: Electrical/specialty centers, home centers (*e.g.,* Home Depot, Lowes), and lighting showrooms. DOE then developed an average premium weighted by estimated shipments that go through each distribution channel. DOE applied the average shipment-weighted premium to the distributor net prices of CFLKs packaged with the representative lamp unit to obtain the average CFLK consumer price. Based on manufacturer feedback received during the preliminary analysis, DOE determined that a fluorescent lamp, CFL, or LED in a CFLK comprises 15 percent of the CFLK consumer price. DOE applied this percentage to the CFLK consumer price to obtain the consumer price of the representative lamp unit packaged with the CFLK. DOE received several comments on the pricing methodology.

ALA agreed that for CFLKs packaged with ceiling fans, a CFL would comprise 15 percent of the CFLK price. (ALA, No. 93 at p. 10) Hunter Fans also agreed with the 15 percent estimate for CFLs in a CFLK. (Hunter Fans, Public Meeting Transcript, No. 82 at p. 164) Hunter Fans, Westinghouse, Lamps Plus, and The Minka Group remarked that the percentage of consumer price attributable to an LED in a CFLK was too low, and that it is actually closer to 30 percent. (Hunter Fans, Public Meeting Transcript, No. 82 at p. 164; Westinghouse, Public Meeting Transcript, No. 82 at p. 165; Lamps Plus, Public Meeting Transcript, No. 82 at p. 165; The Minka Group, Public Meeting Transcript, No. 82 at p. 165) ALA commented that for CFLKs packaged with ceiling fans, an LED would comprise 30 percent of the consumer CFLK price and for a CFLK sold alone, an LED would comprise over 50 percent of the consumer price. (ALA, No. 93 at p. 10)

In the preliminary analysis, DOE used the methodology of applying a percentage of the CFLK consumer price attributable to the lamp only for CSL 1 because the representative lamp unit at this level is sold with CFLKs for which distributor net prices were available. Specifically, DOE applied 15 percent to CFLK consumer prices to obtain the consumer lamp price for a 13 W spiral CFL, the representative lamp unit at CSL 1. The CFL representative lamp unit at the baseline is also sold with CFLKs, but distributor net prices were not available for these CFLKs. The LED representative lamp units at all other levels are not sold with CFLKs. For these cases, DOE developed a ratio between the consumer price of the 13 W spiral CFL representative lamp unit when sold with a CFLK to the blue-book [23] price of the lamp when sold alone. DOE then applied this ratio to the blue-book price of the representative lamp unit when sold alone to obtain the consumer price of the lamp if it were sold with a CFLK. Therefore, with the exception of the 13 W spiral CFL representative lamp unit, the consumer lamp prices for the other CFL representative lamp units are not necessarily 15 percent of the total CFLK consumer price nor 30 percent for the LED representative lamp units. Maintaining this same methodology, in the NOPR analysis, DOE also analyzed an 11 W spiral CFL at EL 2, a lamp that is also not sold with CFLKs. In this case DOE applied the methodology described above except used retail prices instead of blue-book prices, a change in the analysis that is expanded on further in this section.

[22] Prices suggested by manufacturers that distributors pay for a product.

[23] Blue-book prices refer to suggested retail prices issued by lamp manufacturers and are usually specified for bulk quantity purchases.

Westinghouse noted that assuming that an LED lamp is 15 or 30 percent of the CFLK consumer price, the consumer price of the lamp at CSL 5, which requires an LED lamp, would imply that a CFLK at that level costs about $100. Westinghouse stated that $100 for a CFLK was unreasonably high, especially when compared to CFLKs packaged with CFLs sold at Home Depot for $25–$30, and could potentially put manufacturers out of business. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 204–207) However, Westinghouse commented that it is difficult to know whether the considered LED lamp price is too high or not, as price projections for LED lamps are difficult to estimate. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 210–211) Lamps Plus stated that regardless, if the price of a CFLK attributable to an LED was higher than 27 percent, sales would be significantly affected. (Lamps Plus, Public Meeting Transcript, No. 82 at p. 217) Lamps Plus added that at the $100 price point, consumers may choose to buy a lower cost light fixture instead of the CFLK. (Lamps Plus, Public Meeting Transcript, No. 82 at pp. 213–214)

In the preliminary analysis, DOE calculated the remaining CFLK consumer price (*i.e.,* CFLK price excluding the lamps and sockets) based on the lamp and socket prices [24] and total CFLK consumer price determined for CSL 1. DOE assumed that this remaining CFLK consumer price was the same at all levels, and the only changes in the total CFLK consumer price were a function of the lamp and socket consumer prices at a particular level. DOE maintained this approach in the NOPR analysis using the lamp, socket, and total CFLK consumer prices determined for EL 1. The total CFLK consumer price at all ELs for both the lamp and light kit replacement scenario remained under approximately $60. For further clarity, DOE presents the consumer prices for the lamp, socket, remaining CFLK consumer price, and total CFLK consumer price at each level in chapter 7 of the NOPR TSD.

Noting that lamps meeting higher CSLs were not currently sold in CFLKs, Westinghouse commented that the consumer lamp price and socket price were not being analyzed correctly because the analysis leaves out the current cost to consumers. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 182) Westinghouse commented that DOE did not determine the price of an incandescent lamp packaged with a CFLK in this analysis. (Westinghouse, Public Meeting Transcript, No. 82 at p. 167) Westinghouse added that the baseline price for a CFLK uses a medium base CFL, but that this product is more expensive than a CFLK with incandescent lamps. (Westinghouse, Public Meeting Transcript, No. 82 at p. 117)

Because representative lamp units at the baseline and ELs under consideration did not utilize incandescent technology, DOE did not develop prices for incandescent lamps. For further information on the selection of the representative lamp units, see section IV.C.

Overall, DOE maintained the general methodology used in the preliminary analysis to determine consumer prices of lamps sold with CFLKs in the NOPR analysis. However, in addition to updating the price data used, to more accurately reflect prices consumers will pay, DOE made the following modifications.

When developing consumer prices for representative lamp units not currently sold in CFLKs, in the NOPR analysis DOE used home center channel retail prices of the representative lamp units when sold alone instead of using the blue-book prices of the lamps. Because the home center channel has the highest volume of CFLKs, DOE determined that these prices more closely represent prices paid by CFLK consumers.

As noted, an average shipment-weighted premium on distributor net prices is used to calculate the consumer price of a CFLK packaged with the 13 W spiral CFL representative lamp unit. DOE updated the CFLK retail prices used to determine this premium for the NOPR analysis. Additionally, because DOE did not have distributor net price lists from all manufacturers, DOE adjusted the premium to ensure that it reflected the majority of the CFLK market. DOE based this adjustment on a ratio of CFLK retail prices from manufacturers that represent a majority of the market to the manufacturers for which DOE had distributor net prices.

In the preliminary analysis, to determine the consumer price of the 13 W spiral CFL representative lamp unit sold with a CFLK, DOE applied 15 percent to the consumer price of CFLKs sold with a ceiling fan and CFLKs sold alone. While comments from stakeholders verified that 15 percent should be applied to obtain the price of a CFL packaged with a CFLK sold with a ceiling fan, it is not clear that the same percentage would apply to CFLKs sold alone. Further CFLKs are primarily sold with ceiling fans. Therefore, in the NOPR analysis DOE only used consumer prices of CFLKs sold with ceiling fans to determine the consumer price of the 13 W spiral CFL representative lamp unit. (See chapter 7 of the NOPR TSD for further information on the methodology and results of the pricing analysis.) DOE welcomes feedback on the pricing methodology and results.

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of CFLKs at different efficacies in representative U.S. homes and commercial buildings, and to assess the energy savings potential of increased CFLK efficacy. To develop annual energy use estimates, DOE multiplied CFLK input power by the number of hours of use (HOU) per year. The energy use analysis estimates the range of operating hours of CFLKs in the field (*i.e.,* as they are actually used by consumers). The energy use analysis provides the basis for other analyses that DOE performed, particularly assessments of the energy savings and the savings in consumer operating costs that could result from adoption of amended standards.

1. Operating Hours

a. Residential Sector

To determine the average HOU of CFLKs in the residential sector, DOE collected data from a number of sources. Consistent with the approach taken in the GSL preliminary analysis,[25] DOE used data from various field metering studies of GSL operating hours in the residential sector. To account for any difference in CFLK HOU compared to GSL HOU, DOE considered two factors: (1) The relative HOU for GSLs installed in ceiling light fixtures compared to all GSLs based on data from the Residential Lighting End-Use Consumption Study (RLEUCS),[26] and (2) the HOU associated with the specific room types in which CFLKs are installed based on installation location data from a Lawrence Berkeley National Laboratory survey of ceiling fan and CFLK owners

[24] For consumer prices of sockets, DOE estimated the manufacturer production cost of different socket types based on feedback received in manufacturer interviews and then applied the appropriate manufacturer and distributor markups.

[25] DOE has published a framework document and preliminary analysis for amending energy conservation standards for general service lamps. Further information is available at *www.regulations.gov* under Docket ID: EERE–2013–BT–STD–0051.

[26] DNV KEMA Energy and Sustainability and Pacific Northwest National Laboratory. *Residential Lighting End-Use Consumption Study: Estimation Framework and Baseline Estimates.* 2012. *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf.*

(LBNL survey)[27] and room-specific HOU data from RLEUCS. As in the GSL preliminary analysis, DOE assumed that CFLK operating hours do not vary by light source technology.

DOE determined the regional variation in average HOU using average HOU data from regional metering studies, all of which are listed in the energy use chapter (chapter 6 of the NOPR TSD). DOE organized regional variation in HOU by each EIA Residential Energy Consumption Survey (RECS) reportable domain (*i.e.,* state, or group of states). For regions without HOU metered data, DOE used data from adjacent regions.

To estimate the variability in CFLK HOU by room type, DOE developed HOU distributions for each room type using data from the Northwest Energy Efficiency Alliance's Residential Building Stock Assessment Metering Study (RBSAM),[28] which is a metering study of 101 single-family houses in the Northwest. DOE assumed that the shape of the HOU distribution for a particular room type would be the same across the United States, even if the average HOU for that room type varied by geographic location. To determine the room and geographic location-specific HOU distributions, DOE scaled the HOU distribution for a given room type from the RBSAM study by the average HOU in a given region, adjusted based on the geographic location-specific variability in HOU between different room types from RLEUCS.

Based on the approach described in this section, DOE estimated the national weighted-average HOU of CFLKs to be 2.0 hours per day. For more details on the methodology DOE used to estimate the HOU for CFLKs in the residential sector, see chapter 6 of the NOPR TSD. DOE requests comment on the data and methodology used to estimate operating hours for CFLKs in the residential sector, as well as on the assumption that CFLK operating hours do not vary by light source technology (see section VII.E).

b. Commercial Sector

The HOU for CFLKs in commercial buildings were developed using lighting data for 15 commercial building types obtained from the 2010 U.S. Lighting Market Characterization (LMC).[29] For each commercial building type presented in the LMC, DOE determined average HOU based on the fraction of installed lamps utilizing each of the light source technologies typically used in CFLKs and the HOU for each of these light source technologies. A national-average HOU for the commercial sector was then estimated by weighting the building-specific HOU for lamps used in CFLKs by the relative floor space of each building type as reported in in the 2003 EIA Commercial Buildings Energy Consumption Survey (CBECS).[30] To capture the variability in HOU for individual consumers in the commercial sector, DOE applied a triangular distribution to each building type's weighted-average HOU with a minimum of 80 percent and a maximum of 120 percent of the weighted-average HOU value. For further details on the commercial sector operating hours, see chapter 6 of the NOPR TSD.

2. Input Power

DOE developed its estimate of the power consumption of CFLKs by scaling the input power and lumen output of the representative lamp units for CFLKs characterized in the engineering analysis to account for the lumen output of CFLKs in the market. DOE estimated average CFLK lumen output based on a weighted average of CFLK models from data collected in 2014 from in-store shelf surveys and product offerings on the Internet. DOE estimated the market share of each identified CFLK model based on price. See chapter 6 of the NOPR TSD for details on the price-weighting market share adjustment and how DOE estimated average weighted lumen output for all CFLKs

3. Lighting Controls

In response to the energy use analysis presented in the preliminary analysis, stakeholders provided comment only on DOE's handling of dimmable CFLKs. In the preliminary analysis, DOE did not account for energy savings resulting from dimming. Fanimation expects that a high percentage of CFLKs will have dimming functionality in the future. (Fanimation, Public Meeting Transcript, No. 82 at p. 112) ALA and Westinghouse added that dimmable CFLs are not a viable option for use in CFLKs due to their size, slow startup time, insufficient dimming capability, and cost, which leads to consumer dissatisfaction. (ALA, No. 93 at p. 7; Westinghouse, Public Meeting Transcript, No. 82 at pp. 110–111) ALA and Westinghouse also believe that the current control incompatibility issues associated with dimmable LED CFLKs prevent dimmable LEDs from being a viable option, but ALA believes that in five years LED CFLKs with acceptable dimming functionality could represent up to 7.5 percent of the CFLK market. (Id.)

Based on the technical issues ALA and Westinghouse raised, as well as the significant price premium for dimmable CFLs, DOE assumed that CFLKs are not likely to feature dimmable CFL lamps. DOE requests comments on this assumption (see section VII.E). In the NOPR analyses, DOE did not assume CFL CFLKs were operated with controls. On the other hand, DOE does believe that some fraction of LED and incandescent CFLKs are likely to be operated with a dimmer, which DOE considers to be the only relevant lighting control for CFLKs. For the NOPR analyses, DOE used the results of an LBNL survey[31] to estimate that 11 percent of CFLKs are operated with dimmers. DOE assumed that the fraction of CFLKs used with dimmers is the same in the residential sector and the commercial sector, and DOE requests comment on this assumption (see section VII.E). Furthermore, DOE has assumed that an equal fraction of LED and incandescent CFLKs are operated with dimmers, based on the increasing fraction of commercially available dimmers that are now compatible with LEDs, the increase in LED lamps that are being designed to operate on legacy dimmers, and the assumption that integral LEDs have built-in dimming capability with no compatibility issues. DOE used the 2010 LMC[32] and the aforementioned LBNL survey to account for the likelihood that a CFLK with a dimmer will be installed in a given room type. This affects the impact of dimming controls on energy use because, as discussed previously, average HOU varies by room type.

For dimmable CFLKs, DOE assumed an average energy reduction of 30 percent. This estimate was based on a meta-analysis of field measurements of

[27] Kantner, C.L.S., S.J. Young, S.M. Donovan, and K. Garbesi. *Ceiling Fan and Ceiling Fan Light Kit Use in the U.S.—Results of a Survey on Amazon Mechanical Turk.* 2013. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL–6332E. *http://www.escholarship.org/uc/item/3r67c1f9.*

[28] Ecotope Inc. *Residential Building Stock Assessment: Metering Study.* 2014. Northwest Energy Efficiency Alliance: Seattle, WA. Report No. E14–283. *http://neea.org/docs/default-source/reports/residential-building-stock-assessment-metering-study.pdf?sfvrsn=6.*

[29] Navigant Consulting, Inc. *Final Report: 2010 U.S. Lighting Market Characterization.* 2012. *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf.*

[30] U.S. Department of Energy–Energy Information Administration. *2003 CBECS Survey Data.* (Last accessed October 6, 2014.) *http://www.eia.gov/consumption/commercial/data/2003/index.cfm?view=microdata.*

[31] Kantner, et al. (2013), op. cit.

[32] Navigant Consulting, Inc. *Final Report: 2010 U.S. Lighting Market Characterization.* 2012. *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf.*

energy savings from commercial lighting controls by Williams, *et al.*[33] Because field measurements of energy savings from controls in the residential sector are very limited, DOE assumed that controls would have the same impact as in the commercial sector. DOE requests comments on this approach (see section VII.E). In addition, following publication of the GSL preliminary analysis, NEMA agreed with a similar assumption made in that analysis (*i.e.,* that 30 percent energy savings due to dimming in the residential sector is a reasonable estimate).[34] DOE was able to find a single study [35] that suggests energy savings from dimming may be larger than 30 percent in the residential sector. However, because of the very small sample size of this study (the findings were based on metered data from two houses in California), DOE did not base its analysis on the findings of this study. Chapter 6 of the NOPR TSD provides details on how DOE accounted for the impact of dimmers on CFLK energy use. DOE requests comments on the assumption that the only lighting controls used with CFLKs are dimmers, and the energy savings estimate from dimmers in the residential sector (see section VII.E).

F. Life-Cycle Cost and Payback Period Analysis

DOE conducts LCC and PBP analyses to evaluate the economic impacts on individual consumers of potential energy conservation standards. The effect of new or amended energy conservation standards on individual consumers usually involves a reduction in operating cost and an increase in purchase cost. DOE uses the following two metrics to measure consumer impacts:

- The LCC is the total consumer expense of an appliance or product over the life of that product, consisting of total installed cost (product price, sales tax, and installation costs) plus operating costs (expenses for energy use, maintenance, and repair). To compute the operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product.
- The PBP (payback period) is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more-efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost at higher efficiency levels by the initial change in annual operating cost when amended or new standards are assumed to take effect.

For each CFLK standards case (*i.e.,* case where a standard would be in place at a particular TSL), DOE measures the change in LCC based on the estimated change in efficacy distribution in the standards case relative to the estimated efficacy distribution in the no-standards case. These efficacy distributions include market trends for products that may exceed the efficacy associated with a given TSL as well as the current energy conservation standards. In contrast, the PBP only considers the average time required to recover any increased first cost associated with a purchase at a particular efficacy level relative to the least efficient product on the market.

For each considered efficacy level, DOE calculated the LCC and PBP for a nationally representative consumer sample in each of the residential and commercial sectors. DOE developed consumer samples based on the 2009 RECS and the 2003 CBECS, for the residential and commercial sectors, respectively. For each consumer in the sample, DOE determined the energy consumption of CFLKs and the appropriate electricity price. By developing consumer samples, the analysis captured the variability in energy consumption and energy prices associated with the use of CFLKs.

DOE added sales tax, which varied by state, to the cost of the product developed in the product price determination to determine the total installed cost. DOE assumed that the installation costs did not vary by efficacy level, and therefore did not consider them in the analysis. DOE welcomes comments on this assumption (see section VII.E). Inputs to the calculation of operating expenses include annual energy consumption, energy prices and price projections, repair and maintenance costs, product lifetimes, and discount rates. DOE created distributions of values for product lifetime and discount rates, with probabilities attached to each value, to account for their uncertainty and variability.

The computer model DOE uses to calculate the LCC and PBP relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions and CFLK user samples. The model calculated the LCC and PBP for products at each efficacy level for sample of 10,000 consumers per simulation run.

DOE calculated the LCC and PBP for all consumers as if each were to purchase a new product in the year that compliance with any amended standards is expected to be required. For this NOPR, DOE estimates publication of a final rule in 2016. Consistent with 42 U.S.C. 6295(m) and 6295(ff), DOE used 2019 as the first year of compliance with any amended standards.

Table IV.8 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The subsections that follow provide further discussion. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in chapter 8 and its appendices of the NOPR TSD.

TABLE IV.8—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS *

Inputs	Source/method
Product Cost	Multiplied the weighted-average consumer price of each CFLK lamp and socket (determined in the product price determination) with a scaling factor to account for the total weighted-average CFLK lumen output.
	For LED lamps, DOE used a price learning analysis to project CFLK lamp prices to the compliance year.
Sales Tax	Derived 2019 population-weighted-average tax values for each state based on Census population projections and sales tax data from Sales Tax Clearinghouse.
Disposal Cost	Assumed 35% of commercial CFLs are disposed of at a cost of $0.70 per CFL.
	Assumptions based on industry expert feedback and a Massachusetts Department of Environmental Protection mercury lamp recycling rate report.

[33] Williams, A., B. Atkinson, K. Garbesi, E. Page, and F. Rubinstein. Lighting Controls in Commercial Buildings. *LEUKOS*. 2012. 8(3): pp. 161–180.

[34] NEMA's comment (NEMA, No. 34, at p.21) is available at the GSL rulemaking docket available at *http://www.regulations.gov/#!documentDetail;D=EERE–2013-BT-STD-0051-0034.*

[35] Consortium for Energy Efficiency. Residential Lighting Controls Market Characterization. Available at: *http://library.cee1.org/sites/default/files/library/11458/CEE_LightingMarketCharacterization.pdf.*

TABLE IV.8—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSIS *—Continued

Inputs	Source/method
Energy Use	Derived in the energy use analysis. Varies by geographic location and room type in the residential sector and by building type in the commercial sector.
Energy Prices	Electricity: Based on 2014 marginal electricity price data from the Edison Electric Institute. Variability: Marginal electricity prices vary by season, U.S. region, and baseline electricity consumption level.
Energy Price Trends	Based on *AEO 2015* price forecasts.
Lamp Replacements	For lamp failures during the lifetime of the CFLK, consumers replace lamps with lamp options available in the market that have the same base type and provide a similar lumen output to the initially packaged lamps.
Residual Value	Represents the value of surviving lamps at the end of the CFLK lifetime. DOE discounts the residual value to the start of the analysis period and calculates it based on the remaining lamp's lifetime and price in the year the CFLK is retired.
Product Lifetime	Based on a ceiling fan lifetime distribution, with a mean of 13.8 years.
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's Survey of Consumer Finances.
Efficacy Distribution	Estimated by the market-share module of shipments model. See chapter 9 of the NOPR TSD for details.
Assumed Compliance Date	2019.

* References for the data sources mentioned in this table are provided in the sections following the table or in chapter 8 of the NOPR TSD.

1. Product Cost

DOE developed the weighted-average CFLK socket costs and consumer prices for all representative lamp units presented in the engineering analysis in the product price determination (chapter 7 of the NOPR TSD). DOE did not account for the remaining price of the CFLK (*i.e.,* CFLK price excluding the lamps and sockets) in the LCC calculation because these are assumed to be the same for all CFLKs regardless of efficacy. As discussed earlier, DOE scaled the lumen output of each representative lamp unit by a factor equal to the ratio of the market-weighted average total lumen output to the baseline lamp lumen output. For consistency, DOE also multiplied the price of the lamp and socket by the same scaling factor to determine the total product cost.

DOE also used a price learning analysis to account for changes in lamp prices that are expected to occur between the time for which DOE has data for lamp prices (2014) and the assumed compliance date of the rulemaking (2019). For details on the price learning analysis, see section IV.G.

DOE applied sales tax, which varies by geographic location, to the total product cost. DOE collected sales tax data from the Sales Tax Clearinghouse [36] and used population projections from the Census Bureau [37] to develop population-weighted-average sales tax values for each state in 2019.

2. Disposal Cost

Disposal cost is the cost a consumer pays to dispose of their retired CFLK. In the preliminary analysis, DOE assumed that 10 percent of commercial consumers pay $1 per lamp to dispose of CFL and LED lamps. Westinghouse agreed with DOE's assumed disposal cost of $1 per lamp for CFL lamps, but disagreed with DOE's assumption that LED lamps have a disposal cost associated with them. (Westinghouse, Public Meeting Transcript, No. 82 at p. 195) ALA agreed with Westinghouse regarding disposal costs for LED lamps, stating that LEDs would not have equivalent disposal costs to CFLs because LEDs do not contain mercury. (ALA, No. 93 at p. 10)

Because LED lamps do not contain mercury, DOE assumed in the NOPR analyses that LED CFLKs do not have an associated disposal cost. In the preliminary analysis, DOE assumed that 10 percent of commercial consumers pay a $1 per lamp disposal cost for CFLs. DOE also assumed that the fraction of commercial consumers who pay to recycle CFLs is smaller than the fraction who pay to recycle linear fluorescent lamps. However, DOE received comments from stakeholders during the GSL preliminary analysis public meeting indicating that the commercial consumers who pay to recycle linear fluorescent lamps also pay to recycle CFLs.[38] DOE estimates that the fraction of commercial consumers who pay disposal fees for fluorescent lamps will increase to 35 percent by 2019 based on a 2004 report from the Association of Lighting and Mercury Recyclers,[39] which estimated a 29 percent commercial recycling rate, and a 2009 draft report from the Massachusetts Department of Environmental Protection [40] that indicated a recycling rate of approximately 34 percent. Given this increased recycling percentage and DOE's assumption that the rate of commercial fluorescent lighting recycling would increase by the compliance date of this rulemaking, DOE has assumed that 35 percent of consumers of commercial CFLs pay to recycle their lamps by 2019. DOE assumes that this fraction will have saturated by 2019 and will remain constant throughout the analysis period due to the availability of free options for recycling small numbers of CFLs and the likelihood that some CFLs in the commercial sector will not be disposed of through recommended methods. DOE also reduced the disposal cost from $1 per lamp to $0.70 per lamp based on feedback from a lighting industry expert and stakeholder comments received on the GSL preliminary analysis TSD.[41] DOE requests comment and relevant data on the disposal cost assumptions used in its analyses (see section VII.E).

3. Electricity Prices

In the preliminary analysis, DOE used average retail electricity prices to conduct its analyses. In response to this methodology, ALA suggested DOE use marginal retail electricity prices rather

[36] *https://thestc.com/STRates.stm.* Last accessed March 5th 2015.

[37] U.S. Census Bureau, Population Division, Interim State Population Projections, 2005. Table A1: Interim Projections of the Total Population for the United States and States: April 1, 2000 to July 1, 2030.

[38] The public meeting transcript for the energy conservation standards preliminary analysis for GSLs is available at: *http://www.regulations.gov/#!documentDetail;D=EERE-2013-BT-STD-0051-0029.*

[39] *http://www.lamprecycle.org/wp-content/uploads/2014/02/ALMR_capacity_statement.2004.-pdf.pdf.*

[40] *http://www.mass.gov/eea/docs/dep/toxics/stypes/09hglrrd.pdf.*

[41] These comments can be viewed on the General Service Lamps Energy Conservation Standards docket Web site: *http://www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0051.*

than average retail electricity prices. (ALA, No. 93 at p. 5) Marginal electricity prices may provide a better representation of consumer costs than average electricity prices because marginal electricity prices more accurately reflect the expected change in a consumer's electric utility bill due to an increase in end-use efficiency. Therefore, DOE used marginal electricity prices to calculate the operating costs associated with each efficacy level in the NOPR analyses. In the LCC analysis, marginal electricity prices vary by season, region, and baseline household electricity consumption level. DOE estimated these prices using data published with the Edison Electric Institute (EEI) Typical Bills and Average Rates reports for summer and winter 2014.[42] DOE assigned seasonal marginal prices to each household or commercial building in the LCC sample based on its location and its baseline monthly electricity consumption for an average summer or winter month. For a detailed discussion of the development of electricity prices, see appendix 8B of the NOPR TSD.

4. Electricity Price Trends

To arrive at electricity prices in future years, DOE multiplied the marginal 2014 electricity prices by the forecast of annual residential or commercial electricity price changes for each Census division from EIA's *AEO 2015,* which has an end year of 2040.[43] For each purchase sampled, DOE applied the projection for the Census division in which the purchase was located. The *AEO* electricity price trends do not distinguish between marginal and average prices, so DOE used the *AEO 2015* trends for the marginal prices. DOE reviewed the EEI data for the years 2007 to 2014 and determined that there is no systematic difference in the trends for marginal vs. average electricity prices in the data.

DOE used the electricity price trends associated with the *AEO* reference case scenarios for the nine Census divisions. The reference case is a business-as-usual estimate, given known market, demographic, and technological trends. DOE also included *AEO* High Growth and *AEO* Low-Growth scenarios in the analysis. The high- and low-growth cases show the projected effects of alternative economic growth assumptions on energy markets. To estimate the trends after 2040, DOE used the average rate of change during 2025–2040.

5. Lamp Replacements

In the LCC analysis, DOE assumes that in both the commercial and residential sectors, lamps fail only at the end of the lamp service life. The service life (in years) is determined by dividing the lamps' rated lifetime (in hours) by the lamps' average operating hours per year.

Replacement costs include, in principle, both the lamps and labor associated with replacing a CFLK lamp at the end of its lifetime. However, DOE assumes that labor costs for lamp replacements are negligible and therefore did not include them in the analysis. Thus, DOE considers that the only first costs associated with lamp replacements are lamp purchase costs to consumers.

DOE assumed that consumers replace failed lamps with new lamps chosen from options available in the lighting market that have the same base type and provide an equivalent lumen output. DOE modeled this decision using a consumer-choice model, which incorporates consumer sensitivity to first cost and operation and maintenance (O&M) cost. DOE accounted for the first cost associated with purchasing a replacement lamp, the electricity consumption and operating costs depending on replacement lamp wattage, and the residual value of the lamp at the end of the CFLK lifetime. For details, see chapter 8 of the NOPR TSD.

6. Product Lifetime

DOE accounted for variability in the CFLK lifetimes by assigning a lifetime distribution[44] that is tied to the lifetime of the ceiling fan[45] to which the CFLK is attached. DOE used the ceiling fan lifetime distribution determined in the preliminary analysis of the energy conservation standards rulemaking for ceiling fans.[46] If originally packaged lamps fail before the end of the CFLK lifetime, DOE assumed that consumers replace those lamps with lamps of the same socket type and equivalent lumen output, as described in the previous section.

7. Residual Value

The residual value represents the remaining dollar value of surviving lamps at the end of the CFLK lifetime, discounted to the compliance year. DOE assumed that all lamps with lifetimes shorter than the CFLK lifetime are replaced. To account for the value of any initially packaged or replacement lamps with remaining life to the consumer, the LCC model applies this residual value as a "credit" at the end of the CFLK lifetime, which is discounted back to the start of the analysis period. Because DOE estimates that LED lamps undergo price learning, the residual value of these lamps is calculated based on the LED lamp price in the year the CFLK is retired.

8. Discount Rates

In the calculation of LCC, DOE applies discount rates appropriate to households to estimate the present value of future operating costs. DOE estimated a distribution of residential discount rates for CFLKs based on consumer financing costs and opportunity cost of funds related to appliance energy cost savings and maintenance costs.

To establish residential discount rates for the LCC analysis, DOE identified all relevant household debt or asset classes to approximate a consumer's opportunity cost of funds related to appliance energy cost savings. It estimated the average percentage shares of the various types of debt and equity by household income group using data from the Federal Reserve Board's Survey of Consumer Finances[47] (SCF) for 1995, 1998, 2001, 2004, 2007, and 2010. Using the SCF and other sources, DOE developed a distribution of rates for each type of debt and asset by income group to represent the rates that may apply in the year in which amended standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of the distributions. The average rate across all types of household debt and equity and income groups, weighted by the shares of each type, is 4.4 percent. See chapter 8 of the NOPR TSD for further details on the development of consumer discount rates.

[42] Edison Electric Institute. Typical Bills and Average Rates Report. Winter 2014 published April 2014, Summer 2014 published October 2014. See *http://www.eei.org/resourcesandmedia/products/Pages/Products.aspx.*

[43] U.S. Energy Information Administration. *Annual Energy Outlook 2015 with Projections to 2040.* 2015. Washington, DC Report No. DOE/EIA–0383(2015). *http://www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf.*

[44] DOE used a Weibull distribution to model the lifetime of ceiling fans. Weibull distributions are commonly used to model appliance lifetimes.

[45] The lifetime of the ceiling fan, rather than that of the CFLK, is used because the fan, having moving parts, is likely to have a shorter life, and the available data suggest that when fans cease to function, their light kit is also retired.

[46] DOE has published a framework document and preliminary analysis for establishing energy conservation standards for ceiling fans. Further information is available at *www.regulations.gov* under Docket ID: *EERE–2012–BT–STD–0045.*

[47] Board of Governors of the Federal Reserve System. Survey of Consumer Finances. 1995, 1998, 2001, 2004, 2007, and 2010. (Last accessed October 10, 2014.) *http://www.federalreserve.gov/econresdata/scf/scfindex.htm.*

To establish commercial discount rates for the LCC analysis, DOE estimated the cost of capital for companies that purchase CFLKs. The weighted-average 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 their cost of capital is the weighted average of the cost to the firm of equity and debt financing, as estimated from financial data for publicly traded firms in the sectors that purchase CFLKs. For this analysis, DOE used Damodaran online[48] as the source of information about company debt and equity financing. The average rate across all types of companies, weighted by the shares of each type, is 5.0 percent. See chapter 8 of the NOPR TSD for further details on the development of commercial sector discount rates.

9. Efficacy Distributions

To accurately estimate the share of consumers that would be affected by a potential energy conservation standard at a particular efficacy level, DOE's LCC analysis considered the projected distribution (*i.e.,* market shares) of product efficacies that consumers purchase under the no-standards case and each of the standards cases (*i.e.,* the cases where a standard would be set at each TSL) at the assumed compliance year. The estimated market shares for the no-standards case and each standards case for CFLKs are determined by the shipments analysis and are shown in Table IV.9. See section IV.G of this notice and chapter 9 of the NOPR TSD for further information on the derivation of the market efficacy distributions.

TABLE IV.9—MARKET EFFICACY DISTRIBUTION BY TRIAL STANDARD LEVEL IN 2019

Trial standard level	Sub-baseline (%)	EL 0 (%)	EL 1 (%)	EL 2 (%)	EL 3 (%)	EL 4 (%)	Total (%)
No-Standards	55.9	0.0	26.3	10.2	3.5	4.1	100
TSL 0	0.0	0.0	82.2	10.2	3.5	4.1	100
TSL 1	0.0	0.0	82.2	10.2	3.5	4.1	100
TSL 2	0.0	0.0	0.0	51.3	3.5	45.2	100
TSL 3	0.0	0.0	0.0	0.0	3.5	96.5	100
TSL 4	0.0	0.0	0.0	0.0	0.0	100.0	100

10. LCC Savings Calculation

In the reference scenario, DOE calculated the LCC savings at each TSL based on the change in LCC for each standards case compared to the no-standards case, considering the efficacy distribution of products derived by the shipments analysis. Unlike the roll-up approach applied in the preliminary analysis, where the market share of ELs below the standard level 'rolls up' to the least efficient EL still available in each standards case, the reference approach allows consumers to choose more-efficient (and sometimes less expensive) products at higher ELs and is intended to more accurately reflect the impact of a potential standard on consumers.

DOE also performed the roll-up approach as an alternative scenario to calculate LCC savings. For details on both the market-transformation and the roll-up approach, see chapter 8 of the NOPR TSD.

11. Payback Period Analysis

The payback period is the amount of time it takes the consumer to recover the additional installed cost of more-efficient products, compared to the least efficient products on the market, through energy cost savings. Payback periods are expressed in years. Payback periods that exceed the life of the product mean that the increased total installed cost is not recovered in reduced operating expenses.

The inputs to the PBP calculation for each efficacy level are the change in total installed cost of the product and the change in the initial annual operating expenditures relative to the least efficient product on the market. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates and energy price trends are not needed. DOE did not consider the impact of replacement lamps (that replace the initially packaged lamps when they fail) in the calculation of the PBP.

As noted above, EPCA, as amended, establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable test procedure. (42 U.S.C. 6295(o)(2)(B)(iii)) For each considered efficacy level, DOE determined the value of the first year's energy savings by calculating the energy savings in accordance with the applicable DOE test procedure, and multiplying those savings by the average energy price forecast for the year in which compliance with the amended standards would be required.

G. Shipments Analysis

DOE uses projections of product shipments to calculate the national impacts of potential amended energy conservation standards on energy use, NPV, and future manufacturer cash flows. Historical shipments data are used to build up an equipment stock, and to calibrate the shipments model to project shipments over the course of the analysis period based on the estimated future demand for CFLKs. Details of the shipments analysis are described in chapter 9 of the NOPR TSD.

The shipments model projects total shipments and market share efficacy distributions in each year of the 30-year analysis period (2019–2048) for the no-standards case and each of the standards cases. Shipments are calculated for the residential and commercial sectors assuming 95 percent of shipments are to the residential sector and 5 percent are to the commercial sector. DOE requests comments on this assumed breakdown of CFLK usage (see section VII.E). DOE further assumed in its analysis that CFLKs are primarily found on low-volume ceiling fans. DOE requests any information regarding shipments of CFLKs intended for high-volume ceiling fans. DOE also assumed that the distribution of CFLKs by light source

[48] Damodaran, A. *Cost of Capital by Sector.* January 2014. (Last accessed September 25, 2014.) *http://people.stern.nyu.edu/adamodar/New_Home_Page/datafile/wacc.htm.*

technology in the commercial sector is the same as the light source technology distribution in the residential sector, and DOE welcomes comments and input on this assumption (see section VII.E).

The shipments model consists of three main components: (1) A demand model that determines the total demand for new CFLKs in each year of the analysis period, (2) a stock model that tracks the age distribution of the stock over the analysis period, and (3) a modified consumer-choice model that determines the market shares of purchased CFLKs across ELs.

The CFLK shipments demand model considers four market segments that impact the net demand for total shipments: Replacements for retired stock, additions due to new building construction, additions due to expanding demand in existing buildings, and reductions due to building demolitions, which erodes demand from replacements and existing buildings.

The stock accounting model tracks the age (vintage) distribution of the installed CFLK stock. The age distribution of the stock is a key input to both the national energy savings (NES) and NPV calculations, because the operating costs for any year depend on the age distribution of the stock. Older, less efficient units may have higher operating costs, while newer, more-efficient units have lower operating costs. The stock accounting model is initialized using historical shipments data and accounts for additions to the stock (*i.e.,* shipments) and retirements. The age distribution of the stock in 2012 is estimated using results from the LBNL survey of ceiling fan owners.[49] The stock age distribution is updated in subsequent years using projected shipments and retirements determined by the stock age distribution and a product retirement function.

The modified consumer-choice model estimates the market shares of purchases in each year in the analysis period for each efficacy level presented in the engineering analysis. In the case of CFLKs, the lamps included with the CFLK are chosen by the CFLK manufacturer. A key assumption of DOE's CFLK consumer-choice model is that when LED lamps reach price parity with comparable CFL lamps, manufacturers will purchase LED lamps to package with a CFLK, making only those lamps available to the consumer. In other words, DOE assumes that CFLK manufacturers will not pay a price premium to package with CFLs compared to LED lamps. DOE requests feedback on this assumption (see section VII.E). Prior to the point when LED lamps reach price parity with CFLs, market share to LED CFLKs is allocated following an adoption curve discussed in more detail below.

As described in the engineering analysis, DOE assumed that CFLK manufacturers could respond in two ways to an amended energy conservation standard. Manufacturers could maintain the current base type and number of lamps in a CFLK design and simply replace lamps currently packaged with CFLKs with a more-efficient option (lamp replacement scenario), or they could reconfigure CFLKs to include a different base type and/or number of lamps, in addition to packaging with more-efficient lamp options (light kit replacement scenario). DOE assumed that there was no inherent preference between the two scenarios and split market share evenly between them. DOE requests comment on the likelihood of CFLK manufacturers selecting each substitution scenario and information on any alternative scenarios that manufacturers may choose (see section VII.E).

DOE's shipments model estimates the adoption of LED technologies using an incursion curve and a modified consumer-choice model in both the no-standards and amended standards cases. In the preliminary analysis, DOE estimated the market share of LED CFLKs in the compliance year would be approximately 27 percent in its reference scenario. This estimate was based on the market shares of LED A-type lamps presented in the report, *Energy Savings Potential of Solid-State Lighting in General Illumination Applications*[50] (SSL report). DOE assumed that LED incursion into CFLKs would lag behind general service applications by two years. Westinghouse tentatively agreed with this projected market share of LED CFLKs in the compliance year (2019). (Westinghouse, Public Meeting Transcript, No. 82 at p. 234) Westinghouse appreciated that DOE's estimated LED CFLK adoption rate is projected to trail the LED GSL adoption rate, but also noted that CFLK manufacturers are dependent on what products are available to them. (Id.) ALA believes DOE's LED incursion estimate is too high and estimates that LED CFLKs will have no more than 15 percent market share in 2018. (ALA, No. 93 at p. 4)

Based on the current market share of LED CFLKs, a market share lower than 27 percent in the compliance year is a reasonable assumption. For the NOPR analysis, DOE used the Bass diffusion curve developed in the SSL report for GSLs to estimate the market share apportioned to LED ELs. DOE assumed the adoption of LEDs in the CFLK market would trail behind adoption of LED technology in the GSL market by 3.5 years. In the NOPR analysis, DOE's LED incursion curve for CFLKs results in a market share of 14 percent for LED lamps in 2019. DOE requests comment on this approach (see section VII.E). Based on observed trends in the efficacy of LED lamps on the market over time, DOE assumed the market for LED lamps would naturally move to more efficacious ELs in the no-standards case as well as the standards cases. DOE requests comment on this assumption (see section VII.E).

In the preliminary analysis, DOE assumed that only LEDs will continue to undergo significant cost reduction due to price learning, and DOE estimated the learning rate based on price learning projections for the general LED market. Westinghouse and ALA agree with DOE's assumption that only LEDs will continue to undergo significant cost reduction due to price learning; however, ALA believes DOE's LED price learning assumption estimate is too high. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 231–233; ALA, No. 93 at p. 10) Westinghouse, on the other hand, was tentatively in agreement with DOE's LED price learning estimates for CFLKs. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 231–233)

In the NOPR analysis, DOE again assumed that price learning would occur only for LEDs. DOE requests comment on this assumption (see section VII.E). DOE used the price trends developed in the GSLs preliminary analysis for the reference scenario in the base case of that rulemaking (*i.e.,* shipments of LED GSLs were affected by the EISA 2007 backstop but not by a GSL final rule). That scenario assumed that LED GSLs would experience the same learning rate historically observed for CFLs. Most recent estimates for LED GSL price trends indicate faster historic price decline;[51] therefore DOE believes the

[49] Kantner, et al. (2013), op. cit.

[50] Navigant Consulting, Inc. *Energy Savings Potential of Solid-State Lighting in General Illumination Applications.* 2012. *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_energy-savings-report_jan-2012.pdf.*

[51] Navigant Consulting, Inc. *Energy Savings Forecast of Solid-State Lighting in General Illumination Applications.* 2014. U.S. Department of Energy. Report No. DOE/EE–1133. *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/energysavingsforecast14.pdf.*

scenario it used may be a conservative estimate of LED GSL price trends. Details on the development of the price trends are in chapter 9 of the NOPR TSD and chapter 9 of the GSL preliminary analysis TSD.[52]

In the preliminary analysis for the concurrent GSL energy conservation standards rulemaking,[53] DOE considered lamps that have base types specified by ANSI, have a lumen output of at least 310 lumens, and are intended to serve in general lighting applications to meet the GSL definition. Therefore, DOE considers candelabra-base lamps that meet the lumen output and general application requirements to meet the GSL definition, which available information indicates would include all candelabra-base lamps currently packaged with CFLKs. All lamps that meet the GSL definition would be subject to the EISA 2007 backstop requirement prohibiting the sale of any GSL that does not meet a minimum efficacy standard of 45 lm/W if the concurrent GSL rulemaking is not completed by January 1, 2017, or if the energy savings of the GSL final rule are not greater than or equal to the savings from a minimum efficacy standard of 45 lumens per watt. 42 U.S.C. 6295(i)(6)(A)(v)

The Consolidated and Further Continuing Appropriations Act, 2015 (Public Law 113–235, Dec. 16, 2014), in relevant part, restricts the use of appropriated funds in connection with several aspects of DOE's incandescent lamps energy conservation standards program. Specifically, section 313 states that none of the funds made available by the Act may be used to implement or enforce standards for GSILs, intermediate base incandescent lamps and candelabra base incandescent lamps. Thus, DOE is not considering GSILs in the GSL rulemaking. Because GSILs are not included in the scope of the GSL rulemaking, DOE assumed that any GSL final rule would not yield sufficient energy savings to avoid triggering the EISA 2007 45 lm/W backstop requirement in 2020. Accordingly, DOE has assumed in both the no-standards and the standards-case shipment projections that candelabra-base lamps with efficacy below the minimum requirement of 45 lm/W will no longer be an option available for packaging with CFLKs beginning January 1, 2020.

In the preliminary analysis, DOE used an initial relative price elasticity of demand of −0.34, which is the value DOE has typically used for residential appliances. DOE notes that the fractional drop in CFLK shipments in the standards cases is proportional to the change in CFLK purchase price compared to the total price of a ceiling fan and CFLK system. Given that the CFLK price is relatively small compared to the ceiling fan price, DOE will address comments related to price elasticity in the ceiling fan ECS NOPR. For the CFLK NOPR analyses, DOE again used an initial relative price elasticity of demand of −0.34.

In the preliminary analysis, DOE assumed that the vast majority of CFLKs were sold with ceiling fans and noted that a standard for ceiling fans could also reduce CFLK shipments (and vice versa). For this NOPR, DOE did not assume a standard on ceiling fans in its projections for CFLK shipments because DOE has not yet proposed a ceiling fan standard.[54] In any ECS NOPR for ceiling fans, DOE will consider the impact of these proposed CFLK standards in its projections of ceiling fan shipments. In any CFLK ECS final rule, DOE will take into account the impact of a potential proposed ceiling fan standard on CFLK shipments and will consider taking comment on its revised analysis as appropriate.

H. National Impact Analysis

The NIA assesses the NES and the NPV from a national perspective of total consumer costs and savings that would be expected to result from new or amended standards at specific ELs. (''Consumer'' in this context refers to consumers of the product being regulated.) DOE calculates the NES and NPV based on projections of annual product shipments, along with the annual energy consumption, total installed cost, and the costs of relamping. For the NOPR analysis, DOE projected the energy savings, operating-cost savings, product costs, and NPV of consumer benefits over the lifetime of CFLKs shipped from 2019 through 2048.

DOE evaluates the impacts of amended standards by comparing a no-standards-case projection with standards-case projections. The no-standards-case projection characterizes energy use and consumer costs in the absence of amended energy conservation standards. The standards-case projections characterize energy use and consumer cost for the market distribution where CFLKs that do not meet the TSL being analyzed are excluded as options available to the consumer. As described in section IV.G of this notice, DOE developed market share distributions for CFLKs at each EL in the no-standards case and each of the standards cases in its shipments analysis.

DOE uses a spreadsheet model to calculate the energy savings and the national consumer costs and savings from each TSL. Interested parties can review DOE's analyses by changing various input quantities within the spreadsheet. The NIA spreadsheet model uses typical values (as opposed to probability distributions) as inputs.

Table IV.10 summarizes the inputs and methods DOE used for the NIA analysis for the NOPR. Discussion of these inputs and methods follows the table. See chapter 10 of the NOPR TSD for further details.

TABLE IV.10—SUMMARY OF INPUTS AND METHODS FOR THE NATIONAL IMPACT ANALYSIS

Inputs	Method
Shipments	Annual shipments from shipments model.
Assumed Compliance Date of Standard.	2019.
No Standard-Case Forecasted Efficacies.	Estimated by market-share module of shipments model including impact of SSL incursion.
Standards-Case Forecasted Efficacies.	Estimated by market-share module of shipments model including impact of SSL incursion.

[52] U.S. Department of Energy—Office of Energy Efficiency and Renewable Energy. Preliminary Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: General Service Lamps. 2014. Washington, DC *http://www.regulations.gov/#!documentDetail;D=EERE-2013-BT-STD-00051-0022.*

[53] The GSL energy conservation standards preliminary analysis technical support document and public meeting information are available at regulations.gov under docket ID EERE–2013–BT–STD–0051–0022: *http://www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0051.*

[54] The ceiling fans energy conservation standards docket (docket number EERE-2012-BT-STD-0045-0065) is located at regulations.gov: *http://www.regulations.gov/#!docketDetail;D=EERE-2012-BT-STD-0045.*

TABLE IV.10—SUMMARY OF INPUTS AND METHODS FOR THE NATIONAL IMPACT ANALYSIS—Continued

Inputs	Method
Annual Energy Consumption per Unit.	Annual weighted-average values are a function of energy use at each EL including impacts of relamping over the CFLK lifetime.
Total Installed Cost per Unit	Annual weighted-average values are a function of cost at each EL. Incorporates projection of future LED lamp prices based on historical data.
Annual Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.
Repair and Maintenance Cost per Unit.	Annual repair values do not change with efficacy level. Replacement lamp costs are calculated for each efficacy level over the analysis period.
Energy Prices	*AEO 2015* forecasts (to 2040) and extrapolation thereafter.
Energy Site-to-Primary Conversion.	A time-series conversion factor based on *AEO 2014.*
Discount Rate	Three and seven percent.
Present Year	2015.

1. National Energy Savings

The NES analysis involves a comparison of national energy consumption of the considered products in each potential standards case (TSL) with consumption in the case with no new or amended energy conservation standards. DOE calculated the national energy consumption by multiplying the number of units (stock) of each product (by vintage or age) by the unit energy consumption (also by vintage). DOE accounts for changes in unit energy consumption as the lamps packaged with the CFLK are retired at the end of the lamp lifetime and new lamps are purchased as replacements for the existing CFLK. DOE uses a consumer-choice model, described in section IV.G, to determine the mix of lamps chosen as replacements.

DOE calculated annual NES based on the difference in national energy consumption for the no-standards case and for the case where a standard is set at each TSL. DOE estimated energy consumption and savings based on site energy and converted the electricity consumption and savings to primary energy (*i.e.,* the energy consumed by power plants to generate site electricity) using annual conversion factors derived from *AEO 2014.* Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

In response to the recommendations of a committee on ''Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards'' appointed by the National Academy of Sciences, DOE announced its intention to use FFC measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (August 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in which DOE explained its determination that EIA's National Energy Modeling System (NEMS) is the most appropriate tool for its FFC analysis and its intention to use NEMS for that purpose. 77 FR 49701 (August 17, 2012). NEMS is a public domain, multi-sector, partial equilibrium model of the U.S. energy sector [55] that EIA uses to prepare its *AEO.* The approach used for deriving FFC measures of energy use and emissions is described in appendix 10B of the NOPR TSD.

In response to the calculated NES presented in the preliminary analysis, the Joint Comment requested that DOE review the savings estimates to confirm that they accurately represent the effect of a standard set at each CSL. The Joint Comment conducted an analysis of energy savings per unit for CFLKs packaged with sub-baseline lamps compared to CFLKs packaged with lamps corresponding to each of several ELs considered by DOE. The Joint Comment compared the results of this analysis to the NES reported by DOE for each case when a standard is set at a particular efficacy level, and suggested that the estimated energy savings in the preliminary analysis for CSL 0 may be too low. (Joint Comment, No. 95 at p. 3)

DOE has reviewed and confirmed its analysis of NES at each efficacy level. ASAP, *et al.'s* analysis does not take into account two significant factors that account for the divergence in estimated energy savings. First, ASAP *et al.'s* analysis does not take into account significant changes in the CFLK market efficacy distribution over the course of the analysis period, even in the absence of an amended standard for CFLKs, instead assuming a persistent, significant fraction of CFLKs are packaged with sub-baseline products. DOE's analysis, on the other hand, assumed significant and rapid LED incursion into the CFLK market, which displaced CFLKs packaged with sub-baseline products early in the analysis period, even in the absence of amended standards. Second, ASAP *et al.'s* analysis does not take into account the lifetime of the lamps originally packaged with a CFLK and appears to assume that when the originally packaged lamps are retired, those lamps are always replaced by lamps with the same efficacy. DOE's analysis, in contrast, assumes significant LED incursion into the market for lamps that replace the originally packaged lamps, which can have a significant impact on the efficacy and energy consumption of a CFLK over its lifetime, particularly for CFLKs originally packaged with sub-baseline lamps. As a result, DOE's calculation of the lifetime energy consumption for a CFLK originally packaged with sub-baseline lamps yields a lower value than an analysis that assumes that the efficacy of that CFLK is constant. Thus, the energy savings potential associated with a standard set at any given CSL is lower. DOE notes that the aforementioned assumption that the 45 lm/W standard requirement will take effect on January 1, 2020 further reduces the energy savings potential for this rulemaking by impacting both the lamps available for packaging with a CFLK and the replacement lamps available to consumers.

[55] For more information on NEMS, refer to *The National Energy Modeling System: An Overview,* DOE/EIA–0581 (98) (Feb.1998) (Available at: *http://www.eia.gov/oiaf/aeo/overview/).*

2. Net Present Value Analysis

The inputs for determining the NPV of the total costs and benefits experienced by consumers are: (1) Total annual installed cost; (2) total annual savings in operating costs; and (3) a discount factor to calculate the present value of costs and savings. DOE calculates net savings each year as the difference between the no-standards case and each standards case in terms of total savings in operating costs versus total increases in installed costs. DOE calculates operating-cost savings over the lifetime of each product shipped during the forecast period.

The operating-cost savings are primarily energy cost savings, which are calculated using the estimated energy savings in each year and the projected price of electricity. To estimate electricity prices in future years, DOE multiplied the average regional electricity prices by the forecast of annual national-average residential or commercial electricity price changes in the reference case from *AEO 2015,* which has an end year of 2040. To estimate price trends after 2040, DOE used the average annual rate of change in prices from 2025 to 2040. As part of the NIA, DOE also analyzed scenarios that used inputs from the *AEO 2015* Low Economic Growth and High Economic Growth cases.

Operating-cost savings are also impacted by the costs incurred by consumers to relamp their CFLK over the course of the CFLK lifetime, as well as any impact the new lamps may have on the efficacy of the CFLK. Any remaining residual life in lamps at the end of the CFLK lifetime (for either the initially packaged lamps or replacement lamps) is expressed as a credit that is deducted from the operating cost.

DOE estimated the range of potential impacts of amended standards by considering high and low benefit scenarios. In the high benefits scenario, DOE used the High Economic Growth *AEO 2015* estimates for new housing starts and electricity prices along with its reference LED price learning trend. As discussed in section IV.G, the reference LED price trend assumes the learning rate measured from historical CFL price trends can be applied to cumulative LED shipments to determine future LED prices. In the low benefits scenario, DOE used the Low Economic Growth *AEO 2015* estimates for housing starts and electricity prices, along with a high LED learning rate. The high LED learning rate is estimated from historical LED price trends and shows a faster price decline in comparison to the CFL learning rate as estimated by LBNL.[56] The benefits to consumers from amended CFLK standards are lower if LED prices decline faster because consumers convert to LED CFLKs more quickly in the no-standards case. NIA results based on these alternative scenarios are presented in appendix 10C of the NOPR TSD.

In calculating the NPV, DOE multiplies the net savings in future years by a discount factor to determine their present value. For this NOPR, DOE estimated the NPV of consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget (OMB) to Federal agencies on the development of regulatory analysis.[57] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the ''social rate of time preference,'' which is the rate at which society discounts future consumption flows to their present value.

I. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended standards on consumers, DOE evaluates the impact on identifiable subgroups of consumers that may be disproportionately affected by a new or amended national standard. DOE evaluates impacts on particular subgroups of consumers by analyzing the LCC impacts and PBP for those particular consumers from alternative standard levels. For this NOPR, DOE analyzed the impacts of the considered standard levels on low-income households and small businesses. Chapter 11 of the NOPR TSD describes the consumer subgroup analysis.

J. Manufacturer Impact Analysis

1. Overview

DOE conducted an MIA for CFLKs to estimate the financial impact of proposed standards on manufacturers of CFLKs. The MIA has both quantitative and qualitative aspects. The quantitative part of the MIA relies on the GRIM, an industry cash-flow model customized for the CFLKs covered in this rulemaking. The key GRIM inputs are data on the industry cost structure, equipment costs, shipments, and assumptions about markups, and conversion costs. The key MIA output is INPV. DOE used the GRIM to calculate cash flows using standard accounting principles and to compare changes in INPV between a no-standards case and various TSLs (the standards case). The difference in INPV between the base and standards cases represents the financial impact of amended energy conservation standards on CFLK manufacturers. Different sets of assumptions (scenarios) produce different INPV results. The qualitative part of the MIA addresses factors such as manufacturing capacity; characteristics of, and impacts on, any particular subgroup of manufacturers; and impacts on competition.

DOE conducted the MIA for this rulemaking in three phases. In the first phase, DOE prepared an industry characterization based on the market and technology assessment, preliminary manufacturer interviews, and publicly available information. In the second phase, DOE estimated industry cash flows in the GRIM using industry financial parameters derived in the first phase and the shipment scenarios used in the NIA. In the third phase, DOE conducted interviews with a variety of CFLK manufacturers that account for more than 30 percent of domestic CFLK sales covered by this rulemaking. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics specific to each company and obtained each manufacturer's view of the CFLK industry as a whole. The interviews provided information that DOE used to evaluate the impacts of amended standards on manufacturers' cash flows, manufacturing capacities, and direct domestic manufacturing employment levels. See section V.B.2.b of this NOPR for the discussion on the estimated changes in the number of domestic employees involved in manufacturing CFLKs covered by standards. See section IV.J.4 of this NOPR for a description of the key issues that manufacturers raised during the interviews.

During the third phase, DOE also used the results of the industry characterization analysis in the first phase and feedback from manufacturer interviews to group manufacturers that exhibit similar production and cost structure characteristics. DOE identified one manufacturer subgroup for a separate impact analysis—small business manufacturers—using the small business employee threshold of 750 total employees published by the Small Business Administration (SBA). This threshold includes all employees in a business' parent company and any other subsidiaries. Based on this classification, DOE identified 34 CFLK manufacturers that qualify as small businesses. The complete MIA is presented in chapter 12 of the NOPR TSD, and the analysis required by the

[56] Gerke, B., A. Ngo, A. Alstone, and K. Fisseha. *The Evolving Price of Household LED Lamps: Recent Trends and Historical Comparisons for the US Market.* 2014. Lawrence Berkeley National Laboratory: Berkeley, CA. Report No. LBNL–6854E.

[57] U.S. Office of Management and Budget. Circular A–4: Regulatory Analysis,'' (Sept. 17, 2003), section E (Available at: *www.whitehouse.gov/omb/memoranda/m03–21.html*).

Regulatory Flexibility Act, 5 U.S.C. 601, *et. seq.,* is presented in section VI.B of this NOPR and chapter 13 of the NOPR TSD.

2. GRIM Analysis and Key Inputs

DOE uses the GRIM to quantify the changes in cash flows over time due to amended energy conservation standards. These changes in cash flows result in either a higher or lower INPV for the standards case compared to the no-standards case (the case where a new standard is not set). The GRIM analysis uses a standard annual cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. It then models changes in costs, investments, and manufacturer margins that result from amended energy conservation standards. The GRIM uses these inputs to calculate a series of annual cash flows beginning with the base year of the analysis, 2015, and continuing to 2048. DOE computes INPV by summing the stream of annual discounted cash flows during the analysis period. DOE used a real discount rate of 7.4 percent for CFLK manufacturers. Initial discount rate estimates were derived from industry corporate annual reports to the Securities and Exchange Commission (SEC 10-Ks). DOE initially derived a real discount rate of 5.9 percent from publicly available SEC 10-Ks. During manufacturer interviews, CFLK manufacturers were asked to provide feedback on this discount rate. Based on manufacturer feedback that the 5.9 percent discount was too low for the CFLK industry and that 7.4 percent was a more accurate reflection of their typical rate of return on their investments, DOE revised the real discount rate to be 7.4 percent for this analysis. Many inputs into the GRIM come from the engineering analysis, the NIA, manufacturer interviews, and other research conducted during the MIA. The major GRIM inputs are described in detail in the following sections.

a. Capital and Product Conversion Costs

DOE expects amended CFLK energy conservation standards to cause manufacturers to incur conversion costs by bringing their tooling and product designs into compliance with amended standards in the light kit replacement scenario. For the MIA, DOE classified these conversion costs into two major groups: (1) Capital conversion costs and (2) product conversion costs. Capital conversion costs are investments in property, plant, and equipment necessary to adapt or change existing tooling equipment such that new product designs can be fabricated and assembled. Product conversion costs are investments in research, development, testing, marketing, certification, and other non-capitalized costs necessary to make product designs comply with amended standards.

Using feedback from manufacturer interviews, DOE conducted a bottom-up analysis to calculate the capital and product conversion costs for CFLK manufacturers for each product class at each EL. To conduct this bottom-up analysis, DOE used manufacturer input from manufacturer interviews regarding the types and dollar amounts of discrete capital and product expenditures that would be necessary to convert specific production lines for CFLKs at each EL. DOE examined conversion costs for each replacement scenario separately. In the lamp replacement scenario, CFLK manufacturers comply with amended standards by replacing the lamps in the CFLKs with more efficacious lamps that meet amended standards. DOE assumed that there would be no capital or product conversion costs for the lamp replacement scenario because CFLK manufacturers are not required to adjust the type or number of lamps in their CFLK, nor are they required to make any adjustments to the existing fixtures. In the light kit replacement scenario, CFLK manufacturers can comply with amended standards by changing the fixture designs (*i.e.,* changing the number of sockets and/or using more efficacious substitutes with different base types and/or shapes than the baseline lamp). In the light kit replacement scenario, however, manufacturers would incur product and capital conversion costs at ELs that require LED lamps. Based on manufacturer feedback DOE determined that some CFLKs would need to be redesigned due to potential heat sink issues associated with LED lamps and the potentially larger size of LED lamps. Manufacturers would also need to purchase tooling equipment necessary to produce these redesigned CFLKs. Once DOE compiled these capital and product conversion costs, DOE took average values (*i.e.,* average number of hours or average dollar amounts) based on the range of responses given by manufacturers for each capital and product conversion cost at each EL. See chapter 12 of the NOPR TSD for a complete description of DOE's assumptions for the capital and product conversion costs and section IV.C.4 of this NOPR for further discussion on more efficacious substitutes and replacement scenarios.

b. Manufacturer Production Costs

Manufacturing more efficacious CFLKs can result in changes in manufacturer production costs (MPCs) as a result of varying components required to meet ELs at each TSL. Changes in MPCs for these more efficacious components can impact the revenue, gross margin, and the cash flows of CFLK manufacturers. Typically, DOE develops MPCs for the covered products and uses the prices as an input to the LCC analysis and NIA. However, because the CFLK standard is based on the efficacy of the lamps with which it is packaged and lamps are difficult to reverse-engineer, DOE directly derived end-user prices and used them to calculate the MPCs for CFLKs in this rulemaking.

To determine MPCs of CFLKs from end-user prices, DOE divided the end-user price of CFLKs at each EL by a manufacturer markup and by a distributor markup. DOE determined the manufacturer markup by examining the SEC 10-Ks of all publicly traded CFLK manufacturers to estimate an average CFLK manufacturer markup of 1.37. DOE determined the distributor markup by surveying distributor net prices in the three main CFLK distribution channels to estimate a distributor markup of 1.52 for CFLKs. Feedback from manufacturer interviews indicated that the respective markups were appropriate for the CFLK industry. In the no-standards case, the MSP is represented by the end-user price divided by the distributor markup. For a complete description of end-user prices, see the product price determination in section IV.D of this NOPR.

c. Shipment Scenarios

INPV, which is the key GRIM output, depends on industry revenue, which depends on the quantity and prices of CFLKs shipped in each year of the analysis period. Industry revenue calculations require forecasts of: (1) Total annual shipment volume of CFLKs; (2) the distribution of shipments across the product class (because prices vary by product class); and, (3) the distribution of shipments across ELs (because prices vary with lamp efficacy).

Since the majority of CFLKs are sold with ceiling fans, DOE modeled CFLK shipments based on ceiling fan shipments. DOE modeled ceiling fan shipments and the growth of ceiling fan shipments using replacements shipments of failed ceiling fan units, new construction starts as projected by *AEO 2015,* and the number of additions to existing buildings due to expanding demand throughout the analysis period. DOE then determined that 88 percent of ceiling fan shipments included a CFLK, which was used as the basis for CFLKs shipped in this analysis.

In the standards case, the change in the number of shipments is driven by changes in average CFLK price as a result of the standard. The lifetime of CFLKs is estimated to be the same as the lifetime of a ceiling fan in this analysis, and is not projected to impact the shipments of CFLKs. For a complete description of the shipments, see the shipments analysis discussion in section IV.G of this NOPR.

d. Markup Scenarios

As discussed in the previous manufacturer production costs section, the MPCs for CFLKs are the manufacturers' costs for those units. These costs include materials, labor, depreciation, and overhead, which are collectively referred to as the cost of goods sold (COGS). The MSP is the price received by CFLK manufacturers from their consumers, typically a distributor, regardless of the downstream distribution channel through which the CFLKs are ultimately sold. The MSP is not the cost the end user pays for CFLKs because there are typically multiple sales along the distribution chain and various markups applied to each sale. The MSP equals the MPC multiplied by the manufacturer markup. The manufacturer markup covers all the CFLK manufacturer's non-production costs (*i.e.,* selling, general and administrative expenses [SG&A], research and development [R&D], interest) as well as profit. Total industry revenue for CFLK manufacturers equals the MSPs at each EL multiplied by the number of shipments at that EL.

Modifying these manufacturer markups in the standards case yields a different set of impacts on CFLK manufacturers than in the no-standards case. For the MIA, DOE modeled two standards-case markup scenarios for CFLKs to represent the uncertainty regarding the potential impacts on prices and profitability for CFLK manufacturers following the implementation of amended energy conservation standards. The two scenarios are: (1) A preservation of gross margin, or flat, markup scenario; and (2) a two-tiered markup scenario. Each scenario leads to different manufacturer markup values, which, when applied to the inputted MPCs, result in varying revenue and cash-flow impacts on CFLK manufacturers.

The preservation of gross margin markup scenario assumes that the COGS for each product is marked up by a preservation of gross margin percentage to cover SG&A expenses, R&D expenses, interest expenses, and profit. This allows manufacturers to preserve the same gross margin percentage in the standards case as in the no-standards case. This markup scenario represents the upper bound of the CFLK industry's profitability in the standards case because CFLK manufacturers are able to fully pass additional costs due to standards to their consumers.

To derive the preservation of gross margin markup percentages for CFLKs, DOE examined the SEC 10-Ks of all publicly traded CFLK manufacturers to estimate the industry average gross margin percentage. Manufacturers were then asked to verify the industry gross margin percentage derived from SEC 10-Ks during manufacturer interviews.

DOE also modeled a two-tiered markup scenario, which reflects the industry's high and low efficacy product pricing structure. DOE modeled the two-tiered markup scenario because multiple manufacturers stated in interviews that they offer multiple tiers of product lines that are differentiated, in part, by efficacy level. The higher efficacy tiers typically earn premiums (for the manufacturer) over the baseline efficacy tier. Several manufacturers suggested that amended standards would lead to a reduction in premium markups and reduce the profitability of higher efficacy products. During the MIA interviews, manufacturers provided information on the range of typical ELs in those tiers and the change in profitability at each level. DOE used this information to estimate markups for CFLKs under a two-tiered pricing strategy in the no-standards case. In the standards case, DOE modeled the situation in which standards result in less product differentiation, compression of the markup tiers, and an overall reduction in profitability.

3. Discussion of Comments

Interested parties commented on the assumptions and results of the preliminary analysis. Hunter Fans stated that because CFLK manufacturers are not lamp manufacturers, if the standard requires a more efficacious LED lamp than the lamp manufacturers produce for CFLKs, the fan manufacturers would have to stop producing CFLKs. (Hunter Fans, Public Meeting Transcript, No. 82 at pp. 208–209) Westinghouse agreed, emphasizing that CFLK product development trails the development of applicable lamps. If the standard is set beyond the efficacy of commercially available lamps, CFLK manufacturers would be forced to wait, and choose between significantly redesigning existing products and exiting the market. (Westinghouse, Public Meeting Transcript, No. 82 at pp. 141–142) Westinghouse also noted that it becomes somewhat burdensome for fan manufacturers to lead the efficacy on lamps instead of lamps manufacturers as a result of a lamps rulemaking such as the ongoing GSL energy conservation standards rulemaking. (Westinghouse, Public Meeting Transcript, No. 82 at p. 192).

DOE understands that most CFLK manufacturers do not manufacture lamps but rather purchase lamps from another supplier or manufacturer. DOE has determined that the proposed TSL can be met with replacement lamps currently available on the market. See section V.C of this NOPR for more information on the selection of the proposed TSL.

4. Manufacturer Interviews

DOE conducted additional interviews with manufacturers following the preliminary analysis as part of the NOPR analysis. In these interviews, DOE asked manufacturers to describe their major concerns with this CFLK rulemaking. Manufacturers identified two major areas of concern: (1) Duplicative regulation and (2) shift to air conditioning.

a. Duplicative Regulation

Some manufacturers commented that a separate regulation specifically for CFLKs was unnecessary, as most lamps placed in CFLKs would be covered by other lighting energy conservation standards, such as the ongoing GSLs rulemaking. 78 FR 73737 (December 9, 2013). These manufacturers claimed that there would not be significant additional energy savings from separate CFLK standards.

b. Shift to Air Conditioning

Manufacturers were also concerned about a potential technology shift in the CFLK market as a result of energy conservation standards. Manufacturers stated that CFLK standards may require that more efficacious lamps be used in CFLKs, which could significantly increase the price of the overall ceiling fan. Manufacturers pointed out that this could cause consumers to choose air conditioning systems rather than ceiling fans. These manufacturers claimed that this could result in more energy use, since ceiling fans could be more efficient at cooling rooms than air conditioners.

K. Emissions Analysis

In the emissions analysis, DOE estimated the change in power sector emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and mercury (Hg) from potential energy conservation standards for CFLKs. In addition, DOE estimated emissions impacts in production activities (extracting, processing, and transporting fuels) that provide the energy inputs to power plants. These are referred to as ''upstream'' emissions. Together, these emissions account for the FFC. In accordance with DOE's FFC Statement of Policy (76 FR 51281 (August 18, 2011), as amended at 77 FR 49701 (August 17, 2012)), the FFC analysis includes impacts on emissions of methane (CH_4) and nitrous oxide (N_2O), both of which are recognized as greenhouse gases.

DOE primarily conducted the emissions analysis using emissions factors for CO_2 and most of the other gases derived from data in *AEO 2014.* Combustion emissions of CH_4 and N_2O were estimated using emissions intensity factors published by the Environmental Protection Agency (EPA) in its GHG Emissions Factors Hub.[58] DOE developed separate emissions factors for power sector emissions and upstream emissions. The method that DOE used to derive emissions factors is described in chapter 13 of the NOPR TSD.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying each ton of gas by the gas' global warming potential (GWP) over a 100-year time horizon. Based on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,[59] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

The *AEO 2014* projections incorporate the projected impacts of existing air quality regulations on emissions. *AEO 2014* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of October 31, 2013. DOE's estimation of impacts accounts for the presence of the emissions control programs discussed in the following paragraphs.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (DC). (42 U.S.C. 7651 *et seq.*) SO_2 emissions from 28 eastern states and DC were also limited under the Clean Air Interstate Rule (CAIR). 70 FR 25162 (May 12, 2005). CAIR created an allowance-based trading program that operates along with the Title IV program. In 2008, CAIR was remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit, but it remained in effect.[60] In 2011, EPA issued a replacement for CAIR, the Cross-State Air Pollution Rule (CSAPR). 76 FR 48208 (August 8, 2011). On August 21, 2012, the DC Circuit issued a decision to vacate CSAPR,[61] and the court ordered EPA to continue administering CAIR. On April 29, 2014, the U.S. Supreme Court reversed the judgment of the DC Circuit and remanded the case for further proceedings consistent with the Supreme Court's opinion.[62] On October 23, 2014, the DC Circuit lifted the stay of CSAPR.[63] Pursuant to this action, CSAPR went into effect (and CAIR ceased to be in effect) as of January 1, 2015.

Because *AEO 2014* was prepared prior to the Supreme Court's opinion, it assumed that CAIR remains a binding regulation through 2040. Thus, DOE's analysis used emissions factors that assume that CAIR, not CSAPR, is the regulation in force. However, the difference between CAIR and CSAPR is not relevant for the purpose of DOE's analysis of emissions impacts from energy conservation standards.

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the adoption of an energy conservation standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. In past rulemakings, DOE recognized that there was uncertainty about the effects of energy conservation standards on SO_2 emissions covered by the existing cap-and-trade system, but it concluded that negligible reductions in power sector SO_2 emissions would occur as a result of standards.

Beginning in 2016, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants. 77 FR 9304 (Feb. 16, 2012). In the MATS rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (HAP), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. *AEO 2014* assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2016. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, emissions will be far below the cap established by CAIR, so it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by any regulated EGU. Therefore, DOE believes that energy conservation standards will generally reduce SO_2 emissions in 2016 and beyond.

CAIR established a cap on NO_X emissions in 28 eastern states and DC.[64] Energy conservation standards are expected to have little effect on NO_X emissions in those states covered by CAIR because excess NO_X emissions allowances resulting from the lower electricity demand could be used to permit offsetting increases in NO_X emissions. However, standards would be expected to reduce NO_X emissions in the states not affected by the caps, so DOE estimated NO_X emissions reductions from the standards considered in this NOPR for these states.

[58] See *http://www.epa.gov/climateleadership/inventory/ghg-emissions.html*.

[59] IPCC, 2013: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Chapter 8.

[60] See *North Carolina* v. *EPA,* 550 F.3d 1176 (D.C. Cir. 2008); *North Carolina* v. *EPA,* 531 F.3d 896 (D.C. Cir. 2008).

[61] See *EME Homer City Generation, LP* v. *EPA,* 696 F.3d 7, 38 (D.C. Cir. 2012), *cert. granted,* 81 U.S.L.W. 3567, 81 U.S.L.W. 3696, 81 U.S.L.W. 3702 (U.S. June 24, 2013) (No. 12–1182).

[62] *See EPA* v. *EME Homer City Generation,* 134 S.Ct. 1584, 1610 (U.S. 2014). The Supreme Court held in part that EPA's methodology for quantifying emissions that must be eliminated in certain States due to their impacts in other downwind States was based on a permissible, workable, and equitable interpretation of the Clean Air Act provision that provides statutory authority for CSAPR.

[63] *See Georgia* v. *EPA,* Order *(DC. Cir. filed October 23, 2014)* (*No. 11–1302),*

[64] CSAPR also applies to NO_X and it would supersede the regulation of NO_X under CAIR. As stated previously, the current analysis assumes that CAIR, not CSAPR, is the regulation in force. The difference between CAIR and CSAPR with regard to DOE's analysis of NO_X emissions is slight.

The MATS limit mercury emissions from power plants, but they do not include emissions caps and, as such, DOE's energy conservation standards would likely reduce Hg emissions. DOE estimated mercury emissions reduction using emissions factors based on *AEO 2014,* which incorporates the MATS.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this proposed rule, DOE considered the estimated monetary benefits from the reduced emissions of CO_2 and NO_X that are expected to result from each of the TSLs considered. To make this calculation analogous to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the forecast period for each TSL. This section summarizes the basis for the monetary values used for each of these emissions and presents the values considered in this NOPR.

For this NOPR, DOE relied on a set of values for the SCC that was developed by a Federal interagency process. The basis for these values is summarized in the next section, and a more detailed description of the methodologies used is provided in appendices 14A and 14B of the NOPR TSD.

1. Social Cost of Carbon

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Estimates of the SCC are provided in dollars per metric ton of CO_2. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in CO_2 emissions, while a global SCC value is meant to reflect the value of damages worldwide.

Under section 1(b) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), agencies must, to the extent permitted by law, ''assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.'' The purpose of the SCC estimates presented here is to allow agencies to incorporate the monetized social benefits of reducing CO_2 emissions into cost-benefit analyses of regulatory actions. The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.

As part of the interagency process that developed these SCC estimates, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. The main objective of this process was to develop a range of SCC values using a defensible set of input assumptions grounded in the existing scientific and economic literatures. In this way, key uncertainties and model differences transparently and consistently inform the range of SCC estimates used in the rulemaking process.

a. Monetizing Carbon Dioxide Emissions

When attempting to assess the incremental economic impacts of CO_2 emissions, the analyst faces a number of challenges. A report from the National Research Council[65] points out that any assessment will suffer from uncertainty, speculation, and lack of information about: (1) Future emissions of GHGs; (2) the effects of past and future emissions on the climate system; (3) the impact of changes in climate on the physical and biological environment; and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise questions of science, economics, and ethics and should be viewed as provisional.

Despite the limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing CO_2 emissions. The agency can estimate the benefits from reduced (or costs from increased) emissions in any future year by multiplying the change in emissions in that year by the SCC values appropriate for that year. The NPV of the benefits can then be calculated by multiplying each of these future benefits by an appropriate discount factor and summing across all affected years.

The interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. In the meantime, the interagency group will continue to explore the issues raised by this analysis and consider public comments as part of the ongoing interagency process.

b. Development of Social Cost of Carbon Values

In 2009, an interagency process was initiated to offer a preliminary assessment of how best to quantify the benefits from reducing carbon dioxide emissions. To ensure consistency in how benefits are evaluated across Federal agencies, the Administration sought to develop a transparent and defensible method, specifically designed for the rulemaking process, to quantify avoided climate change damages from reduced CO_2 emissions. The interagency group did not undertake any original analysis. Instead, it combined SCC estimates from the existing literature to use as interim values until a more comprehensive analysis could be conducted. The outcome of the preliminary assessment by the interagency group was a set of five interim values: global SCC estimates for 2007 (in 2006$) of $55, $33, $19, $10, and $5 per metric ton of CO_2. These interim values represented the first sustained interagency effort within the U.S. government to develop an SCC for use in regulatory analysis. The results of this preliminary effort were presented in several proposed and final rules.

c. Current Approach and Key Assumptions

After the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates. Specially, the group considered public comments and further explored the technical literature in relevant fields. The interagency group relied on three integrated assessment models commonly used to estimate the SCC: the FUND, DICE, and PAGE models. These models are frequently cited in the peer-reviewed literature and were used in the last assessment of the Intergovernmental Panel on Climate Change (IPCC). Each model was given equal weight in the SCC values that were developed.

Each model takes a slightly different approach to model how changes in emissions result in changes in economic damages. A key objective of the interagency process was to enable a consistent exploration of the three models, while respecting the different approaches to quantifying damages taken by the key modelers in the field. An extensive review of the literature was conducted to select three sets of input parameters for these models:

[65] National Research Council, *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use,* National Academies Press: Washington, DC (2009).

climate sensitivity, socio-economic and emissions trajectories, and discount rates. A probability distribution for climate sensitivity was specified as an input into all three models. In addition, the interagency group used a range of scenarios for the socio-economic parameters and a range of values for the discount rate. All other model features were left unchanged, relying on the model developers' best estimates and judgments.

In 2010, the interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, was included to represent higher-than-expected impacts from climate change further out in the tails of the SCC distribution. The values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects,[66] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.11 presents the values in the 2010 interagency group report,[67] which is reproduced in appendix 14A of the NOPR TSD.

TABLE IV.11—ANNUAL SCC VALUES FROM 2010 INTERAGENCY REPORT, 2010–2050

[2007$ per metric ton CO_2]

Year	Discount rate			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

The SCC values used for this notice were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[68] Table V.12 shows the updated sets of SCC estimates from the 2013 interagency update in 5-year increments from 2010 to 2050. The full set of annual SCC estimates between 2010 and 2050 is reported in appendix 14B of the NOPR TSD. The central value that emerges is the average SCC across models at the 3-percent discount rate. However, for purposes of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance of including all four sets of SCC values.

TABLE IV.12—ANNUAL SCC VALUES FROM 2013 INTERAGENCY REPORT, 2010–2050

[2007$ per metric ton CO_2]

Year	Discount rate			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
2010	11	32	51	89
2015	11	37	57	109
2020	12	43	64	128
2025	14	47	69	143
2030	16	52	75	159
2035	19	56	80	175
2040	21	61	86	191
2045	24	66	92	206
2050	26	71	97	220

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable because they will evolve with improved scientific and economic understanding.

[66] It is recognized that this calculation for domestic values is approximate, provisional, and highly speculative. There is no *a priori* reason why domestic benefits should be a constant fraction of net global damages over time.

[67] *Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.* Interagency Working Group on Social Cost of Carbon, U.S. Government (February 2010) (Available at: *www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf*).

[68] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* Interagency Working Group on Social Cost of Carbon, U.S. Government (May 2013; revised November 2013) (Available at: *http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf*).

The interagency group also recognizes that the existing models are imperfect and incomplete. The National Research Council report mentioned previously points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of analytical challenges that are being addressed by the research community, including research programs housed in many of the Federal agencies participating in the interagency process to estimate the SCC. The interagency group intends to periodically review and reconsider those estimates to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report adjusted to 2014$ using the implicit price deflator for gross domestic product (GDP) from the Bureau of Economic Analysis. For each of the four sets of SCC cases specified, the values for emissions in 2015 were $12.2, $41.2, $63.4, and $121 per metric ton avoided (values expressed in 2014$). DOE derived values after 2050 using the relevant growth rates for the 2040–2050 period in the interagency update.

DOE multiplied the CO_2 emissions reduction estimated for each year by the SCC value for that year in each of the four cases. To calculate a present value of the stream of monetary values, DOE discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SCC values in each case.

2. Social Cost of Other Air Pollutants

As noted previously, DOE has estimated how the considered energy conservation standards would reduce site NO_X emissions nationwide and decrease power sector NO_X emissions in those 22 states not affected by the CAIR. DOE estimated the monetized value of net NO_X emissions reductions resulting from each of the TSLs considered for this NOPR based on estimates developed by EPA for 2016, 2020, 2025, and 2030.[69] The values reflect estimated mortality and morbidity per ton of directly emitted NO_X reduced by electricity generating units. EPA developed estimates using a 3-percent and a 7-percent discount rate to discount future emissions-related costs. The values in 2016 are $5,562/ton using a 3-percent discount rate and $4,920/ton using a 7-percent discount rate (2014$). DOE extrapolated values after 2030 using the average annual rate of growth in 2016–2030. DOE multiplied the emissions reduction (tons) in each year by the associated $/ton values, and then discounted each series using discount rates of 3 percent and 7 percent as appropriate.

DOE is evaluating appropriate monetization of avoided SO_2 and Hg emissions in energy conservation standards rulemakings. DOE has not included monetization of those emissions in the current analysis.

M. Utility Impact Analysis

The utility impact analysis estimates several effects on the electric power industry that would result from the adoption of new or amended energy conservation standards. The utility impact analysis estimates the changes in installed electrical capacity and generation that would result for each TSL. The analysis is based on published output from NEMS, which is updated annually to produce the *AEO* reference case, as well as a number of side cases that estimate the economy-wide impacts of changes to energy supply and demand. DOE uses published side cases that incorporate efficiency-related policies to estimate the marginal impacts of reduced energy demand on the utility sector. The output of this analysis is a set of time-dependent coefficients that capture the change in electricity generation, primary fuel consumption, installed capacity and power sector emissions due to a unit reduction in demand for a given end use. These coefficients are multiplied by the stream of electricity savings calculated in the NIA to provide estimates of selected utility impacts of new or amended energy conservation standards. Chapter 15 of the NOPR TSD describes the utility impact analysis in further detail.

N. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in selecting a proposed standard. Employment impacts from new or amended energy conservation standards include both direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the products subject to standards, their suppliers, and related service firms. The MIA addresses those impacts (see section V.B.2.b). Indirect employment impacts are changes in national employment that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more-efficient appliances. Indirect employment impacts from standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, caused by: (1) Reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased consumer spending on new products to which the new standards apply; and (4) the effects of those three factors throughout the economy.

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sector employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS).[70] BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy.[71] There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less labor-intensive than other sectors. Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of energy conservation standards is to shift economic activity from a less labor-intensive sector (*i.e.,* the utility sector) to more labor-intensive sectors (*e.g.,* the retail and service sectors). Thus, based on the BLS data alone, DOE believes net national employment may increase due to shifts in economic activity resulting from energy conservation standards.

DOE estimated indirect national employment impacts for the standard levels considered in this NOPR using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 3.1.1 (ImSET).[72]

[69] *http://www2.epa.gov/benmap/sector-based-pm25-benefit-ton-estimates.*

[70] Data on industry employment, hours, labor compensation, value of production, and the implicit price deflator for output for these industries are available upon request by calling the Division of Industry Productivity Studies (202–691–5618) or by sending a request by email to *dipsweb@bls.gov.*

[71] See Bureau of Economic Analysis, *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II),* U.S. Department of Commerce (1992).

[72] J. M. Roop, M. J. Scott, and R. W. Schultz, *ImSET 3.1: Impact of Sector Energy Technologies,* PNNL–18412, Pacific Northwest National

Continued

ImSET is a special-purpose version of the ''U.S. Benchmark National Input-Output'' (I–O) model, which was designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model having structural coefficients that characterize economic flows among 187 sectors most relevant to industrial, commercial, and residential building energy use.

DOE notes that ImSET is not a general equilibrium forecasting model, and understands the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run for this rule. Therefore, DOE generated results for near-term timeframes, where these uncertainties are reduced. For more details on the employment impact analysis, see chapter 16 of the NOPR TSD.

V. Analytical Results

The following section addresses the results from DOE's analyses with respect to potential amended energy conservation standards for CFLKs. It addresses the TSLs examined by DOE and the projected impacts of each of these levels if adopted as energy conservation standards for CFLKs. Additional details regarding DOE's analyses are contained in the NOPR TSD supporting this notice.

A. Trial Standard Levels

DOE analyzed the benefits and burdens of four TSLs for CFLKs. These TSLs were developed using the ELs for the product class analyzed by DOE. DOE presents the results for those TSLs in this rule. The results for all ELs that DOE analyzed are in the NOPR TSD. Table V.1 presents the TSLs and the corresponding ELs for CFLKs. TSL 4 represents the maximum technologically feasible (''max-tech'') improvements in energy efficiency for the CFLK product class.

TABLE V.1—CFLK TRIAL STANDARD LEVELS

All CFLKs efficacy level	Trial standard level
1	1
2	2
3	3
4	4

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

DOE analyzed the economic impacts on CFLK consumers by looking at the effects potential amended standards at each TSL would have on the LCC and PBP. DOE also examined the impacts of potential standards on consumer subgroups. These analyses are discussed below.

a. Life-Cycle Cost and Payback Period

In general, higher-efficiency products affect consumers in two ways: (1) Purchase price increases, and (2) annual operating costs decrease. In the case of CFLKs, however, DOE projects that higher-efficiency CFLKs will have a lower purchase price than less efficient products. Inputs used for calculating the LCC and PBP include total installed costs (*i.e.,* product price plus installation costs), and operating costs (*i.e.,* annual energy use, energy prices, energy price trends, repair costs, and maintenance costs). The LCC calculation also uses product lifetime and a discount rate. Chapter 8 of the NOPR TSD provides detailed information on the LCC and PBP analyses.

Table V.2 and Table V.3 show the LCC and PBP results for the TSL efficacy levels considered for the All CFLKs product class. In the first table, the simple payback is measured relative to the least efficient product on the market. In the second table, the LCC savings are measured relative to the no-standards efficacy distribution in the compliance year (see section IV.F.10 of this notice).

TABLE V.2—AVERAGE LCC AND PBP RESULTS BY EFFICACY LEVEL FOR ALL CFLKS

EL	Average costs 2014$				Simple payback years	Average lifetime years
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
Residential Sector						
Sub*	2.8	17.4	70.3	71.3		13.8
0	5.5	3.6	40.4	45.6	0.2	13.8
1	8.8	3.4	40.0	48.4	0.4	13.8
2	19.4	2.9	33.4	51.8	1.2	13.8
3	10.5	2.0	23.4	32.8	0.5	13.8
4	9.3	1.9	22.0	30.3	0.4	13.8
Commercial Sector						
Sub*	2.8	76.9	194.5	196.7		13.8
0	5.5	15.8	136.9	142.9	0.0	13.8
1	8.8	14.9	157.2	167.3	0.1	13.8
2	19.4	12.8	140.8	160.6	0.3	13.8
3	10.5	9.0	107.7	117.8	0.1	13.8
4	9.3	8.5	104.9	113.8	0.1	13.8

* ''Sub'' corresponds to the sub-baseline (*i.e.,* lamps which have efficacies below the baseline set for the new product class structure proposed in this rulemaking).

Laboratory (2009) (Available at: *www.pnl.gov/main/publications/external/technical_reports/PNNL–18412.pdf*).

Note: The results for each EL are calculated assuming that all consumers use products at that efficacy level. The PBP is measured relative to the least efficient product currently available on the market.

TABLE V.3—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS-CASE EFFICACY DISTRIBUTION FOR ALL CFLKS

TSL	Life-cycle cost savings	
	% of consumers that experience	Average savings *
	Net cost	2014$
Residential Sector		
	0.6	23.0
1	0.6	23.0
2	9.7	24.3
3	7.6	30.9
4	7.6	30.9
Commercial Sector		
	10.5	28.7
1	10.5	28.7
2	1.9	53.4
3	0.3	67.7
4	0.3	67.8

Note: The results for each TSL represent the impact of a standard set at that TSL, based on the no-standards-case and standards-case efficacy distributions calculated in the shipments analysis. The calculation excludes consumers with zero LCC savings (no impact).

b. Consumer Subgroup Analysis

In the consumer subgroup analysis, DOE estimated the impact of the considered TSLs on low-income households and small businesses. Table V.4 and Table V.5 compare the average LCC savings for each TSL and the simple PBP at each efficacy level for the two consumer subgroups to the average LCC savings and the simple PBP for the entire sample. In most cases, the average LCC savings and the simple PBP for low-income households and small businesses are not substantially different from the average LCC savings and simple PBP for all households and all buildings, respectively. Chapter 11 of the NOPR TSD presents the complete LCC and PBP results for the subgroups.

TABLE V.4—COMPARISON OF LCC SAVINGS AND PBP FOR LOW-INCOME HOUSEHOLDS AND ALL HOUSEHOLDS

TSL	Average LCC savings (2014$)		Simple payback period (years)	
	All	Low-income	All	Low-income
	23.0	23.0	0.2	0.2
1	23.0	23.0	0.4	0.4
2	24.3	24.1	1.2	1.2
3	30.9	30.6	0.5	0.5
4	30.9	30.7	0.4	0.4

TABLE V.5—COMPARISON OF LCC SAVINGS AND PBP FOR SMALL BUSINESSES AND ALL BUILDINGS

TSL	Average LCC savings (2014$)		Simple payback period (years)	
	All	Small businesses	All	Small businesses
	28.7	31.7	0.0	0.0
1	28.7	31.7	0.1	0.1
2	53.4	51.9	0.3	0.3
3	67.7	65.4	0.1	0.1
4	67.8	65.5	0.1	0.1

c. Rebuttable-Presumption Payback

As discussed in section IV.F.11, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for a product that meets the standard is less than three times the value of the first year's energy savings resulting from the standard. DOE expresses this criterion as having a simple payback period of less than three years. In calculating a rebuttable-presumption payback period for each of the considered TSLs, DOE based the energy use calculation on DOE test procedures for CFLKs,[73] as required by EPCA. Table V.6 shows the results of this analysis for the considered TSLs.

TABLE V.6—REBUTTABLE-PRESUMPTION PAYBACK PERIOD RESULTS

TSL	Residential sector	Commercial sector
	0.2	0.4
1	0.4	0.1
2	1.1	0.2
3	0.5	0.1
4	0.4	0.1

While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for this rule are economically justified through a more detailed analysis of the economic impacts of those levels, pursuant to 42 U.S.C. 6295(o)(2)(B)(i), that considers the full range of impacts to the consumer, manufacturer, nation, and environment. The results of that analysis serve as the basis for DOE to evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification.

2. Economic Impacts on Manufacturers

DOE performed an MIA to estimate the impact of amended energy conservation standards on manufacturers of CFLKs. The section below describes the expected impacts on manufacturers at each TSL. Chapter 12 of the NOPR TSD explains the analysis in further detail.

a. Industry Cash-Flow Analysis Results

Table V.7 and Table V.8 present the financial impacts (represented by changes in INPV) of proposed standards on CFLK manufacturers as well as the conversion costs that DOE estimates CFLK manufacturers would incur at each TSL. To evaluate the range of cash-flow impacts on the CFLK industry, DOE modeled two markup scenarios that correspond to the range of anticipated market responses to amended standards. Each scenario results in a unique set of cash flows and corresponding industry values at each TSL.

In the following discussion, the INPV results refer to the difference in industry value between the no-standards case and the standards case that result from the sum of discounted cash flows from the base year (2015) through the end of the analysis period (2048). The results also discuss the difference in cash flows between the no-standards case and the standards case in the year before the compliance date for proposed standards. This difference in cash flow represents the size of the required conversion costs relative to the cash flow generated by the CFLK industry in the absence of amended energy conservation standards.

To assess the upper (less severe) end of the range of potential impacts on CFLK manufacturers, DOE modeled a preservation of gross margin, or flat, markup scenario. This scenario assumes that in the standards case, manufacturers would be able to pass along all the higher production costs required for more efficacious products to their consumers. Specifically, the industry would be able to maintain its average no-standards-case gross margin (as a percentage of revenue) despite the higher product costs in the standards-case. In general, the larger the product price increases, the less likely manufacturers are to achieve the cash flow from operations calculated in this scenario because it is less likely that manufacturers would be able to fully mark up these larger cost increases.

To assess the lower (more severe) end of the range of potential impacts on the CFLK manufacturers, DOE modeled a two-tiered markup scenario. This scenario represents the lower end of the range of potential impacts on manufacturers because manufacturers reduce profit margins on high efficacy products as these products become the baseline, higher volume product.

TABLE V.7—MANUFACTURER IMPACT ANALYSIS FOR CEILING FAN LIGHT KITS—PRESERVATION OF GROSS MARGIN MARKUP SCENARIO

	Units	No-standards case	Trial standard levels			
			1	2	3	4
INPV	*(2014$ millions)*	94.8	98.9	96.8	92.1	91.9
Change in INPV	*(2014$ millions)*		4.1	2.1	(2.6)	(2.8)
	(%)		4.3	2.2	(2.8)	(3.0)
Product Conversion Costs	*(2014$ millions)*			0.6	0.8	0.8
Capital Conversion Costs	*(2014$ millions)*			1.4	1.7	1.8
Total Conversion Costs	*(2014$ millions)*			1.9	2.5	2.6

[73] Specifically, DOE used the CFLK test procedures as proposed in the CFLK TP NOPR. 79 FR 64688 (Oct. 31, 2014).

TABLE V.8—MANUFACTURER IMPACT ANALYSIS FOR CEILING FAN LIGHT KITS—TWO-TIERED MARKUP SCENARIO

	Units	No-standards case	Trial standard level			
			1	2	3	4
INPV	*(2014$ millions)*	94.8	97.9	86.8	74.9	74.7
Change in INPV	*(2014$ millions)*		3.1	(7.9)	(19.9)	(20.0)
	(%)		3.3	(8.4)	(21.0)	(21.1)
Product Conversion Costs	*(2014$ millions)*			0.6	0.8	0.8
Capital Conversion Costs	*(2014$ millions)*			1.4	1.7	1.8
Total Conversion Costs	*(2014$ millions)*			1.9	2.5	2.6

TSL 1 sets the efficacy level at EL 1 for all CFLKs. At TSL 1, DOE estimates impacts on INPV range from $3.1 million to $4.1 million, or a change in INPV of 3.3 percent to 4.3 percent. At TSL 1, industry free cash flow (operating cash flow minus capital expenditures) is expected to remain constant at $5.0 million, which is the same as the no-standards-case value in 2018, the year leading up to the standard.

Percentage impacts on INPV are slightly positive at TSL 1. DOE anticipates that most manufacturers would not lose any of their INPV at this TSL. DOE estimates that 100 percent of shipments will meet the efficacy standards at TSL 1 in 2019, the expected compliance year of the standard. Since none of the shipments are required to be converted at this efficacy level, DOE projects that there will be no conversion costs at this TSL.

At TSL 1, the shipment-weighted average MPC decreases by 9 percent relative to the no-standards-case MPC in 2019, the expected year of compliance. Manufacturers are able to maintain their manufacturer markups in both the preservation of gross margin and the two-tiered markup scenarios, resulting in slightly positive INPV impacts at TSL 1.

TSL 2 sets the efficacy level at EL 2 for all CFLKs. At TSL 2, DOE estimates impacts on INPV range from −$7.9 million to $2.1 million, or a change in INPV of −8.4 percent to 2.2 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 15 percent to $4.2 million, compared to the no-standards-case value of $5.0 million in 2018, the year leading up to the proposed standard.

Percentage impacts on INPV range from slightly negative to slightly positive at TSL 2. DOE anticipates that most manufacturers would not lose a significant portion of their INPV at TSL 2 because the ELs at this TSL can be met by purchasing replacement lamps that are currently available on the market. DOE projects that in 2019, 40 percent of all CFLK shipments would meet or exceed the efficacy level required at TSL 2.

For each of TSLs 2–4, DOE expects that most manufacturers will not incur any conversion costs in the lamp replacement scenario. In addition, as ELs rise with each TSL, product conversion costs will increase incrementally in proportion with the increasing amount of R&D needed to design more efficacious CFLKs in the light kit replacement scenario. Manufacturers will also incur capital conversion costs driven by retooling costs associated with producing fixtures using LEDs.

For TSL 2, DOE expects that product conversion costs will rise from zero at TSL 1 to $0.6 million in the light kit replacement scenario. Manufacturers will incur product conversion costs, primarily driven by increased R&D efforts needed to redesign CFLKs to use LED lamps that meet the ELs, at TSL 2. Capital conversion costs will increase from zero at TSL 1 to $1.4 million at TSL 2 in the light kit replacement scenario.

At TSL 2, under the preservation of gross margin markup scenario, the shipment-weighted average MPC increases by 27 percent relative to the no-standards-case MPC in 2019. In this scenario, INPV impacts are slightly negative because the higher production costs are outweighed by the $1.9 million in conversion costs. Under the two-tiered markup scenario, the 27 percent MPC increase is slightly outweighed by a lower average markup of 1.35 (compared to the preservation of gross margin markup of 1.37) and $1.9 million in conversion costs, resulting in slightly negative impacts at TSL 2.

TSL 3 sets the efficacy level at EL 3 for all CFLKs. At TSL 3, DOE estimates impacts on INPV range from −$19.9 million to −$2.6 million, or a change in INPV of −21.0 percent to −2.8 percent. At this level, industry free cash flow is estimated to decrease by approximately 20 percent to $4.0 million, compared to the no-standards-case value of $5.0 million in 2018.

Percentage impacts on INPV range from moderately negative to slightly negative at TSL 3. TSL 3 proposes the first efficacy level that will require manufacturers to use LED lamps, as CFLs are currently not capable of meeting the ELs required at TSL 3. DOE projects that in 2019, 17 percent of all CFLKs shipments would meet or exceed the ELs at TSL 3.

At TSL 3, DOE estimates manufacturers will incur product conversion costs of $0.8 million in the light kit replacement scenario. Product conversion costs are driven primarily by increased R&D efforts needed to redesign CFLKs to accommodate the more efficacious LEDs. Manufacturers are estimated to incur $1.7 million in capital conversion costs as a result of retooling costs necessary to produce redesigned CFLK fixtures that use LEDs TSL 3.

At TSL 3, under the preservation of gross margin markup scenario, the shipment-weighted average MPC increases by 1 percent relative to the no-standards-case MPC in 2019. In this scenario, INPV impacts are slightly negative because the slightly higher production costs are outweighed by the $2.5 million in conversion costs. Under the two-tiered markup scenario, the 1 percent MPC increase is moderately outweighed by a lower average markup of 1.35 (compared to the preservation of gross margin markup scenario markup of 1.37) and $2.5 million in conversion costs, resulting in moderately negative impacts at TSL 3.

TSL 4 sets the efficacy level at max-tech, EL 4, for all CFLKs. At TSL 4, DOE estimates impacts on INPV to range from −$20.0 million to −$2.8 million, or a change in INPV of −21.1 percent to −3.0 percent. At this level, industry free cash flow is estimated to decrease by approximately 21 percent to $4.0 million, compared to the no-standards-case value of $5.0 million in 2018.

Percentage impacts on INPV are slightly negative to moderately negative at TSL 4. DOE projects that in 2019, 9 percent of all CFLK shipments would meet or exceed the ELs at TSL 4.

DOE expects total conversion costs in the light kit replacement scenario to increase from $2.5 million at TSL 3 to $2.6 million at TSL 4. DOE estimates manufacturers will incur product conversion costs of $0.8 million as they allocate more capital to R&D efforts necessary to redesign CFLKs that meet max-tech ELs. DOE estimates that manufacturers will incur $1.8 million in capital conversion costs due to retooling costs associated with the high number of models that will be redesigned in the light kit replacement scenario at TSL 4.

At TSL 4, under the preservation of gross margin markup scenario, the shipment-weighted average MPC increases by 1 percent relative to the no-standards-case MPC in 2019. In this scenario, the INPV impacts are slightly negative because the slightly higher production costs are outweighed by $2.6 million in conversion costs. Under the two-tiered markup scenario, the 1 percent MPC increase is outweighed by a lower average markup of 1.35 (compared to the preservation of gross margin markup scenario markup of 1.37) and $2.6 million in conversion costs, resulting in moderately negative impacts at TSL 4.

b. Impacts on Employment

DOE determined that there was only one CFLK manufacturer with domestic production of CFLKs, and this manufacturer's sales of ceiling fans packaged with CFLKs represents a very small portion of their overall revenue. During manufacturer interviews, manufacturers stated that the vast majority of manufacturing of the CFLKs they sell is outsourced to original equipment manufacturers located abroad. These original equipment manufacturers produce CFLKs based on designs from domestic CFLK manufacturers. Because of this feedback, DOE did not quantitatively assess any potential impacts on domestic production employment as a result of amended energy conservation standards on CFLKs. DOE seeks comment on the assumption that there is only one CFLK manufacturer with domestic production. Additionally, DOE seeks comment on any potential domestic employment impacts as a result of amended energy conservation standards for CFLKs.

c. Impacts on Manufacturing Capacity

CFLK manufacturers stated that they did not anticipate manufacturing capacity constraints as a result of an amended energy conservation standard. If manufacturers choose to redesign their CFLK fixtures to comply with amended standards, the original equipment manufacturers of CFLKs would be able to make the changes necessary to comply with standards in the estimated three years from the publication of the final rule to the compliance date. Additionally, at the proposed standard, manufacturers have a range of options to comply with standards for a significant portion of the CFLKs by replacing the lamps with existing products that are sold on the market today. DOE does not anticipate any impact on the manufacturing capacity at the proposed amended energy conservation standards in this NOPR. See section V.C.1 for more details on the proposed standard. DOE seeks comment on any potential impact on manufacturing capacity at the efficacy level proposed in this NOPR.

d. Impacts on Subgroups of Manufacturers

Using average cost assumptions to develop an industry cash-flow estimate may not be adequate for assessing differential impacts among manufacturer subgroups. Small manufacturers, niche product manufacturers, and manufacturers exhibiting cost structures substantially different from the industry average could be affected disproportionately. DOE identified only one manufacturer subgroup that would require a separate analysis in the MIA because it is a small business. DOE analyzes the impacts on small businesses in a separate analysis in section VI.B of this NOPR. DOE did not identify any other adversely impacted manufacturer subgroups for CFLKs for this rulemaking based on the results of the industry characterization. DOE seeks comment on any other potential manufacturer subgroups that could be disproportionally impacted by amended energy conservation standards for CFLKs.

e. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of recent or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. Multiple regulations affecting the same manufacturer can strain profits and lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts a cumulative regulatory burden analysis as part of its rulemakings for CFLKs.

DOE identified a number of requirements, in addition to amended energy conservation standards for CFLKs, that CFLK manufacturers will face for products they manufacture approximately three years prior to and three years after the estimated compliance date of these amended standards. The following section addresses key related concerns that manufacturers raised during interviews regarding cumulative regulatory burden.

Manufacturers raised concerns about existing regulations and certifications separate from DOE's energy conservation standards that CFLK manufacturers must meet. These include California Title 20, which has energy conservation standards identical to DOE's existing CFLK standards, but requires an additional certification, and Interstate Mercury Education and Reduction Clearinghouse (IMERC) labeling requirements, among others.

DOE discusses these and other requirements in chapter 12 of the NOPR TSD, which lists the estimated compliance costs of those requirements when available. In considering the cumulative regulatory burden, DOE evaluates the timing of regulations that impact the same product because the coincident requirements could strain financial resources in the same profit center and consequently impact capacity. DOE identified the upcoming ceiling fan standards rulemaking and the GSLs standards rulemaking, as well as the 45 lm/W standard for GSLs in 2020, as potential sources of additional cumulative regulatory burden on CFLK manufacturers.

DOE has initiated a rulemaking to evaluate the energy conservation standards of ceiling fans by publishing a notices of availability for a framework document (78 FR 16443; Mar. 15, 2013) and preliminary analysis TSD (79 FR 64712; Oct. 31, 2014), hereafter the ''CF standards rulemaking.'' The CF standards rulemaking affects the same set of manufacturers as the proposed amended CFLK standard and has a similar projected compliance date. Due to these similar projected compliance dates, manufacturers could potentially be required to make investments to bring CFLKs and ceiling fans into compliance during the same time period. Additionally, redesigned CFLKs could also require adjustments to ceiling fan redesigns separate from those potentially required by the ceiling fan rule.

DOE has initiated a rulemaking to evaluate the energy conservation standards of GSLs by publishing notices of availability for a framework document (78 FR 73737; Dec. 9, 2013) and preliminary analysis TSD (79 FR 73503; Dec. 11, 2014), hereafter the ''GSL standards rulemaking.'' In addition, if standards from the GSL standards rulemaking do not produce savings greater than or equal to the savings from a minimum efficacy standard of 45 lm/W, sales of GSLs that do not meet the minimum 45 lm/W standard would be prohibited as of January 1, 2020. (42 U.S.C. 6295(i)(6)(A)(v)) Any potential standards established by the GSL rulemaking are also projected to require compliance in 2020. Potential standards promulgated from the GSL standards rulemaking and/or the enactment of the GSL 45 lm/W provision will impact GSLs available to be packaged with CFLKs. Therefore, regardless of the standards proposed in this rulemaking, CFLK manufacturers will likely need to package more efficacious lamps with CFLKs.

In addition to the proposed amended energy conservation standards on CFLKs, several other existing and pending Federal regulations may apply to other products produced by lamp manufacturers and may subsequently impact CFLK manufacturers. These lighting regulations include the finalized metal halide lamp fixture standards (79 FR 7745 [Feb. 10, 2014]), the finalized general service fluorescent lamp standards (80 FR 4041 [Jan. 26, 2015]), and the ongoing high-impact discharge lamp standards (77 FR 18963 [Feb. 28, 2012]). DOE acknowledges that each regulation can impact a manufacturer's financial operations. Multiple regulations affecting the same manufacturer can strain manufacturers' profit and possibly cause them to exit particular markets. Table V.9 lists the other DOE energy conservation standards that could also affect CFLK manufacturers in the three years leading up to and after the estimated compliance date of amended energy conservation standards for these products.

TABLE V.9—OTHER DOE REGULATIONS POTENTIALLY AFFECTING CFLK MANUFACTURERS

Regulation	Approximate compliance date	Estimated industry total conversion expenses
Metal Halide Lamp Fixtures	2017	$25 million (2012$).[74]
General Service Fluorescent Lamps	2018	$26.6 million (203$).[75]
HID Lamps	* 2018	N/A.†
Ceiling Fans	* 2019	N/A.†
General Service Lamps	* 2019	N/A.†
Candelabra-Base Incandescent Lamps and Intermediate-Base Incandescent Lamps.	β N/A	N/A.†
Other Incandescent Reflector Lamps	β N/A	N/A.†

* The dates listed are an approximation. The exact dates are pending final DOE action.

† For energy conservation standards for rulemakings awaiting DOE final action, DOE does not have a finalized estimated total industry conversion cost.

β These rulemakings are placed on hold due to the Consolidated and Further Continuing Appropriations Act, 2015 (Public Law 113–235, Dec. 16, 2014).

Note: For minimum performance requirements prescribed by the Energy Independence and Security Act of 2007 (EISA 2007), DOE did not estimate total industry conversion costs because an MIA was not completed as part of the final rule codifying these statutorily-prescribed standards.

DOE did not receive any data on other regulatory costs that affect the industry modeled in the cash-flow analysis. To the extent DOE receives specific costs associated with other regulations affecting the CFLK profit centers modeled in the GRIM, DOE will incorporate that information, as appropriate, into its cash-flow analysis. DOE seeks comment on the compliance costs of any other regulations on products that CFLK manufacturers also manufacture, especially if compliance with those regulations is required three years before or after the estimated compliance date of this proposed standard.

3. National Impact Analysis

a. Significance of Energy Savings

To estimate the energy savings attributable to potential standards for CFLKs, DOE compared the energy consumption of those products under the no-standards case to their anticipated energy consumption under each TSL. The savings are measured over the entire lifetime of products purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2019–2048). Table V.10 presents DOE's projections of the NES for each TSL considered for CFLKs. The savings were calculated using the approach described in section IV.H of this notice.

TABLE V.10—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CFLKS SHIPPED IN 2019–2048

	Trial standard level (quads)			
	1	2	3	4
Primary Energy	0.0080	0.047	0.065	0.066
FFC Energy	0.0083	0.049	0.068	0.069

[74] Estimated industry conversion expenses were published in the TSD for the February 2014 Metal Halide Lamp Fixtures final rule. 79 FR 7745 The TSD for the 2014 Metal Halide Lamp Fixture final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/16*.

[75] Estimated industry conversion expenses were published in the TSD for the January 2015 general service fluorescent lamps final rule. 80 FR 4042 The TSD for the 2015 general service fluorescent lamps final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/24*.

OMB Circular A–4 [76] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A–4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using nine, rather than 30, years of product shipments. The choice of a nine-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[77] The review timeframe established in EPCA is generally not synchronized with the product lifetime, product manufacturing cycles, or other factors specific to CFLKs. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES sensitivity analysis results based on a nine-year analytical period are presented in Table V.11. The impacts are counted over the lifetime of CFLKs purchased in 2019–2027.

TABLE V.11—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CFLKS; NINE YEARS OF SHIPMENTS [2019–2027]

	Trial standard level (quads)			
	1	2	3	4
Primary Energy	0.0080	0.047	0.063	0.064
FFC Energy	0.0083	0.049	0.066	0.067

b. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV of the total costs and savings for consumers that would result from the TSLs considered for CFLKs. In accordance with OMB's guidelines on regulatory analysis,[78] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate.

Table V.12 shows the consumer NPV results with impacts counted over the lifetime of products purchased in 2019–2048.

TABLE V.12—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CFLKS SHIPPED IN 2019–2048

Discount rate	Trial standard level (billion 2014$)			
	1	2	3	4
3%	0.21	0.66	0.95	0.97
7%	0.21	0.50	0.70	0.71

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.13. The impacts are counted over the lifetime of products purchased in 2019–2027. As mentioned previously, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology or decision criteria.

TABLE V.13—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CFLKS; NINE YEARS OF SHIPMENTS [2019–2027]

Discount rate	Trial standard level (billion 2014$)			
	1	2	3	4
3%	0.21	0.66	0.92	0.93
7%t	0.21	0.50	0.68	0.69

The above results reflect the use of a default trend to estimate the change in price for CFLKs over the analysis period (see section IV.G of this document). DOE also conducted a sensitivity analysis that considered a higher rate of price decline than the reference case. The results of these alternative cases are presented in appendix 10C of the NOPR TSD. In the high-price-decline case, the NPV is lower than in the default case. This is due the faster adoption of LED

[76] U.S. Office of Management and Budget, ''Circular A–4: Regulatory Analysis'' (Sept. 17, 2003) (Available at: *http://www.whitehouse.gov/omb/circulars_a004_a-4/*).

[77] Section 325(m) of EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6 year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some consumer products, the compliance period is 5 years rather than 3 years.

[78] U.S. Office of Management and Budget, ''Circular A–4: Regulatory Analysis,'' section E, (Sept. 17, 2003) (Available at: *http://www.whitehouse.gov/omb/circulars_a004_a-4/*).

CFLKs in the no-standards case which results in consumers moving to CFLKs that already meet or exceed potential standards. Therefore in this scenario, setting a standard does not move as many consumers to a higher efficacy level, resulting in lower energy savings from the standard.

c. Indirect Impacts on Employment

DOE expects energy conservation standards for CFLKs to reduce energy bills for consumers of those products, with the resulting net savings being redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.N of this document, DOE used an input/output model of the U.S. economy to estimate indirect employment impacts of the TSLs that DOE considered in this rulemaking. DOE understands that there are uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Therefore, DOE generated results for near-term timeframes (2019–2024), where these uncertainties are reduced.

The results suggest that the proposed standards are likely to have a negligible impact on the net demand for labor in the economy. The net change in jobs is so small that it would be imperceptible in national labor statistics and might be offset by other, unanticipated effects on employment. Chapter 16 of the NOPR TSD presents detailed results regarding anticipated indirect employment impacts.

4. Impact on Utility or Performance of Products

DOE has tentatively concluded that the standards proposed in this NOPR would not reduce the utility or performance of the CFLKs under consideration in this rulemaking. Manufacturers of these products currently offer units that meet or exceed the proposed standards.

5. Impact of Any Lessening of Competition

DOE has considered any lessening of competition that is likely to result from the proposed standards. The Attorney General determines the impact, if any, of any lessening of competition likely to result from a proposed standard, and transmits such determination in writing to the Secretary, together with an analysis of the nature and extent of such impact.

To assist the Attorney General in making such determination, DOE has provided DOJ with copies of this NOPR and the accompanying TSD for review. DOE will consider DOJ's comments on the proposed rule in determining whether to proceed to a final rule. DOE will publish and respond to DOJ's comments in that document.

6. Need of the Nation To Conserve Energy

Enhanced energy efficiency, where economically justified, improves the nation's energy security, strengthens the economy, and reduces the environmental impacts (costs) of energy production. Reduced electricity demand due to energy conservation standards is also likely to reduce the cost of maintaining the reliability of the electricity system, particularly during peak-load periods. As a measure of this reduced demand, chapter 15 of the NOPR TSD presents the estimated impact on generating capacity, relative to the no-standards case, for the TSLs that DOE considered in this rulemaking.

Energy savings from amended standards for CFLKs are expected to yield environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases. Table V.14 provides DOE's estimate of cumulative emissions reductions expected to result from the TSLs considered in this rulemaking. The table includes both power sector emissions and upstream emissions. The emissions were calculated using the multipliers discussed in section IV.K. DOE reports annual emissions reductions for each TSL in chapter 13 of the NOPR TSD.

TABLE V.14—CUMULATIVE EMISSIONS REDUCTION FOR CFLKS SHIPPED IN 2019–2048

	Trial standard level			
	1	2	3	4
Power Sector Emissions				
CO_2 (*million metric tons*)	0.65	3.21	4.40	4.49
SO_2 (*thousand tons*)	0.95	3.46	4.58	4.66
NO_X (*thousand tons*)	0.67	2.79	3.76	3.83
Hg (*tons*)	0.00	0.01	0.01	0.01
CH_4 (*thousand tons*)	0.04	0.25	0.35	0.36
N_2O (thousand tons)	0.01	0.04	0.05	0.05
Upstream Emissions				
CO_2 (*million metric tons*)	0.02	0.13	0.19	0.20
SO_2 (*thousand tons*)	0.00	0.03	0.04	0.04
NO_X (*thousand tons*)	0.21	1.88	2.69	2.76
Hg (*tons*)	0.00	0.00	0.00	0.00
CH_4 (*thousand tons*)	1.25	10.9	15.7	16.1
N_2O (thousand tons)	0.00	0.00	0.00	0.00
Total FFC Emissions				
CO_2 (*million metric tons*)	0.67	3.35	4.59	4.68
SO_2 (*thousand tons*)	0.96	3.48	4.62	4.70
NO_X (*thousand tons*)	0.88	4.67	6.45	6.59
Hg (*tons*)	0.00	0.01	0.01	0.01
CH_4 (*thousand tons*)	1.28	11.20	16.04	16.43
CH_4 (thousand tons CO_2eq) *	35.9	314	449	460
N_2O (thousand tons)	0.01	0.04	0.05	0.05

TABLE V.14—CUMULATIVE EMISSIONS REDUCTION FOR CFLKS SHIPPED IN 2019–2048—Continued

	Trial standard level			
	1	2	3	4
N_2O (*thousand tons CO_2eq*) *	1.39	9.87	13.93	14.25

* CO_2eq is the quantity of CO_2 that would have the same GWP.

As part of the analysis for this proposed rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the considered TSLs for CFLKs. As discussed in section IV.L of this notice, for CO_2, DOE used the most recent values for the SCC developed by an interagency process. The four sets of SCC values for CO_2 emissions reductions in 2015 resulting from that process (expressed in 2014$) are represented by $12.2/metric ton (the average value from a distribution that uses a 5-percent discount rate), $41.2/metric ton (the average value from a distribution that uses a 3-percent discount rate), $63.4/metric ton (the average value from a distribution that uses a 2.5-percent discount rate), and $121/metric ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). The values for later years are higher due to increasing damages (public health, economic and environmental) as the projected magnitude of climate change increases.

Table V.15 presents the global value of CO_2 emissions reductions at each TSL. For each of the four cases, DOE calculated a present value of the stream of annual values using the same discount rate as was used in the studies upon which the dollar-per-ton values are based. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values; these results are presented in chapter 14 of the NOPR TSD.

TABLE V.15—ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR PRODUCTS SHIPPED IN 2019–2048

TSL	SCC case * (Million 2014$)			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
Power Sector Emissions				
1	8.5	30.5	44.7	86.6
2	32.7	128.9	196.9	386.3
3	43.4	173.2	265.7	521.9
4	44.2	176.4	270.7	531.8
Upstream Emissions				
1	0.24	0.83	1.18	2.28
2	1.35	5.34	8.17	16.0
3	1.86	7.47	11.5	22.6
4	1.90	7.64	11.7	23.1
Total FFC Emissions				
1	8.77	31.28	45.84	88.86
2	34.1	134	205	402
3	45.3	181	277	544
4	46.1	184	282	555

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.2, $41.2, $63.4, and $121 per metric ton (2014$). The values are for CO_2 only (*i.e.,* not CO_{2eq} of other greenhouse gases).

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed on reduced CO_2 emissions in this rulemaking is subject to change. DOE, together with other Federal agencies, will continue to review various methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this proposed rule the most recent values and analyses resulting from the interagency review process.

DOE also estimated the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from the considered TSLs for CFLKs. The dollar-per-ton value that DOE used is discussed in section IV.L of this document. Table V.16 presents the cumulative present values for NO_X emissions for each TSL calculated using 7-percent and 3-percent discount rates.

TABLE V.16—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR CFLKS SHIPPED IN 2019–2048

TSL	(Million 2014$) 3% discount rate	7% discount rate
Power Sector Emissions		
1	3.81	3.54
2	13.5	9.54
3	17.8	12.0
4	18.1	12.2
Upstream Emissions		
1	1.47	1.67
2	8.97	6.18
3	12.5	8.13
4	12.7	8.26
Total FFC Emissions		
1	5.28	5.21
2	22.5	15.7
3	30.2	20.1
4	30.8	20.4

7. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) No other factors were considered in this analysis.

8. Summary of National Economic Impacts

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this rulemaking. Table V.17 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL for CFLKs considered in this rulemaking, at both a 7-percent and 3-percent discount rate. The CO_2 values used in the columns of each table correspond to the four sets of SCC values discussed above.

TABLE V.17—NET PRESENT VALUE OF CONSUMER SAVINGS COMBINED WITH PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

TSL	(Billion 2014$) Consumer NPV at 3% discount rate added with:			
	SCC Case $12.2/metric ton and 3% NO_X Values	SCC Case $41.2/metric ton and 3% NO_X Values	SCC Case $63.4/metric ton and 3% NO_X Values	SCC Case $121/metric ton and 3% NO_X Values
1	0.22	0.25	0.26	0.30
2	0.72	0.82	0.89	1.08
3	1.02	1.16	1.25	1.52
4	1.04	1.18	1.28	1.55
TSL	Consumer NPV at 7% discount rate added with:			
	SCC Case $12.2/metric ton and 7% NO_X Values	SCC Case $41.2/metric ton and 7% NO_X Values	SCC Case $63.4/metric ton and 7% NO_X Values	SCC Case $121/metric ton and 7% NO_X Values
1	0.22	0.25	0.26	0.30
2	0.55	0.65	0.72	0.92
3	0.76	0.90	0.99	1.26
4	0.77	0.91	1.01	1.28

Although adding the value of consumer savings to the values of emission reductions informs DOE's evaluation, two issues should be considered. First, the national operating-cost savings are domestic U.S. monetary savings that occur as a result of market transactions, while the value of CO_2 reductions is based on a global value. Second, the assessments of operating-cost savings and the SCC are performed with different methods that use different time frames for analysis. The national operating-cost savings is measured for the lifetime of products shipped in 2019 to 2048. Because CO_2 emissions have a very long residence time in the atmosphere,[79] the SCC values in future years reflect future climate-related impacts resulting from the emission of CO_2 that continue beyond 2100.

C. Conclusion

When considering proposed standards, the new or amended energy conservation standard that DOE adopts for any type (or class) of covered product must be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens by, to the greatest extent practicable, considering the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard must also result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B))

For this NOPR, DOE considered the impacts of standards for CFLKs at each TSL, beginning with the maximum technologically feasible level, to determine whether that level was economically justified. Where the max-tech level was not justified, DOE then considered the next most efficient level and undertook the same evaluation until it reached the highest efficacy level that is both technologically feasible and economically justified and saves a significant amount of energy.

To aid the reader as DOE discusses the benefits and/or burdens of each TSL, tables in this section present a summary of the results of DOE's quantitative analysis for each TSL. In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. These include but are not limited to the impacts on identifiable subgroups of consumers who may be disproportionately affected by a national standard and impacts on employment.

DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. There is evidence that consumers undervalue future energy savings as a result of: (1) A lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases; (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (for example, between renters and owners, or builders and purchasers). Having less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher-than-expected rate between current consumption and uncertain future energy cost savings.

In DOE's current regulatory analysis, potential changes in the benefits and costs of a regulation due to changes in consumer purchase decisions are included in two ways. First, if consumers forego the purchase of a product in the standards case, this decreases sales for product manufacturers, and the impact on manufacturers attributed to lost revenue is included in the MIA. Second, DOE accounts for energy savings attributable only to products actually used by consumers in the standards case; if a regulatory option changes the number of products purchased by consumers, then the potential energy savings from the potential energy conservation standard changes as well. DOE provides estimates of shipments and changes in the volume of product purchases in chapter 9 of the NOPR TSD. However, DOE's current analysis does not explicitly control for heterogeneity in consumer preferences, preferences across subcategories of products or specific features, or consumer price sensitivity variation according to household income.[80]

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy conservation standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[81] DOE welcomes comments on how to more fully assess the potential impact of energy conservation standards on consumer choice and how to quantify this impact in its regulatory analysis in future rulemakings.

1. Benefits and Burdens of TSLs Considered for CFLK Standards

Table V.18 and Table V.19 summarize the quantitative impacts estimated for each TSL for CFLKs. The national impacts are measured over the lifetime of CFLKs purchased in the 30-year period that begins in the anticipated year of compliance with amended standards (2019–2048). The energy savings, emissions reductions, and value of emissions reductions refer to FFC results. The ELs contained in each TSL are described in section V.A of this notice.

TABLE V.18—SUMMARY OF ANALYTICAL RESULTS FOR CFLK TSLS: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4
Cumulative FFC National Energy Savings				
quads	0.008	0.049	0.068	0.069

[79] The atmospheric lifetime of CO_2 is estimated of the order of 30–95 years. Jacobson, MZ, ''Correction to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming,' '' *J. Geophys. Res.* 110. pp. D14105 (2005).

[80] P.C. Reiss and M.W. White, Household Electricity Demand, Revisited, *Review of Economic Studies* (2005) 72, 853–883.

[81] Alan Sanstad, Notes on the Economics of Household Energy Consumption and Technology Choice. Lawrence Berkeley National Laboratory (2010) (Available online at: *www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf).*

TABLE V.18—SUMMARY OF ANALYTICAL RESULTS FOR CFLK TSLS: NATIONAL IMPACTS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4
NPV of Consumer Costs and Benefits (2014$ billion)				
3% discount rate	0.21	0.66	0.95	0.97
7% discount rate	0.21	0.50	0.70	0.71
Cumulative FFC Emissions Reduction (Total FFC Emissions)				
CO_2 (*million metric tons*)	0.67	3.35	4.59	4.68
SO_2 (*thousand tons*)	0.96	3.48	4.62	4.70
NO_X (*thousand tons*)	0.88	4.67	6.45	6.59
Hg (*tons*)	0.00	0.01	0.01	0.01
CH_4 (*thousand tons*)	1.28	11.2	16.0	16.4
CH_4 (*thousand tons CO_2eq*) *	35.9	314	449	460
N_2O (*thousand tons*)	0.01	0.04	0.05	0.05
N_2O (*thousand tons CO_2eq*) *	1.39	9.87	13.93	14.2
Value of Emissions Reduction (Total FFC Emissions)				
CO_2 (*2014$ billion*) **	0.009 to 0.089	0.034 to 0.402	0.045 to 0.544	0.046 to 0.555
NO_X—3% discount rate (*2014$ million*)	5.28	22.5	30.2	30.8
NO_X—7% discount rate (*2014$ million*)	5.21	15.7	20.1	20.4

* CO_2eq is the quantity of CO_2 that would have the same GWP.
** Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.

TABLE V.19—SUMMARY OF ANALYTICAL RESULTS FOR CFLK TSLS: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1 *	TSL 2 *	TSL 3 *	TSL 4 *
Manufacturer Impacts				
Industry NPV (*2014$ million*) (No-Standards-Case INPV = *2014$ million*)	97.9–98.9	86.8–96.8	74.9–92.1	74.7–91.9
Industry NPV (*% change*)	3.3–4.3	(8.4)–2.2	(21.0)–(2.8)	(21.1)–(3.0)
Residential Sector				
Consumer Average LCC Savings (*2014$*):				
All CFLKs	23.0	24.3	30.9	30.9
Consumer Simple PBP ** (*years*):				
All CFLKs	0.4	1.2	0.5	0.4
% of Consumers that Experience Net Cost:				
All CFLKs	0.6	9.7	7.6	7.6
Commercial Sector				
Consumer Average LCC Savings (*2014$*):				
All CFLKs	28.7	53.4	67.7	67.8
Consumer Simple PBP ** (*years*):				
All CFLKs	0.1	0.3	0.1	0.1
% of Consumers that Experience Net Cost:				
All CFLKs	10.5	1.9	0.3	0.3

* Parentheses indicate negative (−) values.
** Simple PBP results are calculated assuming that all consumers use products at that efficacy level. The PBP is measured relative to the least efficient product currently available on the market.

DOE first considered TSL 4, which represents the max-tech efficacy level. TSL 4 would save 0.07 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $0.71 billion using a discount rate of 7 percent, and $0.97 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 4.68 Mt of CO_2, 4.70 thousand tons of SO_2, 6.59 thousand tons of NO_X, 0.01 ton of Hg, 16.4 thousand tons of CH_4, and 0.05 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 4 ranges from $46.1 million to $554.9 million.

At TSL 4, the average LCC impact is a savings of $30.9 in the residential sector and a savings of $67.8 in the commercial sector. The simple payback period is 0.4 years in the residential sector and 0.1 years in the commercial sector. The fraction of consumers experiencing a net LCC cost is 7.6 percent in the residential sector and 0.3 percent in the commercial sector.

At TSL 4, the projected change in INPV ranges from a decrease of $20.0 million to a decrease of $2.8 million, which represent decreases of 21.1 percent and 3.0 percent, respectively.

The Secretary tentatively concludes that at TSL 4 for CFLKs, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the potential reduction in industry value and the potentially limited availability of compliant CFLKs discussed in section IV.C.4. Consequently, the Secretary has tentatively concluded that TSL 4 is not justified.

DOE then considered TSL 3, which would save an estimated 0.068 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $0.70 billion using a discount rate of 7 percent, and $0.95 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 4.59 Mt of CO_2, 4.62 thousand tons of SO_2, 6.45 thousand tons of NO_X, 0.01 tons of Hg, 16.0 thousand tons of CH_4, and 0.05 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 3 ranges from $45.3 million to $544.4 million.

At TSL 3, the average LCC impact is a savings of $30.9 in the residential sector and a savings of $67.7 in the commercial sector. The simple payback period is 0.5 years in the residential sector and 0.1 years in the commercial sector. The fraction of consumers experiencing a net LCC cost is 7.6 percent in the residential sector and 0.3 percent in the commercial sector.

At TSL 3, the projected change in INPV ranges from a decrease of $19.9 million to a decrease of $2.6 million, which represent decreases of 21.0 percent and 2.8 percent, respectively.

The Secretary tentatively concludes that at TSL 3 for CFLKs, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the potential reduction in industry value and by the potential limited availability of compliant CFLKs discussed in section IV.C.4. Consequently, the Secretary has tentatively concluded that TSL 3 is not justified.

DOE then considered TSL 2, which would save an estimated 0.049 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $0.50 billion using a discount rate of 7 percent, and $0.66 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 3.35 Mt of CO_2, 3.48 thousand tons of SO_2, 4.67 thousand tons of NO_X, 0.01 tons of Hg, 11.2 thousand tons of CH_4, and 0.04 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 2 ranges from $34.1 million to $402.4 million.

At TSL 2, the average LCC impact is a savings of $24.3 in the residential sector and a savings of $53.4 in the commercial sector. The simple payback period is 1.2 years in the residential sector and 0.3 years in the commercial sector. The fraction of consumers experiencing a net LCC cost is 9.7 percent in the residential sector and 1.9 percent in the commercial sector.

At TSL 2, the projected change in INPV ranges from a decrease of $7.9 million to an increase of $2.1 million, which represents a decrease of 8.4 percent to an increase of 2.2 percent.

After considering the analysis and weighing the benefits and burdens, the Secretary has tentatively concluded that at TSL 2 for CFLKs, the benefits of energy savings, positive NPV of consumer benefits, emission reductions, the estimated monetary value of the emissions reductions, and positive average LCC savings would outweigh the potential reduction in industry value. Accordingly, the Secretary has tentatively concluded that TSL 2 would offer the maximum improvement in efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy.

Therefore, based on the above considerations, DOE proposes to adopt the energy conservation standards for CFLKs at TSL 2. The proposed amended energy conservation standards for CFLKs are shown in Table V.20.

TABLE V.20—PROPOSED AMENDED ENERGY CONSERVATION STANDARDS FOR CFLKS

Product class	Lumens	Minimum required efficacy
		lm/W
All CFLKs	<120	50.
	≥120	$74 - 29.42 \times 0.9983^{lumens}$.

2. Summary of Annualized Benefits and Costs of the Proposed Standards

The benefits and costs of the proposed standards can also be expressed in terms of annualized values. The annualized monetary values are the sum of: (1) The annualized national economic value (expressed in 2014$) of the benefits from operating products that meet the proposed standards (consisting primarily of operating-cost savings from using less energy, minus increases in product purchase costs, which is another way of representing consumer NPV), and (2) the annualized monetary value of the benefits of CO_2 and NO_X emission reductions.[82]

Table V.21 shows the annualized values for CFLKs under TSL 2, expressed in 2014$. The results under the Primary Estimate are as follows.

Using a 7-percent discount rate for benefits and costs other than CO_2 reduction (for which DOE used a 3-percent discount rate along with the average SCC series that has a value of $41.2/t in 2015), the estimated cost of the standards proposed in this rule is $6.0 million per year in increased equipment costs, while the estimated annual benefits are $55 million in reduced equipment operating costs, $7.5 million in CO_2 reductions, and $1.6 million in reduced NO_X emissions. In this case, the net benefit amounts to $59 million per year.

[82] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2014, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (2020, 2030, *etc.*), and then discounted the present value from each year to 2015. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year that yields the same present value.

Using a 3-percent discount rate for all benefits and costs and the average SCC series that has a value of $41.2/t in 2015, the estimated cost of the proposed CFLK standards is $4.0 million per year in increased equipment costs, while the estimated annual benefits are $49 million in reduced operating costs, $7.5 million in CO_2 reductions, and $1.3 million in reduced NO_X emissions. In this case, the net benefit amounts to $46 million per year.

TABLE V.21—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS (TSL 2) FOR CFLKS

	Discount rate (%)	(Million 2014$/year)		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits				
Consumer Operating-Cost Savings	7	55	36	59.
	3	41	24	43.
CO_2 Reduction Value ($12.2/t) **	5	2.6	1.4	2.7.
CO_2 Reduction Value ($41.2/t) **	3	7.5	3.9	7.9.
CO_2 Reduction Value ($63.4/t) **	2.5	11	5	11.
CO_2 Reduction Value ($121/t) **	3	22	12	24.
NO_X Reduction Value	7	1.6	0.90	1.6.
	3	1.3	0.65	1.3.
Total Benefits †	7 plus CO_2 range	60 to 79	38 to 48	63 to 85.
	7	65	40	69.
	3 plus CO_2 range	45 to 64	26 to 36	47 to 68.
	3	49	28	53.
Costs				
Consumer Incremental Product Costs	7	6.0	3.5	6.4.
	3	4.0	2.3	4.2.
Total †	7 plus CO_2 range	54 to 73	34 to 44	57 to 78.
	7	59	37	62.
	3 plus CO_2 range	41 to 60	24 to 34	43 to 64.
	3	46	26	48.

* This table presents the annualized costs and benefits associated with CFLKs shipped in 2019–2048. These results include benefits to consumers which accrue after 2048 from the products purchased in 2019–2048. The results account for the incremental variable and fixed costs incurred by manufacturers due to the standard, some of which may be incurred in preparation for the rule. The Primary Estimate assumes the reference case electricity prices and housing starts from *AEO 2015* and decreasing product prices for LED CFLKs, due to price learning. The Low Benefits Estimate uses the Low Economic Growth electricity prices and housing starts from *AEO 2015* and a faster decrease in product prices for LED CFLKs. The High Benefits Estimate uses the High Economic Growth electricity prices and housing starts from *AEO 2015* and the same product price decrease for LED CFLKs as in the Primary Estimate.

** The CO_2 values represent global monetized values of the SCC, in 2014$, in 2015 under several scenarios of the updated SCC values. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC time series incorporate an escalation factor.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with a 3-percent discount rate ($41.2/t case). In the rows labeled "7% plus CO_2 range" and "3% plus CO_2 range," the operating-cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

Section 1(b)(1) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), requires each agency to identify the problem that it intends to address, including, where applicable, the failures of private markets or public institutions that warrant new agency action, as well as to assess the significance of that problem. The problems that the proposed standards set forth in this NOPR are intended to address are as follows:

- Insufficient information and the high costs of gathering and analyzing relevant information leads some consumers to miss opportunities to make cost-effective investments in energy efficiency.
- In some cases, the benefits of more-efficient equipment are not realized due to misaligned incentives between purchasers and users. An example of such a case is when the equipment purchase decision is made by a building contractor or building owner who does not pay the energy costs.
- There are external benefits resulting from improved energy efficiency of appliances and equipment that are not captured by the users of such products. These benefits include externalities related to public health, environmental protection, and national energy security that are not reflected in energy prices, such as reduced emissions of air pollutants and greenhouse gases that impact human health and global warming. DOE attempts to quantify some of the external benefits through use of SCC values.

The Administrator of the Office of Information and Regulatory Affairs (OIRA) in the OMB has determined that the proposed regulatory action is not a significant regulatory action under section (3)(f) of Executive Order 12866. Accordingly, the rule was not reviewed by OIRA.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011. 76 FR 3281 (Jan. 21, 2011). Executive Order 13563 is supplemental to and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order 13563 requires agencies to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible. In its guidance, OIRA has emphasized that such techniques may include identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes. For the reasons stated in the preamble, DOE believes that this NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*http://energy.gov/gc/office-general-counsel*). DOE has prepared the following IRFA for the products that are the subject of this rulemaking.

1. Description on Estimated Number of Small Entities Regulated

For manufacturers of CFLKs, the SBA has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. See 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description available at: *https://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.* CFLK manufacturing is classified under NAICS code 335210, ''Small Electrical Appliance Manufacturing.'' The SBA sets a threshold of 750 employees or less for an entity to be considered as a small business for this category.

To estimate the number of companies that could be small businesses that sell CFLKs covered by this rulemaking, DOE conducted a market survey using publicly available information. DOE's research involved information provided by trade associations (*e.g.,* ALA [83]) and information from previous rulemakings, individual company Web sites, SBA's database, and market research tools (*e.g.,* Hoover's reports [84]). DOE also asked stakeholders and industry representatives if they were aware of any small businesses during manufacturer interviews and DOE public meetings. DOE used information from these sources to create a list of companies that potentially manufacture or sell CFLKs and would be impacted by this rulemaking. DOE screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a ''small business,'' or are completely foreign owned and operated.

For CFLKs, DOE initially identified a total of 67 potential companies that sell CFLKs in the United States. However, DOE only identified one manufacturer that also manufacturers the lamps sold with their CFLKs. All other CFLK manufacturers source the lamps packaged with their CFLKs. After reviewing publicly available information on these potential CFLK businesses, DOE determined that 40 were either large businesses or businesses that were completely foreign owned and operated. DOE determined that the remaining 27 companies were small businesses that either manufacture or sell covered CFLKs in the United States. The one CFLK manufacturer that also sells lamps that DOE identified is also a small business. Based on manufacturer interviews, DOE estimates that these small businesses account for approximately 25 percent of the CFLK market. One small business accounts for approximately five percent of the CFLK market, while all other small businesses account for one percent or less of the CFLK market individually.

DOE seeks comments, information, and data on the small businesses in the industry, including their numbers and their role in the CFLK market. DOE also requests data on the market share of small businesses in the CFLK market.

2. Description and Estimate of Compliance Requirements

At TSL 2, the proposed standard in today's NOPR, DOE projects that impacts on small businesses as a result of amended standards would be consistent with the overall CFLK industry impacts presented in section V.B.2. Small businesses are not expected to experience differential impacts as a result of the amended CFLK standards due to the majority of large and small businesses sourcing the lamps used in their CFLKs from lamp manufacturers; small and large CFLK businesses typically outsourcing the manufacturing of the CFLKs they sell to original equipment manufacturers located abroad; the range of available options to replace non-complaint lamps with lamps on the market that can meet the proposed standard; and the potential standards from the GSL rulemaking and the 45 lm/W requirement for GSLs that is expected to take effect in 2020.

DOE identified only one CFLK small business that is also a lamp manufacturer. For this analysis, DOE refers to lamp manufacturers as entities that produce and sell lamps, as opposed to purchasing lamps from a third party. The majority of lamps packaged in CFLKs are purchased from lamp manufacturers, then inserted into a CFLK or packaged with a CFLK. Therefore, CFLK businesses will typically not be responsible for the costs associated with producing more efficacious lamps packaged with CFLKs that comply with the proposed standards. Furthermore, because lamp manufacturers typically test and certify their lamps, CFLK businesses can choose to use the testing and certification data provided by the lamp manufacturer to comply with the CFLK standards. Thereby, both large and small

[83] American Lighting Association | Company Information | Industry Information | Lists, *http://www.americanlightingassoc.com//*) (last accessed Mar 16, 2015).

[84] Hoovers | Company Information | Industry Information | Lists, *http://www.hoovers.com/*) (last accessed Mar 31, 2015).

CFLK businesses can significantly reduce their own testing and certification costs associated with compliance to proposed standards.

At the proposed standard level, CFLK businesses have the option to replace the lamps used in their CFLKs with more efficacious lamps available on the market. This lamp replacement option allows most CFLK businesses to comply with the proposed CFLK standards without redesigning their existing CFLKs. DOE's shipments analysis found that over 50 percent of CFLKs sold at TSL 2 will follow this lamp replacement option, allowing these CFLK businesses to avoid redesign and conversion costs. Based on manufacturer interviews, small businesses are just as likely to pursue the lamp replacement option as large businesses.

DOE expects that CFLK businesses that choose to meet amended CFLK standards by redesigning CFLK fixtures instead of replacing lamps are expected to incur conversion costs driven by retooling costs, increased R&D efforts, product certification costs, and testing costs. DOE learned during manufacturer interviews that the majority of the manufacturing of CFLKs sold by small and large CFLK businesses is outsourced to a limited number of original equipment manufacturers located abroad. CFLK businesses pay retooling costs to original equipment manufacturers located abroad, who operate and maintain machinery used to produce the CFLKs those CFLK businesses then sell.

DOE also learned from manufacturer interviews that, in some cases, multiple CFLK businesses, including small and large CFLK businesses, are outsourcing production to the same original equipment manufacturer located abroad. Small businesses are currently competing against large businesses despite purchasing components at lower volumes, and DOE expects that they will continue to compete after the adoption of standards, since the proposed standards will not significantly disrupt most CFLK manufacturers' supply chain. DOE does not expect that small businesses would be disadvantaged compared to large businesses if they chose to redesign their CFLKs. Total estimated conversion costs for the industry at TSL 2 are $1.9 million, which is relatively small compared to an INPV of almost $95 million in the no-standards case.

Potential standards from the GSL standards rulemaking and the minimum efficacy of 45 lm/W required for GSLs, expected to require compliance in 2020, will impact GSLs used in CFLKs (see section V.B.2.e for further details). Therefore, regardless of the standards proposed in this rulemaking, CFLK businesses will likely need to package more efficacious lamps with CFLKs in 2020.

For the reasons outlined above, DOE has determined that most small businesses would not be disproportionally impacted by the proposed CFLK energy conservation standard compared to large businesses. At TSL 2, overall impacts on CFLK INPV range from −8.4 percent to 2.2 percent (see section V.B.2). DOE estimates that the overall percent change in INPV for the CFLK industry is reflective of the range of potential impacts for small businesses.

DOE seeks comment on the potential impacts of the amended standards on CFLK small businesses.

3. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with the proposed amended standard. DOE seeks comment on any rules or regulations that could potentially duplicate, overlap, or conflict with the proposed amended standard.

4. Significant Alternatives to the Rule

The discussion in the previous section analyzes impacts on small businesses that would result from DOE's proposed level, TSL 2. In reviewing alternatives to the proposed rule, DOE examined energy conservation standards set at lower efficiency levels. While TSL 1 would reduce the impacts on small business manufacturers, it would come at the expense of a significant reduction in energy savings and NPV benefits to consumers, achieving 83 percent lower energy savings and 58 percent less NPV benefits to consumers compared to the energy savings and NPV benefits at TSL 2.

DOE believes that establishing standards at TSL 2 balances the benefits of the energy savings and the NPV benefits to consumers at TSL 2 with the potential burdens placed on CFLK manufacturers, including small business manufacturers. Accordingly, DOE is declining to adopt one of the other TSLs considered in the analysis, or the other policy alternatives detailed as part of the regulatory impacts analysis included in chapter 17 of the NOPR TSD.

Additional compliance flexibilities may be available through other means. For example, individual manufacturers may petition for a waiver of the applicable test procedure. (See 10 CFR 431.401.) Further, EPCA provides that a manufacturer whose annual gross revenue from all of its operations does not exceed $8 million may apply for an exemption from all or part of an energy conservation standard for a period not longer than 24 months after the effective date of a final rule establishing the standard. Additionally, Section 504 of the Department of Energy Organization Act, 42 U.S.C. 7194, provides authority for the Secretary to adjust a rule issued under EPCA in order to prevent ''special hardship, inequity, or unfair distribution of burdens'' that may be imposed on that manufacturer as a result of such rule. Manufacturers should refer to 10 CFR part 430, subpart E, and part 1003 for additional details.

C. Review Under the Paperwork Reduction Act

Manufacturers of CFLKs must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for CFLKs, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including CFLKs. See generally 10 CFR part 429. The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910–1400. Public reporting burden for the certification is estimated to average 30 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB control number.

D. Review Under the National Environmental Policy Act of 1969

Pursuant to the National Environmental Policy Act (NEPA) of 1969, DOE has determined that the proposed rule fits within the category of actions included in Categorical Exclusion (CX) B5.1 and otherwise meets the requirements for application of a CX. See 10 CFR part 1021, App. B, B5.1(b); 1021.410(b) and Appendix B, B(1)–(5). The proposed rule fits within the category of actions because it is a rulemaking that establishes energy conservation standards for consumer products or industrial equipment, and for which none of the exceptions identified in CX B5.1(b) apply. Therefore, DOE has made a CX determination for this rulemaking, and DOE does not need to prepare an Environmental Assessment or Environmental Impact Statement for this proposed rule. DOE's CX determination for this proposed rule is available at *http://cxnepa.energy.gov/.*

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 10, 1999), imposes certain requirements on Federal agencies formulating and implementing policies or regulations that preempt state law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the states and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by state and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has tentatively determined that it would not have a substantial direct effect on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of state regulations as to energy conservation for the products that are the subject of this proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) Therefore, no further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. 61 FR 4729 (Feb. 7, 1996). Regarding the review required by section 3(a), section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, this proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on state, local, and tribal governments and the private sector. Pub. L. 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by state, local, and tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of state, local, and tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect them. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820. DOE's policy statement is also available at *http://energy.gov/sites/prod/files/gcprod/documents/umra_97.pdf.*

Because this proposed rule does not contain a Federal intergovernmental mandate, and DOE expects that it will not require expenditures of $100 million or more by the private sector, the requirements of Title II of UMRA do not apply to this proposed rule.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

Pursuant to Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (March 15, 1988), DOE has determined that this proposed rule would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for Federal agencies to review most disseminations of information to the public under information quality guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed this NOPR under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has tentatively concluded that this regulatory action, which proposes amended energy conservation standards for CFLKs, is not a significant energy action because the proposed standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on this proposed rule.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, OMB, in consultation with the Office of Science and Technology Policy (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (Jan. 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the federal government, including influential scientific information related to agency regulatory actions. The purpose of the Bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are ''influential scientific information,'' which the Bulletin defines as ''scientific information the agency reasonably can determine will have, or does have, a clear and substantial impact on important public policies or private sector decisions.'' *Id.* at FR 2667.

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The ''Energy Conservation Standards Rulemaking Peer Review Report'' dated February 2007 has been disseminated and is available at the following Web site: *www1.eere.energy.gov/buildings/appliance_standards/peer_review.html.*

VII. Public Participation

A. Attendance at the Public Meeting

The time, date, and location of the public meeting are listed in the **DATES** and **ADDRESSES** sections at the beginning of this notice. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586–2945 or *Brenda.Edwards@ee.doe.gov.*

Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures which require advance notice prior to attendance at the public meeting. If a foreign national wishes to participate in the public meeting, please inform DOE of this fact as soon as possible by contacting *foreignvisit@ee.doe.gov* so that the necessary procedures can be completed.

DOE requires visitors to have laptops and other devices, such as tablets, checked upon entry into the Forrestal Building. Any person wishing to bring these devices into the building will be required to obtain a property pass. Visitors should avoid bringing these devices, or allow an extra 45 minutes to check in. Please report to the visitor's desk to have devices checked before proceeding through security.

Due to the REAL ID Act implemented by the Department of Homeland Security (DHS), there have been recent changes regarding identification (ID) requirements for individuals wishing to enter Federal buildings from specific states and U.S. territories. As a result, driver's licenses from several states or territory will not be accepted for building entry, and instead, one of the alternate forms of ID listed below will be required. DHS has determined that regular driver's licenses (and ID cards) from the following jurisdictions are not acceptable for entry into DOE facilities: Alaska, American Samoa, Arizona, Louisiana, Maine, Massachusetts, Minnesota, New York, Oklahoma, and Washington. Acceptable alternate forms of Photo-ID include: U.S. Passport or Passport Card; an Enhanced Driver's License or Enhanced ID Card issued by the States of Minnesota, New York, or Washington (Enhanced licenses issued by these states are clearly marked Enhanced or Enhanced Driver's License); a military ID or other federal-government-issued Photo-ID card.

In addition, you can attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's Web site at: *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/66.* Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements for Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the **ADDRESSES** section at the beginning of this notice. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make follow-up contact, if needed.

C. Conduct of the Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA. (42 U.S.C. 6306) A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. There shall not be discussion of proprietary information, costs or prices, market share, or other commercial matters regulated by U.S. anti-trust laws. After the public meeting, interested parties may submit further comments on the proceedings, as well as on any aspect of the rulemaking, until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will allow, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the *docket* section at the beginning of this notice and will be accessible on the DOE Web site. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments, data, and other information using any of the methods described in the **ADDRESSES** section at the beginning of this notice.

Submitting comments via *www.regulations.gov.* The *www.regulations.gov* Web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment itself or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Otherwise, persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to *www.regulations.gov* information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information [CBI]). Comments submitted through *www.regulations.gov* cannot be claimed as CBI. Comments received through the Web site will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section below.

DOE processes submissions made through *www.regulations.gov* before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that *www.regulations.gov* provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or mail. Comments and documents submitted via email, hand delivery/courier, or mail also will be posted to *www.regulations.gov.* If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery/courier, please provide all items on a CD, if feasible, in which case it is not necessary to submit printed copies. No telefacsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, that are written in English, and that are free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: one copy of the document marked ''confidential'' including all the information believed to be confidential, and one copy of the document marked ''non-confidential'' with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person that would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

1. DOE is considering whether all CFLKs with SSL circuitry should be determined to not exceed the 190 W limit and seeks comment on this approach.

2. DOE requests comment on the proposed CFLK product class structure,

a single ''All CFLKs'' product class. See section IV.A.1.

3. DOE requests comment on the CFL and LED technology options being proposed for CFLKs and any additional options that should be included. See section IV.A.4.

4. DOE requests comment on the modeled 14 W CFL (with spiral shape, 800 lm, 82 CRI, 2,700 K CCT, and 10,000-hour lifetime) analyzed as the baseline lamp in this NOPR analysis. See section IV.C.3.

5. DOE requests comment on the criteria used in selecting more efficacious substitute lamps, as well as the characteristics of the lamps selected. Specifically, DOE requests comment on the 3-way lamp used as a basis for the modeled max-tech LED lamp. See section IV.C.4.

6. DOE requests comment on the equations used to define the efficacy requirements at each EL. See section IV.C.5.

7. DOE requests comment on the data and methodology used to estimate operating hours for CFLKs, particularly in the residential sector. DOE also seeks comment on its assumption that CFLK operating hours do not vary by light source technology. See section IV.E.1.

8. DOE estimated 30 percent energy savings from the use of dimmers in the residential sector based on energy savings estimates for lighting controls in the commercial sector and stakeholder comments in response to the GSL preliminary analysis. DOE requests comments on the assumption that the only relevant lighting controls used with CFLKs are dimmers, and on the energy savings estimate from dimmers in the residential sector. See section IV.E.3.

9. DOE requests comment on its assumption that the fraction of CFLKs used with dimmers is the same in the residential sector and the commercial sector (11 percent). See section IV.E.3.

10. DOE requests comment on its assumption that CFLs packaged in CFLKs are not dimmable. See section IV.E.3.

11. DOE requests comment and relevant data on the disposal cost assumptions used in its analyses. See section IV.F.2.

12. DOE assumed that the installation costs for CFLKs are the same for all ELs for each of the residential and commercial sectors. DOE also assumed that the installation cost for replacement lamps after the original lamps packaged with the CFLK fail are negligible. Therefore, in the LCC analysis, DOE did not include installation costs for CFLKs or for replacement lamps. DOE welcomes comment on its approach of not including installation costs in the LCC analysis. See section IV.F.

13. DOE requests comment on the overall methodology and results of the LCC and PBP analyses. See section IV.F.

14. In evaluating overall U.S. shipments of CFLKs, DOE assumed in its analysis that CFLKs are primarily found on low-volume ceiling fans. DOE requests any information regarding shipments of CFLKs intended for high-volume ceiling fans. See section IV.G.

15. DOE considered more efficacious lamps under two different substitution scenarios: (1) A lamp replacement scenario and (2) a light kit replacement scenario. In its analysis, DOE split market share evenly between both scenarios when distributing market share among ELs. DOE requests comment on the likelihood of CFLK manufacturers selecting each substitution scenario and information on any alternative scenarios that manufacturers may choose.

16. DOE assumed that only LEDs will continue to experience price learning because of the relative maturity of the other lamp technologies and their anticipated sharp decline as market share shifts to LED. DOE requests comment on the assumption that only LEDs will continue to undergo significant cost reduction due to price learning.

17. DOE requests comment and input regarding its assumption that the distribution of CFLKs by light source technology in the commercial sector is the same as the light source technology distribution in the residential sector.

18. Although LED technology currently accounts for a small fraction of the CFLK market, manufacturers indicate that LED penetration is expected to dominate the lighting market in a relatively short time. DOE estimated the market penetration of LEDs into the ceiling fan light kit market as a Bass diffusion curve. DOE requests comment on this approach.

19. Based on observed trends on the efficacy of LED lamps on the market over time, DOE assumed the market share for LED lamps would naturally shift to more efficacious ELs in the no-standards and standards shipments cases. DOE requests feedback on this assumption.

20. DOE assumed that when the price of LED lamps reached parity with comparable CFL lamps, manufacturers would choose to package CFLKs only with LED lamps. DOE requests feedback on the likelihood of this assumption.

21. DOE requests comments on its assumed breakdown of CFLK usage as 95 percent in the residential sector and 5 percent commercial sector.

22. DOE requests comments on the overall methodology used to develop shipment forecasts and estimate national energy savings and the NPV of those savings.

23. DOE seeks comment on the assumption that almost all CFLK manufacturing takes place abroad. Additionally, DOE seeks comment on any potential domestic employment impacts as a result of amended energy conservation standards for CFLKs.

24. DOE seeks comment on any potential impact on manufacturing capacity at the efficacy level proposed in this NOPR.

25. DOE seeks comment on any potential manufacturer subgroups that could be disproportionally impacted by amended energy conservation standards for CFLKs.

26. DOE seeks comment on the compliance costs of any other regulations on products that CFLK manufacturers also manufacture, especially if compliance with those regulations is required three years before or after the estimated compliance date of this proposed standard.

27. DOE seeks comments, information, and data on the small businesses in the industry, including their number and their role in the CFLK market. DOE also requests data on the market share of small businesses in the CFLK market. Additionally, DOE seeks comment on the potential impacts of the amended standards on CFLK small businesses.

28. DOE seeks comment on any rules or regulations that could potentially duplicate, overlap, or conflict with the proposed amended standard.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this notice of proposed rulemaking.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

Issued in Washington, DC, on June 18, 2015.

David T. Danielson,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE proposes to amend part 430 of chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

■ 1. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

■ 2. Amend § 430.32 to revise paragraphs (s)(2), (s)(3), and (s)(4) and to add paragraph (s)(5) to read as follows:

§ 430.32 Energy and water conservation standards and their compliance dates.

* * * * *

(s) * * *

(2)(i) Except for the minimum efficacy requirement as provided in paragraph (s)(5) of tis section, ceiling fan light kits with medium screw base sockets manufactured on or after January 1, 2007, must be packaged with screw-based lamps to fill all screw base sockets.

(ii) The screw-based lamps required under paragraph (s)(2)(i) of this section must—

(A) Be compact fluorescent lamps that meet or exceed the following requirements or be as described in paragraph (s)(2)(ii)(B) of this section, except for the minimum efficacy requirement as provided in paragraph (s)(5) of this section:

Factor	Requirements
Rated Wattage (Watts) & Configuration [1].	Minimum Initial Lamp Efficacy (lumens per watt).[2]
Bare Lamp:	
Lamp Power <15 ...	45.0.
Lamp Power ≥15 ...	60.0.
Covered Lamp (no reflector):	
Lamp Power <15 ...	40.0.
15< Lamp Power <19.	48.0.
19< Lamp Power <25.	50.0.
Lamp Power ≥25 ...	55.0.
With Reflector:	
Lamp Power <20 ...	33.0.
Lamp Power ≥20 ...	40.0.
Lumen Maintenance at 1,000 hours.	≥90.0%.
Lumen Maintenance at 40 Percent of Lifetime.	≥80.0%.
Rapid Cycle Stress Test.	At least 5 lamps must meet or exceed the minimum number of cycles.
Lifetime	≥6,000 hours for the sample of lamps.

[1] Use rated wattage to determine the appropriate minimum efficacy requirements in this table.

[2] Calculate efficacy using measured wattage, rather than rated wattage, and measured lumens to determine product compliance. Wattage and lumen values indicated on products or packaging may not be used in calculation.

(B) Light sources other than compact fluorescent lamps that have lumens per watt performance at least equivalent to comparably configured compact fluorescent lamps meeting the energy conservation standards in paragraph (s)(2)(ii)(A) of this section.

(3) Ceiling fan light kits manufactured on or after January 1, 2007, with pin-based sockets for fluorescent lamps must use an electronic ballast and be packaged with lamps to fill all sockets. Except for the minimum efficacy requirement as provided in paragraph (s)(5) of this section, these lamp ballast platforms must meet the following requirements:

Factor	Requirement
System Efficacy per Lamp Ballast Platform in Lumens per Watt (lm/w)	≥50 lm/w for all lamps below 30 total listed lamp watts. ≥60 lm/w for all lamps that are ≤24 inches and ≥30 total listed lamp watts. ≥70 lm/w for all lamps that are >24 inches and ≥30 total listed lamp watts.

(4) Except for the requirements as provided in paragraph (s)(5) of this section, ceiling fan light kits with socket types other than those covered in paragraphs (s)(2) and (3) of this section, including candelabra screw base sockets, manufactured on or after January 1, 2009—

(i) Shall not be capable of operating with lamps that total more than 190 watts. On [DATE 30 DAYS AFTER DATE OF FINAL RULE PUBLICATION IN THE **Federal Register**], ceiling fan light kits with integrated solid-state lighting (SSL) circuitry that

(A) Have only SSL drivers and light sources that are not consumer replaceable,

(B) Do not include any other light source, and

(C) Include SSL drivers with a maximum operating wattage of no more than 190 W, are considered to incorporate some electrical device or measure that ensures they do not exceed the 190 W limit.

(ii) Shall be packaged to include the lamps described in paragraph (s)(4)(i) of this section with the ceiling fan light kits.

(5) Ceiling fan light kits manufactured on or after [DATE 3 YEARS AFTER DATE OF FINAL RULE PUBLICATION IN THE **Federal Register**] shall meet the requirements shown in the table:

Metric	Minimum standard
Minimum Average Lamp Efficacy for lamps with output <120 lumens	50 lm/W.
Minimum Average Lamp Efficacy for lamps with output ≥120 lumens	$(74 - 29.42 \times 0.9983^{lumens})$ lm/W.

* * * * *

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