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10 CFR Part 430
Energy Conservation Program: Energy Conservation Standards for Ceiling Fans; Proposed Rule

DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EERE–2012–BT–STD–0045]

RIN 1904–AD28

Energy Conservation Program: Energy Conservation Standards for Ceiling Fans

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 fans. 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 ceiling fans, and also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES: *Comments:* DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than March 14, 2016. See section VII, ''Public Participation,'' for details.

Comments regarding the likely competitive impact of the proposed standard should be sent to the Department of Justice contact listed in the **ADDRESSES** section before February 12, 2016.

Meeting: DOE will hold a public meeting on Wednesday, Feburary 3, 2016 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.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E–089, 1000 Independence Avenue SW., Washington, DC 20585.

Instructions: Any comments submitted must identify the NOPR on Energy Conservation Standards for ceiling fans and provide docket number EE–2012–BT–STD–0045 and/or regulatory information number (RIN) 1904–AD28. 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: CeilingFan2012STD0045@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.*

EPCA requires the Attorney General to provide DOE a written determination of whether the proposed standard is likely to lessen competition. The U.S. Department of Justice Antitrust Division invites input from market participants and other interested persons with views on the likely competitive impact of the proposed standard. Interested persons may contact the Division at *energy.standards@atr.usdoj.gov* before February 12, 2016. Please indicate in the ''Subject'' line of your email the title and Docket Number of this rulemaking notice.

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: *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/65.* 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.*

EPCA requires the Attorney General to provide DOE a written determination of whether the proposed standard is likely to lessen competition (42 U.S.C. 6295(o)(2)(B)(i)(V). The U.S. Department of Justice Antitrust Division invites input from market participants and other interested persons with views on the likely competitive impact of the proposed standard. Interested persons may contact the Division at *Atr.ops-energystandards@usdoj.gov* before February 12, 2016. Please indicate in the ''Subject'' line of your email the title and Docket Number of this rulemaking notice.

FOR FURTHER INFORMATION CONTACT: 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_fans@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), Public Law 94–163 (42 U.S.C. 6291, *et seq.*), established the Energy Conservation Program for Consumer Products Other Than Automobiles.[2] These products include ceiling fans, which are the subject of this document. (42 U.S.C. 6295(ff))

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 ceiling fans. The proposed standards, which are expressed for each product class as the maximum allowable airflow efficiency in terms of cubic feet per minute per watt (CFM/W), as a function of ceiling fan diameter in inches, are shown in Table I–1. These proposed standards, if adopted, would apply to all ceiling fans listed in Table I–1 and manufactured in, or imported into, the United States on and after the date 3 years after the publication of the final rule for this rulemaking.

TABLE I–1—PROPOSED ENERGY CONSERVATION STANDARDS FOR CEILING FANS

Product class	Maximum airflow efficiency equation *CFM/W**
Very Small-Diameter (VSD)	3.17D − 16.75
Hugger	0.05D + 56.41
Standard	0.30D + 60.61
High-Speed Small-Diameter (HSSD).	4.22D + 0.02
Large Diameter	1.16D − 24.38

* D is the ceiling fan diameter, in inches.

A. Benefits and Costs to Consumers

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

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

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

[3] The average LCC savings are measured relative to the no-standards case efficiency distribution, which depicts the market in the compliance year in the absence of standards (see section IV.F.7). The simple PBP, which is designed to compare specific efficiency levels, is measured relative to the baseline model (see section IV.F), which corresponds to the least efficient model available to purchase.

TABLE I–2—IMPACTS OF PROPOSED ENERGY CONSERVATION STANDARDS ON CONSUMERS OF CEILING FANS

Product class	Average LCC savings (*2014$*)	Simple payback period (*years*)
Standard	8.47	1.5
Hugger	5.59	1.6
Very Small-Diameter	3.01	7.7
High-Speed Small-Diameter	27.63	5.2
Large-Diameter	27.26	4.4

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 CFs in the no-standards case is $1,308.7 million in 2014$. Under the proposed standards, DOE expects that manufacturers may lose up to 12.7 percent of this INPV, which is approximately $166.3 million. Additionally, based on DOE's interviews with the ceiling fan manufacturers, DOE does not expect significant impacts on manufacturing capacity or loss of employment for the industry as a whole to result from enacting the proposed standards for ceiling fans.

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 ceiling fans would save a significant amount of energy. Relative to the case where no energy efficiency performance standard is set (the ''no-standards case''), the lifetime energy savings for ceiling fans purchased in the 30-year period that begins in the anticipated year of compliance with any amended standards (2019–2048) amount to 0.758 quadrillion Btu (quads).[5] This represents an energy savings of 10.9 percent relative to the energy use of these products in the case without amended standards (referred to as the ''no-standards case'').

The cumulative net present value (NPV) of total consumer costs and savings of the proposed standards for ceiling fans ranges from $0.813 billion (at a 7-percent discount rate) to $2.760 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 ceiling fans purchased in 2019–2048.

In addition, the proposed standards for ceiling fans would have significant environmental benefits. DOE estimates that the proposed standards would result in cumulative emission reductions of 45.7 million metric tons (Mt) [6] of carbon dioxide (CO_2), 24.5 thousand tons of sulfur dioxide (SO_2), 84.2 thousand tons of nitrogen oxides (NO_X), 199.6 thousand tons of methane (CH_4), 0.51 thousand tons of nitrous oxide (N_2O), and 0.09 tons of mercury (Hg).[7] The cumulative reduction in CO_2 emissions through 2030 amounts to 8.53 Mt, which is equivalent to the emissions resulting from the annual electricity use of almost 778,000 homes.[8]

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.[9] 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 $0.3 billion and $4.4 billion, with a value of $1.4 billion using the central SCC case represented by $40.0/t in 2015. DOE also estimates the present monetary value of the NO_X emissions reduction to be $0.11 billion at a 7-percent discount rate and $0.27 billion at a 3-percent discount rate.[10]

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

TABLE I–3—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF PROPOSED ENERGY CONSERVATION STANDARDS FOR CEILING FANS (TSL 4) *

Category	Present value *Billion 2014$*	Discount rate (%)
Benefits		
Consumer Operating Cost Savings	2.2	7
	5.2	3
CO_2 Reduction Monetized Value ($12.2/t case) **	0.31	5
CO_2 Reduction Monetized Value ($40.0/t case) **	1.4	3
CO_2 Reduction Monetized Value ($62.3/t case) **	2.3	2.5

[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 2015* (*AEO 2015*) Reference case. *AEO 2015* generally represents current legislation and environmental regulations for which implementing regulations were available as of October 31, 2014.

[8] The conversion from cumulative CO_2 emissions reductions to electricity use emissions from homes is based on the U.S. Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator: *http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results.*

[9] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* Interagency Working Group on Social Cost of Carbon, United States Government (May 2013; revised July 2015) (Available at: *https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf*).

[10] DOE estimated the monetized value of NOx emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, ''Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants,'' published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf.*) See section IV.L.2 for further discussion. Note that the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electricity Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), the values would be nearly two-and-a-half times larger. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emissions, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule. Note that 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 CEILING FANS (TSL 4) *—Continued

Category	Present value *Billion 2014$*	Discount rate (%)
CO_2 Reduction Monetized Value ($117/t case) **	4.4	3
NO_X Reduction Monetized Value †	0.11	7
	0.27	3
Total Benefits††	3.8	7
	6.9	3
Costs		
Consumer Incremental Installed Costs	1.4	7%
	2.4	3%
Total Net Benefits		
Including Emissions Reduction Monetized Value†	2.3	7%
	4.5	3%

* This table presents the costs and benefits associated with ceiling fans 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.

† The $/ton values used for NO_X are described in section IV.L. DOE estimated the monetized value of NO_X emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, "Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants," published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf.*) See section IV.L.2 for further discussion. Note that the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electric Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), the values would be nearly two-and-a-half times larger. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emissions, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule.

†† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to average SCC with 3-percent discount rate ($40.0/t case).

The benefits and costs of the proposed standards, for ceiling fans 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 NO_X and CO_2 emission reductions.[11]

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 ceiling fans shipped in 2019–2048. Because CO_2 emissions have a very long residence time in the atmosphere,[12] 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 $40.0/t in 2015), the estimated annualized cost of the standards proposed in this rule is $140 million per year in increased equipment costs, while the estimated annualized benefits are $220 million in reduced equipment operating costs, $80 million in CO_2 reductions, and $10 million in reduced NO_X emissions. In this case, the annualized net benefit amounts to $170 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that has a value of $40.0/t in 2015, the estimated annualized cost of the proposed ceiling fans standards is $136 million per year in increased equipment costs, while the estimated annualized benefits are $290 million in reduced operating costs, $80 million in CO_2 reductions, and $15 million in reduced NO_X emissions. In this case, the annualized net benefit amounts to $248 million per year.

[11] 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–4. 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.

[12] 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 CEILING FANS (TSL 4)

	Discount rate (%)	(Million 2014$/year)		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits				
Consumer Operating Cost Savings	7	220	195	253.
	3	290	255	341.
CO_2 Reduction Monetized Value ($12.2/t case)**	5	23	21	26.
CO_2 Reduction Monetized Value ($40.0/t case)**	3	80	71	90.
CO_2 Reduction Monetized Value ($62.3/t case)**	2.5	117	105	132.
CO_2 Reduction Monetized Value ($117/t case)**	3	243	217	274.
NO_X Reduction Monetized Value†	7	10	9	26.
	3	15	13	37.
Total Benefits ††	7 plus CO_2 range	254 to 473	225 to 421	305 to 553.
	7	310	275	369.
	3 plus CO_2 range	328 to 547	289 to 485	404 to 652.
	3	384	340	467.
Costs				
Consumer Incremental Installed Product Costs	7	140	177	155.
	3	136	182	152.
Net Benefits				
Total †	7 plus CO_2 range	114 to 333	47 to 243	150 to 398.
	7	170	98	214.
	3 plus CO_2 range	192 to 411	107 to 303	251 to 499.
	3	248	157	315.

* This table presents the annualized costs and benefits associated with ceiling fans 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 ceiling fans with DC motors, due to price trend on the electronics components. The Low Benefits Estimate uses the Low Economic Growth electricity prices and housing starts from AEO 2015 and no price trend for ceiling fans with DC motors. The High Benefits Estimate uses the High Economic Growth electricity prices and housing starts from AEO 2015 and the same product price decrease for ceiling fans with DC motors 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.

† The $/ton values used for NO_X are described in section IV.L. DOE estimated the monetized value of NOx emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, "Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants," published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf.*) See section IV.L.2 I.A.2 for further discussion. For DOE's Primary Estimate and Low Net Benefits Estimate, the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electric Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). For DOE's High Net Benefits Estimate, the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), which are nearly two-and-a-half times larger than those from the ACS study. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emission, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule.

†† 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 ($40.0/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. 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 energy efficiency levels as potential standards, and is still considering them in this rulemaking. However, DOE has tentatively concluded that the potential burdens of the more-stringent energy efficiency levels would outweigh the projected benefits and that the proposed standard achieves the maximum improvement in energy efficiency that is technologically feasible and economically justified. 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 energy efficiency levels 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 ceiling fans.

A. Authority

Title III, Part B of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Public Law 94–163 (42 U.S.C. 6291, *et seq.*) 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 ceiling fans that are the subject of this rulemaking. (42 U.S.C. 6295(ff)) EPCA, as amended, prescribed energy conservation standards for these products and authorized DOE to consider energy efficiency or energy use standards for the electricity used by ceiling fans to circulate air in a room. *Id.*

Under 42 U.S.C. 6295(m), DOE must periodically review its already established energy conservation standards for a covered product. Under this requirement, the next review that DOE would need to conduct must occur no later than 6 years from the issuance of any final rule establishing or amending a standard 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. 6293, 6295(o)(3)(A)) 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 ceiling fans appear at title 10 of the Code of Federal Regulations (CFR) part 430, subpart B, appendix U.

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including ceiling fans. 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 ceiling fans, 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))

Further, EPCA 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))

EPCA 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 in 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))

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)).

Pursuant to the amendments contained in the Energy Independence and Security Act of 2007 (EISA 2007), Public Law 110–140, 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 this rulemaking, DOE proposes to incorporate such energy use into any amended energy conservation standards it adopts in the final rule.

B. Background

1. Current Standards

The Energy Policy and Conservation Act of 1975 (EPCA) defined and established design standards for ceiling fans. EPCA defined a ''ceiling fan'' 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)) In a final rule technical amendment published in the **Federal Register** (FR) on October 18, 2005, DOE codified the statutorily-prescribed design standards for ceiling fans. 70 FR 60407, 60413. These standards are set forth in DOE's regulations at 10 CFR 430.32(s), and require all ceiling fans manufactured on or after January 1, 2007, to have the following features:

(i) Fan speed controls separate from any lighting controls;

(ii) adjustable speed controls (either more than one speed or variable speed); and

(iii) the capability for reverse action (other than fans sold for industrial or outdoor application or where safety would be an issue)).

(42 U.S.C. 6295(ff)(1)(A) and (6))

2. History of Standards Rulemaking for Ceiling Fans

EPCA established energy conservation standards for ceiling fans as described in Section II.B.1 and authorized DOE to consider, subject to the requirements of 42 U.S.C. 6295(o) and (p), establishing energy efficiency or energy use standards for the electricity used by ceiling fans to circulate air in a room. (42 U.S.C. 6295(ff))

As noted in section II.B.1, DOE codified the statutorily-prescribed design standards for ceiling fans in the CFR at 10 CFR 430.32(s). 70 FR 60407, 60413 (Oct. 18, 2005). DOE also adopted test procedures for ceiling fans at 10 CFR part 430, subpart B, appendix U. 71 FR 71340, 71366–67 (Dec. 8, 2006).

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 energy conservation standards rulemaking. 76 FR 56678. DOE also posted the framework document on its Web site, in which it described the procedural and analytical approaches it anticipated using to evaluate amended energy conservation standards for ceiling fans and ceiling fan light kits.

DOE held the public meeting for the framework document on March 22, 2013,[13] to present the framework document, describe the analyses DOE planned to conduct during the rulemaking, seek comments from interested parties on these subjects, and inform them 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 published the preliminary analysis for the ceiling fan energy conservation standards rulemaking on September 29, 2014. 79 FR 58290. DOE posted the preliminary analysis, as well as the complete preliminary technical support document (TSD), on its Web site.[14] The preliminary TSD includes the results of the following DOE preliminary analyses: (1) Market and technology assessment; (2) screening analysis; (3) engineering analysis; (4) markups analysis; (5) energy use analysis; (6) LCC and PBP analyses; (7) shipments analysis; (8) national impact analysis (NIA); and (9) preliminary manufacturer impact analysis (MIA).

DOE held a public meeting on November 19, 2014, to present the preliminary analysis, which included presenting preliminary results for the engineering and downstream economic analyses, seek comments from interested parties on these subjects, and facilitate interested parties' involvement in the rulemaking. At the public meeting, and during the comment period, DOE received comments that addressed issues raised in the preliminary analysis and identified additional issues relevant to this rulemaking.

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

1. Scope of Coverage

EPCA defines a ''ceiling fan'' 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))

In the ceiling fan light kit test procedure final rule published on December 24, 2015. 80 FR 80209, DOE reinterpreted the statutory definition of a ceiling fan to include hugger fans, which are fans that are mounted close to the ceiling, and are safe to use in environments with low ceilings, and also clarify that ceiling fans that produce large volume of airflow also meet the definition. DOE research indicates that all ceiling fans currently on the market, including hugger ceiling fans and ceiling fans that produce a large volume of airflow, appear to meet the EPCA design standards.

The changes in interpretation of the ceiling fan definition discussed above result in the applicability of the design standards set forth in EPCA at 42 U.S.C. 6295(ff)(1) to these fan types 30 days after the publication of the ceiling fan light kit final rule test procedure. DOE is also proposing efficiency standards for these fan types in this ceiling fan NOPR.

During the preliminary analysis public meeting, Southern Company expressed concern over including larger ceiling fans, generally used in commercial and industrial settings under 10 CFR 430. Southern Company suggested that it would be more appropriate for larger ceiling fans to be considered as an ASHRAE product, and not subject to standards established in this rulemaking. (Southern Company, Public Meeting Transcript, No. 83 at p. 188)[15] DOE interprets Southern Company's comments to recommend that DOE exclude larger ceiling fans from this rulemaking and allow ASHRAE to include efficiency requirements for these products in ASHRAE 90.1 standard.

Pursuant to EPCA, ceiling fans are defined as a nonportable device that is

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

[14] The preliminary analysis, preliminary TSD, and preliminary analysis public meeting information are available at regulations.gov under docket number EERE–2012–BT–STD–0045–0066

[15] 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 ceiling fans (Docket No. EERE–2012–BT–STD–0045), which is maintained at *www.regulations.gov.* This notation indicates that the statement preceding the reference is document number 83 in the docket for the ceiling fan energy conservation standards rulemaking, and appears at page 188 of that document.

suspended from a ceiling for circulating air via the rotation of fan blades. (42 U.S.C. 6291(49)) EPCA also defines a ''consumer product'', which includes ceiling fans, as any article of a type that consumes energy and, ''to any significant extent, is ''distributed in commerce for personal use or consumption by individuals.'' Because ceiling fans are considered a consumer product under this definition, and because the definition of ceiling fan does not have a threshold for size, DOE's authority to consider energy conservation standards for ceiling fans includes the larger ceiling fans generally used in commercial and industrial settings referred to by Southern Company. In a separate rulemaking proceeding, DOE is currently negotiating energy conservation standards for commercial and industrial fans and blowers.[16] DOE encourages Southern Company and other interested parties to comment on any proposed standards for this equipment as well, to ensure that DOE's standards for ceiling fans and for commercial and industrial fans and blowers do not overlap.

2. Product Classes

When 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 justify differing standards. 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))

Currently there are no product classes for ceiling fans, because the previous final rule for ceiling fans published on October 18, 2005 set design standards, but did not establish product classes. 70 FR 60407. In this NOPR, DOE is proposing six product classes, which include highly-decorative, very small-diameter, hugger, standard, high-speed small-diameter and large-diameter product classes. For further details on product classes, see section IV.A.1 of this notice.

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. Similarly, DOE must use these test procedures to determine compliance with its energy conservation standards. (42 U.S.C. 6295(s)) As noted, the test procedures for ceiling fans are provided in appendix U. DOE published a NOPR to amend these test procedures on October 17, 2014. 79 FR 62521, and published a supplemental NOPR (SNOPR) to provide further amendments to the published NOPR on June 3, 2015. 80 FR 31487.

Currently no energy efficiency performance standards exist for ceiling fans. DOE proposes to set energy efficiency performance standards in terms of an airflow efficiency equation as proposed in the test procedure NOPR and subsequent SNOPR. 79 FR 62521 (Oct. 17, 2014); 80 FR 31487 (June 3, 2015). The metric used to evaluate performance in this NOPR calculates ceiling fan efficiency as the average of airflows and power consumption at different speeds weighted by hours of operation in each speed, including standby power.

In the test procedure SNOPR, DOE proposed to test all ceiling fans with blade spans less than or equal to 7 feet according to a modified version of the ENERGY STAR® ''Testing Facility Guidance Manual: Building a Testing Facility and Performing the Solid State Test Method for ENERGY STAR Qualified Ceiling Fans,'' version 1.1 test procedure, for any representations with respect to energy use or efficiency of these ceiling fans. DOE also proposed to test all ceiling fans with blade spans less than or equal to 7 feet mounted to the real ceiling. Additionally, DOE proposed to test all ceiling fans with blade spans less than or equal to 7 feet at high and low speeds, with the exception that high-volume small-diameter ceiling fans, which would only be tested at high speed. 80 FR 31489–31490.

In the test procedure NOPR, DOE proposed to test all high-volume ceiling fans according to a modified version of the test procedure in American National Standards Institute/Air Movement and Control Association International, Inc. (ANSI/AMCA) Standard 230–12, ''Laboratory Methods of Testing Air Circulating Fans for Rating and Certification'' (AMCA 230[17]). DOE also proposed that these ceiling fans be tested only at high speed. 79 FR 62532. However, in the test procedure SNOPR, DOE modified the proposed test methods for high-volume ceiling fans. Specifically, instead of testing at only high speed, DOE proposed to test all ceiling fans with blade spans greater than 7 feet at five speeds spaced equally over the range of available speeds: 20%, 40%, 60%, 80%, and 100%. 80 FR 31490.

Additionally, in the test procedure NOPR, DOE also proposed to reinterpret the statutory definition of a ceiling fan to include hugger ceiling fans. DOE also proposed to clarify that multi-mount ceiling fans meet the statutory definition of a ceiling fan. During the public meeting, several manufacturers commented on how the requirements proposed in the ceiling fan test procedure NOPR would affect how they represent the performance of their ceiling fans in the market. DOE also received comments regarding the test procedure and metric in response to the Preliminary Analysis technical support document. DOE will respond to all comments on the proposed test procedure, ceiling fan representations and the proposed metric in the concurrent 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 technology options 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

[16] All information for this rulemaking is available at regulations.gov, under docket number EERE–2013–BT–STD–0006 (*http://www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0006*).

[17] Air Movement and Control Association International, Inc. *ANSI/AMCA Standard 230–12: Laboratory Methods of Testing Air Circulating Fans for Rating and Certification.* 2010. Arlington Heights, IL. (Last accessed February 24, 2014) *https://www.amca.org/store/item.aspx?ItemId=37.*

policy not to include in its analysis any proprietary technology that is a unique pathway to achieving a certain efficiency level. Section IV.B of this notice discusses the results of the screening analysis for ceiling fans, particularly the designs DOE considered, those it eliminated (screened out), and those that are the basis for the standards considered in this rulemaking. For further details on the screening analysis for this rulemaking, see section IV.B of this notice and 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 ceiling fans, 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.1 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 ceiling fans 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).[18] The savings are measured over the entire lifetime of ceiling fans purchased in this 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 national impact analysis (NIA) spreadsheet model to estimate energy savings from potential amended standards for ceiling fans. 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 ceiling fans, the primary fuel is electricity. For more information on FFC multipliers, see section IV.H.1.

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 a manufacturer impact analysis (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 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 net present value 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 analyses.

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

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

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 (including installation) of a more efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost due to a more stringent standard by the change in annual operating cost for the year that standards are assumed to take effect.

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

Southern Company encouraged DOE to pursue an efficiency standard that keeps incremental fan price increases minimal while also having a small payback period. (Southern Company, Public Meeting Transcript, No. 83 at p. 271) In assessing a proposed energy conservation standard, DOE considers not only PBP, but also the other factors discussed in section III.E. Section V.B.1 contains the calculated PBPs for the proposed standard levels.

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 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 ceiling fans. 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 national impacts analysis uses a second spreadsheet set that provides shipments forecasts and calculates national energy savings and net present value 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, and the technology options DOE identified that can improve the efficiency of ceiling fans.

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))

In the ceiling fan test procedure NOPR, DOE proposed test methods for two major categories of ceiling fans; low-volume ceiling fans and high-volume ceiling fans. 79 FR 62521. DOE defined a low-volume ceiling as a ceiling fan that: (1) Is less than or equal to 7 feet in diameter, and has a blade thickness greater than or equal to 3.2 mm at the edge and a maximum tip speed less than or equal to the limit in the Underwriters Laboratory (UL) Standard 507–1999, ''UL Standard for Safety for Electric Fans;''; or (2) has a maximum airflow volume less than or equal to 5,000 CFM. DOE defined a high-volume ceiling as a ceiling fan that: (1) is greater than 7 feet in diameter, or has a blade thickness of less than 3.2 mm at the edge or a maximum tip speed that exceeds the threshold in the UL 507 table; and (2) has a maximum airflow volume greater than 5,000 CFM. 79 FR 62526. In the test procedure NOPR, DOE also proposed definitions for hugger and standard fans. DOE proposed that a hugger ceiling fan is a ceiling fan where the lowest point on the fan blades is no more than 10 inches from the ceiling based on the distance between the lowest point of the fan blade and the ceiling. DOE proposed that a standard ceiling fan is a ceiling fan where the lowest point on the fan blades is more than ten inches from the ceiling. 79 FR 62526.

In the preliminary analysis, DOE further differentiated low-volume and high-volume ceiling fans into five ceiling fan product classes based on capacity and performance-related features that affect consumer utility. The product classes considered in the preliminary analysis were: Hugger, standard, highly-decorative, high-volume small-diameter, and high-volume large-diameter.[19] Table IV–1 provides the product class definitions considered in the preliminary analysis.

TABLE IV–1—PRELIMINARY ANALYSIS PRODUCT CLASSES

	Product class	Definition
Low-volume ...	Hugger	Lowest point on fan blades is ≤10 inches from the ceiling.
	Standard	Lowest point on fan blades >10 inches from the ceiling.
	Highly- decorative.	Rotational speed ≤90 RPM and airflow ≤2,000 CFM at high speed.
High-volume ..	Small-diameter (HVSD).	High-volume ceiling fan with diameter ≤7 feet.
	Large-diameter (HVLD).	High-volume ceiling fan with diameter >7 feet.

DOE received several comments regarding the ceiling fan categories proposed, and the product classes being considered.

Stakeholders provided a variety of recommendations on how to define ''low-volume'' and ''high-volume'' ceiling fans. MacroAir suggested that CFM be the only distinguishing factor between low-volume (max airflow is less than or equal to 5000 CFM) and high-volume (max airflow is greater than 5000 CFM) ceiling fans, and to exclude blade thickness as it may impede innovation. (MacroAir, No. 89 at p. 12) Minka Group suggested that the cutoff airflow for low-volume ceiling fans be increased to 10,000 CFM. (Minka, Public Meeting Transcript, No. 83 at p. 58)

Alternatively, manufacturers recommended differentiating fans based on blade diameter instead of air volume. BAS recommended that all fans less than or equal to 7 feet be considered small-diameter fans, and all fans greater than 7 feet be considered large-diameter fans. (BAS, No. 88 at p. 2) The American Lighting Association (ALA) echoed BAS's recommendation. ALA added that the ''low-volume'' and ''high-volume'' terms can be confusing and misleading and imply that the ''low-volume'' product classes are somehow less effective from a consumer utility perspective than the ''high-volume'' product classes. (ALA, No. 91 at p. 8)

In the test procedure NOPR, DOE proposed separate test methods for low-volume and high-volume ceiling fans because some large-diameter ceiling fans (*i.e.,* those ceiling fans with blade spans greater than 7 feet) are too large to be tested in current low-volume ceiling fan test facilities. Additionally, testing with a single load cell is more practical for large-diameter ceiling fans than testing with numerous air velocity sensors as is typically done for small-diameter ceiling fans. In the test procedure NOPR, DOE proposed to test high-volume small-diameter ceiling fans according to the same procedure as large-diameter ceiling fans (*i.e.,* using a load cell), even though they are less than 7 feet in diameter.

In response to the test procedure NOPR, several stakeholders disagreed with DOE's proposal to test high-volume small-diameter ceiling fans differently than low-volume ceiling fans. BAS stated that there may be instances in which a small-diameter ceiling fan has a large enough measured airflow under the test procedure NOPR low-volume test procedure to qualify it as a high-volume ceiling fan, but when tested according to the high-volume test procedure proposed in the NOPR, the measured airflow would be too low for the fan to qualify as a high-volume fan. (BAS, Public Meeting Transcript, No. 83 at pp. 63–64) According to ALA, manufacturers are already accustomed to testing all ceiling fans with blade spans less than or equal to 7 feet, including high-volume small-diameter fans, according to the current ENERGY STAR test procedure, regardless of airflow volume. (Docket No. EERE–2013–BT–TP–0050, ALA, No. 8 at pp. 7–8)

On June 3, 2015, DOE published a test procedure SNOPR that modified some of the proposals from the test procedure NOPR. 80 FR 31487. In the test procedure SNOPR, DOE proposes that all ceiling fans 7 feet or less in diameter be tested using version 1.1 of the ENERGY STAR test procedure, while all ceiling fans greater than 7 feet be tested using a version of the AMCA 230 test procedure. DOE proposed this change to

[19] The preliminary analysis TSD is available at regulations.gov under docket number EERE–2012–BT–STD–0045.

harmonize the DOE test procedure with accepted industry testing practices. Consequently, definitions for ''low-volume'' and ''high-volume'' ceiling fans are no longer needed, because the test methods proposed are based only on ceiling fan diameter. For this NOPR, DOE accordingly did not adopt the airflow cutoff threshold recommendations from Macro Air and Minka Group because DOE is no longer proposing an airflow volume approach to determine ceiling fan categories.

DOE proposes to define a ''small-diameter ceiling fan'' as ''a ceiling fan that is less than or equal to 7 feet in diameter'', and a ''large-diameter ceiling fan'' as ''a ceiling fan that is greater than 7 feet in diameter.'' DOE is no longer proposing definitions to differentiate product classes as ''low-volume'' and ''high-volume'' ceiling fans.

DOE also received multiple stakeholder comments regarding the product classes considered in the preliminary analysis. In the preliminary analysis, DOE presented product classes that follow the Underwriters Laboratory (UL) ceiling fan safety standards (UL Standard 507–1999, ''UL Standard for Safety for Electric Fans'' (UL 507)) to differentiate between classes. The UL 507 standard uses both blade thickness and tip speed to differentiate fans (See Table IV–3).

BAS commented that the classification of ceiling fans based on blade thickness limits innovation, and therefore recommended a tip speed of 680 feet per minute (fpm) paired with a diameter and distance from blades to ceiling to determine fan classification. (BAS, No. 88 at p. 4) BAS recommended 680 fpm assuming a 52-inch standard fan and a 50 rpm maximum speed. (BAS, No. 88, p. 12) BAS's recommended fan classification, however, defined only the standard, hugger, highly-decorative and large-diameter product classes, and eliminated the HVSD product class. (BAS, No. 88 at p. 4) MacroAir commented that blade thickness is not applicable to define low-volume and high-volume ceiling fans, because it confuses the definition and may impede innovation. (Docket No. EERE–2013–BT–TP–0050, MacroAir, No. 6 at p. 6) ALA, on the other hand, provided comments on product classes that included both blade thickness and tip speed. (ALA, No. 96, p. 8)

Neither BAS nor MacroAir provided specific examples on how incorporating blade thickness in the product class definitions would limit innovation. Additionally, BAS's recommendation on using 680 fpm tip speed to differentiate product classes eliminated the HVSD product class. Instead, HVSD ceiling fans were included as part of the standard or hugger ceiling fan class. However, DOE finds that HVSD ceiling fans provide different utility to the consumer than standard or hugger ceiling fans, and therefore warrant a separate product class. HVSD ceiling fans generally operate at much higher speeds (in terms of RPM) than standard or hugger ceiling fans. In addition, DOE observes that HVSD fans are generally applied in commercial buildings whereas standard fans are installed in residential buildings. Further discussion on the HVSD ceiling fan product class is in section IV.A.1.d.

Based on BAS and MacroAir's comments, DOE considered whether the product class structure presented in the preliminary analysis could be simplified by removing blade thickness criteria. DOE investigated differentiating standard and hugger ceiling fans from HVSD ceiling fans using tip speed, but was unable to determine an appropriate tip speed threshold. In general, DOE had limited tip speed specifications for ceiling fans on the market. However, DOE looked at a database of 1400 ceiling fans, applied three different tip speed thresholds (680, 1200 and 2400 fpm), and calculated the percent of misclassifications of standard and hugger ceiling fans as HVSD ceiling fans. DOE found that between 40 and 100 percent of models were misclassified at these tip speed thresholds. (The lower the tip speed thresholds, the higher the rate of misclassification.) Therefore, DOE proposes to continue to use blade thickness to determine ceiling fan product classes.

DOE prefers to harmonize with existing industry standards and practices to the extent possible. Using the blade thickness limits from the UL 507 standard in the product class definition allows for DOE to harmonize with existing safety standards. All manufacturers will have to comply with the existing UL 507 standard for applications in which the distance between the fan blades and the floor is 10 feet or less, regardless of whether DOE's use of blade thickness in its product class definition. Consequently, including blade thickness in the product class definitions does not introduce new constraints for these applications.[20] However, for ceiling fans in applications in which the distance between the fan blades and the floor is greater than 10 feet, DOE's product class structure allows for manufacturers to consider blade thickness and maximum tip speeds outside the range of the UL 507 standard. Additionally, for high-volume large-diameter (HVLD) ceiling fans, DOE does not include any blade thickness or maximum tip speed requirements.

In the preliminary analysis, the product class structure also incorporated a 5,000 CFM maximum airflow volume cutoff to differentiate between HVSD ceiling fans and low-volume ceiling fans, as described previously in this section. DOE found in the preliminary analysis that, without the CFM cutoff, low-volume ceiling fans were inadvertently being placed in the HVSD product class because some low-volume ceiling fans operate at high RPMs and high airflows. For this NOPR, however, DOE is proposing to analyze a separate product class for very small-diameter (VSD) ceiling fans. (See section IV.A.1.c for further discussion on the VSD product class.) VSD ceiling fans are fans with one or more heads, each of which has a blade span of 18 inches or less and operate at high RPMs (generating high volumes of airflow). VSD ceiling fans provide consumers targeted airflow that can be directed, unlike the airflow of a traditional ceiling fan. Also VSD fans can be mounted in small, awkward spaces where traditional fans will not fit. The low-volume ceiling fans that DOE had identified as being inadvertently placed in the HVSD product class in the preliminary analysis were VSD fans. As part of analyzing VSD fans as a separate product class, DOE is proposing a definition for VSD fans that will avoid misclassifying them as HVSD fans based on diameter (18 inches or less). Consequently, the 5,000 CFM cutoff is no longer necessary. DOE proposes to eliminate the 5,000 CFM cutoff from the product class definitions.

Table IV–2 provides the new product classes that DOE is proposing for all ceiling fans. DOE also proposes new product class names based on updates to the ceiling fan categories and product class definitions. Specifically, DOE is updating product class names based on the elimination of the concept of ''low-volume'' or ''high-volume'' ceiling fans. Therefore, the naming convention for HVSD ceiling fans is changed to high-speed small-diameter (HSSD) ceiling fans, and HVLD ceiling fans to large-diameter ceiling fans. In addition, all airflow criteria are as measured by the test procedure as proposed in the test procedure NOPR and modified by the test procedure SNOPR. 80 FR 31487 (June 3, 2015). DOE requests comment

[20] Underwriters Laboratories Inc. UL Standard for Safety for Electric Fans, UL 507. 1999. Northbrook, IL. (Last accessed February 24, 2014) *http://www.comm-2000.com/ProductDetail.aspx?UniqueKey=8782.*

on the product class structure proposed.
See issue 1 in section VII.E.

TABLE IV–2—PROPOSED CEILING FAN PRODUCT CLASSES

	Product classes	Product class definitions
Small-Diameter (7 feet or less).	Highly-decorative	A ceiling fan with a maximum rotational speed of 90 RPM and less than 1,840 CFM airflow at high speed.
	Belt-driven	A ceiling fan with a series of one or more fan heads, each driven by a belt connected to one or more motors.
	Very Small-Diameter (VSD)	A ceiling fan that is not a highly-decorative ceiling fan or belt-driven ceiling fan; and has one or more fan heads, each of which has a blade span of 18 inches or less.
	Hugger	A ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and where the lowest point on fan blades is ≤10 inches from the ceiling; and has a blade thickness of ≥3.2 mm at the edge and a maximum tip speed ≤ the applicable limit in Table IV–3.
	Standard	A ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and where the lowest point on fan blades is >10 inches from the ceiling; and has a blade thickness of ≥3.2 mm at the edge and a maximum tip speed ≤ the applicable limit in Table IV–3.
	High-speed small-diameter (HSSD).	A ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and has a blade thickness of <3.2 mm at the edge or a maximum tip speed > the applicable limit in Table IV–3.
Large-Diameter	Large-diameter	A ceiling fan that is greater than 7 feet in diameter.

TABLE IV–3—UL 507 BLADE THICKNESS AND MAXIMUM TIP SPEED LIMITS

Airflow direction *	Thickness (t) of edges of blades		Maximum speed at tip of blades	
	Mm	(inch)	m/s	(feet per minute)
Downward-Only	4.8 > t ≥ 3.2	(3/16 > t ≥ 1/8)	16.3	(3200)
Downward-Only	t ≥ 4.8	(t ≥ 3/16)	20.3	(4000)
Reversible	4.8 > t ≥ 3.2	(3/16 > t ≥ 1/8)	12.2	(2400)
Reversible	t ≥ 4.8	(t ≥ 3/16)	16.3	(3200)

* The "downward-only" and "reversible" airflow directions are mutually exclusive; therefore, a ceiling fan that can only produce airflow in the downward direction need only meet the "downward-only" blade edge thickness and tip speed requirements and a ceiling fan that can produce airflow in the downward and upward directions need only meet the "reversible" requirements.

The following sections provide further details on each product class proposed, and the methodology DOE is using to determine these product classes.

a. Highly-Decorative Ceiling Fans

In the preliminary analysis, DOE defined highly-decorative ceiling fans as ceiling fans with a rotational speed of 90 RPM or less, and an airflow of 2,000 CFM or less at high speed, as tested using the current DOE test procedure, because the primary utility of highly-decorative ceiling fans is not airflow.[21] Consequently, highly-decorative ceiling fans typically produce less airflow.

BAS stated that using a combination of CFM and RPM to define highly-decorative ceiling fans is better than simply using RPM. BAS also commented that it would be hard to measure CFM for some of these highly-decorative ceiling fans using the ENERGY STAR test procedure. BAS recommended using tip speed as the defining characteristic for highly-decorative ceiling fans, and stated that assuming a 52-inch fan and a 50 rpm speed, a maximum tip speed of less than or equal to 680 fpm would be appropriate. (BAS, No. 79 at p. 33)

On the other hand, Matthews Fan Company suggested that CFM, possibly as a function of fan diameter, be used to define highly-decorative ceiling fans because some of their smaller fans run at higher than 90 RPM speeds and would not fall under the proposed definition. (Matthews, Public Meeting Transcript, No. 83 at p. 176) Matthews Fan Company stated that if the RPM was used to define these fans, that a 1,100 RPM minimum cutoff would be appropriate because their small-diameter fans include high-speed blower motors. Matthews added that these fans are designed to provide directional airflow into a space directly underneath or across the room. (Matthews, Public Meeting Transcript No. 83 at p. 177)

ALA recommended that within the small diameter fans, the highly-decorative product class is (i) maximum rotational speed of 90 RPM and less than 2,000 CFM airflow at high speed; or (ii) belt-driven fans. (ALA, No. 91 at p. 8)

DOE first considered using only a maximum tip speed to define highly-decorative ceiling fans. DOE investigated which ceiling fans on the market would be categorized as highly-decorative using a tip speed of 680 fpm, as suggested by BAS. BAS did not provide any supporting information as to why the suggested maximum speed is appropriate for the assumed diameter. In general, relatively few decorative ceiling fans advertise rpm or tip speed in their specifications. In addition, DOE found that relatively few ceiling fans advertise that they operate entirely below the 680 fpm threshold recommended by BAS. Therefore, DOE could not endorse BAS's tip speed recommendation. DOE also looked into tip speeds slightly higher than 680 fpm that could potentially be used to define the highly-decorative product class. DOE looked at a database of 1,400 ceiling fans, and the next tip speed closest to 680 fpm was 803 fpm.

[21] The preliminary analysis TSD is available at *regulations.gov* under docket number EERE–2012–BT–STD–0045.

However, this ceiling fan was advertised as a ''traditional'' standard ceiling fan, not a highly-decorative ceiling fan. Hence, DOE concluded that any tip speed that is 803 fpm and above could not be used to define highly-decorative ceiling fans, as this would inadvertently place traditional ceiling fans into the highly-decorative ceiling fan product class. Thus, DOE could not definitively identify a tip speed that could be used to define highly-decorative ceiling fans. Therefore, DOE does not propose to define highly-decorative ceiling fans using only tip speed, to avoid misclassifying fans based on limited tip speed data.

DOE also considered using only a maximum CFM cutoff for the highly-decorative ceiling fans, per Matthews Fan Company's comments. DOE analyzed published CFM results of ceiling fans sold in the market, and observed which ceiling fans would be classified as highly-decorative using only a maximum CFM cutoff. DOE observed that some fans advertised and designed primarily to provide directed airflow in a small space—characteristics of VSD fans for which DOE proposes to set standards—were misclassified as highly-decorative ceiling fans. Further discussion on VSD ceiling fans is provided in IV.A.1.c.

DOE also considered using only the 1,100 RPM cutoff for the highly-decorative ceiling fans suggested by Matthews Fan Company. DOE performed market research on ceiling fans specifications and identified only three ceiling fans that had RPMs greater than the 1,100 RPM suggested by Matthews Fan Company. DOE confirmed, however, that these ceiling fans would be classified as VSD ceiling fans, because they are advertised for use when air circulation needs to be directed, or if space is tight. In addition, Matthews Fan Company stated in its comments that these high RPM ceiling fan are designed to provide directional airflow into a space directly underneath. (Matthews, Public Meeting Transcript No. 83 at p. 177) Therefore, DOE does not propose to define highly-decorative ceiling fans using only RPM, to avoid misclassifying fans based on limited data.

After finding that using only tip speed, RPM, or airflow to define highly-decorative ceiling fans may result in misclassifications, DOE proposes to use a definition based on both a CFM and RPM cutoff, similar to what was analyzed and considered in the preliminary analysis. DOE expects that this approach will minimize misclassifications. DOE is proposing this definition based on both CFM and RPM because relatively low maximum RPM may indicate that a ceiling fan was not designed primarily to provide airflow, as would relatively low maximum airflow. However, criteria for a low maximum RPM by itself might misclassify some larger ceiling fans that operate at relatively low RPM, but provide high volumes of airflow, as highly decorative ceiling fans. Conversely, criteria for low maximum CFM by itself might incorrectly misclassify some VSD ceiling fans as highly decorative category. ALA supports an RPM and CFM cutoff for highly decorative ceiling fans. (ALA, No. 91 at p. 8) DOE requests comment on the approach to use both fan speed and an airflow threshold to delineate highly-decorative ceiling fans. See issue 2 in section VII.E.

In the preliminary analysis, DOE used a 2,000 CFM (as tested per the current DOE test procedure) cutoff for highly-decorative fans. For this document, DOE is updating the CFM cutoff value from 2,000 CFM to 1,840 CFM because the test procedure SNOPR updates the method of test to mounting ceiling fans directly to the real ceiling, which yields a different airflow measurement. DOE determined the percentage reduction in CFM from the current DOE test procedure to mounting directly to the ceiling by performing tests on ceiling fans in both configurations and calculating a scaling factor. Applying this scaling factor, DOE proposes that a highly-decorative ceiling fan is a ceiling fan with a maximum rotational speed of 90 RPM and less than 1,840 CFM airflow at high speed.

b. Belt-Driven Ceiling Fans

DOE did not include a separate product class for belt-driven ceiling fans in the preliminary analysis. According to ALA, a belt-driven ceiling fan is a series of one or more fan heads suspended from the ceiling, each driven by a belt connected to one or more motors that are independently suspended from the ceiling. (ALA, No. 91 at p. 11)

ALA suggested including belt-driven fans within the highly-decorative product class. (ALA, No. 91 at p. 11) ALA also commented that belt-driven ceiling fans are purchased by consumers principally for their aesthetic qualities. Typically, a belt-driven fan will use one or two motors to power multiple fan heads—up to seven or eight—that rotate at low speed. The fan heads may rotate at very slow speeds, with maximum speeds under 90 rpm, if there are many fan heads attached to the same motor. (ALA, No. 91 at p. 11)

DOE's research on belt-driven ceiling fans indicates that the market share is less than 1 percent. DOE has observed that these fans are used in bars and restaurants that have decorative ceilings with limited electrical boxes on the ceiling to mount multiple conventional ceiling fans. Belt-driven ceiling fans use one or two motors to power multiple fan heads, eliminating the need for many electrical boxes. Additionally, belt-driven ceiling fans are highly customizable, in that consumers can decide number of fan heads and the kind of fan belts to use in their belt-driven ceiling fans, for example.

ALA suggested including belt-driven ceiling fans within the highly-decorative ceiling fan product class. (ALA, No. 91 at p. 11) EPCA requires that if DOE sets energy efficiency standards for ceiling fans, it must consider ''establishing separate exempted product classes for highly decorative fans for which air movement performance is a secondary design feature.'' (42 U.S.C. 6295(ff)(6)(B)(ii)) Because belt-driven ceiling fans can have up to seven to eight fan heads, DOE has determined that the total airflow that these ceiling fan heads will provide indicates that air movement performance is not a secondary design feature for these fans.

Instead, DOE proposes to separate belt-driven ceiling fans into their own product class because they provide a distinct utility for consumers. DOE proposes to define belt-driven ceiling fans as a ceiling fan with a series of one or more fan heads, each driven by a belt connected to one or more motors.

In the NOPR, DOE agrees with manufacturers' that the market share for belt-driven ceiling fans is small. Due to the limited number of basic models for belt-driven ceiling fans, DOE did not have data to directly analyze and establish standards for this additional product classes. As a result, DOE does not propose standards for belt-driven ceiling fans in this rulemaking.

c. Very Small-Diameter Ceiling Fans

In the preliminary analysis, DOE did not have a separate product class for ceiling fans less than or equal to 18 inches in diameter. DOE received comments on the preliminary analysis that these ''very small-diameter fans'' require special consideration.

ALA expressed concerns with DOE's proposed treatment of ceiling fans with very small diameters. ALA defines a ''very small-diameter ceiling fan'' as a ceiling fan with one or more fan heads, each of which has a blade span of 18 inches or less. ALA estimated that very small-diameter fan sales represent between 0.3 and 0.5 percent of the U.S.

ceiling fan market. ALA added that these fans would be disproportionately penalized under DOE's candidate standard levels for low-volume standard and hugger ceiling fans, which do not appear to have been based on testing of any ceiling fan smaller than 44 inches in diameter. According to ALA, very small-diameter fans would be disadvantaged because very small diameter ceiling fans use high-velocity AC motors to operate at high speeds, and there is no DC motor on the market, or currently in development, that would provide an acceptable substitute for this functionality. (ALA, No. 91 at p. 9) ALA requests that DOE consider very small-diameter ceiling fans to be outside the scope of this rulemaking or otherwise exempt them from energy efficiency standards. (ALA, No. 91 at p. 9) ALA commented that if DOE does not determine that very small-diameter ceiling fans are outside the scope of the rulemaking or otherwise exempt them from standards, DOE should establish a separate product class for very small-diameter ceiling fans because of the unique utility that they provide to consumers. (ALA, No. 91 at p. 9) ALA commented that very small-diameter fans could also be multi-head or orbital fans that also provide consumers a distinct utility from traditional ceiling fans. (ALA, No. 91 at p. 10) These ceiling fans provide consumers targeted airflow that can be directed, unlike the airflow of a traditional ceiling fan. Also VSD fans can be mounted in small, awkward spaces where traditional fans will not fit. (ALA, No. 91 at p. 10) Therefore, ALA proposed to define very small-diameter fans as ''a ceiling fan with one or more fan heads, each of which has a blade span of 18 inches or less.'' (ALA, No. 8 at p. 6)

In response to the comments received on very small-diameter ceiling fans, DOE conducted testing of ceiling fans with blade spans of 18 inches or less to obtain data on their performance. DOE determined from testing that very small-diameter ceiling fans have much lower airflow capacity and airflow efficiency than standard and hugger fans. Further discussion on airflow capacity and efficiency results for VSD ceiling fans are in chapter 5 of the NOPR TSD. Additionally, very small-diameter fans provide a different utility to consumers, in that these fans can be mounted in small places where traditional ceiling fans will not fit. DOE concluded that for these reasons, a separate product class for very small-diameter ceiling fans is warranted.

Therefore, DOE proposes to adopt the very small-diameter fan definition suggested by ALA. DOE proposes that very small-diameter ceiling fans be defined as a ceiling fan that is not a highly-decorative ceiling fan or belt-driven ceiling fan; and has one or more fan heads, each of which has a blade span of 18 inches or less.

d. Standard and Hugger Ceiling Fans

In the test procedure NOPR, DOE proposed standard and hugger ceiling fan definitions based on the distance between the lowest point of the fan blades and the ceiling. For standard ceiling fans, DOE proposed that the lowest point of the fan blades is more than 10 inches from the ceiling. For hugger ceiling fans, DOE proposed that the lowest point of the fan blades is no more than 10 inches from the ceiling. 79 FR 62526 (October 17, 2014). With the current proposal to classify fans as ''small-diameter'' and ''large-diameter'', instead of ''low-volume'' and ''high-volume'', DOE proposes to update the standard and hugger ceiling fan definitions to differentiate them from other small-diameter product classes, such as VSDs.

Several manufacturers commented on the proposed definition of hugger ceiling fans in the test procedure NOPR, and on how they characterize their own hugger ceiling fans. Emerson stated that its hugger ceiling fans are designed to be mounted 11 to 12-inches from the ceiling, instead of 9 to 10 inches to avoid turbulent air, which causes the fan to vibrate, wobble, and make noise. (Emerson, Public Meeting Transcript, No. 83 at p. 73) The Minka Group stated that it classifies hugger ceiling fans as fans that are mounted directly to the ceiling without a downrod. Minka Group added that they measure the distance between the top of the blade instead of the bottom. Minka Group also stated that there was no advantage to including tri-mount fans to this category. (Minka, Public Meeting Transcript, No. 83 at p. 74) DOE understands tri-mount to mean a fan that can be mounted flush to the ceiling, with a standard downrod, or on a slope. Hunter Fan stated that it calls a fan a hugger ceiling fan when it's directly bolted to the ceiling. (Hunter, Public Meeting Transcript, No. 83 at p. 93) BAS mentioned that defining hugger ceiling fans as just mounted to the ceiling without a downrod would be problematic because, with the exception of their multi-mount ceiling fans, all of its fans are mounted to the ceiling without a downrod but still have 16 inches between the blades and ceiling. (BAS, Public Meeting Transcript, No. 83 at p. 94)

DOE recognizes that the ceiling fan industry does not have a standardized definition for hugger ceiling fans. While some ceiling fan manufacturers define hugger ceiling fans based on how they are mounted to the ceiling, others find this definition problematic. For the purposes of promulgating standards, DOE definitions, to the extent possible, are based on product specifications to provide verifiable methods of determining product class. Consequently, DOE proposes to base the hugger ceiling fan product class definition on the distance between the lowest point of ceiling fan blade and the ceiling, as specified by the manufacturer in the product literature shipped with the product. DOE proposes that the lowest point of the fan blades is no more than 10 inches from the ceiling for hugger fans.

While BAS stated that the 10-inch height is appropriate for the hugger definition, they also stated that CFM numbers would not drop dramatically when using the 10-inch specification, so the hugger classification has the potential to be eliminated entirely. (BAS, Public Meeting Transcript, No. 83 at p. 82)

DOE tested a multi-mount fan in both standard and hugger configurations based on the test methods presented in the test procedure NOPR, which assumes testing ceiling fans to a false ceiling, to evaluate relative performance. DOE observed a 16 percent decrease in CFM for a hugger configuration compared to a standard configuration. DOE did not observe any change in power consumption. DOE assumes, based on ceiling fan testing in multiple configurations that the relative performance between standard and hugger configurations would be the same even under the test procedure SNOPR, which assumes testing ceiling fans mounted directly to ceiling. Additionally, as described in the preliminary analysis, DOE determined that hugger fans offer a different functionality to the consumer because hugger fans can be safely used in rooms with lower ceilings. DOE concludes that these reasons warrant a separate product class for hugger ceiling fans.

DOE also received comments regarding the hugger definition in response to the test procedure NOPR. (DOE used the same definition for hugger fans in the preliminary analysis and in the test procedure NOPR.) ALA requested that DOE use the term ''close to ceiling'' instead of ''hugger.'' ALA mentioned that ''hugger'' ceiling fan can cause confusion with its commonly understood meaning in the industry. ALA proposed to define close to ceiling fans as: Not VSD or highly-decorative; and the lowest point on the fan blades is less than or equal to 10 inches from the ceiling; and has a blade thickness of greater than or equal to 3.2 millimeters at the edge, and having a maximum tip speed less than or equal to the applicable limit in the UL 507 table. (ALA, No. 96 at p. 8) BAS recommended that within the small-diameter fans (7 feet or less), hugger fans are those that have a tip speed greater than 680 fpm and have a blade to ceiling distance less than or equal to 10 inches. (BAS, No. 88 at p. 2)

DOE received no adverse comments from interested parties on its proposal to include in the definition of a hugger ceiling fan a distance of less than or equal to 10 inches from the lowest point of the fan blade to the ceiling. Thus, DOE proposes to include this criterion for the hugger fan product class in this NOPR.

DOE expects that keeping the name ''hugger'' is less costly and disruptive for manufacturers than changing to ''close to ceiling'' per ALA's suggestion. The majority of ceiling fans for which the lowest point of the fan blade is less than or equal to 10 inches from the ceiling are already referred to as ''hugger'' ceiling fans by manufacturers and no change in marketing material would likely be required. For fans where the blade is less than or equal to 10 inches from the ceiling and mounted on a downrod, some manufacturers would need to make changes to marketing material that to meet the proposed definition where the products are not already referred to as hugger ceiling fans by the industry. Based on online research on ceiling fans sold in the market, DOE estimates that these fans are in the minority. DOE proposes to continue to use the term ''hugger'' to remain consistent with the majority of the market.

After considering the elements of the hugger definition discussed above, DOE proposes that a hugger ceiling fan is a ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and where the lowest point on fan blades is ≤10 inches from the ceiling; and has a blade thickness of ≥3.2 mm at the edge and a maximum tip speed ≤ the applicable limit in Table IV–3.

DOE also received comments on the standard ceiling fan definition proposed in the test procedure NOPR. ALA suggested defining small-diameter standard ceiling fans as: Not VSD or highly decorative; and lowest point on fan blades is greater than 10 inches from the ceiling; and has a blade thickness of greater than or equal to 3.2 millimeters at the edge and a maximum tip speed less than or equal to the applicable limit in the UL 507 table. (ALA, No. 96 at p. 8) BAS recommended that within the small-diameter fans (7 feet or less), the standard fans are those that have a tip speed greater than 680 fpm, and have a blade to ceiling distance greater than 10 inches. (BAS, No. 88 at p. 2)

DOE received no adverse comments from interested parties on its proposal to include the distance from the lowest point of the fan blade to the ceiling to be greater than 10 inches in the definition of standard ceiling fans. DOE continues to include this distance in the standard ceiling fan proposal in this document. Additionally, as discussed previously, DOE proposes to adopt the UL 507 standard blade thickness and maximum tip speed limits when defining product classes, so as to not misclassify ceiling fans. Therefore, DOE proposes to use the same definition for standard ceiling fans as was used in the preliminary analysis and presented in the previous paragraph.

e. High-Speed Small-Diameter Ceiling Fans

In the preliminary analysis, DOE analyzed the HVSD product class, which included ceiling fans with a blade span less than or equal to 7 feet and an airflow greater than or equal to 5,000 CFM. As discussed in section IV.A.1, DOE proposes to classify fans as ''small-diameter'' and ''large-diameter'', instead of ''low-volume'' and ''high-volume'' for this NOPR. Consequently, DOE proposes to rename the HVSD ceiling fans product class analyzed in the preliminary analysis to high-speed small-diameter (HSSD), ceiling fans for this document. DOE also proposes to exclude the 5000 CFM cutoff from the HVSD definition in the HSSD ceiling fan definition. DOE proposes to define HSSD ceiling fans as fans that are not VSD or highly-decorative; and have a blade thickness of less than 3.2 millimeters at the edge or a maximum tip speed greater than the applicable limit in Table IV–3.

DOE received several comments on the HVSD definition presented in the preliminary analysis. BAS's suggested product class structure no longer included HVSD ceiling fans, and instead incorporates HVSD ceiling fans into standard or hugger ceiling fans. (BAS, No. 88, p. 4) ALA proposed defining industrial fans (formerly HVSD) as fans that are not VSD or highly decorative; and have a blade thickness of less than 3.2 millimeters at the edge or a maximum tip speed greater than the applicable limit in the UL 507 table. (ALA, No. 96 at p. 8)

DOE finds that HSSD ceiling fans provide different utility to the consumer than standard or hugger ceiling fans. HSSD ceiling fans generally operate at much higher speeds (in terms of RPM) than standard or hugger ceiling fans, and are installed in commercial applications. HSSD ceiling fans are available in a blade span range similar to standard and hugger ceiling fans, but an HSSD fan typically provides more airflow at a given blade span because it runs at much higher RPMs. DOE observes that HSSD fans are generally applied in commercial buildings whereas standard fans are installed in residential buildings. These factors indicate that HSSD ceiling fans provide a different utility to consumers compared to standard fans that warrants a separate product class for these ceiling fans. DOE proposes to define HSSD ceiling fans as suggested by ALA as a ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and has a blade thickness of less than 3.2 mm at the edge or a maximum tip speed greater than the applicable limit in Table IV–3.

f. Large-Diameter Ceiling Fans

In the preliminary analysis, DOE defined HVLD ceiling fans as fans that have a blade span greater than 7 feet. DOE proposes to rename HVLD ceiling fans as large-diameter ceiling fans for this document to be consistent with the proposal to establish product classes for ceiling fans primarily by diameter and not airflow. All fans categorized as HVLD in the preliminary analysis will be categorized as large-diameter in this document.

DOE received no comments on the HVLD definition described in the preliminary analysis. DOE proposes to use the HVLD definition from the preliminary analysis to define large-diameter ceiling fans for this NOPR. Therefore, DOE proposes to define large-diameter ceiling fans as a ceiling fan that is greater than 7 feet in diameter.

2. Technology Options

In the preliminary analysis market and technology assessment, DOE identified and assessed several technology options that were expected to improve the efficiency of ceiling fans, as measured by the DOE test procedure. These technologies fall into three main categories: (1) More efficient motors, which included direct-drive single phase induction motors, geared motors, brushless direct current (DC) motors, and three-phase induction motors; (2) more efficient blades, which included fewer fan blades, twisted blades, airfoil blades, beveled blades, curved blades, blade attachments and blade material;

and (3) ceiling fan controls, which include occupancy sensors. DOE then evaluated these technology options in the screening analysis to determine which would be screened out, and which would be retained and incorporated as design options in the engineering analysis.

In the preliminary analysis, DOE also requested comments on technology options that it had not identified that could be incorporated into the analysis. This section provides a discussion of newly considered technology options, and a list of the technology options DOE then analyzed in the screening analysis. DOE considered capacitor start induction run (CSIR) motors, capacitor start capacitor run (CSCR) motors, startup energy, wind and temperature sensors, fan optimization and gearless direct current (DC) motors as new technology options in this section. The new technology options were provided in response to DOE's request for comments to the preliminary analysis, and DOE also conducted additional research of new technologies.

a. CSIR and CSCR Motors

In the preliminary analysis, DOE specifically requested comment on whether there are other single-phase alternating current motor options, like CSIR and CSCR motors, which can be incorporated into ceiling fans and increase ceiling fan efficiency. ALA commented that CSIR and CSCR motors have been researched for ceiling fan applications and were found to be problematic. These motors create audible noise, high blade tip speeds and excessive motor temperatures when enclosed within ceiling fan housings. (ALA, No. 91 at p. 16) DOE also did not find any CSIR or CSCR motors that are incorporated in commercial products or working prototypes. DOE did not include CSCR and CSIR motors as technology options for these reasons.

b. Startup Energy

In its written comments, MacroAir suggested that DOE consider designs that reduce startup energy. MacroAir suggested DOE study various fans comparing their moment of inertia with startup power. (MacroAir, No. 89 at p. 7)

DOE recognizes that certain fan designs that reduce ceiling fan startup energy may have energy savings potential. However, MacroAir did not provide data on the magnitude of the savings potential. In addition, DOE is not aware of any industry test methods for measuring fan startup energy. Furthermore, the industry test procedure for small-diameter and larger-diameter ceiling fans requires that the airflow or thrust (for small-diameter or large-diameter ceiling fans, respectively) be measured only after the ceiling fan reaches steady state. Therefore, startup power, or reduction of startup power, is not reflected in the proposed metric. DOE did not include designs that reduce ceiling fan startup energy in the engineering analysis for this reason.

c. Wind and Temperature Sensors

Wind and temperature sensors detect temperature changes in the surrounding space, or potential wind speed reductions below certain thresholds. Ceiling fans could potentially adjust fan speed based on the wind and temperature in the space the ceiling fan is located when coupled with these sensors. This type of modulation could enable the ceiling fan to better match demand and reduce energy consumption. DOE received several comments on this potential technology option.

BAS commented that it is the only manufacturer of a ceiling fan with a temperature sensor. (BAS, Public Meeting Transcript, No. 83 at p. 194) MacroAir stated that implementing wind and temperature sensors in ceiling fans could lead to energy savings and suggested that DOE investigate this technology further. (MacroAir, No. 89 at p. 12) However, ALA stated that it is not aware of any ceiling fans or working prototypes that include integrated wind or temperature sensors, or data that would indicate that these products could lead to energy savings in real world applications. (ALA, No. 91 at p. 15)

DOE investigated the applications of wind and temperature sensors in ceiling fans. To DOE's knowledge, only one manufacturer incorporates temperature sensors in its ceiling fans. Qualitative data on how wind and temperature sensors reduce energy consumption of a ceiling fan is not available because this technology is new. Therefore, DOE is unable to fully evaluate whether these sensors reduce energy consumption in ceiling fan applications at this time. Consequently, DOE did not consider wind and temperature sensors as technology options for this rulemaking. DOE requests data on how wind and temperature sensors could reduce energy consumption in a ceiling fan. See issue 3 in section VII.E.

d. Fans With Fewer Blades and Fan Optimization

In the preliminary analysis, DOE observed that large-diameter fans with fewer blades are generally more efficient because they are subject to less air resistance, so DOE evaluated fewer blades as a design option. DOE requested comment in the preliminary analysis on how manufacturers choose the number of blades to use for large-diameter fans and how it affects efficiency.

BAS commented that isolating the number of blades as a design option ignores many factors and that fewer fan blades by itself does not affect efficiency. BAS suggested that a combination of factors such as cord width, angle of attack, and blade attachments, paired with number of blades, are considered by manufacturers in a more holistic approach when optimizing fan designs for efficiency. (BAS, No. 79 at p. 38; BAS, Public Meeting Transcript, No. 83 at p. 211) Additionally MacroAir stated that reducing the number of fan blades from eight to six is limiting to the market and may impede future innovations. (MacroAir, No. 89 at p. 7)

After further investigation, DOE agrees with BAS and MacroAir and proposes to replace reducing the number of fan blades for large-diameter ceiling fans as a design option with a fan optimization design option. Fan optimization represents the increase in the efficiency of a fan by adjusting or optimizing the design features that already exist in the fan. These adjustments could include changing blade pitch, fine-tuning motor RPM, and changing internal motor characteristics like the diameter of the wire, number of windings, skew angle, stack height and capacitors. DOE observed that ceiling fans with the same blade span, blade material, number of blades, type of motor and size of motor have a range of performances, indicating that some ceiling fans are optimized, whereas others are not. Fan optimization provides manufacturers more flexibility in making design changes to improve ceiling fan efficiency. DOE included fan optimization as a design option for standard and hugger fans in the preliminary analysis. DOE is now considering the fan optimization technology option for all ceiling fan product classes.

e. Gearless DC Motors

MacroAir commented that direct drive by itself should be uncoupled from any motor type and included as a design feature, because any transfer of energy is a loss in efficiency. MacroAir stated that gearbox losses are between 5 percent and 35 percent. (MacroAir, No. 89 at p. 5) MacroAir specifically suggested incorporating a gearless DC motor technology option in the analysis, which it considers max-tech. (MacroAir, No. 89 at p. 5)

DOE researched gearless ceiling fan designs in response to MacroAir's comment. DOE found several large-diameter ceiling fans on the market that use gearless DC motor designs. This indicates that the gearless DC motor technology option is technologically feasible in ceiling fans. Gearboxes have losses that may reduce overall ceiling fan efficiency, as MacroAir commented. Eliminating the gearbox and associated losses could, in turn, improve overall ceiling fan efficiency. DOE included gearless motors as a technology option for consideration in the screening analysis for these reasons. Further details on this technology option can be found in section IV.B.

DOE is no longer considering the following technology options from the preliminary analysis for this NOPR: Three-phase induction motors, twisted blades, beveled blades, and alternate blade material. DOE screened out these technology options in the preliminary analysis based on the four screening criteria, outlined in section IV.B. Additionally, DOE received no comments from interested parties about including these technology options for the NOPR. Therefore, DOE continues to screen out the above technology options.

For this NOPR, DOE proposes to analyze the technology options listed in Table IV–4. The technology options for this NOPR include a subset of the technology options from the preliminary analysis, in addition to new technology options based on interested party feedback and additional DOE research. The screening analysis provides further discussion on which of these technology options DOE retained as design options for the engineering analysis.

TABLE IV–4 TECHNOLOGY OPTIONS AND DESCRIPTIONS

Technology option	Description
Fan optimization	This represents increasing the efficiency of a fan by adjusting existing design features. These adjustments could include changing blade pitch, fine-tuning motor RPM, and changing internal motor characteristics such as the diameter of the wire, number of windings, skew angle, stack height, and capacitors.
More efficient motors:	
Larger direct drive motors.	This represents increasing the efficiency of a fan by increasing the size of (or the quality of steel used in) the stator and rotor stack, improving the lamination design, increasing the cross section of copper wiring, or operating the fan at reduced speed through capacitor speed control.
Brushless DC motor.	DC motors are permanent magnet synchronous AC motors driven by a converter plus inverter combination control system. In this configuration, the motor displays characteristics of direct current motors; thus, they are called brushless direct current motors. Because there is no electrical current flowing in the rotor of a DC motor, there are no rotor energy losses, thereby resulting in greater efficiency than standard AC motors.
Geared DC motor	DC motor fans with geared motors have fan blades attached to the motor via a geared mechanism, which allows the fan blades to rotate at a different speed from the motor.
Gearless DC motor.	Fans with a DC motor that drive the fan blades directly without the use of a geared mechanism.
More efficient blades	
Curved blades	Curved blades are blades for which the centerline of the blade cross section is cambered. Curved blades generally have uniform thickness and no significant internal volume.
Airfoil blades	Airfoil blades use curved surfaces to improve aerodynamics, but the thickness is not uniform and the top and bottom surfaces do not follow the same path from leading edge to trailing edge.
Blade attachments	Blade attachments refer to upswept blade tips or other components that can be fastened to a fan blade to potentially increase airflow or reduce drag.
Ceiling fan controls	
Occupancy sensors.	Occupancy sensors use technologies that detect the presence of people through movement, body heat, or other means. Ceiling fans used with an occupancy sensor could power down if they sense that a room is unoccupied.

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))

In sum, 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. The reasons for excluding technology options for this NOPR are discussed below.

The subsequent sections include comments from interested parties pertinent to the screening criteria, DOE's evaluation of each technology option against the screening analysis criteria, and whether DOE determined that a technology option should be screened out based on the screening criteria. DOE requests comment on the screened out and remaining technology options for each product class. See issue 4 in section VII.E.

1. Screened-Out Technologies

a. Standard and Hugger Ceiling Fans

In the preliminary analysis, DOE screened out the following technologies for standard and hugger fans: Occupancy sensors, geared motors, three-phase induction motors; and blade design elements including twisted blades, airfoil blades and beveled blades, fans with fewer blades, blade attachments, and alternative blade materials. In line with the technologies DOE screened out, Hunter Fan stated in comments on the preliminary analysis that the aesthetic appeal of ceiling fans must be considered because it can affect consumer utility. (Hunter, Public Meeting Transcript, No. 83 at p. 197)

In the preliminary analysis, DOE screened out the occupancy sensors technology option because DOE did not have enough information to determine whether occupancy sensors are technologically feasible for use in all ceiling fans. DOE requested comments on sensors as a technology option. See issue 5 in section VII.E.

In response to DOE's request for comment on sensors, ALA, Hunter, Westinghouse, and Lutron on behalf of Westinghouse commented to support DOE's decision to screen out occupancy sensors from the analysis. (Hunter, Public Meeting Transcript, No. 83 at p. 193) ALA and Westinghouse stated that occupancy sensors would be problematic for ceiling fans installed in bedrooms. Many consumers operate the ceiling fan continuously while sleeping, but the occupancy sensor would not detect the movement necessary to continuously operate through the night. (ALA, No. 91 at p. 16; Westinghouse, Public Meeting Transcript, No. 83 at p. 206) BAS, however, stated that a schedule can be included in the occupancy sensor to get around the issue of the ceiling fan turning off in the bedroom. (BAS, Public Meeting Transcript, No. 83 at p. 206)

Westinghouse also commented that occupancy sensors can be difficult to manage in a residential space. It stated that to include an occupancy sensor to the ceiling fan, the room might have to have one as well to meet local building codes. (Westinghouse, Public Meeting Transcript, No. 83 at p. 195)

Occupancy sensors have the potential to save energy by reducing the number of ceiling fan operating hours. DOE did not find or receive enough data to evaluate any potential tradeoff between consumer utility and the energy savings of reduced operating hours. DOE also researched the option of introducing occupancy sensor schedulers in ceiling fans. DOE did not find data to show that occupancy sensor schedulers can be installed reliably in all ceiling fans. At this time, DOE proposes to continue to screen out occupancy sensors because DOE cannot satisfactorily evaluate the energy savings potential, technological feasibility and impact on consumer utility of implementing sensors or schedule controls. DOE requests comment and data to evaluate these factors. See issue 5 in section VII.E.

DOE did not receive comments on the decision to screen out three-phase induction motors or blade design elements including twisted blades, airfoil blades and beveled blades, fans with fewer blades, blade attachments, and alternative blade materials for standard and hugger ceiling fans. DOE continues to screen out these technology options for this NOPR.

b. Very Small-Diameter Ceiling Fans

As discussed in section IV.A.1, DOE proposes to analyze a new product class for ceiling fans with blade spans of 18 inches or less. DOE proposes to screen out the same technologies for very small-diameter fans as for standard and hugger fans as described in section IV.B.1.a. DOE did not receive any feedback on the decision to screen out these technologies.

VSD ceiling fans are used in residential applications, similar to standard and hugger ceiling fans. Thus, as discussed for standard and hugger ceiling fans, DOE proposes to screen out blade technology options that could affect appearance of VSD ceiling fans.

During manufacturer interviews, DOE asked whether the same design options considered in the preliminary analysis for the standard and hugger fans could be considered for VSD ceiling fans. These design options included fan optimization, larger direct drive motor, and DC motors. DOE has not received any objections from manufacturers regarding its consideration of these design options for VSD ceiling fans. One manufacturer pointed out that there are no VSD ceiling fans with DC motors currently available in the market, but speculated that DC motors in VSD ceiling fans could be technologically feasible because they are used in more traditional ceiling fans (standard and hugger ceiling fans). The manufacturer also acknowledged that there is limited data on efficiency improvements of these design options specifically for VSD ceiling fans. Further discussion on how these design options were incorporated is provided in chapter 5 of the NOPR TSD.

DOE requests comment on the technologies that it screened out for VSD ceiling fans. See issue 4 in section VII.E.

c. High-Speed Small-Diameter Ceiling Fans

In the preliminary analysis, DOE screened out the following eight technologies for HVSD ceiling fans: More efficient direct-drive single-phase induction motors, geared motors, three-phase induction motors, fans with fewer blades, twisted blades, blade attachments, alternative blade materials, and occupancy sensors. In line with the technologies that DOE screened out, BAS commented that that they do not use geared motors with variable frequency drives in acoustically sensitive places. (BAS, Public Meeting Transcript, No. 83 at p. 214)

DOE received no comments objecting to screening out these technology options in the preliminary analysis. DOE does not expect that these technology options or the applicability of the screening criteria to them will be affected by the proposed change in name and definition of the HVSD product class to the HSSD product class analyzed in this document. Therefore DOE proposes to continue to screen out these technology options for HSSD fans in this NOPR.

d. Large-Diameter Ceiling Fans

In the preliminary analysis, DOE screened out the following technologies for large-diameter fans: More efficient direct-drive single-phase induction motors, twisted blades, blade attachments, alternative blade materials and occupancy sensors.

In the preliminary analysis, DOE described blade attachments as an attachable clip that can be added to a fan blade to increase airflow or reduce drag. DOE asked for comment in the preliminary analysis about blade configurations and blade designs as technology options to improve ceiling fan efficiency.

BAS commented that more than half of the large-diameter manufacturers use some form of blade attachment and that winglets are the most common type of blade attachment. BAS stated that a properly designed winglet can increase the efficiency of a ceiling fan and provided articles to show that blade attachment are used to increase fuel efficiency in aircrafts. (BAS, No. 79 at p. 17) MacroAir stated that it does not use blade attachments and does not consider blade attachments to provide performance or efficiency gains. (MacroAir, No. 89 at p. 13)

There is disagreement in the industry whether blade attachments improve fan efficiency. Because DOE has not received sufficient information to conclude that blade attachments increase the efficiency of large-diameter fans, DOE continues to screen out blade attachments.

DOE did not receive comment on the decision to screen out more efficient direct-drive single-phase induction motors, twisted blades, alternative blade materials, and occupancy sensors for large-diameter fans. DOE continues to screen out these technology options for large-diameter fans for this NOPR.

2. Remaining Technologies

DOE tentatively concludes that the technology options not screened out meet all four screening criteria to be examined further as design options in DOE's NOPR analysis. 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). In summary, DOE did not screen out the following technology options:

a. Fan Optimization

In the preliminary analysis, DOE screened in fan optimization for standard and hugger ceiling fans. DOE observed that ceiling fans with the same blade span, blade material, number of blades, type of motor and size of motor have a range of performances indicating that some ceiling fans are optimized, whereas others are not. DOE research since the preliminary analysis indicated that ceiling fans in all product classes can be optimized.

Matthews Fan stated that increasing the angle of the blade causes heat rise on the motor and the fan might not continue to meet the UL safety requirements and therefore adjusting the blade pitch is not possible. (Matthews, Public Meeting Transcript, No. 83 at p. 227)

Increasing the blade pitch can increase the heat rise on the motor and that blade pitch optimizing needs to be done within the UL safety requirements. The fan optimization design option, as proposed, includes other adjustments that manufacturers can make to improve efficiency. Consequently, manufacturers do not have to adjust blade pitch, but have the flexibility to determine which adjustments to existing designs are cost-effective and comply with UL safety requirements. DOE continues to consider fan optimization as a viable technology option for improving fan efficiency that meets DOE's screening criteria. Consequently, DOE considered fan optimization in its analysis for all product classes.

b. Larger Direct-Drive Motor

DOE screened in larger-direct drive motors as a technology option in the preliminary analysis. In response, ALA commented that DOE has not accounted for the difficulties associated with motor redesign that is required for larger AC motors. ALA stated that a significant constraint on ceiling fans is the maximum internal temperature permitted by UL 507. According to ALA, using a larger AC motor could create higher internal temperature and lead to failure in UL testing. (ALA, No. 91 at p. 5)

DOE recognizes ALA's concerns but proposes to continue to screen in larger direct-drive motors for analysis in this NOPR. DOE identified several commercially-available ceiling fan model series that use larger direct-drive single-phase induction motors and still adhere to existing safety standards. For example, the 52-inch Monte Carlo Homeowner Max uses a 153 × 15 mm motor [22] and the 52-inch Monte Carlo Designer Max uses a 188 × 15 mm motor.[23] DOE conducted testing to evaluate the impact on performance of using larger direct-drive motors. DOE's internal test data shows that the efficiency of low-volume ceiling fans can be improved through the use of a larger AC direct-drive motor. Discussions with manufacturers confirmed that ceiling fan efficiency can be improved by increasing the size of the motor, but that the improvement may be small and increases production cost. Based on these findings, DOE continues to consider larger direct-drive motors as a viable technology option for improving fan efficiency that meets DOE's screening criteria. Consequently, DOE considered larger direct-drive motors in its analysis for standard and hugger fans. DOE accounts for costs associated with implementing a larger-direct drive motor in the engineering and MIA analyses. DOE also screened in larger direct-drive motors for very small-diameter ceiling fans based on information received during manufacturer interviews and requests comments on the inclusion of this design option for VSD ceiling fans. See issue 4 in section VII.E.

c. DC Motor

Brushless DC Motors in Standard, Hugger, and HSSD Product Classes

In the preliminary analysis, DOE screened in brushless DC motors for standard, hugger and HVSD ceiling fans. These ceiling fans typically use AC induction motors. In AC induction motors, current flowing through copper wire windings in the stator induce a current in the motor rotor to create a magnetic field. There are energy losses associated with this process. In DC motors, the rotor is a permanent magnet that generates a magnetic field without the need for induced current. Therefore, the energy losses associated with inducing current in the rotor in an AC motor are not present in DC motors. Consequently, DC motors are typically more efficient than AC induction motors. Another advantage of DC motors is that they tend to be smaller and make less noise than AC induction motors. However, DC motors require additional controls to enable them to function on power sources typical in a home. Implementing DC motor technology in ceiling fans may increase manufacturing and product retail cost. These cost impacts are analyzed in the engineering and downstream analyses. DOE requested comment on the motor

[22] Monte Carlo. *52″ Homeowner Max, http://www.montecarlofans.com/38090/52-Homeowner-Max-5HM52BPN.html.*

[23] Monte Carlo. *52″ Designer Max, http://www.montecarlofans.com/37831/52-Designer-Max_5DM52RZW.html.*

technology options in the preliminary analysis.

ALA commented that brushless DC motors should be screened out of DOE's analysis, because they have only been available in the market for a short time, and therefore not enough data exists to fully evaluate the long-term reliability of ceiling fans with DC motors. (ALA, No. 91 at p. 16) However, the California Investor Owned Utilities (CA IOUs) supported the inclusion of DC motors as a technology option and urged DOE to incorporate only the assumptions regarding manufacturing, warranty, maintenance, and repair costs based on recent and accurate data or research from manufacturers rather than more informal assumptions. CA IOUs recommended that DOE conduct research regarding DC motors through direct outreach with manufacturers. (CA IOUs, No. 91 at p. 2) BAS commented that the latest generation of DC motor controllers don't require a power converter and can drive the motor directly from line voltage inverter. This eliminates one power conversion stage, reducing cost, and improving efficiency and reliability. According to BAS, DC motors are manufactured using similar techniques as AC motors and share many critical components. Therefore the reliability and the control system is not different for a DC motor compared to an AC motor. (BAS, No. 79 at p. 29) Similarly, the Appliance Standards Awareness Project (ASAP) noted that it is not aware that DC motors are less reliable than AC motors. (ASAP, et al., No. 92 at p. 2) In their submitted comments, ASAP stated several instances of manufacturers indicating that there should not be any concerns related to reliability of DC motors, including manufacturer responses to the preliminary TSD, and comments during the preliminary analysis public meeting. (ASAP, et al., No. 92 at pp. 2–3)

ALA commented that quiet fan speed controls and variable speed controls are not compatible with brushless DC motors. ALA stated that requiring DC motors in small-diameter ceiling fans would lead to the elimination of existing wall-mounted controls for AC motor fans and associated light kits. (ALA, No. 91 at p. 7)

In consideration of the above comments, DOE investigated DC motor impacts on consumer utility and product availability. Through market research, DOE found that most manufacturers offer ceiling fans with DC motors. DOE is also aware of ceiling fans that use DC motors and have wall mounted controls such as the BAS Haiku models that come with optional wall controls.[24] However, DC motors are a relatively new technology and that reliability issues may become apparent as ceiling fans using these motors in the field mature. However, their availability in the market indicates to DOE that manufacturers have deemed DC motors technologically feasible, practicable to manufacture, install, and service and have acceptable impacts on utility (including reliability and product availability). Consequently, DOE screened in DC motors for this NOPR. DOE accounted for differences in reliability between DC and AC motors in downstream analyses in section IV.F.4.

Brushless DC Motors in Very Small-Diameter Ceiling Fans

For this NOPR, DOE analyzed a new product for very small-diameter ceiling fans that have blade spans of 18 inches or less. Currently there is no very small-diameter ceiling fan on the market that uses a DC motor; however conversations with one VSD manufacturer indicated that DC motors are technologically feasible in very small-diameter ceiling fans. Therefore DOE screens in the DC motor technology option for very small-diameter ceiling fans. DOE requests comment on including DC motors as a technology option. See issue 4 in section VII.E.

Geared and Gearless DC Motors for Large-Diameter Ceiling Fans

In the preliminary analysis, DOE screened in brushless DC motors for large-diameter fans. DOE requested comment on whether brushless DC motors meet the screening criteria for large-diameter ceiling fans.

In response to the preliminary analysis, MacroAir requested that DOE include gearless DC motors as a new technology option (see section IV.A.2). It stated that gearbox losses are between 5 and 35 percent. (MacroAir, No. 89 at p. 5)

DOE found two manufacturers with large-diameter ceiling fans using a gearless DC motor, including MacroAir's newly released AirVolution-D model. (MacroAir, No. 89 at p. 10) Market availability of fans using gearless DC motors indicates to DOE that this technology option is technologically feasible and meets the other three screening criteria. Thus, DOE screened in gearless DC motors for large-diameter ceiling fans for consideration in the engineering analysis.

DOE did not receive any comments objecting to the consideration of brushless DC motors as a design option analyzed in the preliminary analysis for large-diameter ceiling fans. Thus, DOE screened in this technology option for consideration in the engineering analysis for this NOPR. Note, DOE refers to this design option as a geared DC motor to make a clear distinction between fans with a gearbox and fans without a gearbox.

[24] Big Ass Solutions. *Haiku, http://www.bigassfans.com/for-home/haiku/.*

d. Curved Blades and Airfoil Blades

In the preliminary analysis, DOE screened in curved and airfoil blade technology options for high-speed small-diameter and large-diameter ceiling fans. DOE requested comment about the blade technology options, but did not receive any comments opposing the inclusion of curved and airfoil blades in the analyses for these fan product classes. Therefore, DOE continues to screen in curved and airfoil blades for HSSD and large-diameter ceiling fans in this NOPR.

C. Engineering Analysis

In the engineering analysis, DOE established the relationship between the manufacturer production cost (MPC) and improved ceiling fan efficiency. This relationship serves as the basis for cost-benefit calculations for individual consumers, manufacturers, and the Nation. DOE typically structures the engineering analysis using one of three approaches: (1) Design option; (2) efficiency level; or (3) reverse engineering (or cost assessment). The design-option approach involves adding the estimated cost and associated efficiency of various efficiency-improving design changes to the baseline product to model different levels of efficiency. The efficiency-level approach uses estimates of costs and efficiencies of products available on the market at distinct efficiency levels to develop the cost-efficiency relationship. The reverse-engineering approach involves testing products for efficiency and determining cost from a detailed bill of materials (BOM) derived from reverse engineering representative products. The efficiency ranges from that of the least-efficient ceiling fans sold today (*i.e.*, the baseline) to the maximum technologically feasible efficiency level. At each efficiency level examined, DOE determines the MPC; this relationship is referred to as a cost-efficiency curve.

For this analysis, DOE structured its engineering analysis for ceiling fans using a combination of the design-option approach and the reverse-engineering approach. The analysis is performed in terms of incremental increases in efficiency due to the implementation of selected design options, while the estimated MPCs for each successive design option are based on product teardowns and a bottom-up manufacturing cost assessment. Using this hybrid approach, DOE developed the relationship between MPC and ceiling fan efficiency. DOE welcomed comments on an alternative approach in the preliminary analysis.

DOE used the design option approach in the engineering analysis and selected representative sizes for each product class to account for differences in ceiling fan utility and efficiency based on blade diameter. DOE selected representative sizes based on the available range of sizes in each product class and based on the number of sales per size. For each representative size in each proposed product class, DOE identified a baseline efficiency as a reference point from which to measure changes resulting from each design option. Efficiency is represented in terms of the metric proposed in the test procedure NOPR (*i.e.,* aggregate airflow efficiency). The baseline represents the most common, least efficient ceiling fan in the market for each product class and representative size. DOE then developed separate cost-efficiency relationships for each product class analyzed. The following is a summary of the method DOE used to determine the cost-efficiency relationship for ceiling fans:

- Perform airflow efficiency tests on a representative sample of ceiling fans in each product class.
- Develop a detailed BOM for the tested ceiling fans through product teardowns, and construct a ceiling fan cost model.
- Use a combination of test data, data from spec sheets, the cost model, and feedback from manufacturers to calculate the incremental increase in efficiency and cost increase of adding specific design options to a baseline model.

In the 2014 test procedure NOPR, DOE proposed to test standard ceiling fans mounted to an artificial ceiling. ALA commented that the candidate standard levels in the preliminary analysis were based on airflow measurements made without an artificial ceiling. ALA recommended that DOE adjust the analysis to adhere to the final test procedure. (ALA, No. 91 at p. 2)

Since the preliminary analysis, DOE published a test procedure SNOPR on June 3, 2015, in which DOE proposes to test all ceiling fans mounted directly to the ceiling. DOE used test data for standard ceiling fans mounted directly to the ceiling to update the engineering analysis for this NOPR.

In response to the approach taken by DOE, MacroAir stated it doesn't understand why a design approach was used for the efficiency levels and a performance approach was taken in the candidate standard levels (CSL). MacroAir suggested a consistent approach should be maintained throughout the analysis process. (MacroAir, No. 89 at p. 13)

Typically, DOE structures an energy conservation standard in terms of a performance requirement, *i.e.,* a maximum level of energy consumption or a minimum level of energy efficiency, often as a function of some form of capacity or size. For this rulemaking, DOE is structuring the standard using a minimum level of airflow efficiency (CFM/W) as a function of diameter. The various levels of efficiency being considered for the standard, or candidate standard levels, were developed using efficiency levels described in the engineering analysis. See chapter five of the NOPR TSD. In the engineering analysis, DOE developed efficiency levels using design-options, which are technologies that exist in the market that have passed the screening criteria. See chapter four of the NOPR TSD. The efficiency levels examined represent a certain path, or combination of design options, that demonstrate how various levels of efficiency can be achieved. While this analysis is meant to show one way of achieving certain levels of efficiency, the actual structure of the standards (in the form of equations defining a minimum level of air flow efficiency (CFM/W) as a function of diameter) allows any design path to be used. Also, establishing standards in this manner, as opposed to requiring specific design requirements be used (*e.g.,* a standard specifying one type of motor), allows manufacturers freedom in meeting a standard and avoids limiting innovation. Manufacturers may choose to use any technologies and designs they desire to achieve the specified CFM/W standard.

In written comments, ASAP noted that DOE evaluated efficiency levels that are structured as a function of ceiling fan diameter. ASAP expressed concern that standards as a function of diameter may not be directly related to the performance of the fan. (ASAP, et al., No. 92 at p. 3)

In response to ASAP's comment, DOE examined how fan efficiency behaves as a function of both fan diameter and airflow to evaluate whether standards as a function of one or the other are more appropriate. DOE collected data for airflow, blade diameter and airflow efficiency for all the ceilings fans found on Web sites of ten retailers, including, among others, Home Depot, Lowe's, Walmart and Menards. DOE then plotted ceiling fan efficiency as a function of both diameter and airflow and compared the correlation coefficient, or R^2 value, for each relationship. DOE found that both airflow and fan diameter have similar correlation coefficients as a function of airflow efficiency and neither is statistically better than the other. Because of this, DOE next examined which characteristic could be considered a better indicator, or proxy, for utility.

DOE sets standards that are technologically feasible and economically justified without diminishing utility to consumers. Neither airflow nor diameter is a perfect proxy for utility, because consumers make purchasing decisions based on both. However, DOE believes that blade diameter is a *better* proxy for utility than airflow. The size of a fan determines the cooling area, impacts room aesthetics, and determines if a fan physically fits into a room. Literature published by manufacturers clearly indicates that blade span is an important criteria for consumer fan selection. Manufacturers include sizing guides in published product literature to instruct consumers on how to properly size a fan for a given room size. These fan sizing guides specify the affected square footage of a room based on fan blade diameter. DOE did not find such guides for other ceiling fan characteristics such as airflow. Furthermore, DOE believes that standards as a function of airflow instead of fan diameter could result in substitution issues. For example, two ceiling fans of different sizes but similar airflow might not fit into the same space, will not have airflow produced over the same area, and have different room aesthetics. However, DOE believes that standards as a function of diameter would not result in substitution issues, because the substitute fan would fit into the same space, produce airflow over the same area and the room aesthetics would not be affected. This indicates to DOE that ceiling fan blade diameter is a primary characteristic considered by consumers when selecting a fan and a better proxy for consumer utility than airflow. Consequently, DOE proposes standards as a function of fan diameter to ensure that fans at a given diameter (and, by proxy, fans that provide a similar utility to the consumer) are subject to the same standard.

ASAP also stated that two fans of the same diameter could provide different airflows. ASAP stated that manufacturers could simply meet the standard by reducing the speed of the fan, which would reduce airflow and fan utility. (ASAP, et al., No. 92 at p. 3)

Ceiling fans of the same size can produce different airflows, and slowing down a fan can significantly reduce energy consumption. While manufacturers may opt to do so to meet the levels proposed, DOE did not include slowing down the fan as a design option; manufacturers can meet the levels proposed without reducing speed. Also, DOE expects that manufacturers will not reduce airflow to levels that are unacceptable when other cost-justified pathways to compliance are available. DOE requests comment on what an acceptable reduction of fan speed is such that it does not affect consumer utility. See issue 6 in section VII.E.

1. Baseline and Max-Tech Models

To analyze technology options for energy efficiency improvements, DOE defined a baseline and a max-tech model for each ceiling fan product class. Typically, the baseline model is a model that just meets current energy conservation standards, whereas a max-tech model is the highest efficiency model in the market. DOE set the baseline and max-tech efficiencies for each product class based on test data and certified airflow efficiency data from manufacturer Web sites and brochures. Further details can be found in chapter 5 of the TSD.

a. Standard and Hugger Ceiling Fans

In the preliminary analysis, DOE combined the cost efficiency curves of flat-blade fans and unconventional-blade fans in the standard and hugger product classes to create an aggregate curve for all standard ceiling fans and all hugger ceiling fans. DOE used the maximum efficiency of the unconventional-blade fans as the max-tech for the aggregate curve to ensure that even at max-tech, all types of ceiling fans, including designs with unconventional-blades, can achieve this level of efficiency.

In response to this approach, the CA IOUs expressed concern that the max-tech efficiency for the combined conventional and unconventional class is significantly lower than the conventional blade fan class. Therefore, the CA IOUs commented, DOE should consider conventional blade fan model efficiency for the max-tech level instead of the unconventional blade fan model. (CA IOUs, No. 91 at p. 1)

DOE appreciates the comment from the CA IOUs to use the max-tech level of the flat-blade fan for the aggregate curve instead of the max-tech level of the unconventional-blade fan. However, doing so could result in a standard that cannot be met by unconventional blade fans, eliminating them from the market. DOE considers the elimination of unconventional blade fans from the market a loss of consumer utility and a reduction in product availability because, while these fans are functionally indistinguishable from flat-blade ceiling fans, a majority of consumers purchase unconventional-blade fans because of their aesthetic appeal. Overly stringent ceiling fan standards could force manufacturers to reduce the aesthetic quality of some ceiling fans to comply with energy conservation standards, therefore reducing consumer utility. Thus, DOE continued to use the max-tech efficiency level of the unconventional-blade fans as the max-tech efficiency level for the aggregate curve in this NOPR.

b. Very Small-Diameter Ceiling Fans

After the preliminary analysis DOE decided to introduce a separate product class for very small-diameter ceiling fans based on feedback from interested parties (see section IV.A.1.c for more details on the very small-diameter product class). DOE used publicly available market data and test data to identify the baseline very small-diameter ceiling fans for all representative sizes.

c. High-Speed Small-Diameter Ceiling Fans

In the preliminary analysis, DOE chose a baseline airflow efficiency of 211 cfm/W for the 56-inch HSSD ceiling fans. DOE selected this efficiency based on information listed in manufacturer specification sheets because DOE did not have any test results for this product class.

During the preliminary analysis public meeting, Westinghouse and ALA commented that 211 cfm/W is too high for the baseline efficiency for 56 inch high-speed small-diameter fans. Westinghouse stated that the baseline 56-inch high-speed small-diameter airflow efficiency should be 95 cfm/W. (Westinghouse, Public Meeting Transcript, Public Meeting Transcript, No. 83 at p. 250) ALA provided published data to support its statement showing baseline fans with airflow efficiencies ranging between 90 and 115 cfm/W, and airflow ranging from 6,118 to 9,154 cfm. Additionally, ALA stated that it is aware that HSSD fan manufacturers list extremely high cfm levels on their manufacturer specification sheets. These models will have cfm levels similar to the baseline models recommended by ALA when tested according to the DOE test procedure. (ALA, No. 91 at p. 4)

Since the preliminary analysis, DOE tested baseline 56-inch HSSD ceiling fans. Those tests confirmed comments received from interested parties that the value used in the preliminary analysis is too high. DOE reduced the baseline airflow efficiency for a 56 inch HSSD ceiling fan from 211 cfm/W to 91 cfm/W, which corresponded to the lowest efficiency of the HSSD ceiling fans tested.

d. Large-Diameter Ceiling Fans

In the preliminary analysis DOE described the baseline for the large-diameter ceiling fan product class as having curved blades, a three-phase induction motor with a gearbox, and an exposed motor with no housing. DOE described a max-tech large-diameter ceiling fan as a ceiling fan with airfoil blades and a DC motor.

MacroAir commented on the baseline and max-tech levels for the large-diameter ceiling fan product class. MacroAir stated that geared motors are a typical component of baseline large-diameter fans. MacroAir also suggested that the max-tech unit has a brushless DC motor and a direct drive (without gears). (MacroAir, No. 89 at p. 5)

DOE agrees with MacroAir because DOE found that large-diameter ceiling fans with a brushless DC motor have the highest efficiency. Therefore, for its analysis, DOE assumes that the max-tech efficiency level for large-diameter ceiling fans includes a gearless DC motor.

2. Manufacturing Cost Analysis

DOE estimated the manufacturing costs using a reverse-engineering approach, which involves a bottom-up manufacturing cost assessment based on a detailed BOM derived from teardowns of the product being analyzed. The detailed BOM includes labor costs, depreciation costs, utilities, maintenance, tax, and insurance costs, in addition to the individual component costs. These manufacturing costs are developed to be an industry average and do not take into account how efficiently a particular manufacturing facility operates.

For the reverse-engineering approach, DOE purchased off-the-shelf ceiling fans available on the market with a range of efficiencies and dismantled them component by component to determine what technologies and designs manufacturers use to increase airflow efficiency. DOE then used independent costing methods, along with component-supplier data, to estimate the costs of the components. DOE derived detailed manufacturing cost estimates based on its reverse engineering analysis, which include the cost of the product components, labor, purchased parts and materials, and investment. The testing and teardown results indicated that the manufacturing costs among different units from different manufacturers can vary based on the type of material, amount of material, and/or process used.

a. Standard and Hugger Ceiling Fans

In the preliminary analysis, DOE developed a single, aggregated cost-efficiency curve for unconventional-blade and flat-blade fans for both standard and hugger product classes. The MPC for the max-tech (efficiency level 4, or EL 4) reflected a shipment weighted average of: (1) The full cost of an unconventional-blade fan with a DC motor, and (2) the full cost of a flat-blade fan with an AC motor.

ALA commented that the preliminary analysis costs for the EL 4 design option for standard and hugger fans are much too low. (ALA, No. 91 at p. 6) ALA stated that the aggregate curve would effectively require DC motors for all ceiling fans. For flat-blade fans, the minimum efficiencies required to comply with DOE's EL 4 would require either DC motor technology or some combination of a larger AC motor and other technologies that DOE has already screened out from consideration. Westinghouse stated that if a DC motor with flat blade is required to achieve EL 4, then the costs should also mirror that. (Westinghouse, Public Meeting Transcript, No. 83 at p. 245)

DOE acknowledges that to comply with the EL 4 efficiency for both flat-blade fans and unconventional-blade fans, DC motors is the only remaining screened-in design option. Therefore, DOE adjusted the costs at EL 4 to represent a shipment weighted average of the full cost of an unconventional-blade fan and flat-blade fan that both use a DC motor.

b. Very Small-Diameter and High-Speed Small-Diameter Ceiling Fans

DOE used the reverse engineering approach described in section IV.C.2 to estimate the manufacturing costs of very small-diameter and HSSD ceiling fans. DOE received some feedback on the high-speed small-diameter manufacturing costs. DOE used this feedback together with the results from the reverse engineering to estimate the manufacturing costs for HSSD ceiling fans. DOE did not receive any feedback from interested parties on the manufacturing costs of very small-diameter ceiling fans. Therefore DOE relied on the manufacturing cost results from the reverse engineering approach.

c. Large-Diameter Ceiling Fans

In the preliminary analysis, DOE found that large-diameter fans have a wide variety of motor horsepower. For consistency, DOE assumed that all the large-diameter fans analyzed use a 1-horsepower motor because they are available in 8-, 12-, and 20-foot fans. DOE estimated the cost of 1-horsepower motors by evaluating the average price of a 1-horsepower motors available on the market. DOE requested comment on the assumption to use a 1-horsepower motor for all representative sizes.

BAS stated that a 1-horsepower motor is not representative of the entire large-diameter market. BAS suggested that 20-foot fans should have a 2-horsepower motor, 12-foot fans should have a 1-horsepower motor, and 8-foot fans should have a 0.5-horsepower motor. (BAS, No. 79 at p. 4) MacroAir agreed with BAS stating that the 1-horsepower motor is a poor assumption for all large-diameter fans. MacroAir provided a breakdown in the percentage of sales based on motor horsepower, which shows 36 percent of their large-diameter fans are sold with a 1-horsepower motor, 23 percent are sold with a 2-horsepower motor and 13 percent are sold with a 0.5-horsepower motor. All other motor sizes that MacroAir sells have sales of 13 percent or less. (MacroAir, No. 89 at p. 10)

Based on the feedback from BAS and MacroAir, DOE assumed that 20-foot fans use 2-horsepower motors, 12-foot fans use 1-horsepower motors, and 8-foot fans use 0.5-horsepower motors. DOE tore down two 20-foot large-diameter ceiling fans to estimate the manufacturing costs for the fans and their subassemblies, including the fan motors. DOE adjusted its assumptions regarding motor costs based on input received during manufacturer interviews and these teardowns.

Chapter 5 of the NOPR TSD discusses the baseline efficiencies for each product class, the design options DOE considered, the methodology used to develop manufacturing production costs, and the cost-efficiency curves. The LCC and PBP analyses uses the cost-efficiency relationships developed in the engineering analysis.

3. Installed Costs

During the preliminary analysis public meeting, DOE received comments on the installed costs for standard ceiling fans. The installed costs are a function of MPC, manufacturer markup and retail markup. In the preliminary analysis, DOE presented baseline and EL 4 installed costs of $107 and $149, respectively, for standard fans.

During the public meeting, Westinghouse and Fanimation stated that the installed cost for the baseline is too high and the installed costs for EL 4 is too low. (Westinghouse, Public Meeting Transcript, No. 83 at p. 242; Fanimation, Public Meeting Transcript, No. 83 at p. 243)

In response to Westinghouse and Fanimation, DOE re-evaluated its MPC estimates. As stated, MPC is one of the factors DOE used to calculate installed costs. (See sections IV.D and IV.F for discussion of the other factors). In the preliminary analysis, DOE calculated the MPC as the product of factory costs and factory markup. This approach was used to calculate MPC, because standard and hugger ceiling fans are typically outsourced by U.S. manufacturers to factories in China. DOE calculated baseline and max-tech (EL 4) MPCs for 52 inch standard ceiling fans of $41.33 and $65.56, respectively, in the preliminary analysis.[25]

DOE revisited all the assumptions in the cost model from the preliminary analysis and updated all the inputs to the cost model to reflect the costs in 2015$. Additionally, DOE increased the manufacturing purchase volume to reflect manufacturers' comments. DOE presented the updated factory costs to manufacturers during interviews, who generally agreed with the updated costs.

During manufacturer interviews, DOE also received feedback that the overhead burden, shipping costs and tariffs should be included in the MPC. In this NOPR, DOE included these costs in the MPC to be more representative of the manufacturer cost structure described by manufacturers.

During the interviews, DOE attempted to gather more information about the factors it used to derive the MPC. Manufacturers generally agreed with the factory markup of 1.2 used in the preliminary analysis. Manufacturers also agreed with the overhead burden of $2.50 per unit and the shipping tariff of 4.7 percent. DOE increased the shipping costs from China from $2.50 per unit to $3.60 per unit based on feedback received during interviews.

After reevaluating its installed costs and considering manufacturer feedback, DOE increased the baseline MPC from $41.33 to $54.93. DOE increased the

[25] In the preliminary analysis, DOE presented MSPs instead of MPCs. The MPCs were marked up to the MSP using the distribution channel markups. The MSP for the baseline 52-inch ceiling fan was $56.62 and for the MSP for the max-tech 52-inch ceiling fan was $89.82.

costs for the 52-inch standard ceiling fan for EL 4 from $65.56 to $90.93. More details about the factory costs and the MPC can be found in chapter 5 of the NOPR TSD. DOE requests comments on the new baseline MPC of $54.93 for 52-inch standard ceiling fans. See issue 7 in section VII.E.

DOE did not receive any comments about the installed costs that were presented in the preliminary analysis for all the other product classes. However the installed costs for these product classes changed with updates in manufacturing costs and the distribution channel.

D. Markups Analysis

DOE uses distribution channel markups and sales taxes (where appropriate) to convert the manufacturer production cost estimates from the engineering analysis to consumer prices, which are then used in the LCC, PBP, and the manufacturer impact analyses. The markups are multipliers that are applied to the purchase cost at each stage in the distribution channel.

DOE characterized four distribution channels to describe how standard, hugger and VSD ceiling fans pass from manufacturers to consumers. These four distribution channels can be characterized as follows:

Manufacturer → Home Improvement Center → Consumer
Manufacturer/Home Improvement Center (in-store label) → Consumer
Manufacturer → Wholesaler → Contractor → Consumer
Manufacturer → Showroom → Consumer

DOE developed separate markups for home improvement centers that have their in-store label ceiling fans and for those that sell independent-label ceiling fans. As indicated in the market assessment, Hampton Bay and Harbor Breeze ceiling fans, which are two of the top three ceiling fan brands in the market, are the in-store brands for Home Depot and Lowe's, respectively. In this case, Home Depot and Lowe's serve as both in-store brand manufacturer and home improvement center that carry both store-brand and independent-brand ceiling fans. For in-store label ceiling fans, DOE developed an overall markup that encompasses the margins for manufacturing as well as selling the product. For the independent-label ceiling fans sold through home centers, separate markups were developed for the brand manufacturer and for the home improvement centers which serve only as a retailer.

For large-diameter and HSSD ceiling fans, the two distribution channels that DOE considered can be characterized as follows:

Manufacturer → Dealer → Customer
Manufacturer → In-house Dealer → Customer

The second distribution channel for large-diameter and HSSD ceiling fans is a direct sale channel where the manufacturer sells the product directly to a customer through its in-house dealer. DOE is assuming the markup for in-house dealers is the same as the conventional dealer markup; therefore, the overall markup for these two distribution channels is the same.

To account for manufacturers' non-production costs and profit margin, DOE applies the manufacturer markup to the full MPC derived in the engineering analysis. The resulting manufacturing selling price (MSP) is the price at which the manufacturer can recover all production and non-production costs and earn a profit. To meet new or amended energy conservation standards, manufacturers typically introduce design changes to their product lines, which increases manufacturer production costs. As production costs increase, manufacturers typically incur additional overhead.

To calculate the manufacturer markups, DOE reviewed 10–K reports [26] submitted to the U.S. Securities and Exchange Commission (SEC) by publicly-owned ceiling fan companies. The financial figures necessary for calculating the manufacturer markup are net sales, costs of sales, and gross profit. Few ceiling fan manufacturing companies are publicly owned, and most of the publicly-owned ceiling fan manufacturing companies are subsidiaries of more diversified parent companies, so the financial information summarized may not be exclusively for the ceiling fan portion of their business and can also include financial information from other product sectors. DOE discussed the manufacturer markup with manufacturers during interviews, and used product specific feedback on market share, markups and cost structure from manufacturers to adjust the manufacturer markup calculated through review of SEC 10–K reports.

To develop markups for the market participants involved in the distribution of ceiling fans, DOE utilized several sources, including: (1) The SEC 10–K reports and U.S. Census Bureau's annual retail trade survey for building material and supplier dealer industry [27] (to develop home improvement center markups); (2) the U.S. Census Bureau's annual wholesale trade report for electrical and electronic appliance, television, and radio set merchant wholesaler industry [28] (to develop wholesaler markups); (3) 2014 RSMeans Electrical Cost Data [29] (to develop contractor markups); and (4) the SEC 10–K reports (to develop dealer markups).

To develop the markups when home centers serve as both brand manufacturer and retailer, DOE relied upon input from an industry expert.[30]

For each of the market participants, DOE developed baseline and incremental markups based on the product markups at each step in the distribution chain. The baseline markup relates the change in the MSP of baseline models to the change in the consumer purchase price. The incremental markup relates the change in the MSP of higher-efficiency models (the incremental cost increase) to the change in the consumer purchase price.

In addition to the markups, DOE derived state and local taxes from data provided by the Sales Tax Clearinghouse.[31] These data represent weighted average taxes that include county and city rates. DOE derived shipment-weighted average tax values for each region considered in the analysis.

Chapter 6 of the NOPR TSD provides further detail on the estimation of markups.

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of ceiling fans at different efficiency levels in representative U.S. homes and commercial buildings, and to assess the energy savings potential of increased ceiling fan efficiency. To develop annual energy use estimates, DOE multiplied ceiling fan input power by the number of hours of use (HOU) per

[26] U.S. Securities and Exchange Commission, Annual 10–K Reports (various years between 2007 and 2013), available at *http://sec.gov.*

[27] U.S. Census Bureau. *2012 Annual Retail Trade Survey.* Building Material and Supplier Dealer. 2012 (Last Accessed April 22, 2015) *http://www.census.gov/retail/arts/historic_releases.html.*

[28] U.S. Bureau of the Census. *2012 Annual Wholesale Trade Report, NAICS 423620: Electrical and Electronic Appliance, Television and Radio Set Merchant Wholesaler.* 2012. Washington, DC. (Last Accessed April 22, 2015) *http://www.census.gov/wholesale/index.html.*

[29] RS Means Company Inc. *Electrical Cost Data: 36th Annual Edition.* 2014. Kingston, MA.

[30] Mehta, V. Personal communication. Email to Colleen Kantner, LBNL. November 24, 2013.

[31] Sales Tax Clearinghouse Inc., State Sales Tax Rates Along with Combined Average City and County Rates (2014) available at *http://thestc.com/STrates.stm* (last accessed May 27, 2014).

year. The energy use analysis estimates the range of operating hours of ceiling fans 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. Inputs for Standard, Hugger, and VSD Ceiling Fans

a. Sample of Purchasers

As in the preliminary analysis, DOE has included only residential applications in the energy use analysis of standard, hugger, and VSD ceiling fans. DOE used the Energy Information Administration (EIA) 2009 Residential Energy Consumption Survey (RECS) [32] to choose a random sample of households in which new ceiling fans could be installed. RECS is a national sample survey of housing units that collects statistical information on the consumption of, and expenditures for, energy in housing units, along with data on energy-related characteristics of the housing units and occupants. RECS collected data on 12,083 housing units, and was constructed by EIA to be a national representation of the household population in the United States.

In creating the sample of RECS households, DOE used the subset of RECS records that met the criterion that the household had at least one ceiling fan. DOE chose a sample of 10,000 households from RECS to estimate annual energy use for standard, hugger, and VSD ceiling fans. Because RECS provides no means of determining the type of ceiling fan in a given household, DOE used the same sample for the standard, hugger, and VSD product classes.

b. Operating Hours

As in the preliminary analysis, DOE used data from a study [33] that surveyed ceiling fan owners to estimate the operating hours for each sampled RECS household. In that study, the authors asked a nationally representative sample of more than 2,500 ceiling fan users to report their ceiling fan operating hours for high, medium, and low speeds. The LBNL study reported a distribution of operating hours, with an average of 6.45 hours of operation per day. The operating hour for each sample used is drawn from the distribution of operating hours reported in the LBNL study, and further apportioned into operating hours at different fan speeds.

In the preliminary analysis, DOE used the results from the LBNL study to estimate that consumers run their standard, hugger, and VSD ceiling fans at high speed 41 percent of the time, at medium speed 37 percent of the time, and low speed 22 percent of the time. ALA submitted the results of an AcuPOLL survey [34] showing that consumers most often operate their standard, hugger, and VSD ceiling fans on medium speed, not high speed, and asked DOE to adjust its assumptions regarding hours of use at low, medium, and high speeds in light of these results. (ALA, No. 8 at p. 6) Hunter Fan Company also asked DOE to review the standard, hugger, and VSD ceiling fan hours of use assumptions in light of the AcuPOLL survey results, especially because energy consumption at medium speed is typically less than the mid-point in energy consumption between high and low speeds. (Hunter Fan Company, Public Meeting Transcript, Public Meeting Transcript, No. 83 at pp. 15, 104)

In light of ALA's and Hunter's comments and the AcuPOLL survey results, DOE compared the LBNL and AcuPOLL survey results and takes both into account in determining the fraction of time spent at each fan speed. In the NOPR analyses, DOE estimated that the fraction of time that standard, hugger, and VSD ceiling fans were operated at each speed was equal to the simple average of the fractions reported by the LBNL and AcuPOLL surveys: 33 percent on high speed, 38 percent on medium speed, and 29 percent on low speed. DOE then used these fractions were used to apportion the total hours of use into hours of use at high, medium and low speeds.

c. Power Consumption at Each Speed and Standby

DOE determined the power consumption at high, medium, and low speed for each representative fan size in the engineering analysis. These values are shown in chapter 5 of the NOPR TSD. DOE estimated that all ceiling fans with DC motors expend standby power, and that 7 percent of standard, hugger, and VSD ceiling fans with AC motors come with a remote, and therefore consume power while in standby mode. DOE further estimated 0.7 watts as the power consumption value for standby for all representative fans belonging to the standard, hugger, and VSD product classes, based on testing conducted in association with developing the engineering analysis.

2. Inputs for Large-Diameter and High-Speed Small-Diameter Ceiling Fans

a. Sample of Purchasers

As in the preliminary analysis, DOE has included only commercial and industrial applications in the energy use analysis of large-diameter and HSSD ceiling fans. Although some large-diameter and HSSD fans are used in residential applications, they represent a very small portion of the total market for large-diameter and HSSD ceiling fans. Similar to standard, hugger, and VSD ceiling fans, DOE developed a sample of 10,000 fans to represent the range of large-diameter and HSSD ceiling fan energy use. The sample captured variations in operating hours.

b. Operating Hours

In the preliminary analysis, DOE used feedback from manufacturers to estimate total hours of operation for large-diameter and HSSD ceiling fans. Manufacturers suggested a range of possible hours of operation, depending on industry and application, with 12 hours per day as a representative value. To represent a range of possible operating hours around this representative value, DOE drew 10,000 samples from a uniform distribution between 6 hours per day and 18 hours per day when calculating the energy use of large-diameter and HSSD fans. DOE also used manufacturer feedback to determine the proportion of operating time spent at each speed, estimating that, on average, large-diameter and HSSD fans spend approximately 10 percent of the time at high or low speed, and the rest of their time (approximately 80 percent) at a medium speed.

BAS used DOE's preliminary analysis assumptions to conduct an analysis of large-diameter ceiling fan operation by month for a specific consumer in the sample of consumers used in DOE's LCC analysis. (BAS, No. 88 at pp. 37–38) BAS ultimately concluded that DOE must have assumed the consumer operated the fan in reverse during the winter months; or else, the consumer would have experienced a draft by operating the ceiling fan in the forward direction at medium speed. (BAS, No. 88 at p. 38) BAS suggested that DOE assume a 7 percent increase in energy consumption for all hours (if any) that

[32] U.S. Department of Energy–Energy Information Administration. *2009 RECS Survey Data.* (Last accessed October 10, 2014.) *http://www.eia.gov/consumption/residential/data/2009/.*

[33] 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.*

[34] AcuPOLL® Precision Research, Inc. *Survey of Consumer Ceiling Fan Usage and Operations.* 2013.

a large-diameter ceiling fan is assumed to be operating in reverse, because an airfoil operating in reverse does not move as efficiently through the air. BAS also recommended conducting the analysis assuming a large-diameter ceiling fan operates slowly in the forward direction during the winter (heating) months, which will prevent the consumer from experiencing a draft and also reduce overall energy consumption relative to operating the ceiling fan at medium speed in reverse. (BAS, No. 88 at p. 39) The analysis proposed by BAS—which used DOE's assumption of 12 hours per day in active mode and assumes the fan operates very slowly in the forward direction during the heating months—resulted in the following hours of use per day by speed setting: 0.6 hours per day at max speed, three hours at 80 percent of max speed, 1.2 hours at 60 percent of max speed, 7.2 hours at 25 percent of max speed, and 12 hours in standby mode. (BAS, No. 88 at pp. 45, 47) MacroAir also provided suggested hours of use for large-diameter ceiling fans at different settings: three hours per day at max speed, four hours at 80 percent of max speed, six hours at 60% percent max speed four hours at 40 percent max speed, one hour at 20 percent max speed, and six hours in standby mode. (MacroAir, No. 89 at pp. 9–10)

To clarify, in the energy use analysis from the preliminary analysis, DOE did not consider any direction of rotation other that the forward direction. The analysis assumed that once a large-diameter ceiling fan's hours of use were sampled from the distribution, that ceiling fan operated in the forward direction over three speeds every day for that many hours. DOE assumed that 80 percent of that time the fan operated at medium speed (intermediate RPM), 10 percent of the time at low speed (at or near minimum RPM) and 10 percent at high speed (at or near maximum RPM).

DOE appreciates BAS' comment regarding the induced draft from operating a large-diameter ceiling fan at medium speed during the winter (heating) months. For the NOPR analyses, DOE continued to assume that large-diameter ceiling fans only operated in the forward direction.[35] However, DOE assumed different hours of use by setting than in the preliminary analysis. DOE calculated the hours of use at each speed using a simple average of the values provided by BAS and MacroAir, resulting in: 1.8 hours at max speed, 3.5 hours at 80 percent speed, 3.6 hours at 60 percent speed, 2 hours at 40 percent speed, and 4.1 hours at 20 percent speed.[36] Modeling large-diameter ceiling fan operating hours based on fraction of time spent at each of five speeds aligns with the ceiling fans test procedure SNOPR, which proposes to test all large-diameter ceiling fans at max speed, 80 percent speed, 60 percent speed, 40 percent speed, and 20 percent speed. 80 FR 31487 (June 3, 2015).

DOE did not receive any comments in response to the operating hours distribution for HSSD fans in the preliminary analysis, and has therefore maintained the same approach. This approach assumes a uniform distribution for daily operating hours of between 6 and 18 hours per day and that such fans spend approximately 10 percent of the time at each of high and low speed, and approximately 80 percent of the time at a medium speed. DOE requests data on operating hours for HSSD ceiling fans. See issue 8 in section VII.E.

c. Power Consumption at Each Speed and Standby

For the large-diameter ceiling fan product class, the power consumption for a given representative fan was determined by the weighted average of power consumption at the five speeds discussed previously, where each speed was weighted by the fraction of time spent at that speed.

For the HSSD ceiling fan product class, as in the preliminary analysis, DOE determined power consumption at high speed for each representative fan in the engineering analysis. To estimate the power consumption at medium speed, DOE multiplied the high-speed power by the average ratio between high-speed power and medium-speed power in the standard, hugger, and VSD fans engineering analysis. DOE used the same approach for low-speed power, using the average ratio between high-speed power and low-speed power from the standard, hugger, and VSD fans engineering analysis.

In the preliminary analysis, DOE considered all HSSD fans at the efficiency levels with a DC motor to have standby power, assuming a remote control was included for all such fans. DOE estimated 0.7 watts as the standby power value for all representative fans in the HSSD product class. Because these fans also have standby power as a result of a remote control receiver, this is the same value used for standard, hugger and VSD fans, as discussed in section IV.E.1.c. DOE also considered all large-diameter fans to have standby power, because available information indicated that all large-diameter ceiling fans in the market use a variable-frequency drive that consumes standby power. BAS indicated that there are a number of large-diameter ceiling fans without variable-frequency drives (VFDs) that have standby power consumption. (BAS, Public Meeting Transcript, No. 83 at p. 285) DOE appreciates this clarification and has not made the assumption in the NOPR analyses that all large-diameter ceiling fans have VFDs, but retains the assumption from the preliminary analysis that all large-diameter ceiling fans have standby power. For HSSD and large-diameter ceiling fans with standby power consumption, DOE calculated the number of standby hours as the total annual hours not spent in active mode. The standby power for large-diameter ceiling fans (with fan blades exceeding 7 feet in diameter) was estimated to be 7 watts in the engineering analysis (see chapter 5 of the NOPR TSD).

3. Impact on Air Conditioning or Heating Equipment Use

In response to comments on the framework document, DOE issued a Request for Information (RFI) regarding the potential interaction between ceiling fans and air conditioning usage. 78 FR 62494. While RFI commenters were generally in agreement on the theoretical energy savings potential from substituting ceiling fan usage for air conditioning usage, no clear evidence was presented indicating that ceiling fans are actually used in this manner. Therefore, DOE did not account for any impact on air conditioning or heating equipment use in response to an amended ceiling fan energy conservation standard in the preliminary analysis.

In response, MacroAir commented that DOE should consider several possible sources of savings in air conditioning use in its analyses, including: savings from air conditioning usage being displaced by ceiling fan use, savings from reduction in the required size of air conditioning units, and savings related to consumers using their ceiling fan rather than air conditioning

[35] DOE is not aware of any information on how frequently these fans might be used in reverse, nor did it have any data to support a different energy consumption when operating in reverse, compared to the energy consumption in the forward direction, for an equivalent speed.

[36] In calculating the average, DOE assumed that the 7.2 hours attributed by BAS to 25% speed correspond to the 20% speed setting. In addition, BAS assumed large-diameter ceiling fans are operated 12 hours per day, whereas MacroAir assumed large-diameter ceiling fans are operated 18 hours per day. The calculation of the average hours of use at each setting therefore results in large-diameter ceiling fans operating for 15 hours per day.

unit (as a result of increased future electricity prices combined with changing consumer behavior to save money). (MacroAir, No. 89 at pp. 8–9) BAS agreed, indicating that air conditioning units use more power than ceiling fans for the same level of perceived cooling. (BAS, No. 88 at p. 42) ALA added that the LBNL study cited by DOE in the preliminary analysis shows that approximately 25 percent of ceiling fan owners reduce their air conditioning usage when using a ceiling fan; therefore, ALA requested DOE conduct a sensitivity analysis to understand how a ceiling fan price increase would affect air conditioning usage. (ALA, No. 90 at p. 13) Other interested parties—including Hunter Fan Company, Southern Company, Moshe Pardo, and Norman Kennedy—cited the likelihood of increased air conditioning use from an energy conservation standard for ceiling fans. (Hunter Fan Company, Public Meeting Transcript, No. 83 at p. 256; Southern Company, Public Meeting Transcript, No. 83 at pp. 263–264; Moshe Pardo, No. 85 at p. 1; Norman Kennedy, No. 87 at p. 1)

DOE agrees that ceiling fans can be an inexpensive and effective replacement for air conditioning use. The savings identified by MacroAir are associated with ceiling fans in general. It seems unlikely that consumers would substantially increase air conditioning use, or forego purchasing a ceiling fan in lieu of an air conditioning unit, due to a modest increase in the initial cost of a ceiling fan due to an amended energy conservation standard. Because the interaction between ceiling fan use and air conditioning use is unlikely to be different in the case of amended standards than it would be in the no-standards case, DOE did not account for such interaction for the NOPR analyses. DOE requests specific information and any relevant data on how the proposed standards could affect the operation of air conditioners. See issue 9 in 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 (life-cycle cost) is the total consumer expense of an appliance or product over the life of that product, consisting of total installed cost (manufacturer selling price, distribution chain markups, 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 change in annual operating cost for the year that amended or new standards are assumed to take effect.

For any given efficiency level, DOE measures the change in LCC relative to the LCC in the no-new-standards case, which reflects the estimated efficiency distribution of ceiling fans in the absence of new or amended energy conservation standards. In contrast, the PBP for a given efficiency level is measured relative to the baseline product.

DOE calculated the LCC and PBP for each considered efficiency level for a nationally representative consumer sample for each of the product classes. DOE developed consumer samples that account for variation in factors such as geographic location. Two types of consumer samples were created: one for the standard, hugger and VSD group of fans and another for the HSSD and large-diameter group. This was done to capture the variability in energy consumption, discount rates and energy prices associated with the different groups of ceiling fans.

For VSD, hugger, and standard ceiling fans, DOE created a sample in a manner similar to that outlined in section IV.E.1. Due to a lack of data on the location of HSSD and large- diameter fans, DOE assumed that the geographic distribution of HSSD and large-diameter fan purchasers is similar to that of standard, hugger, and VSD ceiling fan purchasers. Therefore, DOE chose the location of HSSD and large-diameter fan purchasers according to the geographic distribution of households in RECS. For each consumer in the sample used for HSSD and large-diameter fans, DOE determined the energy consumption of ceiling fans and the appropriate electricity price for the location and sector.

The calculation of the total installed cost includes MPCs, manufacturer markups, retailer and distributor markups, and sales taxes. Installation costs were assumed not to vary by efficiency level, and therefore were not considered in the analysis. DOE welcomes comments on this assumption. See issue 10 in 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, discount rates, and sales taxes, 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 ceiling fan user samples. The model calculated the LCC and PBP for products at each efficiency level for a 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 expected year of compliance with amended standards. For this NOPR, DOE estimated publication of a final rule in the first half of 2016. For purposes of its analysis, DOE assumed a compliance date three years after publication of any final amended standard (*i.e.,* 2019), consistent with the approach taken in the concurrent ceiling fan light kits energy conservation standards rulemaking.

Table IV–5 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. DOE requests comments on the methodology of the LCC and PBP analyses for ceiling fans. See issue 11 in section VII.E.

TABLE IV–5—SUMMARY OF INPUTS AND METHODS FOR THE LCC AND PBP ANALYSES*

Inputs	Source/Method
Purchase Price	DOE estimated the purchase price of ceiling fans (CF) by combining the different cost components along the production, import, distribution and retail chain. DOE further used a price trend to project prices of CF with DC motors to the compliance year.
Sales Tax	Derived 2019 population-weighted-average tax values for each reportable domain based on Census population projections and sales tax data from Sales Tax Clearinghouse.
Energy Use	Derived in the energy use analysis, and takes into account variations in factors such as operating hours. Variation in geographic location is taken into account for certain product classes.
Energy Prices	Electricity: Based on 2014 marginal electricity price data from the Edison Electric Institute. Variability: Electricity prices vary by season, U.S. region, and baseline electricity consumption level.
Energy Price Trends	Based on *AEO 2015* price forecasts.
Product Lifetime	Derived a mean ceiling fan life time of 13.8 years from a best-fit model based on the Weibull distribution.
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.
Efficiency Distribution	Current efficiency distribution is based on in-store and online model counts. Efficiency distribution for the compliance year is 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 and in chapter 8 of the NOPR TSD.

1. Purchase Price

DOE estimates the purchase price by combining manufacturing and production cost, manufacturer markups, tariffs, import costs, retail markups, and sales tax. Section IV.D provides the details of the markups analysis.

DOE used a price trend to account for changes in the incremental DC motor price that are expected to occur between the time for which DOE has data for DC motor prices (2014) and the assumed compliance date of the rulemaking (2019). DOE estimated a 6 percent price decline rate associated with the electronics used to control DC motor fans based on an analysis of the Producer Price Index (PPI) of semiconductor components.[37] This rate is only applied to the incremental cost between a DC motor and an AC motor and not to the price of the entire ceiling fan. For details on the price trend 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[38] and used population projections from the Census bureau[39] to develop population-weighted-average sales tax values for each state in 2019.

Southern Company suggested DOE allow for some percentage of low-income consumers to have zero installation cost, as they would install the ceiling fan themselves. (Southern Company, Public Meeting Transcript, No. 83 at p. 296) DOE notes that in the NOPR analyses, as in the preliminary analysis, DOE assumed that installation costs are the same regardless of efficiency level and do not affect the LCC or PBP.

2. 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 electricity prices, rather than average electricity prices, for its LCC and PBP analyses in order to remove fixed monthly charges and demand charges from the analysis. (ALA, No. 90 at p. 12) Because marginal electricity price captures more accurately the small, incremental cost or savings associated with a change in energy use relative to the consumer's bill in the reference case, it may provide a better representation of consumer costs than average electricity prices. Therefore, DOE used average electricity prices to characterize the baseline efficiency level and marginal electricity prices to characterize incremental energy costs associated with the other efficiency levels considered. In the LCC analysis, the 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.[40] DOE assigned seasonal marginal prices to each LCC sample based on the location and the baseline monthly electricity consumption for an average summer or winter month associated with that sample. DOE approximated the electricity prices for the industrial sector using the commercial sector prices. This approximation was made as the type of industrial facility that uses ceiling fans typically occupies a regular building, rather than a heavy industrial complex. For a detailed discussion of the development of electricity prices, see appendix 8B of the NOPR TSD.

3. Electricity Price Trends

To arrive at average and marginal electricity prices in future years, DOE multiplied the average and marginal electricity prices in the reference year (2014) 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.[41] To estimate the trends after 2040, DOE used the average rate of change during 2025–2040.

For each fan 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

[37] PCU334413334413

[38] *https://thestc.com/STRates.stm.* Last accessed April 27th 2015.

[39] 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.

[40] 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.*

[41] U.S. Department of Energy-Energy Information Administration, *Annual Energy Outlook 2015 with Projections to 2040* (Available at: *http://www.eia.gov/forecasts/aeo/*).

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 expected market, demographic, and technological trends. DOE also included prices from 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.

4. Repair Costs

In the preliminary analysis, DOE used information on repairs and installation from manufacturer interviews to estimate the cost to consumers of repairing a ceiling fan. DOE also assumed that 2.5 percent and 9 percent of AC-motor and DC-motor ceiling fans incurred repair costs, respectively. DOE based these assumptions on repair rate estimates provided by a ceiling fan technical expert.[42] Westinghouse Lighting stated that low-price ceiling fans are more likely to be replaced by consumers rather than repaired; therefore, Westinghouse Lighting suggested DOE only include a replacement cost and not a repair cost. (Westinghouse Lighting, Public Meeting Transcript, No. 83 at p. 299) While DOE understands Westinghouse's point that many consumers of low-cost ceiling fans will not find it economically justified to repair their ceiling fan, DOE does not have data to support revising the assumptions used in the preliminary analysis, and DOE has continued to use the same assumptions in the NOPR analyses.

ASAP requested DOE use the same repair costs and assumptions for both AC and DC motors, because ASAP is unaware of any data supporting an increased repair rate for DC motors, and because ASAP projects that any reliability issues that manufacturers are currently experiencing with DC motors will be eliminated by 2019 as more ceiling fans with DC motors are sold and the technology matures. (ASAP, *et al.*, No. 92 at pp. 1–2) BAS agrees with ASAP, and the CA IOUs encouraged DOE to research specific DC motor issues to determine the magnitude of reliability issues and whether these issues are prevalent currently. (BAS, No. 88 at p. 27; CA IOUs, No. 91 at pp. 2–3) On the other hand, ALA commented that the intensity of use can be a limiting factor for the lifetime of ceiling fans with DC motors, which is not the case for fans with AC motors. (ALA, No. 90 at p. 14)

As mentioned previously, in the preliminary analysis, DOE assumed a higher repair rate for ceiling fans with DC motors (9 percent) as compared to ceiling fans with AC motors (2.5 percent). This assumption was based on an estimate provided by a ceiling fan technical expert.[42] DOE appreciates the feedback provided on the prevalence of repairs for ceiling fans with DC motors; however, DOE has looked into the issue further and has found no suitable data with which to update its assumption that the excess rate of failure for DC motors, above the repair rate for AC motors, is 6.5 percent of purchases. While DOE is unaware of any data illuminating the magnitude of the excess repair rate for DC motors, because DC motors incorporate electronics that AC motors do not have, the reliability of AC motors is likely to exceed DC motors. DOE invites comment, input, and data that can improve the estimate of repair costs, particularly repair costs associated with DC motors. See issue 12 in section VII.E.

5. Product Lifetime

DOE estimated ceiling fan lifetimes by fitting a survival probability function to data of historical shipments and the 2012 age distributions of installed stock. Data on the age distribution for the installed standard, hugger, and VSD ceiling fan stock in 2012 was available from the LBNL study.[43] By combining data from the LBNL study with historic data on standard, hugger, and VSD ceiling fan shipments from NPD, ENERGY STAR and Appliance Magazine (see chapter 3 for more information on historical shipments), DOE estimated the percentage of appliances of a given age that are still in operation. This survival function, which DOE assumed has the form of a cumulative Weibull distribution,[44] provides a mean of 13.8 years and a median of 13.0 years for ceiling fan lifetime and is the same distribution employed in the preliminary analysis. DOE welcomes comment on these estimates. See issue 13 in section VII.E.

Shipment data were only available for standard, hugger, and VSD ceiling fans, so DOE assumed the survival probability function of large-diameter and HSSD ceiling fans is the same as that for standard, hugger, and VSD ceiling fans. DOE requests comments and data on product lifetimes of large-diameter and HSSD ceiling fans. See issue 14 in section VII.E.

Hunter Fan Company agreed with DOE's assumed standard, hugger, and VSD ceiling fan life of 13.8 years, and ALA agreed with DOE's lifetime assumptions for all ceiling fan types. (Hunter Fan Company, Public Meeting Transcript, No. 83 at p. 301; ALA, No. 90 at p. 14) MacroAir reports that large-diameter ceiling fans typically have longer lifetimes than standard, hugger, and VSD ceiling fans, but it cannot provide data to support this as large-diameter fans have only been manufactured and sold in the United States for about 13 years. MacroAir did cite its warranties for two product lines—12 years (prorated) for their AC motor line and 50,000 hours of operation for its DC motor line—as evidence of lifetimes longer than the 13.8 years DOE assumed in its analyses. (MacroAir, No. 89 at p. 11)

While the warranty information provided by MacroAir is informative, it does not provide a representative basis for modifying DOE's assumption on lifetime of large-diameter ceiling fans. Thus, DOE has maintained an average lifetime of 13.8 years in the NOPR analyses for all ceiling fan product classes.

6. Discount Rates

In calculating the LCC, DOE applies discount rates appropriate to consumers to estimate the present value of future operating costs. To identify appropriate discount rates for purchasers, DOE estimated the percentage of HSSD and large-diameter fan purchasers in the commercial and industrial sectors. For HSSD fans, DOE estimated the ratio in floor space between likely building types where a fan would be installed in commercial settings to that in industrial settings. Manufacturer interviews informed DOE of the likely locations of CF installations. Floor space estimates by building type were taken from the 2010 U.S. Lighting Market Characterization,[45] which extrapolates estimates for commercial floor space from the 2003 Commercial Buildings Energy Consumption Survey (CBECS) and industrial floor space from the 2006 Manufacturing Energy Consumption Survey (MECS) to 2010 values using measured growth trends. The ratio suggests that 80 percent of HSSD installations are in the commercial sector and 20 percent are in the industrial sector. For large-diameter

[42] Mehta, V. Personal communication. Email to Mohan Ganeshalingam, LBNL. January 14, 2014.

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

[44] Weibull distributions are commonly used to model appliance lifetimes.

[45] Navigant Consulting, Inc. *Final Report: 2010 U.S. Lighting Market Characterization.* January 2012. (Last Accessed March 27, 2014.) *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf.*

fans, DOE used manufacturer feedback about common applications for these fans. DOE estimated that 20 percent of large-diameter ceiling fan installations are in the commercial sector and 80 percent are in the industrial sector.

For residential consumers, DOE estimated a distribution of discount rates for ceiling fans based on consumer financing costs and opportunity cost of funds related to appliance energy cost savings and maintenance costs. First, 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 [46] (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 residential discount rates.

To establish discount rates for commercial and industrial users, DOE estimated the cost of capital for companies that purchase ceiling fans. 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 ceiling fans. For this analysis, DOE used Damodaran online [47] 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 and industrial sector discount rates.

7. Efficiency and Blade Span Distribution in the No-Standards Case

To accurately estimate the share of consumers that would be affected by a potential energy conservation standard at a particular efficiency level, DOE's LCC analysis considered the projected distribution (market shares) of product efficiencies in the no-standards case (*i.e.,* the case without new efficiency performance standards).

For standard, hugger, and VSD ceiling fans, DOE developed the current efficiency market share distributions by product class using online data from Hansen Wholesale [48] and data obtained from in-store visits of major retailers. Ceiling fan models were binned according to their efficiency to arrive at the current distributions. To estimate the efficiency distributions in 2019, DOE applied a consumer-choice model sensitive only to the first cost of options representative of each efficiency level given by the engineering analysis. The consumer-choice model is discussed in detail in section IV.G.1.

For HSSD and large-diameter ceiling fans, DOE developed the current efficiency distributions using model counts available on HSSD and large-diameter fan manufacturer Web sites. DOE assumed the current distribution observed in 2015 would also be representative of the efficiency distribution in 2019.

The estimated market shares for the no-standards case for all ceiling fans are shown in Table IV–6. See chapter 8 of the NOPR TSD for further information on the derivation of the efficiency distributions.

Table IV-6. Market Efficiency Distribution for the No-Standards Case in 2019

Product Class	EL 0 %	EL 1 %	EL 2 %	EL 3 %	EL 4 %	Total* %
Standard	3.1	4.7	28.1	55.4	8.7	100
Hugger	3.1	4.7	27.9	55.1	9.2	100
VSD	4.1	0.0	96.0	0.0		100
HSSD	44.7	44.7	0.0	2.7	8.0	100
Large-Diameter	5.3	5.3	71.3	0.0	18.0	100

* Rows may not sum to 100% due to rounding.

Westinghouse Lighting suggested that EL 0 and EL 1 in the no-standards case should have larger market shares compared to higher efficiency levels due to the lower price point associated with these levels. (Westinghouse Lighting, Public Meeting Transcript, No. 83 at pp. 293–294, 310) As discussed in section IV.G.1, DOE investigated the effect of prices on the efficiency distribution, and did not find a basis to modify the distribution based on model counts.

DOE also developed size distributions within each product class to determine the likelihood that a given purchaser would select each of the representative fan sizes from the engineering analysis. In the preliminary analysis, DOE assumed that the current market share for 56-inch HSSD ceiling fans is 66.7 percent. Westinghouse Lighting and BAS indicated that the current market share for 56-inch HSSD ceiling fans is likely higher—potentially closer to 85 percent—than DOE assumed in the preliminary analysis. (Westinghouse Lighting, Public Meeting Transcript, No. 83 at p. 290; BAS, Public Meeting Transcript, No. 83 at p. 290)

For the NOPR, DOE estimated the distribution of diameters for standard, hugger, HSSD and large-diameter ceiling

[46] 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.*

[47] 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*

[48] *http://www.hansenwholesale.com/.*

fans using the distribution of models currently seen on the market. A limited pool of available VSD fan models indicated a rough split of market share between the two representative blade spans, so DOE assumed that the VSD market was evenly split between the two blade spans. Table IV–7 presents the blade span distribution of each of the product classes. DOE's updated model count data show that 7.0 percent of HSSD models are 36-inch and the other 93.0 percent of models are 48-inch or larger (these were assigned to the 56-inch category). (For the NIA, DOE assumed that blade size distribution remains constant over the years considered in the analysis.)

TABLE IV–7—BLADE SPAN DISTRIBUTION

Product class	Standard			Hugger		VSD		HSSD		Large-Diameter		
Blade Span inches	44	52	60	44	52	13	16	36	56	96	144	240
Market Share %	21.1	72.5	6.5	46.2	53.8	50.0	50.0	7.0	93.0	23.0	27.0	49.0

8. 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 baseline products, 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 efficiency level are the change in total installed cost of the product and the change in the first-year annual operating expenditures relative to the baseline. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed.

Westinghouse Lighting found the PBP estimated for standard ceiling fans from DOE's preliminary analysis to be reasonable, but pointed out that the underlying first cost assumptions need to be updated to obtain a more accurate PBP. (Westinghouse Lighting, Public Meeting Transcript, No. 83 at pp. 272–273) Discussion of updates to the first cost can be found in section IV.F.7. Updated PBP results can be found in section V.B.1.

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 efficiency 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 ceiling fans. Details of the shipments analysis are described in chapter 9 of the NOPR TSD.

The shipments model projects total shipments and market-share efficiency distributions in each year of the 30-year analysis period (2019–2048) for the no-standards case and each of the standards cases calibrated using historical shipments. The shipments model consists of three main components: (1) A shipments demand model that determines the total demand for new ceiling fans 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 model that determines the market shares of purchased ceiling fans across efficiency levels. For standard, hugger, and VSD ceiling fans, DOE used a consumer-choice model sensitive to ceiling fan first cost to estimate market shares across efficiency level. For HSSD and large-diameter ceiling fans, DOE used a roll-up approach to estimate the efficiency distribution in each standards case.

1. Shipments Demand Model

DOE used historical shipment data of hugger, standard, and VSD fans from Appliance Magazine's Statistical Review from 1991 to 2006,[49] data from ENERGY STAR annual reports from 2003 to 2013,[50] and data purchased from NPD Research group from 2007–2011.[51] Figure 9.3.1 in Chapter 9 of this NOPR TSD displays the historical time series used for DOE's shipments analysis.

As the data were not disaggregated by product class, DOE estimated the relative split between standard, hugger, and VSD product classes. In the preliminary analysis, DOE used model counts of ceiling fans available in-store and online to estimate the market share split between hugger and standard ceiling fans. DOE estimated that hugger ceiling fans constitute 21 percent of the standard, hugger, and VSD ceiling fan market, with standard (26 percent) and multi-mount (53 percent) ceiling fans making up the rest of the market. Furthermore, DOE assumed 27 percent of multi-mount ceiling fans are installed in the hugger configuration, with the remaining 73 percent installed in the standard configuration.[52] This resulted in market shares of 35 percent and 65 percent for hugger and standard fans, respectively.

Westinghouse Lighting and Hunter Fan Company indicated that the distribution for standard, hugger, and VSD ceiling fans used in the preliminary analysis should be more heavily weighted toward hugger ceiling fans, because hugger fans are generally less expensive than standard fans. (Westinghouse Lighting, Public Meeting Transcript, No. 83 at pp. 291–292; Hunter Fan Company, Public Meeting Transcript, No. 83 at p. 292)

For the NOPR analyses, DOE used updated online and in-store ceiling fan data, and applied a price-weighting approach based on market share data as a function of retail price for ceiling fans collected by the NPD Group from 2007 to 2011. These data inform the price-weighting scheme, which apportions more market share to ceiling fans with lower first costs. Using the updated, price-weighted data, DOE calculated 48.7 percent and 51.3 percent current

[49] Appliance® Statistical Review, Annual Report, *Appliance Magazine* (1991–2006).

[50] United States Environmental Protection Agency, *ENERGY STAR® and Other Climate Protection Partnerships: Annual Report* (2003–2013).

[51] NPD Group, 2007–2011.

[52] AcuPOLL® Precision Research, Inc. *Survey of Consumer Ceiling Fan Usage and Operations.* 2013.

market shares for hugger and standard ceiling fans, respectively. (This calculation retained the 27 percent/73 percent installation split used in the preliminary analysis for multi-mount fans.) Using these same data, DOE found that price-weighting did not significantly affect the relative market shares at each EL for hugger and standard ceiling fans. Therefore, DOE did not take price into account in developing these estimates. DOE welcomes comment, data, or information on its estimates for the relative split between hugger, standard, and VSD product classes. See issue 15 in section VII.E.

DOE was unable to obtain historical shipment data for HSSD and large-diameter ceiling fans. DOE's estimate for HSSD historical shipments is based on scaling historical shipments of standard, hugger, and VSD ceiling fans using a scaling factor estimated from feedback from manufacturer interviews. DOE's estimate for large-diameter fans is based on matching a linear shipments trend to an estimate of 2013 installed stock assuming large-diameter fans were introduced to the market in 2000. DOE requests data and information on current and historical shipments for HSSD and large-diameter ceiling fans. See issue 16 in section VII.E.

Shipments for standard, hugger, and VSD ceiling fans are calculated for the residential sector. Shipments for HSSD and large-diameter fans are calculated for the commercial and industrial sectors. As all of the inputs used in the downstream analyses are the same for both sectors, DOE does not distinguish between shipments to the commercial or industrial sector. DOE requests comments on the assumed ceiling fan usage by sector for all product classes. See issue 17 in section VII.E.

The ceiling fan shipments demand model considers four market segments that affect 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.

2. Stock-Accounting Model

The stock accounting model tracks the age (vintage) distribution of the installed ceiling fan stock. The age distribution of the stock impacts 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.[53] The stock age distribution is updated for subsequent years using projected shipments and retirements determined by the stock age distribution and a product retirement function.

3. Market-Share Projections

The consumer-choice model used for standard, hugger, and VSD ceiling fans estimates the market shares of purchases in each year in the analysis period for each efficiency level presented in the engineering analysis. DOE assumed that each of these product classes provides a specific utility and consumers do not choose between options in different product classes. The consumer-choice module selects which ceiling fans are purchased within a product class in any given year based on consumer sensitivity to first cost, as well as on the ceiling fan options available, which were determined in the engineering analysis. Deviations from purely cost-driven behavior are accounted for using factors found by calibrating the model to observed historical data. DOE requests comments on its approach for estimating the market share distribution by efficiency level using a consumer-choice model sensitive to first cost for standard, hugger, and VSD ceiling fans. See issue 18 in section VII.E.

For HSSD and large-diameter ceiling fans, in the no-standards case the efficiency distribution over the shipments analysis period is assumed to remain fixed to the current distribution estimated for 2015. In the standards cases, market shares for those levels that do not meet the standard roll-up to the standard level, and shares above the standard level are unchanged. As in the preliminary analysis, DOE assumed no product class switching between the HSSD and large-diameter product classes. DOE welcomes comments on its use of the roll-up approach to estimate market-shares by efficiency levels for HSSD and large-diameter ceiling fans. See issue 19 in section VII.E.

In the preliminary analysis, DOE assumed no product class switching between standard and hugger ceiling fans. Hunter Fan Company suggested that some fraction of consumers may switch among product classes; however, Hunter did not expect the overall market share of standard and hugger ceiling fans to change substantially. (Hunter Fan Company, Public Meeting Transcript, No. 83 at pp. 318–320) Westinghouse Lighting agreed with the possibility of product class switching, because first cost is the main consumer choice point, not whether the fan is standard or hugger. (Westinghouse Lighting, Public Meeting Transcript, No. 83 at p. 320) ALA added that because the ceiling fan market is highly dependent on aesthetics, consumers may choose to switch between product classes. (ALA, No. 90 at p. 18)

Although DOE agrees that consumers are primarily sensitive to first cost when purchasing a ceiling fan, the difference in retail price between comparable efficiency levels in each product classes is relatively small and unlikely to drive a significant fraction of the market to switch product classes. There will be some fraction of consumers that cannot switch product classes due to room-size constraints. For example, only hugger fans can adequately fit in rooms with low ceilings. Therefore, for the NOPR analysis, DOE assumed no product class switching between standard and hugger ceiling fans. Thus, the relative fraction of standard and hugger ceiling fans remains fixed in the no-standards case shipments. In a standards case, the relative fraction of hugger and standard fans could potentially change because standards-case shipments for each product class are calculated based on the change in price relative to the no-standards case shipments for that product class using a relative price elasticity (see discussion below).

4. Price Trend

The consumer-choice model uses ceiling fan prices, which change over time in some cases. There is considerable evidence of learning-by-doing lowering the cost of new technologies along with increases in production of the new technology. The concept behind this empirical phenomenon is that as the new technology is produced in greater numbers, employees and firms will find ways to lower costs. Brushless DC motors are a relatively new technology for use in ceiling fans, and thus DOE expects comparable price declines. Given the absence of data on shipments of DC motors, DOE models learning lowering costs, and thus prices, with time. In the preliminary analysis, DOE adopted a price decline rate of 6 percent applied to the incremental (not total) cost associated with a brushless DC motor, based on information from a technical expert for standard, hugger, and VSD ceiling fans.[42] ASAP

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

supported DOE's use of a price trend for DC motor components, and believes that the price of DC motors and their controls will decline more quickly than the total price of ceiling fans. (ASAP, et al., No. 92 at p. 2) ALA also agrees with DOE's price trend approach, but ALA states that this price decline will cease at some point during the analysis period and requested that DOE identify the year at which the price decline would cease to occur. (ALA, No. 90 at p. 18)

In the NOPR analyses, DOE continued to use the 6 percent price decline rate assumption. DOE is not able to specify a year at which the price decline would cease for DC motors; instead, DOE's approach resulted in the cost of DC motors asymptotically approaching the cost of AC motors. DOE requests input on the validity of its price trend methodology as applied to the incremental cost of a DC motor. See issue 20 in section VII.E.

In the preliminary analysis, DOE's application of a price trend to DC motor ceiling fans in its reference case was independent of the composition of the magnet used in DC motors over the course of the analysis period. This assumption is predicated on the magnets used in DC motor ceiling fans being easily available to manufacturers and not subject to price fluctuations based on limited supply, as in the case of rare-earth materials. DOE requested comment from manufacturers on the composition and price of magnets used in DC motor fans to assess whether rare-earth materials are used to construct DC motor magnets.

BAS provided a table comparing the relative performance and relative price of the three main types of magnets used in DC ceiling fan motors (ferrite, bonded neodymium, and sintered neodymium) and also provided a table of information showing that bonded neodymium and sintered neodymium magnets are approximately 3.5 and 10 times more expensive than ferrite magnets, respectively. (BAS, No. 88 at p. 26) Hunter Fan Company stated that it mainly uses ferrite magnets in its DC motor fans, MacroAir noted that they use sintered neodymium magnets in its new DC motor ceiling fan, and BAS indicated that neodymium magnets are not used in their residential fans. (Hunter Fan Company, Public Meeting Transcript, No. 83 at p. 317; MacroAir, No. 89 at p. 10; BAS, No. 88 at pp. 26–27) BAS indicated that the price of a ferrite magnet manufactured to fit within the frame size of an existing AC motor may only cost $1-$2 per motor, and also suggested that as more DC ceiling fans enter the market, ferrite magnets will be used more commonly. (BAS, No. 88 at pp. 26–27)

The price of the permanent magnet may fluctuate based on the pricing of the raw material used to construct the magnet. As a sensitivity scenario in the NOPR analysis, DOE also analyzed the case in which the cost of a DC motor does not undergo price decline and remains fixed at its 2014 price over the course of the analysis period.

5. Impact of a Standard on Shipments

To estimate the impacts of potential standards on shipments, in the preliminary analysis, DOE used a relative price elasticity of demand of −0.34, which is the value DOE has typically used for residential appliances. Because it is relatively easy to replace the cooling provided by ceiling fans with other means, ALA requested DOE use a higher relative price elasticity of demand for ceiling fans in its analyses. (ALA, No. 90 at pp. 12–13) Hunter Fan Company also expressed concern that DOE's analysis did not show a significant drop in shipments resulting from moving from a no-standards case to efficiency level 1. (Hunter Fan Company, Public Meeting Transcript, No. 83 at p. 256)

In the absence of data necessary to estimate a price elasticity specific to ceiling fans, DOE continued to use a relative price elasticity of −0.34 in its NOPR analysis. In addition, DOE notes that a standard at EL 1, EL 2, or EL 3 would affect a relatively small portion of the ceiling fan market, as a majority of the hugger and standard ceiling fan market is at EL 3 or above. The incremental cost associated with EL 1, EL 2, and EL 3 compared to the baseline is relatively small in relation to the total price of the ceiling fan. For example, the installed cost of EL 1 and EL 2 is the same as that of the baseline for hugger and standard ceiling fans. Thus, even if DOE were to use a higher price elasticity, the shipments model would project only a modest decrease in shipments relative to the no-standards case in the event of an efficiency standard set at EL 1, EL 2, or EL 3. DOE requests data to more accurately estimate a price elasticity of demand specific to ceiling fans. Specifically, DOE requests concurrent data on industry-wide shipments-weighted retail price and efficiency and average household income. See issue 21 in section VII.E.

As was noted in the preliminary analysis, an increase in the price of ceiling fan light kits due to a ceiling fan light kit standard will also impact the shipments of ceiling fans sold with ceiling fan light kits. The ceiling fan NOPR analysis includes the impact on ceiling fan shipments from the ceiling fan light kit price change due to the proposed ceiling fan light kit standard [CITATION to be added]. The impact from a ceiling fan light kit standard to ceiling fan shipments is applied to both the no ceiling fan standards case and the ceiling fan standards case shipments.

H. National Impact Analysis

The NIA assesses the national energy savings (NES) and the net present value (NPV) from a national perspective of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels. (''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 repair costs. For the NOPR analysis, DOE projected the energy savings, operating cost savings, product costs, and NPV of consumer benefits over the lifetime of ceiling fans shipped from 2019 through 2048.

DOE evaluates the impacts of potential 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 ceiling fans 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 ceiling fans 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–8 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–8—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.
Standards-Case Forecasted Efficacies	Estimated by market-share module of shipments model.
Annual Energy Consumption per Unit	Annual weighted-average values are a function of energy use at each EL.
Total Installed Cost per Unit	Annual weighted-average values are a function of cost at each EL.
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	DC motor fans have a 6.5% higher failure rate compared to AC motor fans.
Energy Prices	*AEO 2015* forecasts (to 2040) and extrapolation thereafter.
Energy Site-to-Primary Conversion	A time-series conversion factor based on *AEO 2015.*
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 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. Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

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 2015.*

In 2011, 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 full-fuel-cycle (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 that EIA uses to prepare its *Annual Energy Outlook.*[54] The approach used for deriving FFC measures of energy use and emissions is described in appendix 10B of the NOPR TSD.

The rebound effect accounts for increased usage of an appliance by consumers after the implementation of a standard, reducing the energy savings attributed to a standard. DOE generally accounts for the direct rebound effect in its estimates of the national energy savings. In principle, the rebound effect can reduce expected savings in energy costs to consumers in the standards case. However, the take-back in energy consumption associated with the rebound effect can also be expected to provide benefits to consumers. These benefits from an incremental increase in appliance usage are challenging to monetize, but by definition must be similar to the costs. Therefore, DOE assumed that if it were able to monetize the increased value to consumers of the rebound effect, this value would be similar in value to the forgone energy savings. Accordingly, the economic impacts on consumers with or without the rebound effect are approximately the same, so DOE does not adjust operating cost savings in the NIA based on rebound. Nevertheless, DOE performed a sensitivity scenario assuming a rebound of 3-percent to examine the implications of the rebound. This choice is based on the judgment that in most cases, consumers do not often adjust ceiling fans. The results of this sensitivity analysis can be found in appendix 10C of this NOPR TSD.

[54] 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.

DOE estimated the range of potential impacts of amended standards by considering three sensitivity scenarios: A high-benefit scenario, a low-benefit scenario, and a scenario that includes a 3-percent rebound effect. In the high benefits scenario, DOE used the *AEO 2015* high economic growth case estimates for new housing starts and electricity prices along with its reference price trend for DC motor fans.

As discussed in section IV.G, price trend is only applied to the price premium between a DC motor and a direct drive AC motor. In the low benefits scenario, DOE used the low economic growth *AEO 2015* estimates for housing starts and electricity prices, along with no price trend. In the 3-percent rebound scenario, DOE assumed that there would be increased ceiling fan usage due to the decreased operating cost savings associated with a standard. The 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.[55] 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.

DOE requests comments on the overall methodology used to develop shipment forecasts and estimate NES and the NPV of those savings. See issue 22 in section VII.E.

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 at alternative standard levels.

ALA requested DOE consider the impact of energy conservation standards on low-income consumers. (ALA, No. 90 at p. 18) For this NOPR, DOE analyzed the impacts of the considered standard levels on low-income households and small businesses that purchase ceiling fans.

DOE calculated the LCC and PBP results for standard, hugger, and VSD fans based on a sample of low-income households or consumers who were identified in the RECS 2009 survey as being at or below the ''poverty line.'' The poverty line varies with household size, head of household age, and family income.

In the case of the HSSD and large-diameter fans, DOE conducted a subgroup analysis based on small businesses that purchase ceiling fans by applying the small company discount rate distributions for each sector in the LCC and PBP calculation, instead of the discount rate associated with the entire industry.

Chapter 11 of the NOPR TSD describes the consumer subgroup analysis.

J. Manufacturer Impact Analysis

1. Overview

DOE conducted an MIA for ceiling fans to estimate the financial impact of proposed standards on manufacturers of ceiling fans. 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 ceiling fans covered in this rulemaking. The key GRIM inputs are data on the industry cost structure, manufacturer production costs (MPCs), shipments, and assumptions about manufacturer 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 cases). The difference in INPV between the no-standards case and standards cases represents the financial impact of amended energy conservation standards on ceiling fan 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 ceiling fan manufacturers that account for more than 30 percent of domestic ceiling fan 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 ceiling fan 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 ceiling fans covered by standards. See section IV.J.3 of this NOPR for a description of the key issues that manufacturers raised during the interviews.

During the third phase, DOE 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 businesses. DOE determined that ceiling fan manufacturing falls under the North American Industry Classification System (NAICS) code 335210, small electrical appliance manufacturing. The U.S. Small Business Administration (SBA) defines a small business as having less than 750 total employees for manufacturing operating under this NAICS code. This threshold includes all employees in a business' parent company and any other subsidiaries. Based on this classification, DOE identified up to 37 ceiling fan manufacturers that could potentially qualify as small businesses. ALA commented that many of the manufacturers in the ceiling fan industry are small businesses. (ALA, No. 91, Public Meeting Transcript, pp. 18) DOE agrees that small ceiling fan manufacturers hold a significant share of the ceiling fan market. DOE analyzed the impact on the small business subgroup in the complete MIA, which is presented in chapter 12 of this NOPR TSD, and in the Regulatory Flexibility analysis required by the Regulatory Flexibility Act, 5 U.S.C. 601, *et. seq.*, presented in section VI.B of this NOPR.

2. GRIM Analysis and Key Inputs

DOE uses the GRIM to quantify the changes in cash flows over time due to

[55] United States 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*).

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 GRIM analysis uses a standard annual cash-flow analysis that incorporates MPCs, manufacturer markups, shipments, and industry financial information as inputs. It then models changes in MPCs, investments, and manufacturer margins that may result from analyzed 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 ceiling fan 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 of ceiling fan manufacturers. During manufacturer interviews, DOE asked ceiling fan manufacturers to provide feedback on this discount rate. Based on manufacturer feedback that the 5.9 percent discount was too low for the ceiling fan industry, DOE revised the real discount rate to be 7.4 percent for this analysis. Many of the GRIM inputs 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 ceiling fan energy conservation standards to cause manufacturers to incur conversion costs by bringing their tooling and product designs into compliance with amended standards. 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 so 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 ceiling fan 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 ceiling fans at each EL. Ceiling fan manufacturers identified tooling costs as the primary capital cost that would be necessary to meet higher efficiency levels for ceiling fans. Tooling costs are necessary to produce ceiling fans with optimized designs that accommodate more efficient fan motors and fan blades to meet proposed efficiency levels. The two main types of product conversion costs for ceiling fans that manufacturers shared with DOE during manufacturer interviews were the engineering hours necessary to redesign ceiling fans to meet higher efficiency standards and the testing and certification costs necessary to comply with higher efficiency standards.

ALA commented that achieving greater efficiency through the use of a larger AC motor will impose significant ceiling fan redesign and regulatory approval costs. ALA stated that modifying an existing model to use a larger AC motor will require redesign of ceiling fan motor housings, blade arm tooling, and potentially switchcups and flange skirts to aesthetically accommodate the larger motor and maintain proper spacing to accommodate motor cooling. ALA estimates that tooling costs for this modification is $20,000 per modified model and that each modified model will need a complete safety investigation, at an additional estimated cost of $6,000 per model. (ALA, No. 91 at p. 5) Additionally, ALA commented that a standard requiring larger direct drive motors could cause manufacturers to pass on significant conversion costs associated with product design, engineering, retooling, and regulatory approval to customers. (ALA, No. 91 at p. 5–6)

DOE agrees that certain efficiency levels requiring model redesigns that include replacing the motor powering a ceiling fan and modifying motor housing and rotors will most likely cause manufacturers to incur capital conversion costs for retooling and product conversion costs for redesigning models. DOE used these comments from ALA and other comments from manufacturer interviews to make average value estimates (*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. Additionally, DOE analyzed how conversion costs and increased MPCs will impact the ceiling fan industry as well as how manufacturers will pass along conversion costs and increased production costs to consumers in section V.B.2.a of this NOPR.

b. Manufacturer Production Costs

Manufacturing a higher-efficiency product is typically more expensive than manufacturing a baseline product due to the use of more complex components, which are typically more costly than baseline components. The increases in the MPCs of the analyzed products can affect the revenues, gross margins, and cash flow of the industry, making these product costs key inputs for the GRIM and the MIA.

In the MIA, DOE used the MPCs calculated in the engineering analysis, as described in section IV.C and further detailed in chapter 5 of this NOPR TSD. To calculate the MPCs for ceiling fans, DOE purchased ceiling fans for specific product classes and efficiency levels and performed testing on these units to calculate the efficiencies of those units. DOE then conducted teardowns of these units to cost each ceiling fan model. This allowed DOE to estimate the incremental material, labor, depreciation, and overhead costs for products at each efficiency level within a product class. DOE used modeled data to represent some efficiency levels within a product class when it was unable to purchase ceiling fans at those efficiency levels. Manufacturers provided feedback on these performance and cost breakdowns during manufacturer interviews.

c. Shipment Scenarios

INPV, which is the key GRIM output, depends on industry revenue, which depends on the quantity and prices of ceiling fans shipped in each year of the analysis period. Industry revenue calculations require forecasts of: (1) total annual shipment volume of ceiling fans; (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 ceiling fan efficiency).

DOE modeled the no-standards case ceiling fan shipments and the growth of ceiling fan shipments using replacement 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 taking into account demolitions in the housing stock.

For the standards cases, DOE used a ''roll-up'' approach to estimate shipments for HSSD and large-diameter ceiling fans and a consumer-choice model to estimate shipments for standard, hugger, and VSD ceiling fans. DOE used two different approaches to model shipments based on the availability of data to calibrate the market share model. See section IV.G.3 for further detail.

For HSSD and large-diameter ceiling fans, a roll-up approach was used, in which consumers who would have purchased ceiling fans that fail to meet the new standards in the no-standards case purchase the least efficient, compliant ceiling fans in the standards cases. Consumers that would have purchased compliant ceiling fans in the no-standards case continue to purchase the exact same ceiling fans in the standards cases. For standard, hugger, and VSD ceiling fan, a consumer-choice model was used to project consumer purchases based on consumer sensitivity to first cost.

For all ceiling fans, DOE also included price elasticity in the shipments analysis for all standards cases. When price elasticity is included in the shipment analysis, the total number of ceiling fans declines as the price of a ceiling fan increases due to standards. 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 ceiling fans 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 ceiling fan manufacturers from the first sale, typically to a distributor, regardless of the downstream distribution channel through which the ceiling fans are ultimately sold. The MSP is not the cost the end user pays for ceiling fans, 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 ceiling fan 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 ceiling fan manufacturers equals the MSPs at each EL multiplied by the number of shipments at that EL.

Modifying these manufacturer markups in the standards cases yields a different set of impacts on ceiling fan manufacturers than in the no-standards case. For the MIA, DOE modeled three standards case markup scenarios for ceiling fans to represent the uncertainty regarding the potential impacts on prices and profitability for ceiling fan manufacturers following the implementation of analyzed amended energy conservation standards. The three scenarios are: (1) A preservation of gross margin, or flat, markup scenario; (2) a preservation of operating profit markup scenario; and (3) 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 ceiling fan 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 cases as in the no-standards case. This markup scenario represents the upper bound of the ceiling fan industry's profitability in the standards cases because ceiling fan manufacturers are able to fully pass additional costs due to standards to their consumers.

To estimate the industry average gross margin percentage for ceiling fans for the preservation of gross margin markup scenario, DOE examined the SEC 10-Ks of publicly traded ceiling fan manufacturers. DOE then asked manufacturers to verify the industry average gross margin percentage derived from SEC 10-Ks. For this NOPR analysis, DOE used 1.37 as the manufacturer markup for all ceiling fans in the preservation of gross margin markup scenario.

The preservation of operating profit markup scenario assumes that manufacturers are able to maintain only the no-standards case total operating profit in absolute dollars in the standards cases, despite higher product costs and investment. The no-standards case total operating profit is derived from marking up the COGS for each product by the preservation of gross margin markup. In the standards cases for the preservation of operating profit markup scenario, DOE adjusted the ceiling fan manufacturer markups in the GRIM at each TSL to yield approximately the same earnings before interest and taxes in the standards cases in the year after the compliance date of the amended ceiling fan standards as in the no-standards case. Under this scenario, while manufacturers are not able to yield additional operating profit from higher production costs and the investments that are required to comply with amended ceiling fan energy conservation standards, they are able to maintain the same operating profit in the standards case that was earned in the no-standards case.

DOE also modeled a two-tiered markup scenario, which reflects the industry's high- and low-efficiency product pricing structure. DOE implemented 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 efficiency level. The higher efficiency tiers typically earn premiums (for the manufacturer) over the baseline efficiency tier. Several manufacturers suggested that amended standards would lead to a reduction in premium markups and reduce the profitability of higher efficiency 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 ceiling fans under a two-tiered pricing strategy in the no-standards case. In the standards cases, 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. These topics covered MIA issues regarding the number of small businesses and the capital and product conversion costs associated with potential standards. These two comments were previously discussed in sections IV.J.1 and IV.J.2 respectively. No further comments on the preliminary analysis were submitted regarding the MIA.

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 ceiling fan rulemaking. Manufacturers identified four major areas of concern: (1) Shift to air conditioning; (2) testing burden; and (3) utility of DC motors for residential consumers.

a. Shift to Air Conditioning

Several manufacturers stated that ceiling fan energy conservation standards could cause consumers to forgo the purchase of a ceiling fan in lieu of an air conditioner due to the anticipated price increase, or could cause ceiling fan owners to run their air conditioners more frequently instead of using their ceiling fan. Manufacturers assert that if consumers instead use their air conditioner to cool their homes, this could result in more energy use, as ceiling fans tend to be more efficient at cooling rooms than air conditioners.

Manufacturers also stated that overly stringent ceiling fan standards could force manufacturers to reduce the aesthetic quality of some ceiling fans to comply with energy conservation standards. This could cause consumers to forgo the purchase of these ceiling fans because the aesthetic appearance of ceiling fans is an important factor when consumers purchase ceiling fans. Manufacturers claim this reduction in aesthetic quality could again result in more energy use, because consumers who do not purchase ceiling fans would need to use air conditioners to cool their homes. DOE addresses this issue in section IV.E.3 of this NOPR.

b. Testing Burden

Manufacturers are concerned about the additional testing burden associated with complying with energy conservation standards. Most manufacturers use third-party testing facilities for testing and reporting purposes, which can be expensive. Manufacturers stated that ceiling fan standards would significantly increase the amount that they already invest in testing each year. DOE includes the additional testing and certification costs that manufacturers must make due to standards as part of the MIA. DOE calculates the total industry conversion costs for manufacturers, which includes the additional testing and certification costs of complying with any potential standards. These conversion costs impact the INPVs at each TSL displayed in section V.B.2.a of this NOPR notice.

c. Utility of DC Motors for Residential Consumers

Manufacturers stated that energy conservation standards that required the use of DC motors in residential ceiling fans would limit the overall utility of the fan, as well as increase maintenance costs. Manufacturers claim that DC motors require significantly more maintenance and have a higher warranty factor compared to ceiling fans with AC motors. Additionally, ceiling fans with DC motors require the use of a handheld remote, which manufacturers claim is not preferred by many residential consumers. Therefore, manufacturers stated any ceiling fan standard that required the use of a DC motor would significantly reduce the overall utility of ceiling fans to residential consumers.

DOE conducted a screening analysis as part of this NOPR analysis and concluded that DC motors should be considered as a viable technology for all product classes of covered ceiling fans for the engineering analysis. See section IV.B of this NOPR for a detailed discussion of the screening analysis. Also, DOE did include the additional repair costs of ceiling fans using DC motors as part of the LCC analysis. See section IV.F.4 for a complete description of the repair cost assumptions of DC motors.

For the HSSD and large-diameter product classes, which are expected to represent 3 percent of all covered ceiling fan shipments in 2019, DOE is proposing standards that manufacturers indicated they would most likely meet using a DC motor. Use of DC motors will not significantly impact consumer utility for HSSD and large-diameter ceiling fans because HSSD and large-diameter ceiling fans are used in commercial and industrial applications as opposed to residential applications. Most manufacturers indicated that commercial and industrial consumers do not dislike using a handheld remote that is required when operating a ceiling fan with a DC motor, and in some applications it is preferable. Also, these commercial and industrial consumers tend to be better equipped to respond to the increased maintenance costs associated with owning and operating ceiling fans with DC motors due to these consumers repairing products and equipment they own more frequently compared to residential consumers.

K. Emissions Analysis

The emissions analysis consists of two components. The first component estimates the effect of potential energy conservation standards on power sector and site (where applicable) combustion emissions of CO_2, NO_X, SO_2, and Hg. The second component estimates the impacts of potential standards on emissions of two additional greenhouse gases, CH_4 and N_2O, as well as the reductions to emissions of all species due to ''upstream'' activities in the fuel production chain. These upstream activities comprise extraction, processing, and transporting fuels to the site of combustion. The associated emissions are referred to as upstream emissions.

The analysis of power sector emissions uses marginal emissions factors that were derived from data in *AEO* 2015, as described in section IV.M. The methodology is described in chapter 13 and chapter 15 of the NOPR TSD.

Combustion emissions of CH_4 and N_2O are estimated using emissions intensity factors published by the EPA, GHG Emissions Factors Hub.[56] The FFC upstream emissions are estimated based on the methodology described in chapter 15 of the NOPR TSD. The upstream emissions include both emissions from fuel combustion during extraction, processing, and transportation of fuel, and ''fugitive'' emissions (direct leakage to the atmosphere) of CH_4 and CO_2.

The emissions intensity factors are expressed in terms of physical units per MWh or MMBtu of site energy savings. Total emissions reductions are estimated using the energy savings calculated in the national impact analysis.

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,[57] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

The *AEO* incorporates the projected impacts of existing air quality regulations on emissions. *AEO 2015* generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of October 31, 2014. 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

[56] Available at: *http://www.epa.gov/climateleadership/inventory/ghg-emissions.html.*

[57] 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.

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.[58] 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,[59] 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.[60] On October 23, 2014, the DC Circuit lifted the stay of CSAPR.[61] Pursuant to this action, CSAPR went into effect (and CAIR ceased to be in effect) as of January 1, 2015.

EIA was not able to incorporate CSAPR into *AEO 2015,* so it assumes implementation of CAIR. Although 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 efficiency 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 2015* 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, energy conservation standards will generally reduce SO_2 emissions in 2016 and beyond.[62]

CAIR established a cap on NO_X emissions in 28 eastern States and the District of Columbia.[63] 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.

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 2015,* 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. In order 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 social cost of carbon (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 as an appendix to chapter 14 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

[58] 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).

[59] 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).

[60] *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.

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

[62] DOE notes that the Supreme Court recently determined that EPA erred by not considering costs in the finding that regulation of hazardous air pollutants from coal- and oil-fired electric utility steam generating units is appropriate. See Michigan v. EPA (Case No. 14–46, 2015). The Supreme Court did not vacate the MATS rule and DOE has tentatively determined that the Court's decision on the MATS rule does not change the assumptions regarding the impact of energy efficiency standards on SO_2 emissions (see chapter 13 for further discussion). Further, the Court's does not change the impact of the energy efficiency standards on mercury emissions. DOE will continue to monitor developments related to this case and respond to them as appropriate.

[63] 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.

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 [64] 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.

It is important to emphasize that 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: 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,[65] although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV–9 presents the values in the 2010 interagency group report,[66] which is reproduced in appendix 14A of the NOPR TSD.

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

[65] 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.

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

TABLE IV–9—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, as described in the 2013 update from the interagency working group (revised July 2015).[67]

Table IV–10 shows the updated sets of SCC estimates from the latest interagency update in 5-year increments from 2010 to 2050. The full set of annual SCC values 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–10—ANNUAL SCC VALUES FROM 2013 INTERAGENCY UPDATE (REVISED JULY 2015), 2010–2050
[2007$ per metric ton CO_2]

Year	Discount rate			
	5%	3%	2.5%	3%
	Average	Average	Average	95th percentile
2010	10	31	50	86
2015	11	36	56	105
2020	12	42	62	123
2025	14	46	68	138
2030	16	50	73	152
2035	18	55	78	168
2040	21	60	84	183
2045	23	64	89	197
2050	26	69	95	212

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. 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 (revised July 2015), 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, $40.0, $62.3, and $117 per metric ton avoided (values expressed in 2014$). 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

[67] *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* Interagency Working Group on Social Cost of Carbon, United States Government (May 2013; revised July 2015) (Available at: *http://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf*).

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 NO_X emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, ''Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants,'' published in June 2014 by EPA's Office of Air Quality Planning and Standards. The report includes high and low values for NO_X (as $PM_{2.5}$) for 2020, 2025, and 2030 discounted at 3 percent and 7 percent,[68] which are presented in chapter 14 of the NOPR TSD. DOE assigned values for 2021–2024 and 2026–2029 using, respectively, the values for 2020 and 2025. DOE assigned values after 2030 using the value for 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 will continue for evaluate the monetization of avoided NOx emissions and will make any appropriate updates of the current analysis for the final rulemaking.

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 associated with *AEO 2015.* NEMS produces 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 to estimate the marginal impacts of reduced energy demand on the utility sector. These marginal factors are estimated based on the changes to electricity sector generation, installed capacity, fuel consumption and emissions in the *AEO* Reference case and various side cases. Details of the methodology are provided in the appendices to Chapters 13 and 15 of the NOPR TSD.

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

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. 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).[69] 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.[70] 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 efficiency 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, 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).[71] 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.

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

[68] For the monetized NO_X benefits associated with $PM_{2.5}$, the related benefits (derived from benefit-per-ton values) are based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009), which is the lower of the two EPA central tendencies. Using the lower value is more conservative when making the policy decision concerning whether a particular standard level is economically justified so using the higher value would also be justified. If the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2012), the values would be nearly two-and-a-half times larger. (See chapter 14 of the NOPR TSD for further description of the studies mentioned above.)

[69] 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.*

[70] 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).

[71] J. M. Roop, M. J. Scott, and R. W. Schultz, *ImSET 3.1: Impact of Sector Energy Technologies,* PNNL–18412, Pacific Northwest National Laboratory (2009) (Available at: *www.pnl.gov/main/publications/external/technical_reports/PNNL-18412.pdf).*

analysis, see chapter 16 of the NOPR TSD.

V. Analytical Results and Conclusions

The following section addresses the results from DOE's analyses with respect to the considered energy conservation standards for ceiling fans. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for ceiling fans, and the standards levels that DOE is proposing to adopt in this NOPR. 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 six TSLs for ceiling fans. These TSLs were developed by combining specific efficiency levels for each of the product classes analyzed by DOE. DOE presents the results for the TSLs in this document, while the results for all efficiency levels that DOE analyzed are in the NOPR TSD.

Table V–1 presents the TSLs and the corresponding efficiency levels for ceiling fans. TSL 6 represents the maximum technologically feasible (max-tech) energy efficiency for all product classes. TSL 5 corresponds to the maximum NPV (at a 7 percent discount rate). TSL 4 corresponds to the highest efficiency level for which the LCC savings and NPV are both positive. TSL 3 corresponds to the highest efficiency level that can be met with a standard (AC) motor for all product classes. TSL 2 corresponds to the fan-optimization design-option efficiency level. TSL 1 corresponds to the first non-baseline efficiency level (*i.e.,* EL 1).

TABLE V–1—TRIAL STANDARD LEVELS FOR CEILING FANS

	VSD	Hugger	Standard	HSSD	Large-diameter
TSL 1	EL 1	EL 1	EL 1	EL 1	EL 1
TSL 2	EL 1	EL 2	EL 2	EL 1	EL 1
TSL 3	EL 2	EL 3	EL 3	EL 3	EL 2
TSL 4	EL 2	EL 3	EL 3	EL 4	EL 3
TSL 5	EL 3	EL 3	EL 4	EL 4	EL 3
TSL 6	EL 3	EL 4	EL 4	EL 4	EL 4

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

DOE analyzed the economic impacts on ceiling fan 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. 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 efficiency levels considered for all the ceiling fan product classes. In the first of each pair of tables for each product class, the simple payback is measured relative to the baseline product. In the second table, the LCC savings are measured relative to the no-standards efficiency distribution in the compliance year (see section IV.F.7 of this notice).

TABLE V–2—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR STANDARD FANS

EL	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
0	113.36	19.95	184.36	297.71		13.8
1	113.36	14.98	138.97	252.33		13.8
2	113.36	13.32	123.84	237.20		13.8
3	125.41	11.94	111.28	236.69	1.5	13.8
4	158.30	8.74	82.25	240.55	4.0	13.8

Note: The results for each EL represent the average result if all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–3—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR STANDARD FANS

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
—			
1	0.00%	1.59	48.62
2	0.00%	2.81	36.38

TABLE V–3—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR STANDARD FANS—Continued

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
3	20.22%	3.03	8.47
4	61.77%	−0.40	−0.44

* The calculation excludes consumers with zero LCC savings (no impact).

TABLE V–4—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HUGGER FANS

EL	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
0	101.24	17.34	160.38	261.62		13.8
1	101.24	13.02	121.05	222.29		13.8
2	101.24	11.58	107.93	209.18		13.8
3	111.90	10.48	97.99	209.89	1.6	13.8
4	140.97	8.09	76.43	217.40	4.3	13.8

Note: The results for each EL represent the average result if all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–5—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR HUGGER FANS

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
—			
1	0.00	1.25	41.66
2	0.00	2.20	30.20
3	21.89	1.99	5.59
4	66.01	−4.80	−5.27

* The calculation excludes consumers with zero LCC savings (no impact).

TABLE V–6—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR VSD FANS

EL	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
0	283.94	16.84	155.54	439.48		13.8
1	283.94	14.98	138.64	422.57		13.8
2	306.04	13.97	129.48	435.52	7.7	13.8
3	366.47	8.46	79.59	446.06	9.8	13.8

Note: The results for each EL represent the average result if all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–7—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR VSD FANS

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
—			
1	0.00	0.66	16.47
2	2.39	0.12	3.01

TABLE V–7—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR VSD FANS—Continued

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
3	70.86	−10.42	−10.42

* The calculation excludes consumers with zero LCC savings (no impact).

TABLE V–8—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR HSSD FANS

EL	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
0	145.00	22.83	193.80	338.80		13.8
1	145.00	20.29	172.50	317.50		13.8
2	168.37	18.97	161.35	329.72	6.0	13.8
3	177.01	18.83	166.65	343.66	8.0	13.8
4	217.50	8.95	83.67	301.16	5.2	13.8

Note: The results for each EL represent the average result if all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–9—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR HSSD FANS

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
—			
1	0.00	10.03	21.56
2	59.71	−1.18	−1.29
3	71.46	−14.03	−15.26
4	32.77	25.95	27.63

* The calculation excludes consumers with zero LCC savings (no impact).

TABLE V–10—AVERAGE LCC AND PBP RESULTS BY EFFICIENCY LEVEL FOR LARGE-DIAMETER FANS

EL	Average costs (2014$)				Simple payback (years)	Average lifetime (years)
	Installed cost	First year's operating cost	Lifetime operating cost	LCC		
0	4080.64	246.45	2102.94	6183.58		13.8
1	4080.64	219.48	1875.26	5955.91		13.8
2	4206.91	199.87	1709.68	5916.59	2.7	13.8
3	4420.85	168.25	1486.83	5907.68	4.4	13.8
4	4577.89	160.35	1420.10	5997.99	5.8	13.8

Note: The results for each EL represent the average result if all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

TABLE V–11—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR LARGE-DIAMETER FANS

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
—			
1	0.00	10.41	235.01
2	1.52	14.15	159.69

TABLE V–11—AVERAGE LCC SAVINGS RELATIVE TO THE NO-STANDARDS CASE EFFICIENCY DISTRIBUTION FOR LARGE-DIAMETER FANS—Continued

EL	Life-Cycle cost savings		
	% of Consumers that experience net cost	Average savings (all consumers) (2014$)	Average savings (affected consumers)* (2014$)
3	34.92	22.75	27.26
4	49.05	−52.65	−63.10

* 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 ELs on low-income households and small businesses. Table V–12 to Table V–15 compare the average LCC savings for each EL and the simple PBP at each efficiency level for the two consumer subgroups to the average LCC savings and the simple PBP for the entire sample for all the product classes. In most cases, the average LCC savings and the simple PBP for low-income households and small businesses that purchase ceiling fans 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 set of results and discussion for LCC and PBP for the subgroups.

TABLE V–12—COMPARISON OF LCC SAVINGS AND PBP FOR LOW-INCOME HOUSEHOLDS AND ALL HOUSEHOLDS FOR STANDARD FANS

EL	Average LCC savings (2014$)		Simple payback period (years)	
	All	Low-income	All	Low-income
—	....	....	....	
1	48.62	50.03	0.0	0.0
2	36.38	37.26	0.0	0.0
3	8.47	8.81	1.5	1.5
4	−0.44	−1.30	4.0	4.1

TABLE V–13—COMPARISON OF LCC SAVINGS AND PBP FOR LOW-INCOME HOUSEHOLDS AND ALL HOUSEHOLDS FOR HUGGER FANS

EL	Average LCC savings (2014$)		Simple payback period (years)	
	All	Low-income	All	Low-income
—	....	....	....	....
1	41.66	46.99	0.0	0.0
2	30.20	31.44	0.0	0.0
3	5.59	4.98	1.6	1.6
4	−5.27	−6.60	4.3	4.4

TABLE V–14—COMPARISON OF LCC SAVINGS AND PBP FOR LOW-INCOME HOUSEHOLDS AND ALL HOUSEHOLDS FOR VSD FANS

EL	Average LCC savings (2014$)		Simple payback period (years)	
	All	Low-income	All	Low-income
—	....	....	....	....
1	16.47	15.97	0.0	0.0
2	3.01	1.55	7.7	7.2
3	−10.42	−8.15	9.8	9.3

TABLE V–15—COMPARISON OF LCC SAVINGS AND PBP FOR SMALL BUSINESSES AND ALL BUILDINGS FOR HSSD FANS

EL	Average LCC savings (2014$)		Simple payback period (years)	
	All	Small businesses	All	Small businesses
—				
1	21.56	19.22	0.0	0.0
2	−1.29	−3.85	6.0	6.0
3	−15.26	−17.07	8.0	7.9
4	27.63	17.25	5.2	5.2

TABLE V–16—COMPARISON OF LCC SAVINGS AND PBP FOR SMALL BUSINESSES AND ALL BUILDINGS FOR LARGE-DIAMETER FANS

EL	Average LCC savings (2014$)		Simple payback period (years)	
	All	Small businesses	All	Small businesses
—				
1	235.01	194.80	0.0	0.0
2	159.69	112.87	2.7	2.7
3	27.26	−7.88	4.4	4.3
4	−63.10	−107.69	5.8	5.7

c. Rebuttable Presumption Payback

As discussed in section IV.F.8, 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 energy savings resulting from the standard. The criterion is equivalent to having a simple payback period of less than 3 years. In calculating a rebuttable presumption payback period for each of the considered ELs, DOE based the energy use calculation on the DOE test procedures for ceiling fans, as required by EPCA. Table V–17 shows the results of this analysis for the considered ELs.

TABLE V–17—REBUTTABLE PRESUMPTION PAYBACK PERIOD RESULTS

EL	Standard	Hugger	VSD	HSSD	Large-diameter
—					
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	9.2	3.2	3.3
3	1.5	1.5	11.8	3.9	5.4
4	3.8	3.9		2.8	7.1

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 definitively 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

a. Industry Cash-Flow Analysis Results

Table V–18 through Table V–20 present the financial impacts (represented by changes in INPV) of analyzed standards on ceiling fan manufacturers as well as the conversion costs that DOE estimates ceiling fan manufacturers would incur at each TSL. To evaluate the range of cash-flow impacts on the ceiling fan industry, DOE modeled three 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 cases 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 cases in the year before the compliance date for analyzed standards. This difference in cash flow represents the size of the required conversion costs relative to the cash flow generated by the ceiling fan industry in the absence of amended energy conservation standards.

To assess the upper (less severe) end of the range of potential impacts on ceiling fan manufacturers, DOE modeled a preservation of gross margin, or flat, markup scenario. This scenario assumes that in the standards cases, manufacturers would be able to pass along all the higher production costs required for more efficient 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 cases. 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 ceiling fan manufacturers, DOE modeled two additional markup scenarios; a preservation of operating profit markup and a two-tiered markup. In the preservation of operating profit markup scenario manufacturers are not able to yield additional operating profit from higher production costs and the investments that are required to comply with amended ceiling fan energy conservation standards, but instead are only able to maintain the same operating profit in the standards cases that was earned in the no-standards case. This scenario represents a potential lower end of the range of impacts on manufacturers because manufacturers are only able to maintain the operating profit that they would have earned in the no-standards case despite higher production costs and investments. Manufacturers must therefore, reduce margins as a result of this markup scenario which reduces profitability.

Another manufacturer markup scenario DOE analyzed was the two-tiered markup scenario. In this markup scenario manufacturers have two tiers of manufacturer markups for their products, one for ceiling fans with small motors and one for ceiling fans with larger AC or DC motors. As the stringency of analyzed standards increases, the higher premium markup applied to more efficient products erodes, and all products sold adopt the lower baseline markup. This scenario represents a potential lower end of the range of impacts on manufacturers because manufacturers reduce profit margins on high efficiency products as these products become the baseline, higher volume products. Therefore, manufacturers' profits are also reduced as a result of this markup scenario.

TABLE V–18—MANUFACTURER IMPACT ANALYSIS FOR CEILING FANS—PRESERVATION OF GROSS MARGIN MARKUP SCENARIO

	Units	No-standards case	Trial standard levels					
			1	2	3	4	5	6
INPV	*2014$ millions*	1,308.7	1,307.9	1,306.8	1,296.2	1,293.2	1,253.3	1,229.8
Change in INPV	*2014$ millions*		(0.8)	(1.9)	(12.4)	(15.5)	(55.4)	(78.9)
	(%)		(0.1)	(0.1)	(1.0)	(1.2)	(4.2)	(6.0)
Product Conversion Costs.	*2014$ millions*		0.0	0.1	0.8	1.1	2.0	2.4
Capital Conversion Costs.	*2014$ millions*		0.1	0.2	2.6	3.4	7.3	8.6
Total Conversion Costs.	*2014$ millions*		0.2	0.3	3.4	4.5	9.4	11.0

TABLE V–19—MANUFACTURER IMPACT ANALYSIS FOR CEILING FANS—PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO

	Units	No-standards case	Trial standard levels					
			1	2	3	4	5	6
INPV	*2014$ millions*	1,308.7	1,305.2	1,299.6	1,244.9	1,231.6	1,059.1	925.2
Change in INPV	*2014$ millions*		(3.5)	(9.1)	(63.8)	(77.1)	(249.5)	(383.4)
	(%)		(0.3)	(0.7)	(4.9)	(5.9)	(19.1)	(29.3)
Product Conversion Costs.	*2014$ millions*		0.0	0.1	0.8	1.1	2.0	2.4
Capital Conversion Costs.	*2014$ millions*		0.1	0.2	2.6	3.4	7.3	8.6
Total Conversion Costs.	*2014$ millions*		0.2	0.3	3.4	4.5	9.4	11.0

TABLE V–20—MANUFACTURER IMPACT ANALYSIS FOR CEILING FANS—TWO-TIERED MARKUP SCENARIO

	Units	No-standards case	Trial standard levels					
			1	2	3	4	5	6
INPV	*2014$ millions*	1,308.7	1,311.2	1,315.3	1,147.6	1,142.4	1,091.2	1,058.5
Change in INPV	*2014$ millions*		2.5	6.6	(161.1)	(166.3)	(217.4)	(250.2)
	(%)		0.2	0.5	(12.3)	(12.7)	(16.6)	(19.1)
Product Conversion Costs.	*2014$ million)*		0.0	0.1	0.8	1.1	2.0	2.4
Capital Conversion Costs.	*2014$ millions*		0.1	0.2	2.6	3.4	7.3	8.6
Total Conversion Costs.	*2014$ millions*		0.2	0.3	3.4	4.5	9.4	11.0

TSL 1 sets the efficiency level at EL 1 for all ceiling fans. At TSL 1, DOE estimates impacts on INPV range from −$3.5 million to $2.5 million, or a change in INPV of −0.3 percent to 0.2 percent. At TSL 1, industry free cash flow (operating cash flow minus capital expenditures) is expected to decrease by approximately 0.1 percent to $79.7 million, compared to the no-standards case value of $79.0 million in 2018, the year leading up to the proposed standards.

Percentage impacts on INPV are slightly negative to slightly positive at TSL 1. DOE estimates that 97 percent of standard and hugger ceiling fan shipments, 96 percent of VSD ceiling fan shipments, 54 percent of HSSD ceiling fan shipments, and 96 percent of large-diameter fan ceiling fan shipments would meet or exceed the efficiency levels required at TSL 1.

DOE expects conversion costs to be small compared to the no-standards case industry value because most of the ceiling fan shipments, on a total volume basis, already meet or exceed the efficiency levels analyzed at TSL 1. DOE expects ceiling fan manufacturers to incur approximately $43 thousand in product conversion costs for ceiling fan redesign and testing. DOE estimates manufacturers will incur minimal capital conversion costs associated with TSL 1, as most efficiency gains will be achieved by the optimization of existing ceiling fan designs, not through any major equipment upgrades or capital investments. DOE expects approximately $114 thousand in capital conversion costs for manufacturers, primarily to invest in tooling necessary to produce optimized ceiling fans in models that do not meet the required efficiency levels.

At TSL 1, the shipment-weighted average MPC increases by approximately 0.3 percent for all ceiling fans relative to the no-standards case MPC in 2019, the expected year of compliance. In the preservation of gross margin markup scenario, manufacturers are able to fully pass on this slight cost increase to consumers. However, this slight increase in MPC is outweighed by the approximately $0.2 million in conversion costs that manufacturers would incur, which causes a slightly negative change in INPV at TSL 1 under the preservation of gross margin markup scenario.

Under the preservation of operating profit markup scenario, manufacturers earn the same operating profit as would be earned in the no-standards case, but manufacturers do not earn additional profit from their investments. In this scenario, the 0.3 percent MPC increase results in a very slight reduction in manufacturer markup after the compliance year, from 1.37 in the no-standards case to 1.369 at TSL1. This slight reduction in manufacturer markup and $0.2 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 1 under the preservation of operating profit markup scenario.

Under the two-tiered markup scenario, where manufacturers earn different markups for more efficient products, the average manufacturer markup across the entire analysis period slightly increases from 1.370 in the no-standards case to 1.371 at TSL 1. This increase in manufacturer markup combined with the slight increase in MPC outweighs the $0.2 million in conversion costs that manufacturers incur, causing a slightly positive change in INPV at TSL 1 under the two-tiered markup scenario.

TSL 2 sets the efficiency level at EL 1 for VSD, HSSD, and large-diameter ceiling fans and EL 2 for standard and hugger ceiling fans. At TSL 2, DOE estimates impacts on INPV range from −$9.1 million to $6.6 million, or a change in INPV of −0.7 percent to 0.5 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 0.1 percent to $79.6 million, compared to the no-standards case value of $79.0 million in 2018.

Percentage impacts on INPV range from slightly negative to slightly positive at TSL 2. DOE projects that in 2019, 92 percent of standard and hugger ceiling fan shipments, 96 percent of VSD ceiling fan shipments, 54 percent of HSSD ceiling fan shipments, and 96 percent of large-diameter fan shipments would meet or exceed the efficiency levels required at TSL 2.

DOE expects conversion costs to be small compared to the industry value because most of the ceiling fan shipments, on a total volume basis, already meet or exceed the efficiency levels analyzed at TSL 2. DOE expects that product conversion costs will rise from approximately $43 thousand at TSL 1 to approximately $77 thousand at TSL 2 for ceiling fan redesign and testing. Capital conversion costs will increase from $0.1 million at TSL 1 to $0.2 million at TSL 2. Increased capital conversion costs at TSL 2 are driven by investments in tooling needed to further optimize ceiling fans above aggregated market minimum efficiencies for standard and hugger ceiling fan product classes to meet efficiency levels required at TSL 2.

At TSL 2, the shipment-weighted average MPC increases by approximately 0.8 percent for all ceiling fans relative to the no-standards case MPC in 2019. In the preservation of gross margin markup scenario, manufacturers are not able to recover their $0.3 million in conversion costs through the slight increase in MPC over the course of the analysis period causing a slightly negative change in INPV at TSL 2 under the preservation of gross margin markup scenario.

Under the preservation of operating profit markup, the 0.8 percent MPC increase for all ceiling fans results in a very slight reduction in manufacturer markup after the compliance year, from 1.37 in the no-standards case to 1.369 at TSL 2. This slight reduction in manufacturer markup and $0.3 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 2 under the preservation of operating profit scenario.

Under the two-tiered markup scenario, the average manufacturer markup across the entire analysis period slightly increases from 1.37 in the no-standards case to 1.371 at TSL 2. This increase in manufacturer markup combined with the slight increase in MPC outweighs the $0.3 million in conversion costs that manufacturers incur, causing a slightly positive change in INPV at TSL 2 under the two-tiered markup scenario.

TSL 3 sets the efficiency level at EL 2 for VSD and large-diameter ceiling fans and EL 3 for standard, hugger, and HSSD ceiling fans. At TSL 3, DOE estimates impacts on INPV range from −$161.1 million to −$12.4 million, or decreases in INPV of −12.3 percent to −1.0 percent. At this level, industry free cash flow is estimated to decrease by approximately 1.8 percent to $78.3 million, compared to the no-standards case value of $79.0 million in 2018.

Percentage impacts on INPV range from moderately negative to slightly negative at TSL 3. DOE projects that in 2019, 64 percent of standard and hugger ceiling fan shipments, 96 percent of VSD ceiling fan shipments, 9 percent of HSSD ceiling fan shipments, and 91 percent of large-diameter fan shipments would meet or exceed the efficiency levels analyzed at TSL 3.

DOE expects that manufacturers will incur increased total conversion costs of $3.4 million at TSL 3. DOE expects that product conversion costs will rise from $0.1 million at TSL 2 to $0.8 million at TSL 3 for ceiling fan redesign and testing. Capital conversion costs will increase from $0.2 million at TSL 2 to $2.6 million at TSL 3. Increased capital conversion costs at TSL 3 are driven by investments in tooling needed to produce ceiling fans with larger direct drive motors in the standard, hugger, and VSD ceiling fan product classes as well as accommodating air foil blades in the HSSD and large-diameter fan product classes.

At TSL 3, the shipment-weighted average MPC increases by approximately 5.8 percent for all ceiling fans relative to the no-standards case MPC in 2019. In the preservation of gross margin markup scenario, manufacturers are not able to recover their $3.4 million in conversion costs through the increase in MPC over the course of the analysis period causing a slightly negative change in INPV at TSL 3 under the preservation of gross margin markup scenario.

Under the preservation of operating profit markup, the 5.8 percent MPC increase for all ceiling fans results in a reduction in manufacturer markup after the compliance year, from 1.37 in the no-standards case to 1.362 at TSL 3. This reduction in manufacturer markup and $3.4 million in conversion costs incurred by manufacturers cause a slightly negative change in INPV at TSL 3 under the preservation of operating profit scenario.

Under the two-tiered markup scenario, the average manufacturer markup across the entire analysis period decreases from 1.30 in the no-standards case to 1.354 at TSL 3. This decrease in manufacturer markup and the $3.4 million in conversion costs incurred by manufacturers outweighs the increase in MPC, causing a moderately negative change in INPV at TSL 3 under the two-tiered markup scenario.

TSL 4 sets the efficiency level at EL 2 for VSD ceiling fans, EL 3 for standard, hugger, and large-diameter ceiling fans, and EL 4 for HSSD ceiling fans. At TSL 4, DOE estimates impacts on INPV range from −$166.3 million to −$15.5 million, or decreases in INPV of −12.7 percent to −1.2 percent. At this level, industry free cash flow is estimated to decrease by approximately 2.3 percent to $77.9 million, compared to the no-standards case value of $79.0 million in 2018.

Percentage impacts on INPV range from moderately negative to slightly negative at TSL 4. DOE projects that in 2019, 64 percent of standard and hugger ceiling fan shipments, 96 percent of VSD ceiling fan shipments, 6 percent of HSSD shipments, and 17 percent of large-diameter ceiling fan shipments would meet or exceed efficiency levels analyzed at TSL 4.

TSL 4 is the first TSL that requires DC motors be used to meet required efficiency levels in the large-diameter fan and HSSD ceiling fan product classes. DOE expects total conversion costs to increase from $3.4 million at TSL 3 to $4.5 million at TSL 4. DOE estimates manufacturers will incur product conversion costs of $1.1 million to redesign and test ceiling fans that do not meet required efficiency levels at TSL 4. DOE estimates that manufacturers will incur $3.4 million in capital conversion costs due to retooling costs associated with accommodating larger direct drive motors in the standard, hugger and VSD product classes and DC motors in the HSSD and large-diameter fan product classes.

At TSL 4, the shipment-weighted average MPC increases by approximately 7.0 percent for all ceiling fans relative to the no-standards case MPC in 2019. In the preservation of gross margin markup scenario, manufacturers are not able to recover their $4.5 million in conversion costs through the increase in MPC over the course of the analysis period causing a slightly negative change in INPV at TSL 4 under the preservation of gross margin markup scenario.

Under the preservation of operating profit markup, the 7.0 percent MPC increase for all ceiling fans results in a reduction in manufacturer markup after the compliance year, from 1.37 in the no-standards case to 1.360 at TSL 4. This reduction in manufacturer markup and $4.5 million in conversion costs incurred by manufacturers causes a slightly negative change in INPV at TSL 4 under the preservation of operating profit scenario.

Under the two-tiered markup scenario, the average manufacturer markup across the entire analysis period decreases from 1.370 in the no-standards case to 1.351 at TSL 4. This decrease in manufacturer markup and $4.5 million in conversion costs that manufacturers incur outweigh the increase in MPC, causing a moderately negative change in INPV at TSL 4 under the two-tiered markup scenario.

TSL 5 sets the efficiency level at EL 3 for hugger, VSD, and large-diameter ceiling fans and EL 4 for standard and HSSD ceiling fans. At TSL 5, DOE estimates impacts on INPV range from −$249.5 million to −$55.4 million, or decreases in INPV of −19.1 percent to −4.2 percent. At this level, industry free cash flow is estimated to decrease by approximately 4.9 percent to $75.9 million, compared to the no-standards case value of $79.0 million in 2018.

Percentage impacts on INPV range from significantly negative to slightly negative at TSL 5. DOE projects that in 2019, 9 percent of standard ceiling fan shipments, 64 percent of hugger ceiling fan shipments, no VSD ceiling fan shipments, 6 percent of HSSD shipments, and 17 percent of large-diameter fan shipments would meet or exceed the efficiency levels analyzed at TSL 5.

DOE expects total conversion costs to increase from $4.5 million at TSL 4 to $9.4 million at TSL 5. DOE estimates manufacturers will incur product conversion costs of $2.0 million to redesign and test ceiling fans that do not meet required efficiency levels at TSL 5. DOE estimates that manufacturers will incur $7.3 million in capital conversion costs due to retooling costs associated with accommodating larger direct drive motors in the hugger ceiling fan product class and DC motors in the standard, VSD, HSSD, and large-diameter fan product classes.

At TSL 5, the shipment-weighted average MPC increases by approximately 23.4 percent for all ceiling fans relative to the no-standards case MPC in 2019. In the preservation of gross margin markup scenario, manufacturers are not able to recover their $9.4 million in conversion costs through the increase in MPC over the course of the analysis period causing a slightly negative change in INPV at TSL 5 under the preservation of gross margin markup scenario.

Under the preservation of operating profit markup scenario, the 23.4 percent MPC increase for all ceiling fans results in a reduction in manufacturer markup after the compliance year, from 1.37 in the no-standards case to 1.346 at TSL 5. This reduction in manufacturer markup and $9.4 million in conversion costs incurred by manufacturers causes a significantly negative change in INPV at TSL 5 under the preservation of operating profit markup scenario.

Under the two-tiered markup scenario, the average manufacturer markup across the entire analysis period decreases from 1.37 in the no-standards case to 1.351 at TSL 5. This decrease in manufacturer markup and $9.4 million in conversion costs that manufacturers incur outweigh the increase in MPC, causing a moderately negative in INPV at TSL 5 under the two-tiered markup scenario.

TSL 6 represents max-tech for all ceiling fan product classes. This TSL sets the efficiency level at EL 3 for VSD ceiling fans and EL 4 for standard, hugger, HSSD, and large-diameter ceiling fans. At TSL 6, DOE estimates impacts on INPV range from −$383.4 million to −$78.9 million, or decreases in INPV of −29.3 percent to −6.0 percent. At this level, industry free cash flow is estimated to decrease by approximately 5.7 percent to $75.2 million, compared to the no-standards case value of $79.0 million in 2018.

Percentage impacts on INPV range from significantly negative to slightly negative at TSL 6. DOE projects that in 2019, 9 percent of standard and hugger ceiling fan shipments, no VSD ceiling fan shipments, 6 percent of HSSD shipments, and 17 percent of large-diameter fan shipments would meet the efficiency levels analyzed at TSL 6.

DOE expects total conversion costs to increase from $9.4 million at TSL 5 to $11.0 million at TSL 6. DOE estimates manufacturers will incur product conversion costs of $2.4 million to redesign and test the majority of covered ceiling fans currently offered on the market. DOE estimates that manufacturers will incur $8.6 million in capital conversion costs due to retooling costs associated with accommodating DC motors in all of the ceiling fan product classes.

At TSL 6, the shipment-weighted average MPC increases by approximately 36.9 percent for all ceiling fans relative to the no-standards case MPC in 2016. In the preservation of gross margin markup scenario, manufacturers are not able to recover their $11.0 million in conversion costs through the increase in MPC over the course of the analysis period causing a slightly negative change in INPV at TSL 6 under the preservation of gross margin markup scenario.

Under the preservation of operating profit markup, the 36.9 percent MPC increase for all ceiling fans results in a reduction in manufacturer markup after the compliance years, from 1.37 in the no-standards case to 1.336 at TSL 6. This reduction in manufacturer markup and $11.0 million in conversion costs incurred by manufacturers causes a significantly negative change in INPV at TSL 6 under the preservation of operating profit markup scenario.

Under the two-tiered markup scenario, the average manufacturer markup across the entire analysis period decreases from 1.37 in the no-standards case to 1.351 at TSL 6. This decrease in manufacturer markup and $11.0 million in conversion costs that manufacturers incur outweigh the increase in MPC, causing a moderately negative change in INPV at TSL 6 under the two-tiered markup scenario.

b. Impacts on Employment

DOE quantitatively assessed the impacts of potential amended energy conservation standards on direct employment in the ceiling fan industry. DOE used the GRIM to estimate the domestic labor expenditures and number of domestic production workers in the no-standards case and at each TSL from 2015 to 2048. DOE used statistical data from the U.S. Census Bureau's 2011 Annual Survey of Manufacturers, the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures involved with the manufacturer of the product are a function of the labor intensity of the product, the sales volume, and an assumption that wages remain fixed in real terms over time.

In the GRIM, DOE used the labor content of ceiling fans and the MPCs to estimate the annual labor expenditures in the industry. DOE used Census data and interviews with manufacturers to estimate the portion of the total labor expenditures that is attributable to domestic labor.

The production worker estimates in this section only cover workers up to the line-supervisor level directly involved in fabricating and assembling a product within a manufacturing facility. Workers performing services that are closely associated with production operations, such as material handing with a forklift, are also included as production labor. DOE's estimates account for production workers who manufacture only the specific products covered by this rulemaking.

The employment impacts shown in Table V–21 represent the potential production employment that could result following amended energy conservation standards. The upper bound of the results estimates the maximum change in the number of production workers that could occur after compliance with amended energy conservation standards when assuming that manufacturers continue to produce the same scope of covered products in the same production facilities. It also assumes that domestic production does not shift to lower labor-cost countries. Because there is a real risk of manufacturers evaluating sourcing decisions in response to amended energy conservation standards, the lower bound of the employment results includes the estimated total number of U.S. production workers in the industry who could lose their jobs if some or all existing production were moved outside of the United States. While the results present a range of employment impacts following 2019, the sections below also include qualitative discussions of the likelihood of negative employment impacts at the various TSLs. Finally, the employment impacts shown are independent of the employment impacts from the broader U.S. economy, documented in chapter 17 of this NOPR TSD.

DOE estimates that in the absence of amended energy conservation standards, there would be approximately 39 domestic production workers involved in manufacturing ceiling fans in 2019. The table below shows the range of the impacts of potential amended energy conservation standards on U.S. production workers in the ceiling fan industry.

TABLE V–21—POTENTIAL CHANGES IN THE TOTAL NUMBER OF DOMESTIC CEILING FAN PRODUCTION WORKERS IN 2019

	No-standards case	Trial standard level					
		1	2	3	4	5	6
Total Number of Domestic Production Workers in 2019 (without changes in production locations)	39	39	39	38	38	36	34
Potential Changes in Domestic Production Workers in 2019*		0–(39)	0–(39)	(1)–(39)	(1)–(39)	(3)–(39)	(5)–(39)

* DOE presents a range of potential employment impacts. Numbers in parentheses indicate negative numbers.

At the upper end of the employment impact range, all TSLs show either no change in domestic employment or slight negative impacts. These slightly negative impacts are driven by the reduction in total ceiling fan shipments at higher TSLs. DOE included price elasticity as part of the shipments analysis, so as the average price of ceiling fans increase due to amended standards, fewer ceiling fans would be sold. Therefore, the amount of labor associated with these fewer shipments also decreases. It is important to note that while the average total MPC increases for more efficient ceiling fans, the increase in MPC is almost entirely attributed to the increase in the material costs used to produce more efficient fans. The amount of labor associated with more efficient ceiling fans remains constant even as the total MPC of a ceiling fan increases at higher ELs.

At the lower end of the range, DOE models a situation where all domestic employment associated with ceiling fan production moves abroad as a result of energy conservation standards. In this situation, the handful of manufacturers who currently purchase various ceiling fan components from original equipment manufacturers abroad and assemble ceiling fans domestically may instead purchase fully assembled ceiling fans, and the handful of manufacturers who currently produce ceiling fans domestically may move all ceiling fan production abroad. DOE does not anticipate either of these situations to be probable, because the majority of manufacturers that have domestic production produce large diameter ceiling fans and the associated shipping costs of those large diameter ceiling fans is significant. Therefore, manufacturers would incur much higher shipping costs if production or assembly is moved abroad. Based on manufacturer feedback, DOE does not expect a significant impact on domestic employment at any TSL.

At TSL 4, the proposed TSL in today's NOPR, DOE concludes, based on the shipment analysis, manufacturer interviews, and the potential range of result of the direct employment analysis, that manufacturers could face a slight negative impact on domestic employment due to a slight reduction in overall ceiling fan shipments in 2019. However, DOE does not have information upon which to conclude that any ceiling fan manufacturers would shift their domestic ceiling fan production abroad as a result of the proposed standards.

c. Impacts on Manufacturing Capacity

Ceiling fan manufacturers stated that they anticipate manufacturing capacity constraints if all ceiling fans are required to use DC motors to comply with the amended energy conservation standards. DOE learned during interviews that manufacturers primarily source motors for ceiling fans from either ceiling fan original equipment manufacturers or directly from motor manufacturers and then insert them into their ceiling fan models. During interviews, manufacturers stated that demand for DC motors may outpace supply if DC motors are required for all ceiling fans to comply with amended standards. Manufacturers expressed concern during interviews that currently only a few ceiling fan shipments incorporate DC motors, and there would be major sourcing concerns if all ceiling fan were required to use DC motors.

While the proposed TSL 4 requires HSSD and large-diameter ceiling fans to use DC motors to meet efficiency levels, this only accounts for approximately 2.5 percent of all ceiling fans. Therefore, DOE does not anticipate a manufacturer capacity constraint on the supply of DC motors for this small portion of the overall ceiling fan market. DOE expects that the motor manufacturers that supply ceiling fan manufacturers with DC motors would be able to increase production of DC motors in the estimated 3 years from the publication of the final rule to the compliance date to meet demand for ceiling fans that require DC motors due to amended standards. DOE does not anticipate any significant 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 efficiency levels proposed in this NOPR. See issue 23 in section VII.E.

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; small businesses. 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 ceiling fans for this rulemaking based on the results of the industry characterization. DOE seeks comment on any other potential manufacturer subgroups that could be disproportionally affected by amended energy conservation standards for ceiling fans. See issue 24 in section VII.E.

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 ceiling fans.

DOE identified a number of requirements, in addition to amended energy conservation standards for ceiling fans, that ceiling fan manufacturers will face for products they manufacture approximately 3 years prior to and 3 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 ceiling fan manufacturers must meet. These include California Title 20, which has the same energy conservation standards to DOE's existing ceiling fan standards, but requires an additional certification, and California Air Resources Board Standards limiting the amount of formaldehyde in composite wood used to make fan blades, 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 affect the same product because the coincident requirements could strain financial resources in the same profit center and consequently affect capacity. DOE identified the upcoming ceiling fan light kit standards rulemaking as a potential source of additional cumulative regulatory burden on ceiling fan manufacturers.

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

In addition to the proposed amended energy conservation standards on ceiling fans, several other existing and pending federal regulations may apply to other products produced by ceiling fan manufacturers. DOE acknowledges that each regulation can affect a manufacturer's financial operations. Multiple regulations affecting the same manufacturer can quickly strain manufacturers' profit and possibly cause them to exit particular markets. Table V–22 lists the other DOE energy conservation standards that could also affect ceiling fan manufacturers in the 3 years leading up to and after the estimated compliance date of amended energy conservation standards for these products.

TABLE V–22—OTHER DOE REGULATIONS POTENTIALLY AFFECTING CEILING FAN MANUFACTURERS

Regulation	Approximate compliance date	Estimated industry total conversion expenses
Electric Motors	2016	$84.6 million (2013$).[a]
Ceiling Fan Light Kits	*2019	N/A.†
Commercial and Industrial Fans	*2019	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.
[a] Estimated industry conversion expenses were published in the TSD for the May 2014 electric motors final rule. 79 FR 30933 The TSD for 2014 electric motors final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/42*.

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 ceiling fan 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 ceiling fan manufacturers also manufacture, especially if compliance with those regulations is required 3 years before or after the estimated compliance date of this proposed standard. See issue 25 in section VII.E.

3. National Impact Analysis

a. Significance of Energy Savings

To estimate the energy savings attributable to potential standards for ceiling fans, 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–23 presents DOE's projections of the national energy savings for each TSL considered for ceiling fans. The savings were calculated using the approach described in section IV.H of this notice.

TABLE V–23—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CEILING FANS SHIPPED 2019–2048

	Trial standard level (Quads)					
	1	2	3	4	5	6
Primary energy	0.132	0.201	0.531	0.725	1.303	1.724
FFC energy	0.137	0.210	0.555	0.758	1.362	1.802

OMB Circular A–4 [72] 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 9, rather than 30, years of product shipments. The choice of a 9-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.[73] The review timeframe established in EPCA is generally not synchronized with the product lifetime, product manufacturing cycles, or other factors specific to ceiling fans. 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 9-year analytical period are presented in Table V–24. The impacts are counted over the lifetime of ceiling fans purchased in 2019–2027.

[72] 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/*).

[73] 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.

TABLE V–24—CUMULATIVE NATIONAL ENERGY SAVINGS FOR CEILING FANS; NINE YEARS OF SHIPMENTS
[2019–2027]

	Trial standard level (Quads)					
	1	2	3	4	5	6
Primary energy	0.041	0.061	0.152	0.203	0.401	0.544
FFC energy	0.042	0.064	0.159	0.212	0.419	0.569

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 ceiling fans. In accordance with OMB's guidelines on regulatory analysis,[74] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate.

Table V–25 shows the consumer NPV results with impacts counted over the lifetime of products purchased in 2019–2048.

TABLE V–25—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CEILING FANS SHIPPED IN 2019–2048

Discount rate	Trial standard level (Billion 2014$)					
	1	2	3	4	5	6
3 percent	0.952	1.333	1.944	2.760	4.466	5.251
7 percent	0.400	0.539	0.522	0.813	1.094	1.051

The NPV results based on the aforementioned 9-year analytical period are presented in Table V–26. 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–26—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR CEILING FANS; NINE YEARS OF SHIPMENTS
[2019–2027]

Discount rate	Trial standard level *(Billion 2014$)*					
	1	2	3	4	5	6
3 percent	0.360	0.491	0.561	0.773	0.947	0.834
7 percent	0.203	0.268	0.180	0.280	0.138	−0.126

The above results reflect the use of a default trend to estimate the change in price for ceiling fans over the analysis period (see section IV.G of this document). DOE also conducted a sensitivity analysis that considered one scenario with no price decline. The results of these alternative cases are presented in appendix 10C of the NOPR TSD.

c. Indirect Impacts on Employment

DOE expects energy conservation standards for ceiling fans 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. 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 ceiling fans under consideration in this rulemaking. During manufacturer interviews, manufacturers stated that energy conservation standards that require the use of DC motors in ceiling fans would limit the overall utility of ceiling fans for residential consumers, as well as increase maintenance costs. DOE is proposing standards that manufacturers indicated they would likely meet using a DC motor for the HSSD and large-diameter ceiling fan product classes, which represent less than three percent of expected covered ceiling fan shipments in 2019. Additionally, the

[74] 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/*).

use of DC motors will not significantly impact consumer utility for HSSD and large-diameter ceiling fans because the consumers using these products have significantly different needs for their ceiling fans than the needs of consumers using residential ceiling fans that were referenced by manufacturers during interviews.

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. DOE invites comment from the public regarding the competitive impacts that are likely to result from this proposed rule. See issue 26 in section VII.E. In addition, stakeholders may also provide comments separately to DOJ regarding these potential impacts. See **ADDRESSES** section for information to send comments to DOJ.

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 ceiling fans are expected to yield environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases. Table V–27 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–27—CUMULATIVE EMISSIONS REDUCTION FOR CEILING FANS SHIPPED 2019–2048

	Trial standard level					
	1	2	3	4	5	6
Power Sector Emissions						
CO_2 (*million metric tons*)	7.87	11.99	31.67	43.20	77.91	103.19
SO_2 (*thousand tons*)	4.40	6.71	17.67	24.04	43.61	57.85
NO_X (*thousand tons*)	8.84	13.48	35.64	48.66	87.62	116.00
Hg (*tons*)	0.02	0.02	0.07	0.09	0.16	0.22
CH_4 (*thousand tons*)	0.63	0.97	2.55	3.47	6.29	8.34
N_2O (thousand tons)	0.09	0.14	0.36	0.49	0.89	1.18
Upstream Emissions						
CO_2 (*million metric tons*)	0.45	0.68	1.81	2.48	4.45	5.88
SO_2 (*thousand tons*)	0.08	0.13	0.34	0.46	0.82	1.09
NO_X (*thousand tons*)	6.43	9.81	25.99	35.51	63.72	84.28
Hg (*tons*)	0.00	0.00	0.00	0.00	0.00	0.00
CH_4 (*thousand tons*)	35.52	54.17	143.56	196.12	351.90	465.40
N_2O (thousand tons)	0.00	0.01	0.02	0.02	0.04	0.05
Total FFC Emissions						
CO_2 (*million metric tons*)	8.31	12.67	33.48	45.68	82.36	109.08
SO_2 (*thousand tons*)	4.49	6.84	18.01	24.50	44.43	58.94
NO_X (*thousand tons*)	15.28	23.29	61.63	84.17	151.34	200.27
Hg (*tons*)	0.02	0.03	0.07	0.09	0.16	0.22
CH_4 (*thousand tons*)	36.15	55.14	146.11	199.59	358.18	473.74
CH_4 (*thousand tons CO_2eq*) *	1012.20	1543.84	4091.09	5588.54	10029.17	13264.68
N_2O (thousand tons)	0.09	0.14	0.38	0.51	0.93	1.23
N_2O (*thousand tons CO_2eq*) *	24.83	37.83	99.71	135.69	245.85	326.06

* CO_2eq is the quantity of CO_2 that would have the same global warming potential.

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 ceiling fans. 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), $40.0/metric ton (the average value from a distribution that uses a 3-percent discount rate), $62.3/metric ton (the average value from a distribution that uses a 2.5-percent discount rate), and $117/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–28 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–28—ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION FOR PRODUCTS SHIPPED IN 2019–2048

(Million 2014$)

TSL	SCC Case*			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
Power Sector Emissions				
1	53.88	247.99	394.24	755.34
2	81.92	377.43	600.14	1149.69
3	214.57	992.25	1579.02	3023.52
4	291.62	1350.73	2150.25	4116.32
5	533.47	2455.82	3904.26	7480.15
6	709.41	3260.18	5181.11	9928.66
Upstream Emissions				
1	3.02	14.01	22.30	42.70
2	4.59	21.33	33.98	65.04
3	12.07	56.27	89.70	171.61
4	16.43	76.71	122.32	233.96
5	29.89	138.74	220.94	422.94
6	39.69	183.90	292.76	560.54
Total FFC Emissions				
1	56.90	262.00	416.54	798.03
2	86.52	398.76	634.12	1214.73
3	226.64	1048.53	1668.72	3195.13
4	308.06	1427.44	2272.57	4350.28
5	563.36	2594.56	4125.20	7903.09
6	749.10	3444.09	5473.88	10489.20

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.2, $40.0, $62.3, and $117 per metric ton (2014$). 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 ceiling fans. The dollar-per-ton values that DOE used are discussed in section IV.L of this document. Table V–29 presents the cumulative present value ranges for NO_X emissions for each TSL calculated using 7-percent and 3-percent discount rates. This table presents values that use the low dollar-per-ton values. Results that reflect the range of NO_X dollar-per-ton values are presented in Table V–31.

TABLE V–29—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR CEILING FANS SHIPPED 2019–2048

(Million 2014$)

TSL	3% discount rate	7% discount rate
Power Sector Emissions		
1	28.60	11.67
2	43.48	17.67
3	113.87	45.66
4	154.82	61.76
5	283.19	115.39
6	376.58	154.36
Upstream Emissions		
1	20.48	8.15
2	31.15	12.36
3	81.80	32.02
4	111.29	43.34
5	202.78	80.64
6	269.34	107.74

TABLE V–29—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION FOR CEILING FANS SHIPPED 2019–2048—Continued

(Million 2014$)

TSL	3% discount rate	7% discount rate
Total FFC Emissions		
1	49.08	19.82
2	74.63	30.02
3	195.67	77.68
4	266.11	105.10
5	485.97	196.04
6	645.92	262.11

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–30 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 ceiling fans 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–30—NET PRESENT VALUE OF CONSUMER SAVINGS COMBINED WITH PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS

TSL	Consumer NPV at 3% discount rate added with: (Billion 2014$)			
	SCC case $12.2/metric ton and 3% low NO_X values	SCC case $40.0/metric ton and 3% low NO_X values	SCC case $62.3/metric ton and 3% low NO_X values	SCC case $117/metric ton and 3% low NO_X values
1	1.1	1.3	1.4	1.8
2	1.5	1.8	2.0	2.6
3	2.4	3.2	3.8	5.3
4	3.3	4.5	5.3	7.4
5	5.5	7.5	9.1	12.9
6	6.6	9.3	11.4	16.4
TSL	Consumer NPV at 7% discount rate added with: (Billion 2014$)			
	SCC case $12.2/metric ton and 7% low NO_X values	SCC case $40.0/metric ton and % 7% low NO_X values	SCC case $62.3/metric ton and 7% low NO_X values	SCC case $117/metric ton and 7% low NO_X values
1	0.5	0.7	0.8	1.2
2	0.7	1.0	1.2	1.8
3	0.8	1.6	2.3	3.8
4	1.2	2.3	3.2	5.3
5	1.9	3.9	5.4	9.2
6	2.1	4.8	6.8	11.8

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 from 2019 to 2048. Because CO_2 emissions have a very long residence time in the atmosphere,[75] 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 standards 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 amended standards for ceiling fans 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 efficiency 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

[75] 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).

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 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 decreases the number of products purchased by consumers, this decreases the potential energy savings from an energy conservation standard. 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.[76]

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.[77] 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 Ceiling Fan Standards

Table V–31 and Table V–32 summarize the quantitative impacts estimated for each TSL for ceiling fans. The national impacts are measured over the lifetime of ceiling fans 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 full-fuel-cycle results. The efficiency levels contained in each TSL are described in section V.A of this notice.

TABLE V–31—SUMMARY OF ANALYTICAL RESULTS FOR CEILING FANS TSLS: NATIONAL IMPACTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Cumulative FFC National Energy Savings						
quads	0.137	0.210	0.555	0.758	1.362	1.802
NPV of Consumer Costs and Benefits (2014$ billion)						
3% discount rate	0.952	1.333	1.944	2.760	4.466	5.251
7% discount rate	0.400	0.539	0.522	0.813	1.094	1.051
Cumulative FFC Emissions Reduction (Total FFC Emissions)						
CO_2 *million metric tons*	8.31	12.67	33.48	45.68	82.36	109.08
SO_2 *thousand tons*	4.49	6.84	18.01	24.50	44.43	58.94
NO_X *thousand tons*	15.28	23.29	61.63	84.17	151.34	200.27
Hg *tons*	0.02	0.03	0.07	0.09	0.16	0.22
CH_4 *thousand tons*	36.15	55.14	146.11	199.59	358.18	473.74
CH_4 *thousand tons CO_2eq**.	1012.20	1543.84	4091.09	5588.54	10029.17	13264.68
N_2O *thousand tons*	0.09	0.14	0.38	0.51	0.93	1.23
N_2O *thousand tons CO_2eq**.	24.83	37.83	99.71	135.69	245.85	326.06
Value of Emissions Reduction (Total FFC Emissions)						
CO_2 *2014$ billion***	0.057 to 0.798	0.087 to 1.215	0.227 to 3.195	0.308 to 4.350	0.563 to 7.903	0.749 to 10.489

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

[77] 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–31—SUMMARY OF ANALYTICAL RESULTS FOR CEILING FANS TSLS: NATIONAL IMPACTS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
NO_X—3% discount rate *2014$ million*.	49.1 to 108.9	74.6 to 165.6	195.7 to 433.9	266.1 to 590.0	486.0 to 1078.7	645.9 to 1434.2
NO_X—7% discount rate *2014$ million*.	19.8 to 44.2	30.0 to 67.0	77.7 to 173.4	105.1 to 234.6	196.0 to 437.5	262.1 to 584.9

* CO_2eq is the quantity of CO_2 that would have the same global warming potential (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–32—SUMMARY OF ANALYTICAL RESULTS FOR CEILING FANS TSLS: MANUFACTURER AND CONSUMER IMPACTS

Category	TSL 1 *	TSL 2 *	TSL 3 *	TSL 4 *	TSL 5 *	TSL 6 *
Manufacturer Impacts						
Industry NPV (2014$ million) (*No-Standards Case INPV = 1,309*)	1,305–1,311	1,300–1,315	1,148–1,296	1,142–1,293	1,059–1,253	925–1,230
Industry NPV *$2014 million change*	(3.5)–2.5	(9.1)–6.6	(161.1)–(12.4)	(166.3)–(15.5)	(249.5)–(55.4)	(383.4)–(78.9)
Industry NPV *% change*	(0.3)–0.2	(0.7)–0.5	(12.3)–(1.0)	(12.7)–(1.2)	(19.1)–(4.2)	(29.3)–(6.0)
Consumer Impacts						
Consumer Average LCC Savings *2014$*:						
Standard	48.62	36.38	8.47	8.47	(0.44)	(0.44)
Hugger	41.66	30.20	5.59	5.59	5.59	(5.27)
VSD	16.47	16.47	3.01	3.01	(10.42)	(10.42)
HSSD	21.56	21.56	(15.26)	27.63	27.63	27.63
Large-Diameter	235.01	235.01	159.69	27.26	27.26	(63.10)
Consumer Simple PBP ** *years*:						
Standard	–	–	1.5	1.5	4.0	4.0
Hugger	–	–	1.6	1.6	1.6	4.3
VSD	–	–	7.7	7.7	9.8	9.8
HSSD	–	–	8.0	5.2	5.2	5.2
Large-Diameter	–	–	2.7	4.4	4.4	5.8
% of Consumers that Experience Net Cost:						
Standard	0.00	0.00	20	20	62	62
Hugger	0.00	0.00	22	22	22	66
VSD	0.00	0.00	2	2	71	71
HSSD	0.00	0.00	71	33	33	33
Large-Diameter	0.00	0.00	2	35	35	49

* Parentheses indicate negative (−) values.
** Simple PBP results are calculated assuming that all consumers use products at that efficiency level. The PBP is measured relative to the baseline product.

DOE first considered TSL 6, which represents the max-tech efficiency levels. TSL 6 would save 1.802 quads of energy, an amount DOE considers significant. Under TSL 6, the NPV of consumer benefit would be $1.051 billion using a discount rate of 7 percent, and $5.251 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 6 are 109.08 Mt of CO_2, 58.94 thousand tons of SO_2, 200.27 thousand tons of NO_X, 0.22 ton of Hg, 473.74 thousand tons of CH_4, and 1.23 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 6 ranges from $0.749 billion to $10.489 billion.

At TSL 6, the average LCC impact is a savings of ($10.42) for VSD ceiling fans, ($5.27) for hugger ceiling fans, ($0.44) for standard ceiling fans, $27.63 for HSSD ceiling fans, and ($63.10) for large-diameter ceiling fans. The simple payback period is 9.8 years for VSD ceiling fans, 4.3 years for hugger ceiling fans, 4.0 years for standard ceiling fans, 5.2 years for HSSD ceiling fans, and 5.8 years for large-diameter ceiling fans. The fraction of consumers experiencing a net LCC cost is 71 percent for VSD ceiling fans, 66 percent for hugger ceiling fans, 62 percent for standard ceiling fans, 33 percent for HSSD ceiling fans, and 49 percent for large-diameter ceiling fans.

At TSL 6, the projected change in INPV ranges from a decrease of $383.4 million to a decrease of $78.9 million, which represent decreases of 29.3 percent and 6.0 percent, respectively.

At TSL 6, the corresponding efficiency levels for all product classes are the max-tech efficiency levels. Specifically for the VSD, hugger, standard and large-diameter ceiling fan product classes, the average LCC savings in 2014$ for all consumers, and affected consumers relative to no standards case is negative. Additionally, the percentage of consumers that experience net cost for the VSD, hugger and standard ceiling fan product classes at max-tech efficiencies are greater than 60 percent.

The Secretary tentatively concludes that at TSL 6, 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 negative average LCC savings for the VSD, hugger, standard, and large-diameter ceiling fan product classes and the potential reduction in manufacturer industry value. Consequently, the Secretary has tentatively concluded that TSL 6 is not economically justified.

DOE then considered TSL 5, which corresponds to the maximum NPV at a 7 percent discount rate, which would save 1.362 quads of energy, an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be $1.094 billion using a discount rate of 7 percent, and $4.466 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 82.36 Mt of CO_2, 44.43 thousand tons of SO_2, 151.34 thousand tons of NO_X, 0.16 ton of Hg, 358.18 thousand tons of CH_4, and 0.93 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 5 ranges from $0.563 billion to $7.903 billion.

At TSL 5, the average LCC impact is a savings of ($10.42) for VSD ceiling fans, $5.59 for hugger ceiling fans, ($0.44) for standard ceiling fans, $27.63 for HSSD ceiling fans, and $27.26 for large-diameter ceiling fans. The simple payback period is 9.8 years for VSD ceiling fans, 1.6 years for hugger ceiling fans, 4.0 years for standard ceiling fans, 5.2 years for HSSD ceiling fans, and 4.4 years for large-diameter ceiling fans. The fraction of consumers experiencing a net LCC cost is 71 percent for VSD ceiling fans, 22 percent for hugger ceiling fans, 62 percent for standard ceiling fans, 33 percent for HSSD ceiling fans, and 35 percent for large-diameter ceiling fans.

At TSL 5, the projected change in INPV ranges from a decrease of $249.5 million to a decrease of $55.4 million, which represent decreases of 19.1 percent and 4.2 percent, respectively.

For TSL 5, the efficiency levels for each product class correspond to the following: max-tech efficiency levels for the VSD, standard and HSSD ceiling fan product classes, and EL 3 for hugger and large-diameter ceiling fan product classes. Therefore, for the VSD and standard ceiling fan product classes, the average LCC savings in 2014$ for all consumers and affected consumers relative to no standards case is negative. Additionally, the percentage of consumers that experience net cost for these product classes at max-tech efficiencies are greater than 60 percent. The Secretary tentatively concludes that at TSL 5 for ceiling fans, 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 negative average LCC savings for the VSD and standard ceiling fan product classes and the potential reduction in manufacturer industry value. Consequently, the Secretary has tentatively concluded that TSL 5 is not economically justified.

DOE then considered TSL 4, which corresponds to the highest efficiency level for which the LCC and NPV are both positive, which would save 0.758 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $0.813 billion using a discount rate of 7 percent, and $2.760 billion using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 45.68 Mt of CO_2, 24.50 thousand tons of SO_2, 84.17 thousand tons of NO_X, 0.09 ton of Hg, 199.59 thousand tons of CH_4, and 0.51 thousand tons of N_2O. The estimated monetary value of the CO_2 emissions reduction at TSL 4 ranges from $0.308 billion to $4.350 billion.

At TSL 4, the average LCC impact is a savings of $3.01 for VSD ceiling fans, $5.59 for hugger ceiling fans, $8.47 for standard ceiling fans, $27.63 for HSSD ceiling fans, and $27.26 for large-diameter ceiling fans. The simple payback period is 7.7 years for VSD ceiling fans, 1.6 years for hugger ceiling fans, 1.5 years for standard ceiling fans, 5.2 years for HSSD ceiling fans, and 4.4 years for large-diameter ceiling fans. The fraction of consumers experiencing a net LCC cost is 2 percent for VSD ceiling fans, 22 percent for hugger ceiling fans, 20 percent for standard ceiling fans, 33 percent for HSSD ceiling fans, and 35 percent for large-diameter ceiling fans.

At TSL 4, the projected change in INPV ranges from a decrease of $166.3 million to a decrease of $15.5 million, which represent decreases of 12.7 percent and 1.2 percent, respectively.

For TSL 4, the efficiency levels for each product class correspond to the following: max-tech for HSSD ceiling fan product class, EL 3 for the hugger, standard and large-diameter ceiling fan product classes, and EL 2 for the very-small diameter ceiling fan product class. At TSL 4, the average LCC savings in 2014$ are positive for all product classes. Also, the fraction of consumers that experience net savings at TSL 4 is much greater than the fraction of consumers that experience a net cost.

After considering the analysis and weighing the benefits and burdens, the Secretary has tentatively concluded that at TSL 4, 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 negative impacts on some consumers and on manufacturers, including the conversion costs that could result in a reduction in INPV for manufacturers. Accordingly, the Secretary has tentatively concluded that TSL 4 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 ceiling fans at TSL 4. The proposed amended energy conservation standards for ceiling fans, which are expressed as maximum CFM/W, are shown in Table V–33.

TABLE V–33—PROPOSED AMENDED ENERGY CONSERVATION STANDARDS FOR CEILING FANS

Product class	Maximum airflow efficiency equation (CFM/W) *
Very Small-Diameter (VSD)	3.17D–16.75
Hugger	0.05D+56.41
Standard	0.30D+60.61
High-Speed Small-Diameter (HSSD)	4.22D+0.02
Large Diameter	1.16D–24.38

* D is the ceiling fan diameter, in inches.

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.[78]

[78] 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

Table V–34 shows the annualized values for ceiling fans under TSL 4, 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 $40.0/t in 2015), the estimated cost of the standards proposed in this rule is $140 million per year in increased equipment costs, while the estimated annual benefits are $220 million in reduced equipment operating costs, $80 million in CO_2 reductions, and $10 million in reduced NO_X emissions. In this case, the net benefit amounts to $170 million per year.

Using a 3-percent discount rate for all benefits and costs and the average SCC series that has a value of $40.0/t in 2015, the estimated cost of the proposed ceiling fans standards is $136 million per year in increased equipment costs, while the estimated annual benefits are $290 million in reduced operating costs, $80 million in CO_2 reductions, and $15 million in reduced NO_X emissions. In this case, the net benefit amounts to $248 million per year.

TABLE V–34—ANNUALIZED BENEFITS AND COSTS OF PROPOSED STANDARDS (TSL 4) FOR CEILING FANS

	Discount rate	Million 2014$/year		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits				
Consumer Operating Cost Savings	7%	220	195	253.
	3%	290	255	341.
CO_2 Reduction Value ($12.2/t) **	5%	23	21	26.
CO_2 Reduction Value ($40.0/t) **	3%	80	71	90.
CO_2 Reduction Value ($62.3/t) **	2.5%	117	105	132.
CO_2 Reduction Value ($117/t) **	3%	243	217	274.
NO_X Reduction Value †	7%	10	9	26.
	3%	15	13	37.
Total Benefits ††	7% plus CO_2 range	254 to 473	225 to 421	305 to 553.
	7%	310	275	369.
	3% plus CO_2 range	328 to 547	289 to 485	404 to 652.
	3%	384	340	467.
Costs				
Consumer Incremental Product Costs	7%	140	177	155.
	3%	136	182	152.
Total ††	7% plus CO_2 range	114 to 333	47 to 243	150 to 398.
	7%	170	98	214.
	3% plus CO_2 range	192 to 411	107 to 303	251 to 499.
	3%	248	157	315.

* This table presents the annualized costs and benefits associated with ceiling fans 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 ceiling fans with DC motors, due to price trend on the electronics components. The Low Benefits Estimate uses the Low Economic Growth electricity prices and housing starts from AEO 2015 and no price trend for ceiling fans with DC motors. The High Benefits Estimate uses the High Economic Growth electricity prices and housing starts from AEO 2015 and the same product price decrease for ceiling fans with DC motors 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.

† The $/ton values used for NO_X are described in section IV.L. DOE estimated the monetized value of NOx emissions reductions using benefit per ton estimates from the Regulatory Impact Analysis titled, "Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants," published in June 2014 by EPA's Office of Air Quality Planning and Standards. (Available at: *http://www3.epa.gov/ttnecas1/regdata/RIAs/111dproposalRIAfinal0602.pdf.*) See section IV.L.2 I.A.2for further discussion. For DOE's Primary Estimate and Low Net Benefits Estimate, the agency is presenting a national benefit-per-ton estimate for particulate matter emitted from the Electric Generating Unit sector based on an estimate of premature mortality derived from the ACS study (Krewski et al., 2009). For DOE's High Net Benefits Estimate, the benefit-per-ton estimates were based on the Six Cities study (Lepuele et al., 2011), which are nearly two-and-a-half times larger than those from the ACS study. Because of the sensitivity of the benefit-per-ton estimate to the geographical considerations of sources and receptors of emission, DOE intends to investigate refinements to the agency's current approach of one national estimate by assessing the regional approach taken by EPA's Regulatory Impact Analysis for the Clean Power Plan Final Rule.

†† 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 ($40.0/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.

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.

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:

(1) 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.

(2) 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.

(3) 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 social cost of carbon values.

The Administrator of the Office of Information and Regulatory Affairs (OIRA) in the OMB has determined that the proposed regulatory action is a significant regulatory action under section (3)(f) of Executive Order 12866. Accordingly, pursuant to section 6(a)(3)(B) of the Order, DOE has provided to OIRA: (i) The text of the draft regulatory action, together with a reasonably detailed description of the need for the regulatory action and an explanation of how the regulatory action will meet that need; and (ii) An assessment of the potential costs and benefits of the regulatory action, including an explanation of the manner in which the regulatory action is consistent with a statutory mandate. DOE has included these documents in the rulemaking record.

In addition, the Administrator of OIRA has determined that the proposed regulatory action is an ''economically'' significant regulatory action under section (3)(f)(1) of Executive Order 12866. Accordingly, pursuant to section 6(a)(3)(C) of the Order, DOE has provided to OIRA an assessment, including the underlying analysis, of benefits and costs anticipated from the regulatory action, together with, to the extent feasible, a quantification of those costs; and an assessment, including the underlying analysis, of costs and benefits of potentially effective and reasonably feasible alternatives to the planned regulation, and an explanation why the planned regulatory action is preferable to the identified potential alternatives. These assessments can be found in the technical support document for this rulemaking.

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

1. Description on Estimated Number of Small Entities Regulated

For manufacturers of ceiling fans, 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*. Ceiling fan 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 ceiling fans covered by this rulemaking, DOE conducted a market survey using publicly available information. DOE first attempted to identify all potential ceiling fan manufacturers by researching industry trade associations (*e.g.,* ALA[79]), information from previous rulemakings, individual company Web sites, and SBA's database. DOE then attempted to gather information on the location and number of employees to see if these companies met SBA's definition of a small business for each potential ceiling fan manufacturer by reaching out directly to those potential small businesses and using market research tools (*e.g., www.hoovers.com, www.manta.com, glassdoor.com, www.linkedin.com, etc.*). DOE also asked interested parties 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 ceiling fans and would be affected by this rulemaking. DOE

[79] ALA. Membership Directory and Buyer's Guide 2015. Last Accessed June 9, 2015. *http://www.lightrays-digital.com/lightrays/2015_membership_directory#pg1*.

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 ceiling fans, DOE initially identified 82 potential companies that sell ceiling fans in the United States. After reviewing publicly available information on these potential ceiling fan manufacturers, DOE determined that 45 were either large businesses or businesses that were completely foreign owned and operated. DOE determined that the remaining 37 companies were small businesses that either manufacture or sell covered ceiling fans in the United States. Based on manufacturer interviews, DOE estimates that these small businesses account for approximately 25 percent of the ceiling fan market.

DOE seeks comments, information, and data on the small businesses in the industry, including their numbers and their role in the ceiling fan market. DOE also requests data on the market share of small businesses in the ceiling fan market. See issue 27 in section VII.E.

2. Description and Estimate of Compliance Requirements

At TSL 4, DOE estimates that small ceiling fan businesses selling standard and hugger ceiling fans could be disproportionally impacted by the proposed energy conservation standards compared to large ceiling fan businesses. However, since DOE estimates that more than 90 percent of VSD, HSSD, and large-diameter ceiling fans are manufactured by small businesses, DOE projects the impacts on small businesses that only produce VSD, HSSD, and large-diameter fan product classes to be represented by the overall industry impacts for those particular product classes. DOE displays the overall industry impacts for VSD, HSSD, and large-diameter fan product classes individually at the proposed TSL in Table VI–1, Table VI–2, and Table VI–3.

TABLE VI–1—MANUFACTURER IMPACT ANALYSIS FOR VERY SMALL-DIAMETER CEILING FANS AT THE PROPOSED TRIAL STANDARD LEVEL (TSL 4)

	Units	No-standards case	Proposed trial standard level (TSL 4)		
			Preservation of gross margin	Preservation of operating profit	Two-tiered
INPV	*2014$ thousands*	8,898	8,889	8,855	7,020
Change in INPV	*2014$ thousands*		(9)	(43)	(1,878)
	%		(0.1)	(0.5)	(21.1)
Product Conversion Costs	*2014$ thousands*		3	3	3
Capital Conversion Costs	*2014$ thousands*		9	9	9
Total Conversion Costs	*2014$ thousands*		12	12	12

For the VSD ceiling fan product class, at TSL 4 DOE estimates impacts on INPV range from −$1,878 thousand to −$9 thousand, or decreases in INPV of −21.1 percent to −0.1 percent. DOE projects that in 2019, 96 percent of VSD ceiling fan shipments will meet or exceed efficiency levels analyzed at TSL 4.

TABLE VI–2—MANUFACTURER IMPACT ANALYSIS FOR HIGH-SPEED SMALL-DIAMETER CEILING FANS AT THE PROPOSED TRIAL STANDARD LEVEL (TSL 4)

	Units	No-standards case	Proposed trial standard level (TSL 4)		
			Preservation of gross margin	Preservation of operating profit	Two-tiered
INPV	*2014$ thousands*	29,350	28,030	13,088	27,278
Change in INPV	*2014$ thousands*		(1,323)	(16,265)	(2,072)
	%		(4.5)	(55.4)	(7.1)
Product Conversion Costs	*2014$ thousands*		94	94	94
Capital Conversion Costs	*2014$ thousands*		293	293	293
Total Conversion Costs	*2014$ thousands*		388	388	388

For the HSSD ceiling fan product class, at TSL 4 DOE estimates impacts on INPV range from −$16,265 thousand to −$1,323 thousand, or decreases in INPV of −55.4 percent to −4.5 percent. TSL 4 represents max-tech for the HSSD ceiling fan product class, and DOE projects that in 2019, 6 percent of HSSD ceiling fan shipments will meet or exceed efficiency levels analyzed at TSL 4.

TABLE VI–3—MANUFACTURER IMPACT ANALYSIS FOR LARGE-DIAMETER CEILING FANS AT THE PROPOSED TRIAL STANDARD LEVEL (TSL 4)

	Units	No-standards case	Proposed trial standard level (TSL 4)		
			Preservation of gross margin	Preservation of operating profit	Two-tiered
INPV	*2014$ thousands*	37,840	36,415	33,923	34,870

TABLE VI–3—MANUFACTURER IMPACT ANALYSIS FOR LARGE-DIAMETER CEILING FANS AT THE PROPOSED TRIAL STANDARD LEVEL (TSL 4)—Continued

	Units	No-standards case	Proposed trial standard level (TSL 4)		
			Preservation of gross margin	Preservation of operating profit	Two-tiered
Change in INPV	*2014$ thousands*		(1,425)	(3,917)	(2,970)
	%		(3.8)	(10.4)	(7.8)
Product Conversion Costs	*2014$ thousands*		174	174	174
Capital Conversion Costs	*2014$ thousands*		638	638	638
Total Conversion Costs	*2014$ thousands*		812	812	812

For the large-diameter ceiling fans product class, at TSL 4, DOE estimates impacts on INPV range from −$3,917 thousand to −$1,425 thousand, or decreases in INPV of −10.4 percent to −3.8 percent. DOE projects that in 2019, 17 percent of large-diameter ceiling fan shipments will meet or exceed efficiency levels analyzed at TSL 4.

Because small businesses represent the majority of the VSD, HSSD and large-diameter ceiling fan markets, these estimated industry impacts represent the estimated impacts on small businesses selling VSD, HSSD, and large-diameter ceiling fan product classes.

As a result of this rulemaking, small businesses will incur product conversion costs because products that no longer meet the proposed efficiency levels of amended energy conservation standards will most likely need to be redesigned, tested, and certified. Manufacturers will also incur capital conversion costs due to retooling costs associated with producing more efficient ceiling fans required by the proposed standards. Table VI–4 presents total conversion costs for both large and small manufacturers. At TSL 4, approximately fifty percent of total industry conversion costs are incurred by small manufacturers.

TABLE VI–4—TOTAL CONVERSION COSTS BY MANUFACTURER TYPE

	Units	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Total Conversion Costs for Small Manufacturers.	*2014$ (thousands)*	99	140	1,209	2,273	4,072	4,610
Total Conversion Costs for Large Manufacturers.	*2014$ (thousands)*	57	144	2,221	2,221	5,284	6,411
Total Industry Conversion Costs	*2014$ (thousands)*	156	284	3,430	4,494	9,356	11,022

Because small businesses have significantly less revenue, annual R&D budgets, and annual capital expenditure budgets than large manufacturers, the conversion costs necessary to comply with proposed standards represent the majority of a typical small business' annual R&D budget, almost one and a half times a typical small business' annual capital expenditure budget, and a sizeable portion of a typical small business' annual revenue. Table VI–5 demonstrates the impacts that conversion costs as a result of the proposed standards could have on typical small and large ceiling fan business's annual R&D budgets, annual capital expenditure budgets, and annual revenues.

TABLE VI–5—ESTIMATED TESTING AND CERTIFICATION COSTS AS A PERCENTAGE OF ANNUAL R&D EXPENSE AND REVENUE FOR CEILING FAN MANUFACTURERS

	Product conversion cost as a percentage of annual R&D expense	Capital conversion cost as a percentage of annual capital expenditure	Total conversion cost as a percentage of annual revenue
Typical Small Manufacturer	80	147	7
Typical Large Manufacturer	12	23	1

At TSL 4, an average of 36 percent of standard and hugger ceiling fans would need to be redesigned to meet the efficiency levels required at the proposed TSL. For a typical small business that sells standard and hugger ceiling fans, the cost of redesigning and testing these models would account for 80 percent of a typical small business' annual R&D budget, compared to 12 percent of a typical large business' annual R&D budget.

Capital conversion costs are driven primarily by the retooling costs associated with producing redesigned models that meet efficiency levels required by the proposed standards and would account for 147 percent of a typical small business' annual capital expenditure budget, compared to 23 percent of a typical large business' annual capital expenditure budget.

Additionally, total conversion costs at the proposed standards represents 7 percent of an average small ceiling fan business' revenue, compared to 1 percent of an average large ceiling fan business' revenue. Small ceiling businesses that sell standard and hugger ceiling fans must recover costs that account for a larger percentage of their total revenue with a smaller amount of sales than large ceiling fan businesses.

Due to the difficulty of cost recovery, DOE concludes that small businesses selling standard and hugger ceiling fan product classes could be disproportionately impacted by the proposed amended ceiling fan energy conservation standard compared to large businesses.

DOE seeks comment on the potential impacts of the amended standards on ceiling fan small businesses. See issue 28 in section VII.E.

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. See issue 29 in section VII.E.

4. Significant Alternatives to the Rule

The discussion in the previous section analyzes impacts on small businesses that would result from DOE's proposed rule, TSL 4. In reviewing alternatives to the proposed rule, DOE examined energy conservation standards set at lower efficiency levels. While TSL 1, TSL 2, and TSL 3 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. TSL 1 achieves 82 percent lower energy savings and 51 percent less NPV benefits to consumers compared to the energy savings and NPV benefits at TSL 4. TSL 2 achieves 72 percent lower energy savings and 34 percent less NPV benefits to consumers compared to the energy savings and NPV benefits at TSL 4. TSL 3 achieves 27 percent lower energy savings and 36 percent less NPV benefits to consumers compared to the energy savings and NPV benefits at TSL 4.

Establishing standards at TSL 4 balances the benefits of the energy savings and the NPV benefits to consumers created at TSL 4 with the potential burdens placed on ceiling fan 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 this 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 430.27). 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 ceiling fans 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 ceiling fans, 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 ceiling fans. 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. Public Law 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*.

Although this proposed rule does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more by the private sector. Specifically, the proposed rule would likely result in a final rule that could require expenditures of $100 million or more. Such expenditures may include: (1) Investment in research and development and in capital expenditures by ceiling fan manufacturers in the years between the final rule and the compliance date for the new standards, and (2) incremental additional expenditures by consumers to purchase higher-efficiency ceiling fans, starting at the compliance date for the applicable standard..

Section 202 of UMRA authorizes a Federal agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the proposed rule. (2 U.S.C. 1532(c)) The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The **SUPPLEMENTARY INFORMATION** section of the NOPR and the ''Regulatory Impact Analysis'' section of the NOPR TSD for this proposed rule respond to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. (2 U.S.C. 1535(a)) DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the proposed rule unless DOE publishes an explanation for doing otherwise, or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(d), (f), and (o), 6313(e), and 6316(a), this proposed rule would establish amended energy conservation standards for ceiling fans that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the ''Regulatory Impact Analysis'' section of the NOPR TSD for 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 ceiling fans, 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 Ms. Regina Washington at (202) 586–1214 or by email (*Regina.Washington@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=65*. 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 requests comment on the proposed product class structure based on blade diameter, distance from the ceiling and the UL 507 table. See section IV.A.1.

2. DOE seeks comment on the definition of highly-decorative ceiling fans based on both an RPM and a CFM threshold. See section IV.A.1.a.

3. DOE requests comment on the applications of wind and temperature sensors, and if they reduce or increase the energy consumption of a ceiling fan considering both active and standby of

fan operation. If so, DOE seeks specific data on how wind and temperature sensors reduce or increase energy consumption of a ceiling fan. See section IV.A.2.c.

4. DOE requests comment on the technologies that were assumed to be available and able to allow each product class to meet the specified energy efficiency level, including fan optimization, larger direct-drive motor and DC motors for the very small-diameter product class. See section IV.B.

5. DOE requests comment and data about the performance of occupancy sensors and occupancy sensor schedulers and whether they would reduce or increase the energy consumption of a ceiling fan considering both active and standby/off modes of fan operation. See section IV.B.1.a.

6. One method to improve ceiling fan efficiency is to reduce the fan speed. Some reduction in fan speed may not impact consumer utility. DOE requests comment on what an acceptable reduction of fan speed may be such that it does not affect consumer utility for each of the proposed product classes. See section IV.C.

7. DOE requests comment about the proposed factory costs at each efficiency level for each product class. Specifically DOE seeks comment on the 52-inch standard ceiling fan baseline factory costs of $38.85 and a baseline MPC of $54.93. See section IV.C.3.

8. DOE requests any data on operating hours for each product class and inparticular the HSSD ceiling fan product class. See section IV.E.2.b.

9. DOE requests any relevant data on how the proposed ceiling fan standards could have on the operation of air conditioners, whether and to what level there may be a substitution effect that would cause a reduction in the purchase of residential and/or commercial air conditioning systems in lieu of ceiling fans. In addition, DOE requests any relevant data regarding whether the proposed standards would impact the usage rate of residential and/or commercial air conditioning systems. See section IV.E.3.

10. Installation costs were assumed not to vary by efficiency level for all product classes, and therefore were not considered in the analysis. DOE requests comments on this assumption. See section IV.F.

11. DOE requests comments on the methodology of the LCC and PBP analysis for ceiling fans. See section IV.F.

12. DOE has assumed that the excess rate of failure for DC motors, above the repair rate for AC motors, is 6.5 percent of purchases. DOE also assumed a repair cost of $150 for all product classes other than the large-diameter product class, and a repair cost of $1000 for large-diameter fans. DOE requests comment, input, and data that can improve the estimate of repair costs, particularly repairs costs associated with DC motors. See section IV.F.4.

13. DOE requests comment on the survival function used in this rulemaking, which DOE assumed has the form of a cumulative Weibull distribution, and provides a mean of 13.8 years and a median of 13.0 years for appliance lifetime. This is the same distribution employed in the preliminary analysis. DOE welcomes comment on these estimates. See section IV.F.5.

14. Shipment data were only available for standard, hugger, and VSD ceiling fans, so DOE assumed the survival probability function of large-diameter and HSSD ceiling fans is the same as that for standard, hugger, and VSD ceiling fans. DOE requests comments and data on product lifetimes of large-diameter and HSSD ceiling fans. See section IV.F.5.

15. Using updated, price-weighted data, DOE calculated 48.7 percent and 51.3 percent as the current market share split for hugger and standard ceiling fans, respectively. (This calculation retained the 27 percent/73 percent installation split used in the preliminary analysis for multi-mount fans.) DOE requests comment, data, or information on its estimates for the relative split between hugger, standard, and VSD product classes. See section IV.G.1.

16. DOE requests data and information on current and historical shipments for HSSD and large-diameter ceiling fans. See section IV.G.1.

17. DOE requests comments on the assumed ceiling fan usage by sector for all product classes. See section IV.G.1.

18. DOE requests comments on its approach for estimating the market share distribution by efficiency level using a consumer-choice model sensitive to first cost for standard, hugger, and VSD ceiling fans. See section IV.G.3.

19. DOE requests comments on its use of the roll-up approach to estimate market-shares by efficiency levels for HSSD and large-diameter ceiling fans. See section IV.G.3.

20. DOE assumed that the cost of DC motor ceiling fans would decrease over the course of the shipments analysis due to a price trend applied to the electronics controller used in DC motor fans. DOE estimated the cost of the electronics controller as the incremental price difference between a DC motor and a comparable AC motor. DOE applied a 6% price decline rate to the incremental cost associated with the electronic controller. DOE's methodology leads to an average annual decrease of 0.5% in the total price of a DC motor ceiling fan. DOE requests input on the validity of its price trend methodology as applied to the incremental cost of a DC motor. See section IV.G.4.

21. DOE requests data and information to more accurately estimate a price elasticity of demand specific to ceiling fans. Specifically, DOE requests concurrent data on industry-wide shipments-weighted retail price and efficiency and average household income. See section IV.G.5.

22. DOE requests comments on the overall methodology used to develop shipment forecasts and estimate NES and the NPV of those savings. See section IV.H.2.

23. DOE seeks comment on any potential impact on manufacturing capacity at the efficiency levels proposed in this NOPR. See section V.B.2.c.

24. DOE seeks comment on any other potential manufacturer subgroups that could be disproportionally affected by amended energy conservation standards for ceiling fans. See section V.B.2.d.

25. DOE seeks comment on the cumulative regulatory burden due to compliance costs of any other regulations, such as the ceiling fan light kit proposed rule, on products that ceiling fan manufacturers also manufacture, especially if compliance with those regulations is required 3 years before or after the estimated compliance date of this proposed standard. See section V.B.2.e.

26. DOE invites comment from the public regarding the competitive impacts that are likely to result from this proposed rule. See section V.B.5.

27. DOE seeks comments, information, and data on the small businesses in the industry, including their numbers and their role in the ceiling fan market. DOE also requests data on the market share of small businesses in the ceiling fan market. See section VI.B.1.

28. DOE seeks comment on the potential impacts of the amended standards on ceiling fan small businesses. See section VI.B.2.

29. DOE seeks comment on any rules or regulations that could potentially duplicate, overlap, or conflict with the proposed amended standard. See section VI.B.3.

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 December 23, 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. Section 430.2 is amended by adding the definitions for ''belt-driven ceiling fan,'' ''highly-decorative ceiling fan,'' ''high-speed small-diameter ceiling fan,'' ''hugger ceiling fan,'' ''large-diameter ceiling fan,'' ''small-diameter ceiling fan,'' ''standard ceiling fan,'' and ''very small-diameter ceiling fan'' in alphabetical order to read as follows:

§ 430.2 Definitions.

* * * * *

Belt-driven ceiling fan means a ceiling fan with a series of one or more fan heads, each driven by a belt connected to one or more motors.

* * * * *

Highly-decorative ceiling fan means a ceiling fan with a maximum rotational speed of 90 RPM and less than 1,840 CFM airflow at high speed.

* * * * *

High-speed small-diameter ceiling fan means a ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and has a blade thickness of < 3.2 mm at the edge or a maximum tip speed > the applicable limit in the table in this definition.

SMALL-DIAMETER CEILING FANS, LESS THAN OR EQUAL TO 7 FEET IN DIAMETER

Airflow Direction	Thickness (t) of Edges of Blades		Maximum Speed at Tip of Blades	
	mm	inch	m/s	feet per minute
Downward-only	4.8 > t ≥ 3.2	3/16 > t ≥ 1/8	16.3	3,200
Downward-only	t ≥ 4.8	t ≥ 3/16	20.3	4,000
Reversible	4.8 > t ≥ 3.2	3/16 > t ≥ 1/8	12.2	2,400
Reversible	t ≥ 4.8	t ≥ 3/16	16.3	3,200

* * * * *

Hugger ceiling fan means a ceiling fan that is not a ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and where the lowest point on fan blades is ≤ 10 inches from the ceiling; and has a blade thickness of ≥ 3.2 mm at the edge and a maximum tip speed ≤ the applicable limit in the table in this definition.

SMALL-DIAMETER CEILING FANS, LESS THAN OR EQUAL TO 7 FEET IN DIAMETER

Airflow Direction	Thickness (t) of Edges of Blades		Maximum Speed at Tip of Blades	
	mm	inch	m/s	feet per minute
Downward-only	4.8 > t ≥ 3.2	3/16 > t ≥ 1/8	16.3	3,200
Downward-only	t ≥ 4.8	t ≥ 3/16	20.3	4,000
Reversible	4.8 > t ≥ 3.2	3/16 > t ≥ 1/8	12.2	2,400
Reversible	t ≥ 4.8	t ≥ 3/16	16.3	3,200

* * * * *

Large-diameter ceiling fan means a ceiling fan that is greater than 7 feet in diameter.

* * * * *

Small-diameter ceiling fan means a ceiling fan that is less than or equal to 7 feet in diameter.

* * * * *

Standard ceiling fan means a ceiling fan is not a ceiling fan that is not a very small-diameter ceiling fan, highly-decorative ceiling fan or belt-driven ceiling fan; and where the lowest point on fan blades is > 10 inches from the ceiling; and has a blade thickness of ≥ 3.2 mm at the edge and a maximum tip speed ≤ the applicable limit in the table in this definition.

SMALL-DIAMETER CEILING FANS, LESS THAN OR EQUAL TO 7 FEET IN DIAMETER

Airflow Direction	Thickness (t) of Edges of Blades		Maximum Speed at Tip of Blades	
	mm	inch	m/s	feet per minute
Downward-only	4.8 > t ≥ 3.2	3/16 > t ≥ 1/8	16.3	3,200
Downward-only	t ≥ 4.8	t ≥ 3/16	20.3	4,000
Reversible	4.8 > t ≥ 3.2	3/16 > t ≥ 1/8	12.2	2,400
Reversible	t ≥ 4.8	t ≥ 3/16	16.3	3,200

* * * * *

Very small-diameter ceiling fan means a ceiling fan that is not a highly-decorative ceiling fan or belt-driven ceiling fan; and has one or more fan heads, each of which has a blade span of 18 inches or less.

* * * * *

■ 3. Section 430.32 is amended by:

■ a. Redesignating paragraphs (s)(2), (s)(3), (s)(4) and (s)(5) as (s)(3), (s)(4), (s)(5) and (s)(6).

■ b. Adding a new paragraph (s)(2).

The addition to read as follows:

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

* * * * *

(s) * * *

(1) * * *

(2) Ceiling fans 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:

Product Class	Airflow Efficiency Equation (CFM/W) *
Very small-diameter (VSD)	3.17D − 16.75
Hugger	0.05D + 56.41
Standard	0.30D + 60.61
High-speed small-diameter (HSSD)	4.22D + 0.02
Large-diameter	1.16D − 24.38

* D is the ceiling fan diameter, in inches.

* * * * *

[FR Doc. 2015–33062 Filed 1–12–16; 8:45 am]

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