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[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket Number EERE–2010–BT–STD–0011]

RIN: 1904–AC22

Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnace Fans

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

ACTION: Notice of proposed rulemaking and announcement of public meeting.

SUMMARY: Pursuant to the Energy Policy and Conservation Act of 1975 (EPCA), as amended, the U.S. Department of Energy (DOE) must prescribe energy conservation standards for various consumer products and certain commercial and industrial equipment, including residential furnace fans. EPCA requires DOE to determine whether such standards would be technologically feasible and economically justified, and would save a significant amount of energy. In this notice, DOE is proposing new energy conservation standards for residential furnace fans. The notice also announces a public meeting to receive comment on these proposed standards and associated analyses and results.

DATES: Meeting: DOE will hold a public meeting on November 22, 2013, from 9:00 a.m. to 4:00 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section VII, "Public Participation," for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

Comments: DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than [**INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**]. See section VII, "Public Participation," for details.

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. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards at the phone number above to initiate the necessary procedures. Please also note that any person wishing to bring a laptop computer into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons may also attend the public meeting via webinar. For more information, refer to section VII, "Public Participation," near the end of this notice.

Instructions: Any comments submitted must identify the NOPR for Energy Conservation Standards for Residential Furnace Fans, and provide docket number EE-2010–BT–STD–0011 and/or regulatory information number (RIN) 1904-AC22. Comments may be submitted using any of the following methods:

1. Federal eRulemaking Portal: www.regulations.gov. Follow the instructions for submitting comments.
2. E-mail: FurnFans-2010-STD-0011@ee.doe.gov. Include the docket number and/or RIN in the subject line of the message. Submit electronic comments in Word Perfect, 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 Program, Mailstop EE-2J, 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 Program, 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 e-mail to Chad_S._Whiteman @omb.eop.gov.

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

Docket: The docket is available for review at www.regulations.gov, including Federal Register notices, framework documents, public meeting attendee lists and transcripts, comments, and other supporting documents/materials. All documents in the docket are listed in the www.regulations.gov index. However, not all documents listed in the index may be publicly available, such as 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/41. This web page contains a link to the docket for this notice on the www.regulations.gov site. The www.regulations.gov web page contains simple instructions on how to access all documents, including public comments, in the docket. See section VII, "Public Participation," for further information on how to submit comments through www.regulations.gov.

For further information 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.

FOR FURTHER INFORMATION CONTACT: Mr. Ron Majette, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE-2J, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 586-7935. E-mail: Ronald.Majette@ee.doe.gov.

Mr. Eric Stas, U.S. Department of Energy, Office of the General Counsel, GC-71, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 586-9507. E-mail: Eric.Stas@hq.doe.gov.

For information on how to submit or review public comments, contact Ms. Brenda Edwards at (202) 586-2945 or by email: Brenda.Edwards@ee.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Summary of the Proposed Rule

Title III, Part B[1] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Pub. L. 94-163 (42 U.S.C. 6291-6309, as codified), established the Energy Conservation Program for Consumer Products Other Than Automobiles, a program covering most major household appliances, including the residential furnace fans that are the focus of this notice. Pursuant to EPCA, any new or amended energy conservation standard that DOE prescribes for certain products, such as residential furnace fans, shall 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 specifically provides that DOE must

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

consider and prescribe energy conservation standards or energy use standards for electricity used for purposes of circulating air through duct work (products for which DOE has adopted the term "furnace fans" as shorthand) not later than December 31, 2013. (42 U.S.C. 6295(f)(4)(D))

In accordance with these and other statutory provisions discussed in this notice, DOE is proposing new energy conservation standards for residential furnace fans. Table I.1 below presents the proposed standards, which represent the "estimated annual electrical energy consumption" normalized by the estimated total number of annual operating hours (1870) and the airflow in the maximum airflow-control setting to produce a fan energy rating (FER). These proposed standards, if adopted, would apply to all products listed in Table I.1 and manufactured in, or imported into, the United States on or after the date five years from the publication of the final rule.

Table I.1. Proposed Energy Conservation Standards for Residential Furnace Fans (Compliance Starting Five Years from Final Rule Publication)

Product Class	Product Class Description	Proposed Standard: FER* (W/1000 cfm)
1	Non-Weatherized, Non-Condensing Gas Furnace Fan (NWG-NC)	FER = 0.029 x Q_{Max} + 180
2	Non-Weatherized, Condensing Gas Furnace Fan (NWG-C)	FER = 0.029 x Q_{Max} + 196
3	Weatherized Non-Condensing Gas Furnace Fan (WG-NC)	FER = 0.029 x Q_{Max} + 135
4	Non-Weatherized, Non-Condensing Oil Furnace Fan (NWO-NC)	FER = 0.051 x Q_{Max} + 301
5	Non-Weatherized Electric Furnace / Modular Blower Fan (NWEF/NWMB)	FER = 0.029 x Q_{Max} + 165
6	Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan (MH-NWGNC)	FER = 0.051 x Q_{Max} + 242
7	Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan (MH-NWG-C)	FER = 0.051 x Q_{Max} + 262
8	Manufactured Home Electric Furnace/ Modular Blower Fan (MH-EF/MB)	FER = 0.029 x Q_{Max} + 105

9	Manufactured Home Weatherized Gas Furnace Fan (MH-WG)	Reserved
10	Manufactured Home Non-Weatherized Oil Furnace Fan (MH-NWO)	Reserved

*Q_{Max} is the airflow, in cfm, at the maximum airflow-control setting measured using the proposed DOE test procedure. 78 FR 19606, 19627 (April 2, 2013).

A. Benefits and Costs to Consumers

Table I.2 presents DOE's evaluation of the economic impacts of the proposed standards on consumers of residential furnace fans, as measured by the average life-cycle cost (LCC) savings and the median payback period (PBP). In overview, the average LCC savings are positive for all product classes.

Table I.2 Impacts of Proposed Standards on Consumers of Residential Furnace Fans

Product Class	Average LCC Savings (2012$)	Median Payback Period (years)
Non-Weatherized, Non-Condensing Gas Furnace Fan (NWG-NC)	474	5.38
Non-Weatherized, Condensing Gas Furnace Fan (NWG-C)	371	5.39
Weatherized Non-Condensing Gas Furnace Fan (WG-NC)	247	6.39
Non-Weatherized, Non-Condensing Oil Furnace Fan (NWO-NC)	40	5.49
Non-Weatherized Electric Furnace / Modular Blower Fan (NWEF/NWMB)	185	3.55
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan (MH-NWGNC)	26	3.35
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan (MH-NWG-C)	27	2.73
Manufactured Home Electric Furnace/ Modular Blower Fan (MH-EF/MB)	78	4.61

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 (2013 to 2048). Using a real discount rate of 7.8 percent, DOE estimates that the INPV for manufacturers of residential furnace fans is $252.2 million in 2012$. Under the proposed standards, DOE expects that manufacturers may lose up to 21.6 percent of their INPV, which is approximately $54.4 million. Total conversion costs incurred by industry prior to the compliance date are expected to reach $3.1 million..

C. National Benefits and Costs

DOE's analyses indicate that the proposed standards would save a significant amount of energy. The cumulative energy savings for residential furnace fan products purchased in the 30-year period that begins in the first full year of compliance with new standards (2019–2048) amount to 4.58 quads.[2] For comparison, the estimated annual energy savings in 2030 (0.074 quads) is equal to 0.3 percent of total projected residential energy use in 2030.[3]

The cumulative net present value (NPV) of total consumer costs and savings for the proposed residential furnace fan standards in 2012$ ranges from $8.51 billion (at a 7-percent discount rate) to $26.16 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 residential furnace fans purchased in 2019–2048, discounted to 2013.

[2] A quad is equal to 10^{15} British thermal units (Btu).
[3] Projected residential energy use in 2030 in the Annual Energy Outlook 2013 is 21.65 quads.

In addition, the proposed standards would have significant environmental benefits.[4] The energy savings would result in cumulative emission reductions of 429.8 million metric tons (Mt)[5] of carbon dioxide (CO_2), 230.9 thousand tons of nitrogen oxides (NO_X), 313.5 thousand tons of sulfur dioxide (SO_2), 1.77 tons of mercury (Hg), 913.7 thousand tons of methane (CH_4), and 5.12 thousand tons of nitrous oxide (N_2O).[6]

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 an interagency process. For today's NOPR, DOE used an updated set of SCC values[7] (the derivation of the SCC values is discussed in section IV.L). DOE estimates that the present monetary value of the CO_2 emissions reduction is between $2.25 and $35.56 billion, expressed in 2012$ and discounted to 2013. DOE also estimates the net present monetary value of the NO_X emissions reduction, expressed in 2012$ and discounted to 2013, is $0.109 billion at a 7-percent discount rate and $0.314 billion at a 3-percent discount rate.[8]

Table I.3 summarizes the national economic benefits and costs expected to result from today's proposed standards for residential furnace fans.

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[4] DOE calculates emissions reductions relative to the Annual Energy Outlook 2012 (AEO 2012) Reference case, which incorporated projected effects of all emissions regulations promulgated as of January 31, 2012.

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

[6] DOE also estimated CO_2 and, for CH_4 and N_2O, CO_2 equivalent (CO_2eq) emissions that occur through 2030. The estimated emissions reductions through 2030 are 40 million metric tons CO_2, 2.3 million tons CO_2eq for CH_4, and 167 thousand tons CO_2eq for N_2O.

[7] 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)(Available at: http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf).

[8] DOE did not monetize Hg or SO_2 emission reductions for today's NOPR because it is currently evaluating appropriate valuation of reduction in these emissions.

Table I.3: Summary of National Economic Benefits and Costs of Proposed Residential Furnace Fans Energy Conservation Standards (TSL 4), in Billion 2012$*

Category	Present Value Billion 2012$	Discount Rate
Benefits		
Consumer Operating Cost Savings	11.6	7%
	32.0	3%
CO_2 Reduction Monetized Value ($12.9/t case)**	2.2	5%
CO_2 Reduction Monetized Value ($40.8/t case)**	11.5	3%
CO_2 Reduction Monetized Value ($62.2/t case)**	18.8	2.5%
CO_2 Reduction Monetized Value ($117/t case)**	35.6	3%
NO_X Reduction Monetized Value (at $2,639/ton)	0.1	7%
	0.3	3%
Total Benefits†	23.2	7%
	43.8	3%
Costs		
Consumer Incremental Installed Costs	3.1	7%
	5.8	3%
Net Benefits		
Including CO_2 and NO_X Reduction Monetized Value	20.1	7%
	38.0	3%

* This table presents the costs and benefits associated with residential furnace 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 2012$, 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 used by DOE incorporate an escalation factor. The value for NO_X is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to SCC value in 2015 of $40.8/t.

Although combining the values of operating savings and CO_2 emission reductions provides a useful perspective, 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 residential furnace fans shipped in 2019–2048. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

The benefits and costs of today's proposed standards, for products 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 proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase and installation costs, which is another way of representing consumer NPV); and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[9]

[9] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2013, the present year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of three and seven percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.4. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2019 through 2048) that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

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. (All monetary values below are expressed in 2012$.) 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 SCC series corresponding to a value of $40.8/ton in 2015), the cost of the residential furnace fan standards proposed in today's rule is $231 million per year in increased equipment costs, while the benefits are $872 million per year in reduced equipment operating costs, $571 million in CO_2 reductions, and $8.24 million in reduced NO_X emissions. In this case, the net benefit amounts to $1,220 million per year. Using a 3-percent discount rate for all benefits and costs and the SCC series corresponding to a value of $40.8/ton in 2015, the cost of the residential furnace fans standards proposed in today's rule is $290 million per year in increased equipment costs, while the benefits are $1,585 million per year in reduced operating costs, $571 million in CO_2 reductions, and $15.56 million in reduced NO_X emissions. In this case, the net benefit amounts to $1,882 million per year.

Table I.4: Annualized Benefits and Costs of Proposed Standards for Residential Furnace Fans (TSL 4), in Million 2012$

	Discount Rate	Primary Estimate*	Low Net Benefits Estimate	High Net Benefits Estimate
		million 2012$/year		
Benefits				
Consumer Operating Cost Savings	7%	872	710	1082
	3%	1585	1264	2011
CO_2 Reduction Monetized Value ($12.9/t case)**	5%	139	117	171
CO_2 Reduction Monetized Value ($40.8/t case)**	3%	571	477	702
CO_2 Reduction Monetized Value ($62.2/t case)**	2.5%	877	732	1079
CO_2 Reduction Monetized Value ($117/t case)**	3%	1761	1471	2167
NO_X Reduction Monetized Value (at $2,639/ton)**	7%	8.24	6.97	9.99
	3%	15.56	13.03	19.09
Total Benefits†	7% plus CO_2 range	1,019 to 2,641	834 to 2,188	1,263 to 3,259
	7%	1,451	1,194	1,794
	3% plus CO_2 range	1,740 to 3,362	1,394 to 2,748	2,201 to 4,197
	3%	2,172	1,754	2,732
Costs				
Consumer Incremental Installed Costs	7%	231	273	201
	3%	290	346	250
Net Benefits				
Total†	7% plus CO_2 range	788 to 2,410	561 to 1,915	1,062 to 3,058
	7%	1,220	921	1,593
	3% plus CO_2 range	1,450 to 3,072	1,047 to 2,402	1,951 to 3,947
	3%	1,882	1,407	2,482

* This table presents the annualized costs and benefits associated with residential furnace 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, Low Benefits, and High Benefits Estimates utilize projections of energy prices and housing starts from the AEO 2012 Reference case, Low Estimate, and High Estimate, respectively. Incremental product costs reflect a constant product price trend in the Primary Estimate, an increasing price trend in the Low Benefits Estimate, and a decreasing price trend in the High Benefits Estimate.

** The CO_2 values represent global values of the SCC, in 2012$, in 2015 under several scenarios. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC values increase over time. The value for NO_X (in 2012$) is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to SCC value of $40.8/t in 2015. 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 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 at least some, if not most, product classes covered by today's 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-stringent energy efficiency levels as trial standard levels, and is still considering them in this rulemaking. However, DOE has tentatively concluded that the potential burdens of the more-stringent energy efficiency levels would outweigh the projected benefits. Based on consideration of the public comments DOE receives in response to this notice and related information collected and analyzed during the course of this rulemaking effort, DOE may adopt 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 today's proposal, as well as some of the relevant historical background related to the establishment of standards for residential furnace fans.

A. Authority

Title III, Part B[10] of the Energy Policy and Conservation Act of 1975 (EPCA or the Act), Pub. L. 94-163 (42 U.S.C. 6291-6309, as codified) established the Energy Conservation Program for Consumer Products Other Than Automobiles, a program covering most major household appliances (collectively referred to as "covered products").[11] These include products that use electricity for purposes of circulating air through duct work, hereafter referred to as "residential furnace fans" or simply "furnace fans," the subject of this rulemaking. (42 U.S.C. 6295(f)(4)(D))

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

[10] For editorial reasons, upon codification in the U.S. Code, Part B was redesignated Part A.
[11] All references to EPCA in this document refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act, Pub. L. 112-210 (enacted December 18, 2012).

Commission (FTC) is primarily responsible for labeling, and DOE implements the remainder of the program. Subject to certain criteria and conditions, DOE is required by EPCA to consider and establish energy conservation standards for residential furnace fans by December 31, 2013. (42 U.S.C. 6295(f)(4)(D)) DOE is also required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product prior to the adoption of an energy conservation standard. (42 U.S.C. 6295(o)(3)(A) and (r)) Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those products. (42 U.S.C. 6293(c) and 6295(s)) Similarly, DOE must use these test procedures to determine whether the products comply with standards adopted pursuant to EPCA. (42 U.S.C. 6295(s)) DOE does not currently have a test procedure for furnace fans. Accordingly, to fulfill the statutory requirements, DOE is simultaneously conducting a test procedure rulemaking for residential furnace fans. DOE published a notice of proposed rulemaking (NOPR) in the Federal Register for a residential furnace fans test procedure on May 15, 2012. 77 FR 28674. After considering public comments, DOE subsequently published in the Federal Register a supplemental notice of proposed rulemaking (SNOPR) on April 2, 2013, which contained a revised test procedure proposal for furnace fans. 78 FR 19606. In accordance with the statutory requirements outlined in EPCA, DOE will establish a test procedure for residential furnace fans at or before the time it prescribes furnace fan energy conservation standards Details on the furnace fan test procedure rulemaking are available at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/40.

DOE must follow specific statutory criteria for prescribing new or amended standards for covered products, including residential furnace fans. As indicated above, 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 residential furnace fans, if no test procedure has been established for the product, or (2) if DOE determines by rule that the proposed 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, after receiving comments on the proposed standard, DOE must determine whether the benefits of the standard exceed its burdens by, to the greatest extent practicable, considering the following seven factors:

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

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

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

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

(5) The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the standard;

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

(7) Other factors the Secretary of Energy (Secretary) considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

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

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

Additionally, under 42 U.S.C. 6295(q)(1), the statute 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 covered 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 level, 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)).

Finally, pursuant to the amendments contained in the Energy Independence and Security Act of 2007 (EISA 2007), Pub. L. 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)) The proposed furnace fan energy rating metric would not account for the electrical energy consumption in standby mode and off mode, because energy consumption in those modes is already fully accounted for in the DOE energy conservation standards rulemaking for residential furnaces and residential central air conditioners (CAC) and heat pumps (HP). 76 FR 37408 (June 27, 2011); 76 FR 67037 (Oct. 31, 2011). Manufacturers will be required to use the new metrics and methods adopted in those rulemakings for the purposes of certifying to DOE that their products comply with the applicable energy conservation standards adopted pursuant to EPCA and for making representations about the efficiency of those products. (42 U.S.C. 6293(c); 42 U.S.C. 6295(s))

Background

1. Current Standards

Currently, no Federal energy conservation standards apply to residential furnace fans.

2. History of Standards Rulemaking for Residential Furnace Fans

Pursuant to 42 U.S.C. 6295(f)(4)(D), DOE must consider and prescribe new energy conservation standards or energy use standards for electricity used for purposes of circulating air through duct work. DOE has interpreted this statutory language to allow regulation of the electricity use of any electrically-powered device applied to residential central heating, ventilation, and air-conditioning (HVAC) systems for the purpose of circulating air through duct work.

DOE initiated the current rulemaking by issuing an analytical Framework Document, "Rulemaking Framework for Furnace Fans" (June 1, 2010). DOE then published the Notice of Public Meeting and Availability of the Framework Document for furnace fans in the Federal Register on June 3, 2010. 75 FR 31323. See http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/41. The Framework Document explained the issues, analyses, and process that DOE anticipated using to develop energy conservation standards for residential furnace fans. DOE held a public meeting on June 18, 2010 to solicit comments from interested parties regarding DOE's analytical approach. DOE originally scheduled the comment period on the Framework Document to close on July 6, 2010, but due to the large number and broad scope of questions and issues raised, DOE subsequently published a notice in the Federal Register reopening the comment period from July 15, 2010 until July 27, 2010, to allow additional time for interested parties to submit comments. 75 FR 41102 (July 15, 2010).

As a concurrent effort to the residential furnace fan energy conservation standard rulemaking, DOE also initiated a test procedure rulemaking for residential furnace fans. On May 15, 2012, DOE published a notice of proposed rulemaking for the test procedure in the Federal Register. 77 FR 28674. In that NOPR, DOE proposed to establish methods to measure the performance of covered furnace fans and to obtain a value for the proposed metric, referred to as the "fan efficiency rating" (FER).[12] DOE held the test procedure NOPR public meeting on June 15, 2012, and the comment period closed on July 30, 2012. After receiving comments on the NOPR alleging significant manufacturer burden associated with the proposed test procedure, DOE determined that an alternative test method should be developed. DOE published in the Federal Register an SNOPR on April 2, 2013, which contained its revised test procedure proposal and an explanation of the changes intended to reduce burden. 78 FR 19606. DOE proposed to adopt a modified version of the alternative test method recommended by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and other furnace fan manufacturers to rate the electrical energy consumption of furnace fans. DOE has tentatively concluded that the AHRI-proposed method provides a framework for accurate and repeatable determinations of FER that is comparable to the test method previously proposed by DOE, but at a significantly reduced test burden. As required by EPCA, DOE will complete its final rule for residential furnace fan test procedures in advance of the final rule adopting energy conservation standards for those products. (42 U.S.C. 6295(o)(3)(A) and (r))

To further develop the energy conservation standards for residential furnace fans, DOE gathered additional information and performed a preliminary technical analysis. This process culminated in publication in the Federal Register of a Notice of Public Meeting and the Availability of the Preliminary Technical Support Document (TSD) on July 10, 2012. 77 FR 40530. In that document, DOE requested comment on the following matters discussed in the TSD: (1) the selected product classes; (2) the analytical framework, models, and tools that DOE is using to evaluate standards; and (3) the results of the preliminary analyses performed by DOE.

[12] In the May 15, 2012 NOPR for the test procedure, DOE referred to FER as "fan efficiency rating." However, in the April 2, 2013 test procedure SNOPR, DOE proposed to rename the metric as "fan energy rating," thereby keeping the same abbreviation (FER).

Id. DOE also invited written comments on these subjects, as well as any other relevant issues, and announced the availability of the TSD on its website. Id. at 40530-31. A PDF copy of the preliminary TSD is available at http://www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0011-0037.

The preliminary TSD provided an overview of the activities DOE undertook in developing potential energy conservation standards for residential furnace fans, and discussed the comments DOE received in response to the Framework Document. It also described the analytical methodology that DOE used and each analysis DOE had performed up to that point. These analyses were as follows:

- A *market and technology assessment* addressed the scope of this rulemaking, identified the potential product classes of residential furnace fans, characterized the markets for these products, and reviewed techniques and approaches for improving their efficiency;
- A *screening analysis* reviewed technology options to improve the efficiency of furnace fans, and weighed these options against DOE's four prescribed screening criteria;
- An *engineering analysis* estimated the increase in manufacturer selling prices (MSPs) associated with more energy-efficient furnace fans;
- An *energy use analysis* estimated the annual energy use of furnace fans at various potential standard levels;
- A *markups analysis* converted estimated MSPs to consumer-installed prices.
- A *life-cycle cost (LCC) analysis* calculated, at the consumer level, the discounted savings in operating costs throughout the estimated average life of the product, compared to any increase in installed costs likely to result directly from the adoption of a given standard;

- A *payback period (PBP) analysis* estimated the amount of time it would take consumers to recover the higher expense of purchasing more-energy-efficient products through lower operating costs;
- A *shipments analysis* estimated shipments of residential furnace fans over the time period examined in the analysis (30 years), which were used in performing the national impact analysis;
- A *national impact analysis* assessed the aggregate impacts at the national level of potential energy conservation standards for residential furnace fans, as measured by the net present value of total consumer economic impacts and national energy savings; and
- A *preliminary manufacturer impact analysis* took the initial steps in evaluating the effects new energy conservation standards may have on furnace fan manufacturers.

The nature and function of the analyses in this rulemaking, including the engineering analysis, energy-use characterization, markups to determine installed prices, LCC and PBP analyses, and national impact analysis, are summarized in the July 2012 notice. 77 FR 40530, 40532-33 (July 10, 2012).

The preliminary analysis public meeting took place on July 27, 2012. At this meeting, DOE presented the methodologies and results of the analyses set forth in the preliminary TSD. The numerous comments received since publication of the July 2012 notice, including those received at the preliminary analysis public meeting, have contributed to DOE's proposed resolution of the issues noted by interested parties.

The submitted comments include a joint comment from the American Council for an Energy-Efficiency Economy (ACEEE), Adjuvant Consulting, on behalf of the Northwest Energy Efficiency Alliance (NEEA), the Appliance Standards Awareness Project (ASAP), the National Consumer Law Center (NCLC), and the Natural Resources Defense Council (NRDC); a comment from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI); a second joint comment from California Investor-Owned Utilities (CA IOUs) including Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas Company, and San Diego Gas and Electric (SDGE); a comment from Earthjustice; a comment from ebm-papst Inc. (ebm-papst); a comment from Edison Electric Institute (EEI); and a comment from the Northeast Energy Efficiency Partnership (NEEP). Manufacturers submitting written comments included: First Company, Goodman Global, Inc. (Goodman), Ingersoll Rand, Lennox International, Inc. (Lennox), Morrison Products, Inc. (Morrison), Mortex Product, Inc. (Mortex), National Motor Corporation (NMC), and Rheem Manufacturing Company (Rheem). Comments made during the public meeting by those not already listed include the U.S. Environmental Protection Agency (EPA), the motor manufacturer Regal Beloit, and Unico Incorporated. This NOPR summarizes and responds to the issues raised in these comments. A parenthetical reference at the end of a quotation or paraphrase provides the location of the item in the public record.

III. General Discussion

A. Test Procedure

In the SNOPR for the residential furnace fan test procedure published in the Federal Register on April 2, 2013 (78 FR 19606), DOE proposed to adopt a modified version of a test method recommended by AHRI and supported by other furnace fan manufacturers in the written comments on the May 2012 Test Procedure NOPR. (Docket No. EERE-2010-BT-TP-0010, AHRI, No. 16 at p. 3) DOE agrees with AHRI's assessment that its method provides a framework for accurate and repeatable determinations of FER that is comparable to the test method previously proposed by DOE, but at a significantly reduced test burden. In general, the test burden of the AHRI method is reduced relative to the test procedure originally proposed in the NOPR because it: (1) does not require airflow to be measured directly; (2) avoids the need to make multiple determinations in each airflow-control setting because outlet restrictions to achieve the specified reference system external static pressure (ESP) would be set in the maximum airflow-control setting and maintained for measurements in subsequent airflow-control settings; and (3) can be conducted using the test setup currently required to rate furnace annual fuel utilization efficiency (AFUE) for compliance with residential furnace standards.

In the April 2, 2013 test procedure SNOPR, DOE proposed to incorporate by reference the definitions, test setup and equipment, and procedures for measuring steady-state combustion efficiency provisions of American National Standards Institute (ANSI)/ American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 103-2007, Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers (ASHRAE Standard 103). In addition to these provisions, DOE proposed additional provisions for apparatuses and procedures for measuring throughput temperature, external static pressure, and furnace fan electrical input power. DOE also proposed calculations to derive FER based on the results of testing for each basic model. 78 FR 19606, 19608-09 (April 2, 2013).

In the SNOPR, DOE proposed to define "fan energy rating" (FER) as the estimated annual electrical energy consumption of the furnace fan normalized by: (a) the estimated total number of annual fan operating hours (1,870);[13] and (b) the airflow in the maximum airflow-control setting. Id.at 19608. The estimated annual electrical energy consumption, as proposed, is a weighted average of the furnace fan electrical input power (in Watts) measured separately for multiple airflow-control settings at different external static pressures (ESPs). These ESPs are determined by a reference system that represents national average duct work system characteristics. Id. Table III.1 below includes the proposed reference system ESP values by installation type.

Table III.1: Proposed Reference System ESP Values by Furnace Fan Installation Type

Installation Type	Weighted Average ESP (in. w.c.)
Units with an internal evaporator coil	0.50
Units designed to be paired with an evaporator coil	0.65
Units installed in a manufactured homes[14]	0.30

The proposed rated airflow-control settings correspond to operation in cooling mode (which DOE finds is predominantly associated with the maximum airflow-control setting), heating mode, and constant-circulation mode. Table III.2 illustrates the airflow-control settings that would be rated for various product types.

[13] Details about the derivation of operating hours used to calculate FER are found in the test procedure NOPR. 77 FR 28674, 28680 (May 15, 2012).
[14] Manufactured home external static pressure is much lower than non-manufactured home installations because there is no return air duct work in manufactured homes. Also, the United States Department of Housing and Urban Development (HUD) requirements for manufactured homes stipulate that the duct work for cooling should be set at 0.3 in. w.c.

Table III.2: Proposed Rated Airflow-control Settings by Product Type

Product Type	Rated Airflow-control Setting 1	Rated Airflow-control Setting 2	Rated Airflow-control Setting 3
Single-stage Heating	Default constant-circulation	Default heat	Absolute maximum
Multi-stage or Modulating Heating	Default constant-circulation	Default low heat	Absolute maximum

As shown in Table III.2, for products with single-stage heating, the three proposed rated airflow-control settings are the default constant-circulation setting, the default heating setting, and the absolute maximum setting. 78 FR 19606, 19609 (April 2, 2013). For products with multi-stage heating or modulating heating, the proposed rated airflow-control settings are the default constant-circulation setting, the default low heating setting, and the absolute maximum setting. The absolute lowest default airflow-control setting is used to represent constant circulation if a default constant-circulation setting is not specified. DOE proposed to define "default airflow-control settings" as the airflow-control settings specified for installed use by the manufacturer in the product literature shipped with the product in which the furnace fan is integrated. Id. Manufacturers typically provide detailed instructions for setting the default heating airflow-control setting to ensure that the product in which the furnace fan is integrated operates safely. Manufacturer installation guides also provide detailed instructions regarding compatible thermostats and how to wire them to achieve the specified default settings.

In the SNOPR, DOE proposed to weight the Watt measurements using designated annual operating hours for each function (i.e., cooling, heating, and constant circulation) that are intended to represent national average operation. Table III.3 shows the proposed estimated national average operating hours for each function to be used to calculate FER.

Table III.3: Estimated National Average Operating Hour Values for Calculating FER

Operating Mode	Variable	Single-stage (hours)	Multi-stage or Modulating (hours)
Heating	HH (heating hours)	830	830/HCR (heat capacity ratio)
Cooling	CH (cooling hours)	640	640
Constant Circulation	CCH (constant-circulation hours)	400	400
Total		1,870	(830/HCR) + 1,040

The specified operating hours for the heating mode for multi-stage heating or modulating heating products are divided by the heat capacity ratio (HCR) to account for variation in time spent in this mode associated with turndown of heating output. The HCR is the ratio of the reduced heat output capacity to maximum heat output capacity. The proposed FER equation is:

$$FER = \frac{(CH \times E_{Max}) + (HH \times E_{Heat}) + (CCH \times E_{Circ})}{(CH + 830 + CCH) \times Q_{Max}} \times 1000$$

Where:

CH= annual furnace fan cooling operating hours;

E_{Max}= furnace fan electrical consumption at maximum airflow-control setting operating point;

HH= annual furnace fan heating operating hours;

E_{Heat}= furnace fan electrical consumption at the default heating airflow-control setting operating point for units with single-stage heating or the default low-heating airflow control setting operating point for units with multi-stage heating;

CHH= annual furnace fan constant circulation hours;

E_{Circ}= furnace fan electrical consumption at the default constant-circulation airflow-control setting operating point (or minimum airflow-control setting operating point if a default constant-circulation airflow-control setting is not specified);

Q_{Max}= airflow at maximum airflow-control setting operating point; and

1000= constant to put metric in terms of watts/1000cfm, which is consistent with industry practice.

The public meeting for the energy conservation standards preliminary analysis occurred only two months after the public meeting for the test procedure NOPR. At the time of the preliminary analysis meeting, the comment period for the test procedure NOPR was still open. Consequently, many of the written comments and oral comments made during the preliminary analysis public meeting focused on test procedure issues and echoed comments in the test procedure rulemaking proceeding. While these test procedure issues are germane to the regulation of residential furnace fans more broadly, they are beyond the scope of the present energy conservation standards rulemaking. Accordingly, DOE addressed these test procedure-related comments, with detailed responses, in the April 2, 2013 test procedure SNOPR. Any additional comments made during the preliminary analysis relating to the test procedure that were not discussed in the test procedure SNOPR (*i.e.*, did not result in changes to DOE’s proposed test procedure) will be addressed in the test procedure final rule.

B. Product Classes and Scope of Coverage

Although the title of 42 U.S.C 6295(f) refers to "furnaces and boilers," DOE notes that 42 U.S.C. 6295(f)(4)(D) was written using notably broader language than the other provisions within the same section. Specifically, that statutory provision directs DOE to "consider and prescribe energy conservation standards or energy use standards for electricity used for purposes of circulating air through duct work." Such language could be interpreted as encompassing electrically-powered devices used in any residential HVAC product to circulate air through duct work, not just furnaces, and DOE has received numerous comments on both sides of this issue. At the present time, however, DOE is only proposing to cover those circulation fans that are used in furnaces and modular blowers. DOE is using the term "modular blower" to refer to HVAC products powered by single-phase electricity that comprise an encased circulation blower that is intended to be the principal air-circulation source for the living space of a residence. A modular blower is not contained within the same cabinet as a residential furnace, CAC, or heat pump. Instead, modular blowers are designed to be paired with separate residential HVAC products that provide heating and cooling, typically a separate CAC/HP coil-only unit. DOE finds that modular blowers and electric furnaces are very similar in design. In many cases, the only difference between a modular blower and electric furnace is the presence of an electric resistance heating kit. DOE is aware that some modular blower manufacturers offer electric resistance heating kits to be installed in their modular blower models so that the modular blowers can be converted to stand-alone electric furnaces. In addition, FER values for modular blowers can be easily calculated using the proposed test procedure. DOE proposes to address the furnace fans used in modular blowers in this rulemaking for these reasons. As a result of the extent of the current rulemaking, DOE is not addressing public comments that pertain to fans in other types of HVAC products.

When evaluating and establishing energy conservation standards, DOE divides covered products into product classes by the type of energy used or by capacity or other performance-related features that justify a different standard. In making a determination whether a performance-related feature justifies a different standard, DOE must consider such factors as the utility to the consumer of the feature and other factors DOE determines are appropriate. (42 U.S.C. 6295(q)) For this rulemaking, DOE proposes to differentiate between product classes based on internal structure and application-specific design differences that impact furnace fan energy consumption. Details regarding how internal structure and application-specific design differences that impact furnace fan energy consumption are included in chapter 3 of the NOPR technical support document (TSD). DOE proposes the following product classes for this rulemaking.

- Non-Weatherized, Non-Condensing Gas Furnace Fan (NWG-NC)
- Non-Weatherized, Condensing Gas Furnace Fan (NWG-C)
- Weatherized Non-Condensing Gas Furnace Fan (WG-NC)
- Non-Weatherized, Non-Condensing Oil Furnace Fan (NWO-NC)
- Non-Weatherized Electric Furnace / Modular Blower Fan (NWEF/NWMB)
- Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan (MH-NWG-NC)

- Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan (MH-NWG-C)
- Manufactured Home Electric Furnace / Modular Blower Fan (MH-EF/MB)
- Manufactured Home Weatherized Gas Furnace Fan (MH-WG)
- Manufactured Home Non-Weatherized Oil Furnace Fan (MH-NWO)

Each product class title includes descriptors that indicate the application-specific design and internal structure of its included products. "Weatherized" and "non-weatherized" are descriptors that indicate whether the HVAC product is installed outdoors or indoors, respectively. Weatherized products also include an internal evaporator coil, while non-weatherized products are not shipped with an evaporator coil but may be designed to be paired with one. "Condensing" refers to the presence of a secondary, condensing heat exchanger in addition to the primary combustion heat exchanger in certain furnaces. The presence of an evaporator coil or secondary heat exchanger significantly impacts the internal structure of an HVAC product, and in turn, the energy performance of the furnace fan integrated in that HVAC product. "Manufactured home" products meet certain design requirements that allow them to be installed in manufactured homes (*e.g.*, a more compact cabinet size). Descriptors for "gas," "oil," or "electric" indicate the type of fuel that the HVAC product uses to produce heat, which determines the type and geometry of the primary heat exchanger used in the HVAC product.

C. Technological Feasibility

1. General

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

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

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt a new 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 residential furnace 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 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 products that are the subject of this rulemaking purchased in the 30-year period that begins in the anticipated year of compliance with new standards (2019–2048). These savings are measured over the entire lifetime of products purchased in the 30-year analysis period.[15] DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the base case. The base case represents a projection of energy consumption in the absence of mandatory energy conservation standards, and it considers market forces and policies that affect demand for more-efficient products.

[15] In the past, DOE presented energy savings results for only the 30-year period that begins in the year of compliance. In the calculation of economic impacts, however, DOE considered operating cost savings measured over the entire lifetime of products purchased in the 30-year period. DOE has chosen to modify its presentation of national energy savings to be consistent with the approach used for its national economic analysis.

DOE used its national impact analysis (NIA) spreadsheet model to estimate energy savings from potential standards for the products that are the subject of this rulemaking. 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. DOE reports national energy savings on an annual basis in terms of the primary (source) energy savings, which is the savings in the energy that is used to generate and transmit the site energy. To convert site energy to primary energy, DOE derived annual conversion factors from the model used to prepare the Energy Information Administration's (EIA's) Annual Energy Outlook 2012 (AEO 2012).

DOE has begun to also estimate energy savings using full-fuel-cycle metrics. 76 FR 51282 (Aug. 18, 2011), as amended at 77 FR 49701 (August 17, 2012). The full-fuel-cycle (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 efficiency standards. DOE's approach is based on calculation of an FFC multiplier for each of the primary fuels used by covered products and equipment. For more information on FFC energy savings, see section IV.H.1.

2. Significance of Savings

As noted above, 42 U.S.C. 6295(o)(3)(B) prevents DOE from adopting a standard for a covered product unless such standard would result in "significant" energy savings. 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 this context to be savings that were not "genuinely trivial." The energy savings for all of the TSLs considered in this rulemaking are nontrivial, and, therefore, DOE considers them "significant" within the meaning of section 325 of EPCA.

E. Economic Justification

1. Specific Criteria

As discussed above, 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 new or 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) industry net present value (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, as discussed in section IV.N. 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 life-cycle cost (LCC) and payback period (PBP) associated with new or amended standards. The LCC, which is specified separately in EPCA as one of the seven factors to be considered in determining the economic justification for a new or amended standard, 42 U.S.C. 6295(o)(2)(B)(i)(II), is discussed in the following section. For consumers in the aggregate, DOE also calculates the national net present value of the economic impacts applicable to a particular rulemaking.

b. Life-Cycle Costs

The LCC is the sum of the purchase price of a product (including its installation) and the operating expense (including energy, maintenance, and repair expenditures) discounted over the lifetime of the product. The LCC savings for the considered efficiency levels are calculated relative to a base case that reflects projected market trends in the absence of standards. 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. For its analysis, DOE assumes that consumers will purchase the considered products in the first year of compliance with new standards.

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. DOE identifies the percentage of consumers estimated to receive LCC savings or experience an LCC increase, in addition to the average LCC savings associated with a particular standard level. DOE also evaluates the LCC impacts of potential standards on identifiable subgroups of consumers that may be affected disproportionately by a national standard. DOE's LCC analysis is discussed in further detail in section IV.F.

c. Energy Savings

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

d. Lessening of Utility or Performance of Products

In establishing classes of products, 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)) The standards proposed in today's notice will 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 any lessening of competition that is likely to result from standards. It also directs the Attorney General of the United States (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)(i)(V) and (ii)) DOE will transmit a copy of today's 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

In evaluating the need for national energy conservation, DOE notes that the energy savings from the proposed standards are likely to provide improvements to the security and reliability of the nation's energy system. (42 U.S.C. 6295(o)(2)(B)(i)(VI)) 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. DOE reports the emissions impacts from each TSL it considered in section IV.K of this notice.

DOE also reports estimates of 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 analysis generates values used to determine which of the considered standard levels meet the three-year payback period contemplated under the rebuttable presumption test. The rebuttable presumption payback calculation is discussed in section V.B.1 of this notice. 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).

IV. Methodology and Discussion

This section addresses the analyses DOE has performed for this rulemaking with regard to residential furnace fans. After a brief discussion of the spreadsheet tools and models used, separate subsections will address each component of DOE's analysis.

DOE used three spreadsheet tools to estimate the impact of today's proposed standards. The first spreadsheet calculates LCCs and payback periods of potential standards. The second provides shipments forecasts, and then calculates national energy savings and net present value impacts of potential standards. Finally, DOE assessed manufacturer impacts, largely through use of the Government Regulatory Impact Model (GRIM). All three spreadsheet tools are available online at the rulemaking portion of DOE's website: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/41.

Additionally, DOE estimated the impacts on utilities and the environment that would be likely to result from potential standards for residential furnace fans. DOE used a version of EIA's National Energy Modeling System (NEMS) for the utility and environmental analyses. [16] The NEMS simulates the energy sector of the U.S. economy. EIA uses NEMS to prepare its Annual Energy Outlook, a widely-known energy forecast for the United States. NEMS offers a sophisticated picture of the effect of standards because it accounts for the interactions between the various energy supply and demand sectors and the economy as a whole.

[16] For more information on NEMS, refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is *National Energy Modeling System: An Overview 2003*, DOE/EIA-0581(2003) (March, 2003).

A. Market and Technology Assessment

DOE develops information 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. The subjects addressed in the market and technology assessment for this residential furnace fans rulemaking include: (1) a determination of the scope of this rulemaking; (2) product classes and manufacturers; (3) quantities and types of products sold and offered for sale; (4) retail market trends; (5) regulatory and non-regulatory programs; and (6) technologies or design options that could improve the energy efficiency of the product(s) under examination. The key findings of DOE's market assessment are summarized below. See chapter 3 of the NOPR TSD for further discussion of the market and technology assessment.

1. Definition and Scope of Coverage

EPCA provides DOE with the authority to consider and prescribe new energy conservation standards for electricity used to circulate air through duct work. (42 U.S.C. 6295(f)(4)(D)) In the preliminary analysis, DOE defined a "furnace fan" as "any electrically-powered device used in residential, central heating, ventilation, and air-conditioning (HVAC) systems for the purpose of circulating air through duct work." 77 FR 40530, 40532 (July 10, 2012). DOE considered a typical furnace fan as consisting of a fan motor and its controls, an impeller, and a housing, all of which are components of an HVAC product that includes additional components, including the cabinet.

Interested parties disagreed with DOE's approach to set component-level regulations, which they warned would ignore system effects that could impact both fan and system energy consumption. CA IOUs suggested that "furnace fan" be defined as a unit consisting of a fan motor, its controls, an impeller, shroud, and cabinet that houses all of the heat exchange material for the furnace. According to CA IOUs, their suggested definition would reduce ambiguity and ensure that the components in HVAC products that affect furnace fan energy consumption are considered in this rulemaking. (CA IOUs, No. 56 at p. 1) Ingersoll Rand went further and suggested a system-level regulatory approach, where the entire duct and furnace system would be regulated, maintaining that such approach would produce a more useful metric to consumers when evaluating performance. (Ingersoll Rand, No. 43 at p. 42) Conversely, NEEP observed that by regulating fan energy use separately, the individual efficiency of the component is considered when it would otherwise be ignored by manufacturers. (NEEP, No. 51 at p. 3) Rheem commented that some designs require higher air velocity to improve heat transfer but also require more electrical consumption to drive the blower at the higher velocity. (Rheem, No. 43 at p. 63) Rheem commented that turbulent flow is considerably more efficient for heat transfer than laminar flow, but more energy is required to move turbulent air. (Rheem, No. 54 at p. 10) Similarly, Lennox and Morrison commented that in order to improve heating and cooling efficiency, often a second heating coil is added, but this also leads to higher electrical consumption by the furnace fan. (Lennox, No. 43 at p. 64; Morrison, No. 43 at p. 64) Ingersoll Rand argued that as the efficiency of the furnace fan motor increases, it dissipates less heat and a furnace consumes more gas to compensate and meet house heat load. (Ingersoll Rand, No. 43 at p. 66)

In response, DOE is required by EPCA to consider and prescribe new energy conservation standards or energy use standards for electricity used for purposes of circulating air through duct work. (42 U.S.C. 6295(f)(4)(D)) Pursuant to this statutory mandate, DOE plans to establish energy conservation standards for circulation fans used in residential central HVAC systems. DOE does not interpret its authority as including the duct work itself. DOE is aware that component-level regulations could have system-level impacts. Accordingly, DOE plans to conduct its analyses and set standards in such a way that meets the statutory requirements set forth by EPCA without ignoring system effects, which otherwise might compromise the thermal performance of the HVAC products that incorporate furnace fans. For example, the proposed test procedure outlined in the April 2, 2013 SNOPR specifies that the furnace fan be tested as factory-installed in the HVAC product, thereby enabling the rating metric to account for system effects on airflow delivery and, ultimately, energy performance. 78 FR 19606, 19612-13. In addition, the product class structure allows for differentiation of products with designs that achieve higher thermal efficiency but may have lower fan performance, such as condensing furnaces.

The scope of the preliminary analysis included furnace fans used in furnaces, modular blowers, and hydronic air handlers. Even though DOE has interpreted its authority as encompassing any electrically-powered device used in residential HVAC products to circulate air through duct work, the preliminary analysis scope excluded single package central air conditioners (CAC) and heat pumps (HP) and split-system CAC/HP blower-coil units. At the time of the preliminary analysis, DOE determined that it may consider these and other such products in a future rulemaking as data and information to develop credible analyses becomes available.

Efficiency advocates expressed concern at the exclusion of packaged and split-system CAC products because they believe current standards for these products do not maximize the technologically feasible and economically justified energy savings for the circulation fans integrated in these products. ASAP and Adjuvant stated that the metric used for CAC products does not accurately represent field conditions and requested that they be added to the scope. (ASAP, No. 43 at p. 17; Adjuvant, No. 43 at p. 39) Specifically, efficiency advocates found that the reference external static pressures (ESPs) used to determine the seasonal energy efficiency ratio (SEER) and heating seasonal performance factor (HSPF), which already rate these products, did not reflect field-installed conditions. (ASAP, No. 43 at p. 38; Earthjustice, No. 49 at p. 1) In a joint comment from ACEEE, ASAP, NCLC, NEEA, and NRDC (hereafter referred to as ACEEE, *et al*.), in addition to a comment from CA IOU, efficiency advocates and utilities stated that the reference ESP of 0.1 – 0.2 in. w.c. was too low when compared to the average field ESP of 0.73 in. w.c. identified in the TSD. (ACEEE, *et al*., No. 55 at p. 1; CA IOU, No. 56 at p. 2) ACEEE, *et al*. also noted that SEER and HSPF do not account for continuous-circulation operation which is expected to increase as stricter building codes call for tighter building envelopes. (ACEEE, *et al*., No. 55 at p. 2; CA IOU, No. 56 at p. 3) NEEP commented that SEER and HSPF do not reward for any efficiency gains made by the furnace fan. (NEEP, No. 51 at p. 3) By excluding these products from the analysis, ACEEE, *et al*. argued that DOE is ignoring a significant fraction of the furnace fan market. (ACEEE, *et al*., No. 55 at p. 1)

In contrast, many manufacturers believe that the scope of coverage presented in the preliminary analysis exceeds the statutory authority granted to DOE because the statutory language for this rulemaking is found in 42 U.S.C 6295(f) under the title "Standards for furnaces and boilers." Consequently, manufacturers stated that DOE should not include any non-furnace products such as central air conditioners, heat pumps, or condensing unit-blower-coil combinations. Lennox, Mortex, and First Co. explicitly stated that no equipment other than residential furnaces and boilers should be included, as doing so is beyond DOE's statutory authority. (Lennox, No. 47 at p. 4; Mortex, No. 59 at p. 1; First Co., No. 53 at p. 1) Mortex further stated that the electricity used to circulate air through duct work is already adequately accounted for in existing energy efficiency metrics, and that if DOE insists on proceeding on new energy conservation standards for furnace fans, DOE should limit it to residential warm air furnaces until there is a change made by Congress to include additional products. (Mortex, No. 59 at p. 1) Goodman and Ingersoll Rand argued that packaged equipment and air handlers should not be included in the scope because the electrical energy consumed by these products to circulate air through duct work is already accounted for in SEER and HSPF. (Goodman, No. 50 at p. 7; Ingersoll Rand, No. 57 at pp. A-1) Rheem and Morrison recommended that hydronic air handlers and modular blowers be excluded from the scope because these products have not been previously covered by an energy conservation standard and cannot be defined as furnaces. (Morrison, No. 43 at p. 94; Morrison, No. 58 at p. 9; Rheem, No. 54 at p. 2)

Manufacturers also argued that the electricity used to circulate air through duct work for warm air furnaces with cooling capabilities is already covered by SEER. (Goodman, No. 50 at p. 7; Mortex, No. 59 at p. 1) Additionally, for a residential warm air furnace, Mortex stated that E_{ae}

already accounts for heating-mode-related energy consumption, including energy consumed by the fan. (Mortex, No. 59 at p. 2) Additionally, by including annual furnace fan cooling and heating electricity consumption in the FER metric, central air conditioner and heat pumps products will be covered by multiple metrics. (Goodman, No. 50 at p. 6; Mortex, No. 59 at p. 2)

As discussed in the furnace fan test procedure April 2, 2013 SNOPR, DOE notes that, although the title of this statutory section refers to "furnaces and boilers," the applicable provision at 42 U.S.C. 6295(f)(4)(D) was written using notably broader language than the other provisions within the same section. 78 FR 19606, 19611. Specifically, that statutory provision directs DOE to "consider and prescribe energy conservation standards or energy use standards for electricity used for purposes of circulating air through duct work." Such language could be interpreted as encompassing electrically-powered devices used in any residential HVAC product to circulate air through duct work, not just furnaces, and DOE has received numerous comments on both sides of this issue. At the present time, however, DOE is only proposing energy conservation standards for those circulation fans that are used in residential furnaces and modular blowers (see discussion below). As a result, DOE is not addressing public comments that pertain to fans in other types of HVAC products. The following list describes the furnace fans which DOE proposes to address in this rulemaking.

- Products addressed in this rulemaking: furnace fans used in weatherized and non-weatherized gas furnaces, oil furnaces, electric furnaces, and modular blowers.
- Products not addressed in this rulemaking: furnace fans used in other products, such as split-system CAC and heat pump air handlers, through-the-wall air handlers, small-duct,

high-velocity (SDHV) air handlers, energy recovery ventilators (ERVs), heat recovery ventilators (HRVs), draft inducer fans, exhaust fans, or hydronic air handlers.

DOE is using the term "modular blower" to refer to HVAC products powered by single-phase electricity that comprise an encased circulation blower that is intended to be the principal air circulation source for the living space of a residence. A modular blower is not contained within the same cabinet as a residential furnace, CAC, or heat pump. Instead, modular blowers are designed to be paired with separate residential HVAC products that provide heating and cooling, typically a separate CAC/HP coil-only unit. DOE finds that modular blowers and electric furnaces are very similar in design. In many cases, the only difference between a modular blower and electric furnace is the presence of an electric resistance heating kit. DOE is aware that some modular blower manufacturers offer electric resistance heating kits to be installed in their modular blower models so that the modular blowers can be converted to stand-alone electric furnaces. In addition, FER values for modular blowers can be easily calculated using the proposed test procedure. DOE proposes to address the furnace fans used in modular blowers in this rulemaking for these reasons.

After considering available information and public comments regarding fan operation in cooling mode, DOE maintains its proposal to account for the electrical consumption of furnace fans while performing all active mode functions (*i.e.*, heating, cooling, and constant circulation). DOE recognizes that furnace fans are used not just for circulating air through duct work during heating operation, but also for circulating air during cooling and constant-circulation operation. DOE anticipates that higher airflow-control settings are factory set for cooling operation.

Therefore, DOE expects that the electrical energy consumption of a furnace fan is generally higher while performing the cooling function. Additionally, the design of the fan as well as its typical operating characteristics (*i.e.*, ESP levels during operation in different modes) is directly related to the performance requirements in cooling mode. DOE is also concerned that excluding some functions from consideration in rating furnace fan performance would incentivize manufacturers to design fans that are optimized to perform efficiently at the selected rating airflow-control settings but that are not efficient over the broad range of field operating conditions. In DOE's view, in order to obtain a complete assessment of overall performance and a metric that reflects the product's electrical energy consumption during a representative average use cycle, the metric must account for electrical consumption in a set of airflow-control settings that spans all active mode functions. This would ensure a more accurate accounting of the benefits of improved furnace fans.

DOE is aware that fan electrical consumption is accounted for in the SEER and HSPF metrics that DOE uses for CAC and heat pump products. However, DOE does not agree with manufacturers' comments suggesting that the electricity used to circulate air through duct work is already adequately accounted for in existing energy efficiency metrics of other covered products, particularly the SEER and HSPF metrics of CAC/HP. This is because SEER and HSPF are used to test cooling and heating performance of a CAC or heat pump product, whereas FER rates airflow performance of a furnace fan product. While furnace fan airflow performance contributes to cooling and heating performance, manufacturers can improve SEER and HSPF without improving fan performance. In short, SEER and HSPF-based standards do not directly regulate the efficiency of furnace fans, as required by 42 U.S.C. 6295(f)(4)(D). DOE recognizes that the energy savings in cooling mode from higher-efficiency furnace fans used in some higher-efficiency CAC and heat pumps is already accounted for in the analysis of energy conservation standards for those products. As a result, DOE conducted its analysis in this current rulemaking in such a way as to avoid double-counting these benefits by excluding furnace fan electricity savings that were already included in DOE's analyses for CAC and heat pump products. Chapter 7 of the NOPR TSD provides a more detailed discussion of this issue.

2. Product Classes

DOE identified nine key product classes in the preliminary analysis, each of which was assigned its own candidate energy conservation standard and baseline FER. DOE identified twelve additional product classes that represent significantly fewer shipments and significantly less overall energy use. DOE grouped each non-key product class with a key product class to which it is closely related in application-specific design and internal structure (*i.e.*, the primary criteria used to differentiate between product classes). DOE assigned the analytical results of each key product class to the non-key product classes with which it is grouped because DOE expected the energy use and incremental manufacturer production costs (MPCs) of improving efficiency to be similar within each grouping. Table IV.1 lists the 21 preliminary analysis product classes.

Table IV.1: Preliminary Analysis Product Classes

Key Product Class	Additional Product Classes
Non-Weatherized, Non-Condensing Gas Furnace Fan (NWG-NC)	
Non-weatherized, Condensing Gas Furnace Fan (NWG-C)	
Weatherized Non-Condensing Gas Furnace	Weatherized, Non-Condensing Oil Furnace

Fan (WG-NC)	Fan (WO-NC)
	Weatherized Electric Furnace/Modular Blower Fan (WEF/WMB)
	Manufactured Home Weatherized Gas Furnace Fan (MH-WG)
	Manufactured Home Weatherized Oil Furnace Fan (MH-WO)
	Manufactured Home Weatherized Electric Furnace/Modular Blower Fan (MH-WEF/WMB)
Non-weatherized, Non-Condensing Oil Furnace Fan (NWO-NC)	Non-Weatherized, Condensing Oil Furnace Fan (NWO-C)
	Manufactured Home Non-Weatherized Oil Furnace Fan (MH-NWO)
Non-weatherized Electric Furnace / Modular Blower Fan (NWEF/NWMB)	
Heat/Cool Hydronic Air Handler Fan (HAH-HC)	Heat-Only Hydronic Air Handler Fan (HAH-H)
	Hydronic Air Handler Fan with Coil (HAH-C)
	Manufactured Home Heat/Cool Hydronic Air Handler Fan (MH-HAH-HC)
	Manufactured Home Heat-Only Hydronic Air Handler Fan (MH-HAH-H)
	Manufactured Home Hydronic Air Handler Fan with Coil (MH-HAH-C)
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan (MH-NWG-NC)	
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan (MH-NWG-C)	
Manufactured Home Electric Furnace/ Modular Blower Fan (MH-EF/MB)	

Goodman and Rheem agreed that the selected key product classes are an accurate representation of the market, with Rheem commenting that it manufactures six of the nine proposed key product classes. (Goodman, No. 50 at p. 1; Rheem, No. 54 at p. 4) NEEP found that the proposed key product class structure appropriately allows for differentiation of products with higher thermal efficiency. (NEEP, No. 51 at p. 2) Goodman, Rheem, and Ingersoll Rand disagreed with DOE's approach to specify additional product classes within a key product class, stating that shipment data indicates that the additional product classes are too small to be covered. (Goodman, No. 50 at p. 1; Ingersoll Rand, No. 57 at pp. A-1; Rheem, No. 54 at p. 4)

Mortex expressed concern that the key product classes only represent furnace fan products with the most shipments and, if the energy conservation standards are set inappropriately high for these key product classes, the additional products classes (some of which serve unique applications) may also have trouble meeting any scaled standards levels based thereon. (Mortex, No. 43 at p. 53)

DOE agrees with Goodman, Rheem, and Ingersoll Rand that the additional product classes represent products with few and in many cases, no shipments. Individual discussions with manufacturers for the MIA confirm DOE's assumption. Additionally, review of the AHRI appliance directory reveals that only two of the additional product classes have active models listed: (1) manufactured home weatherized gas furnace fans (MH-WG) and (2) manufactured home non-weatherized oil furnace fans (MH-NWO). The number of active basic models for MH-WG and MH-NWO are 4 and 16, respectively. For this reason, DOE proposes to eliminate the additional product classes except for MH-WG and MH-NWO. Due to the limited number of basic models for MH-WG and MH-NWO, DOE did not have data to directly analyze and establish standards for these additional product classes. As a result, DOE proposes to reserve space to establish standards for MH-WG and MH-NWO furnace fans in the future as sufficient data become available.

As discussed previously in section IV.A.1, DOE proposes to also exclude hydronic air handlers from consideration in this rulemaking, thereby further reducing the number of product classes addressed by this rulemaking to eight. Table IV.2 includes a list of the revised set of product classes for residential furnace fans.

Table IV.2: Proposed Product Classes for Residential Furnace Fans

Product Class
Non-Weatherized, Non-Condensing Gas Furnace Fan (NWG-NC)
Non-Weatherized, Condensing Gas Furnace Fan (NWG-C)
Weatherized Non-Condensing Gas Furnace Fan (WG-NC)
Non-Weatherized, Non-Condensing Oil Furnace Fan (NWO-NC)
Non-Weatherized Electric Furnace / Modular Blower Fan (NWEF/NWMB)
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan (MH-NWG-NC)
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan (MH-NWG-C)
Manufactured Home Electric Furnace / Modular Blower Fan (MH-EF/MB)
Manufactured Home Weatherized Gas Furnace Fan (MH-WG)
Manufactured Home Non-Weatherized Oil Furnace Fan (MH-NWO)

3. Technology Options

In the preliminary analysis, DOE considered seven technology options that would be expected to improve the efficiency of furnace fans: (1) fan housing and airflow path design modifications; (2) high-efficiency fan motors (in some cases paired with multi-stage or modulating heating controls); (3) inverter-driven permanent-split capacitor (PSC) fan motors; (4) backward-inclined impellers; (5) constant-airflow brushless permanent magnet (BPM) motor control relays; (6) toroidal transformers; and (7) switching mode power supplies. Since that time, DOE notes that its proposed scope of coverage no longer includes hydronic air handlers, the only furnace fan product class for which standby mode and off mode energy consumption is not accounted for in a separate DOE rulemaking. Consequently, the standby mode and off mode technology options (options 5 through 7 in the list above) are no longer applicable, because energy consumption in those modes is already fully accounted for in the DOE energy conservation standards rulemaking for residential furnaces and residential CAC and HP for the remaining proposed product classes. 76 FR 37408 (June 27, 2011); 76 FR 67037 (Oct. 31, 2011). In addition, DOE found that multi-staging and modulating heating controls can also improve FER, so hence DOE evaluated multi-staging and modulating heating controls as a separate technology option for the NOPR. Thus, the resultant list of potential technology options identified for the NOPR include: (1) fan housing and airflow path design modifications; (2) inverter-driven PSC fan motors; (3) high-efficiency fan motors; (4) multi-staging and modulating heating controls; and (5) backward-inclined impellers. Each identified technology option is discussed below and in more detail in chapter 3 of the NOPR TSD.

a. Fan Housing and Airflow Path Design Improvements

The preliminary analysis identified fan housing and airflow path design modifications as potential technology options for improving the energy efficiency of furnace fans. Optimizing the shape of the inlet cone[17] of the fan housing, minimizing gaps between the impeller and fan housing inlet, and optimizing cut-off location and manufacturing tolerances were identified as enhancements to a fan housing that could improve efficiency. Separately, modification of elements in the airflow path, such as the heat exchanger, could reduce internal static pressure and as a result, reduce energy consumption. Manufacturer input was requested to determine the use and practicability of these potential technology options.

[17] The inlet cone is the opening of the furnace fan housing through which return air enters the housing. The inlet cone is typically curved inward, forming a cone-like shape around the perimeter of the opening, to provide a smooth surface to direct air from outside the housing to inside the housing and into the impeller.

ASAP expressed support for DOE's consideration of the aerodynamics of furnace fan cabinets in its initial analysis of technology options. (ASAP, No. 43 at p. 16) In particular, ASAP cited a 2003 GE study[18] that quantified energy savings produced by modifying fan housing as justification for its inclusion as an option. (ASAP, No. 43 at p. 71) ACEEE, *et al.* also cited a Lawrence Berkeley National Laboratory (LBNL) study[19] that linked changes in efficiency to modifying the clearance between fan housing and an air handler cabinet wall. (ACEEE, *et al*., No. 55 at p. 2) According to Ingersoll Rand, there are proprietary fan housing designs on the market that already improve mechanical efficiency by 10-20 percent at a cost much lower than the cost to implement high-efficiency motors or make changes to the impeller and its tolerances. (Ingersoll Rand, No. 57 at pp. A-3)

DOE is aware of the studies cited by ASAP and ACEEE, as well as the proprietary housing design mentioned by Ingersoll Rand. For the NOPR, DOE decided to include fan housing design modifications as a technology to be evaluated further in the screening analysis because of these indications that each could improve fan efficiency.

Many interested parties requested that DOE keep airflow path design as a technology option. (Unico, No. 43 at p. 72; EPA, No. 43 at p. 76; ASAP, No. 43 at p. 77; CA IOU, No. 56 at p. 3; ACEEE, *et al.*, No. 55 at p. 2) Manufacturers stated that improving airflow path design, like modifying fan housing, is highly cost-effective when compared to other enhancements. (Rheem, No. 43 at p. 74; Lennox, No. 43 at p. 74; Adjuvant, No. 43 at p. 74) Lennox noted a 10-

[18] Wiegman, Herman, Final Report for the Variable Speed Integrated Intelligent HVAC Blower (2003) (Available at: http://www.osti.gov/bridge/servlets/purl/835010-GyvYDi/native/835010.pdf).
[19] Walker, I.S, State-of-the-art in Residential and Small Commercial Air Handler Performance (2005) LBNL 57330 (Available at: http://epb.lbl.gov/publications/pdf/lbnl-57330plus.pdf).

20 percent improvement in efficiency could be achieved by changing the airflow path when evaluated against a baseline design coupled with a PSC motor. (Lennox, No. 47 at p. 9; Morrison, No. 58 at p. 5) However, the EPA questioned whether considering modified airflow path as a technology option was appropriate when DOE plans to only regulate the fan itself and not the entire air handler. (EPA, No. 43 at p. 62)

While Morrison agreed that airflow path and fan housing design affect performance and efficiency, it argued that establishing a baseline design (over which to determine improvement) might be difficult because parameters used to select an individual manufacturer's design may have taken into account considerations outside the scope of the furnace fan rulemaking. (Morrison, No. 43 at p. 75) Rheem suggested that AHRI should present airflow path and fan housing design data to the DOE in order to help establish the two technology options. (Rheem, No. 43 at p. 79)

Similar to the fan housing design modifications, DOE decided to include airflow path design as a technology option to be evaluated further in the screening analysis as a result of these claims of potential fan efficiency improvement. In response to the comment received from the EPA, DOE believes including airflow path design is appropriate because of its potential to impact fan efficiency. Airflow path design will impact the proposed rating metric, FER, because DOE is proposing to test the furnace fan as it is factory installed in the HVAC product. As discussed previously in section IV.A.1, DOE has conducted its NOPR analyses in such a way as to meet the statutory requirements set forth by EPCA without ignoring system effects. Chapter 3 of the NOPR TSD provides more technical detail regarding fan housing and airflow path design modifications and how these measures could reduce furnace fan energy consumption.

b. Inverter Controls for PSC Motors

In the preliminary analysis, DOE identified inverter-driven PSC motors as a technology option. DOE is aware of a series of non-weatherized gas furnaces with inverter-driven PSC furnace fan motors that was once commercially available. DOE has determined that inverter controls provide efficiency improvement by offering additional intermediate airflow-control settings and a wider range of airflow-control settings (*i.e.*, lower turndown ratio) than conventional PSC controls. The additional airflow-control settings and range enable the furnace fan to better match demand. Publically-available performance data for the series of furnaces using inverter-driven PSCs demonstrate that the use of this technology results in reduced FER values compared to baseline PSC furnace fans. Consequently, DOE considered inverter-driven PSCs as a technologically feasible option for reducing furnace fan energy consumption.

Manufacturers were opposed to listing inverter-driven PSCs as a viable technology option. Goodman commented that there are alternate, more cost-effective solutions to reduce energy consumption for air-moving systems, such as airflow path design. (Goodman, No. 50 at p. 2) Ingersoll Rand and Morrison commented that the small energy savings provided by inverter-driven PSCs are not worth the added cost and complexity when ECM (referred to herein by DOE as a "constant-airflow BPM motor") technology is available at a comparable cost and greater efficiency. (Ingersoll Rand, No. 57 at pp. A-1; Morrison, No. 58 at p. 2; Rheem, No. 54 at p. 6) Morrison suggested that the motor industry was seeking lower-cost alternatives to ECM motors, such as fractional horsepower switched reluctance motors or inverter-driven PSCs, but that no low-cost alternative currently exists. (Morrison, No. 58 at p. 2) NMC, a motor manufacturer, went further, stating that inverter-driven PSC motors using wave chopper controls are not typically more efficient than multi-tap PSC motors and that they are not a practical alternative to brushless permanent magnet technology. (NMC, No. 60 at p. 2)

DOE recognizes manufacturers' concerns with the cost-effectiveness of inverter-driven PSC fan motors. However, DOE decided to include inverter-driven PSC motors as a technology option to be evaluated further in the screening analysis due to their potential to reduce furnace fan energy consumption. DOE evaluates in the engineering analysis the cost-effectiveness of all energy-saving technology options that are not screened out. Chapter 3 of the NOPR TSD provides a more detailed discussion of inverter-driven PSC furnace fan motors.

c. High-Efficiency Motors

In the preliminary analysis, DOE identified four motor types that are typically used in furnace fan assemblies: (1) PSC motors; (2) PSC motors that have more than 3 airflow-control settings and sometimes improved materials (hereinafter referred to as "improved PSC" motors); (3) constant-torque BPM motors (often referred to as "X13 motors"); and (4) constant-airflow BPM motors (often referred to as "ECMs").[20] DOE finds that furnace fans using high-efficiency motor technology options operate more efficiently than furnace fans using baseline PSC motors by:

[20] "ECM" and "X13" refer to the constant-airflow and constant torque (respectively) BPM offerings of a specific motor manufacturer. Throughout this notice, DOE will refer to these technologies using generic terms, which are introduced in the list above. However, DOE's summaries of interested-party submitted comments include the terminology used by the interested party when referring to motor technologies.

- Functioning more efficiently at a given operating condition;
- Maintaining efficiency throughout the expected operating range; and
- Achieving a lower turndown ratio[21] (*i.e.*, ratio of airflow in lowest setting to airflow in highest setting).

Ingersoll Rand commented that a PSC motor will use less energy at higher static pressures, while an ECM increases energy use as static pressure rises. Ingersoll Rand stated that as a result, understanding the impact of switching to an ECM at higher static pressures may confuse the consumer. (Ingersoll Rand, No. 43 at p. 67)

DOE is aware that consumers may be confused when BPM motors (referred to as ECMs by Ingersoll Rand above) consume more energy than PSC motors at higher static pressures, because consumers expect BPM motors to consume less energy than PSC motors under the same operating conditions. In general, input power to the fan motor increases as static pressure increases to provide a given airflow (i.e., the fan motor has to work harder in the face of increased resistance to provide a desired amount of air).[22] DOE agrees with Ingersoll Rand that as static pressure increases, input power to a PSC-driven furnace fan will decrease, which is seemingly contradictory to the principle described above. DOE finds that input power to a PSC-driven furnace fan decreases because the airflow provided by the fan decreases as static pressure rises (i.e., the fan does not have to work as hard in the face of increased resistance because the fan is not providing as much air). Input power to a constant-airflow BPM motor-driven furnace fan, on the other hand, will increase as static pressure rises because the BPM motor-driven fan is

[21] A lower turndown ratio can significantly improve furnace fan efficiency because fan input power has a cubic relationship with airflow.
[22] See chapter 3 of the TSD for more details regarding fan operation.

designed to maintain the desired level of airflow. Recognizing that this behavior could complicate comparing the relative performance of these motor technologies, DOE's proposed rating metric, FER, is normalized by airflow to result in ratings that are in units of watts/cfm. DOE believes that a comparison using a watts/cfm metric will mitigate confusion by accurately reflecting that even though a constant-airflow BPM motor is consuming more power at higher statics, it is also providing more airflow, which is useful to the consumer.

Interested parties recognized the benefits provided by constant-torque and constant-airflow BPM motors. NMC agreed that variable-speed technology is useful in furnace fan applications, because the airflow settings can be adjusted and optimized for a range of static pressure levels. (NMC, No. 60 at p. 1) NEEP supported DOE's proposal for an efficiency level based on a constant-torque ECM as part of the furnace fan analysis, given that these motors are widely available and less expensive than "full blown" ECM motors. (NEEP, No. 51 at p. 3) Morrison commented that ECM technology offers the best cost for performance value. (Morrison, No. 58 at p. 2)

Interested parties agreed that the BPM motor variations (*i.e.*, constant-torque and constant-airflow) and inverter-driven PSC motors generally have lower turndown ratios than a three-speed PSC motor. Table IV.3 contains the turndown ratio estimates supplied publicly by interested parties. Manufacturers generally provided similar feedback during interviews. NMC stated that the turndown ratios achieved by ECM technology allow for continuous circulation at optimal CFM levels, unlike PSC options, which cannot achieve low enough CFM. (NMC, No. 60 at p. 1) Lennox commented that including constant circulation as part of FER will penalize

PSCs and artificially inflate the performance of ECMs. (Lennox, No. 47 at p. 9) Ingersoll Rand stated that furnace fan turndown ability is limited by the physical characteristics of the impeller and bearings. (Ingersoll Rand, No. 57 at pp. A-2)

Table IV.3: Stakeholder Estimated Fan Motor Turndown Ratios

Stakeholder	PSC	Wave chopper controller PSC	Constant-torque ECM	Constant-airflow ECM
NMC (NMC, No. 60 at p. 1)	0.45	0.36	0.45	0.20
Goodman (Goodman, No. 50 at p. 2)	0.70-0.75	-	0.40-0.50	0.25-0.35
Rheem (Rheem, No. 54 at p. 6)	0.60	-	0.30	0.20

Overall, comments regarding high-efficiency motor turndown ratio validated DOE's expectation that lower turndowns are associated with improved PSCs, inverter-driven PSCs, and BPM motor variations. These motors consume significantly less energy over a typical residential furnace fan operating range. DOE disagrees with Lennox that including constant circulation as part of FER would "artificially" inflate the performance of BPM motors compared to PSC motors, because DOE concludes that there is non-trivial use of this mode by consumers. As part of the test procedure rulemaking, DOE estimates that on average, consumers operate furnace fans in constant-circulation mode 400 hours annually. This estimate is used to weight fan constant-circulation electrical energy consumption in FER. Excluding this mode from the rating metric would underestimate the potential efficiency improvements of technology options, such as BPM motors, that could reduce fan electrical consumption while performing this function. A detailed discussion of DOE's estimate for national average constant-circulation furnace fan operating hours can be found in the test procedure NOPR. 77 FR 28674, 28682 (May 15, 2012).

DOE did not revise these estimates in the test procedure SNOPR published on April 2, 2013. 78 FR 19606.

d. Multi-Stage or Modulating Heating Controls

In the preliminary analysis (77 FR 40530 (July 10, 2012)), DOE identified two-stage and modulating heating controls (hereinafter collectively referred to as "multi-stage" controls) as a method of reducing residential furnace fan energy consumption. Multi-stage furnaces typically operate at lower heat input rates and, in turn, a lower airflow-control setting for extended periods of time compared to single-stage furnaces to heat a residence.[23] Due to the cubic relationship between fan input power and airflow, operating at the reduced airflow-control setting reduces overall fan electrical energy consumption for heating despite the extended hours. In the preliminary analysis, DOE analyzed multi-staging controls paired with use of a constant-airflow BPM fan motor as one technology option, because DOE found the two to be almost exclusively used together in commercially-available products.

ASAP, ACEEE, NCLC, NRDC, and NEEA encouraged DOE to consider X13-level motors applied with multi-stage furnace controls as a technology option. ACEEE *et al*. added that they expect an X13-level motor paired with multi-stage furnace controls to operate at a lower speed (corresponding to the lower burner output) in heating mode for a greater number of hours compared to an X13-level motor applied with single-stage furnace controls. According to ACEEE *et al*., the net effect of operating at a lower speed for a greater number of hours could be electricity savings, because motor power decreases with the cube of the speed. (ACEEE *et al*.,

[23] A further discussion of multi-stage heating controls is found in chapter 3 of the preliminary analysis TSD, which can be found at the following web address: http://www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0011-0037.

No. 55 at p. 3) Rheem commented that it does use modulating furnace controls with PSC and X13 motors, not just ECM motors. (Rheem, No. 43 at p. 81) During interviews, other manufacturers also commented that multi-stage heating controls can be and are used regardless of motor type.

Based on comments from Rheem and other manufacturers, DOE recognizes that multi-stage controls can be paired with other motor types, not just constant-airflow BPM motors. DOE agrees with ACEEE *et al.* that implementing multi-stage heating controls independent of motor type could result in residential furnace fan efficiency improvements. Consequently, DOE has decided to de-couple multi-staging controls from the constant-airflow BPM motor technology option. Accordingly, DOE has evaluated multi-staging controls as a separate technology option for the NOPR.

e. Backward-Inclined Impellers

DOE determined in the preliminary analysis that using backward-inclined impellers could lead to possible residential furnace fan energy savings. Although limited commercial data regarding backward-inclined impeller performance were available, DOE cited research by General Electric that showed large improvements in efficiency were achievable under certain operating conditions.[24]

Morrison disagreed with the DOE's findings, stating that literature indicates there are varying degrees of performance improvement when backward-inclined impellers are used in

[24] Wiegman, Herman, Final Report for the Variable Speed Integrated Intelligent HVAC Blower (2003) (Available at: http://www.osti.gov/bridge/servlets/purl/835010-GyvYDi/native/835010.pdf).

place of forward-curved impellers. (Morrison, No. 43 at p. 132) Specifically, Morrison cited an LBNL study[25] where a furnace with a backward-inclined impeller exhibited no efficiency gains compared to a low efficiency forward-curved impeller. (Morrison, No. 58 at p. 3) According to Morrison, limitations on operating speed also make it necessary to couple backward-inclined impellers with high-efficiency motors. (Morrison, No. 58 at p. 2) Other commenters asserted that the optimal range of operation for backward-inclined impellers may fall outside that of typical residential furnace fan use. (SCE, No. 43 at p. 59; Ingersoll Rand, No. 57 at p. A-3; EEI, No. 60 at p. 2; CA IOU, No. 56 at p. 4) CA IOU testing showed that backward-inclined impellers are more sensitive to external static pressures, which could also limit their use. (CA IOU, No. 56 at p. 4) Rheem stated that improved efficiency of backward-inclined impellers is often achieved at mid-flow rates and high static levels. (Rheem, No. 54 at p. 7) Rheem commented that research by the replacement part manufacturer (Lau) reveals that backward-inclined impellers, at diameters typically used in residential applications, offer no significant efficiency improvements. (Rheem, No. 43 at p. 132)

Ebm-papst, a company that provides custom air-movement products, offered a diverging opinion from most manufacturers regarding the energy-saving potential of backward-inclined impellers. That company retrofitted several HVAC products with furnace fan assemblies that incorporated backward-inclined impellers without increasing cabinet size and tested them. Depending on the application and the external static pressure load (typically 0.5 in.w.c. to 1 in.w.c.), ebm-papst found that the backward-inclined impeller achieved input power reductions from 15-30 percent. (ebm-papst Inc., No. 52 at p. 1) Ebm-papst did note that for backward-

[25] Walker, I.S., Laboratory Evaluation of Residential Furnace Blower Performance (2005) (Available at: http://www.escholarship.org/uc/item/7tx9c86s#page-1).

inclined impellers to match the performance of forward-curved impellers without increasing impeller dimensions, fan speed must increase. However, ebm-papst did not anticipate that this would be an obstacle to implementation using available motor technologies. (ebm-papst Inc., No. 52 at p. 1)

DOE recognizes that backward-inclined impellers may not be more efficient than forward-curved impellers under all operating conditions and that there may be considerable constraints to implementation. However, the GE prototype and ebm-papst prototype both demonstrate that significant energy consumption reduction is achievable at some points within the range of residential furnace fan operation. For this reason, DOE has included backward-inclined impellers as a technology option to be evaluated further in the screening analysis, where DOE investigates any other concerns regarding the use of a technology option, such as the practicability to manufacture or impacts on reliability, utility, and safety in the screening analysis.

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 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 screened out from further consideration in the engineering analysis. The reasons for eliminating any technology 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 excluded ("screened out") based on the screening criteria.

1. Screened-Out Technologies

DOE screened out fan housing and airflow path design improvements in the preliminary analysis. DOE had little quantitative data to correlate specific fan housing alterations with efficiency improvements. Additionally, DOE anticipated that any improvements to airflow path design that would result in fan efficiency improvement would require an increase in furnace fan cabinet size or negatively impact heat exchanger performance, thereby compromising the practicability to manufacture or reducing utility to consumers.

Interested parties stated many concerns associated with modifying airflow path designs to reduce residential furnace fan electrical energy consumption. Morrison provided an example illustrating the tradeoffs in thermal performance of selecting an airflow path that enhances fan performance. Specifically, Morrison stated that, "a 90%+ efficient furnace will have higher pressure drop through the furnace than a similarly sized 80%+ efficient furnace because of the added heat transfer surface area." (Morrison, No. 58 at p. 5) Conversely, manufacturers noted that higher SEER requirements call for increased central air conditioner or heat pump indoor coil size, leaving reduced space for other HVAC system components. Having to decrease the size of the fan due to these additional regulations could also make the furnace fan less efficient. (Morrison, No. 43 at p. 62) Mortex and Morrison also commented that the primary concern when selecting an airflow path design is usually safety or impact on heat transfer, not efficiency. (Mortex, No. 43 at p. 135; Morrison, No. 58 at p. 5) AHRI and Rheem outlined all of the possible housing design modifications that would affect airflow path design, including housing shape, distance between components, size of duct openings, and motor mounting. (AHRI, No. 48 at p. 3; Rheem, No. 54 at p. 9) AHRI emphasized that some modifications could improve or decrease efficiency, but all would require an increase in product size and, thus, manufacturing costs. (AHRI, No. 48 at p. 3) During manufacturer interviews, many manufacturers reiterated or echoed that airflow path design modifications would likely require increasing HVAC product size. Manufacturers explained that increasing HVAC products size would have adverse impacts on practicability to install and consumer utility, because the furnace fan market is predominantly a replacement market. Installing HVAC products that are larger in size compared to the products they are purchased to replace would likely present issues, mainly significant increases in installation costs or minimizing product availability to consumers.

DOE did not receive or find additional quantitative data that shows a measurable increase in fan efficiency as a result of a specific fan housing or airflow path design modification. Even after individual discussion with manufacturers, DOE was not able to identify a case where fan housing or airflow path design modifications could lead to potential fan energy savings without increasing the size of the HVAC product in which the furnace fan is used or compromising thermal performance or safety. In response to Morrison's comment, DOE assumes that the "added heat transfer surface area" in the 90%+ efficient furnace that Morrison refers to is the secondary heat exchanger typically used in condensing furnaces. DOE is aware of the impacts on thermal efficiency and furnace fan performance of the additional heat exchanger in condensing furnaces. As discussed in section III.B, DOE accounted for these impacts in its criteria for differentiating product classes. The 90%+ furnace (condensing) and 80%+ furnace (non-condensing) that Morrison refers to would not be in the same product class according to DOE's proposed product classes. In addition, DOE concurs with manufacturers' observations that an increase in envelope size would adversely impact practicability to manufacture and install, as well as product utility. Accordingly, DOE has decided to screen out fan housing and airflow path design modifications until quantitative data become available to show that a fan housing or airflow path design modification results in improved fan efficiency without increasing HVAC product size or compromising thermal performance or safety.

2. Remaining Technologies

Through a review of each technology, DOE found that all of the other identified technologies met all four screening criteria to be examined further in DOE's analysis. In summary, DOE did not screen out the following technology options: (1) inverter-driven PSC fan motors; (2) high-efficiency fan motors; (3) multi-stage heating controls; and (4) backward-inclined impellers. DOE understands that all of these technology options are technologically feasible, given that the evaluated technologies are being used (or have been used) in commercially-available products or working prototypes. These technologies all incorporate materials and components that are commercially available in today's supply markets for the residential furnace fans that are the subject of this NOPR. Therefore, DOE believes all of the efficiency levels evaluated in this notice are technologically feasible. For additional details, please see chapter 4 of the NOPR TSD.

DOE finds that all of the remaining technology options also 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). Interested parties, however, voiced concerns regarding these screening criteria as they apply to BPM fan motors and backward-inclined impellers. DOE addresses these concerns in the sections immediately below. DOE did not receive public comments relevant to the screening analysis criteria for the other remaining technology options.

a. High-Efficiency Motors

AHRI stated that there are a limited number of ECM motor suppliers to furnace fan manufacturers. (AHRI, No. 48 at p. 2) Lennox commented that the technology is proprietary and dominated by a single motor manufacturer. Lennox added that industry competition is adversely affected as a result. (Lennox, No. 47 at p. 6) AHRI and Lennox noted that furnace fan manufacturers already have difficulties securing an adequate supply, so mandating ECM use would impact product availability. (Lennox, No. 47 at p. 8; AHRI, No. 48 at p. 2) AHRI and Mortex stated that no alternative ECM exists at the scale of Regal Beloit ECMs and that limiting PSC applicability would reduce product flexibility. (AHRI, No. 48 at p. 2; Mortex, No. 43 at p. 129) Both Goodman and Ingersoll Rand do not expect that a technology with better or equivalent performance to brushless permanent magnet motors will be available at a reasonable cost in the next decade. (Goodman, No. 50 at p. 2; Ingersoll Rand, No. 57 at pp. A-2)

Regal Beloit disagreed with residential furnace fan manufacturers, claiming that there is more than just a single motor manufacturer offering ECM technology. (Regal Beloit, No. 43 at p. 130) NMC concurred with Regal Beloit, stating that it too sells brushless permanent magnet motors in high volumes to furnace fan manufacturers. (NMC, No. 60 at p. 2) NMC supported DOE’s assumption that after implementation of furnace fan efficiency standards, brushless permanent magnet motor technologies will become increasingly available over time. (NMC, No. 60 at p. 2) Ingersoll Rand confirmed that brushless DC motors are an ECM alternative available from several suppliers, although prices vary. (Ingersoll Rand, No. 57 at pp. A-2) Although Rheem commented that they have applied brushless DC motors produced by more than just a single vendor, their current designs and production processes have been developed to be specifically paired with Regal Beloit products. (Rheem, No. 54 at p. 7) DOE discovered during interviews with manufacturers that there are multiple suppliers of BPM motors. DOE also found further evidence that some manufacturers purchase BPM motors from multiple suppliers. EEI stated that the expiration of Regal Beloit ECM patents around 2020 may increase the availability of this motor type while decreasing cost. (EEI, No. 43 at p. 127)

In the preliminary analysis, DOE requested comment as to whether manufacturers could alternatively develop BPM motor controls in-house when using high-efficiency motors from other, non-Regal Beloit, suppliers. Currently, Regal Beloit offers BPM motors packaged with controls. Manufacturers may buy BPM motors that are not pre-packaged with controls from a supplier other than Regal Beloit, and develop their own controls. DOE anticipated that if furnace fan manufacturers had the ability to develop controls independently of Regal Beloit, this might drive down costs as well as dependency on a single manufacturer.

Most furnace fan manufacturers claimed that development of in-house controls for BPM motors is not an option. For example, Rheem uses General Electric and Regal Beloit software tools to program motors and does not currently have the capability to design motor controls without this tool. (Rheem, No. 54 at p. 6) Lennox and Morrison noted that having to design, build, and test motor controls would increase burden for large manufacturers and be prohibitively expensive to small manufacturers, neither of which have the expertise to develop these type of complex controls internally. (Lennox, No. 47 at p. 6; Morrison, No. 58 at p. 2) Lennox was also fearful that ECM suppliers might find motor control development an attempt to develop a replacement product and cut ties with furnace fan manufacturers. (Lennox, No. 47 at p. 7)

NMC confirmed that many U.S. motor suppliers bring in equipment from a fan manufacturer and develop unique ECM controls tailored to the manufacturer. (NMC, No. 43 at p. 128)

While DOE recognizes that Regal Beloit possesses a number of patents in the BPM motor space, other motor manufacturers (*e.g.*, Broad Ocean or NMC) also offer BPM models. Additionally, DOE is aware that in years past, residential furnace fans paired with constant-airflow BPM motors accounted for 30 percent of the market. While DOE estimates that constant-airflow BPM motors represent only 10-15 percent of the current furnace fan market, the manufacturing capability to meet BPM motor demand exists. Thus, DOE has tentatively concluded that BPM motor technology is currently available from more than one source and will become increasingly available to residential furnace fan manufacturers.

Some fan manufacturers expressed concern that high-efficiency motor reliance on rare earth metals would impact supply. However, DOE is aware of high-efficiency motors that do not contain rare earth materials. DOE is also confident, after manufacturer discussions, that if BPM motors are adopted as a means to meet a future residential furnace fan energy conservation standard, manufacturers would have a number of cost- and performance-competitive suppliers from which to choose who have available, or could rapidly develop, control systems independently of the motor manufacturer.

b. Backward-Inclined Impellers

According to Rheem, backward-inclined impellers must have larger diameter and operate at higher speed than forward-curve impellors in order to attain equivalent performance (*i.e.*, flow and pressure rise). (Rheem, No. 54 at p. 7) Goodman asserted that a 40-50 percent increase in diameter would be necessary for backward-inclined impellers to outperform their forward-curved counterparts. (Goodman, No. 50 at p. 2) According to AHRI, an impeller diameter increase would lead to an increase in overall product size, a change which may not be possible without redesigning the product. (AHRI, No. 48 p. 2) Morrison and Rheem argued that the larger evaporator coil size required to meet higher SEER requirements already limits the space available for furnaces, so an increase in product size due to backward-inclined impellers would severely restrict product application. (Morrison, No. 58 at p. 3; Rheem, No. 54 at p.7) Ingersoll Rand stated that when used with backward-inclined impellers, motors typically operate at twice the RPM of forward-curved impellers for the same air delivery and static pressure. (Ingersoll Rand, No. 57 at pp. A-3) However, ebm-papst stated that they retrofitted existing equipment with backward-curved impellers, which only required making minor changes to the airflow path within the equipment. Ebm-papst also stated that it tested the retrofitted products, which achieved reductions of input power to the furnace fan in the range of 15-30 percent, depending on the specific equipment and the external static pressure (typically tested at 0.5 in.w.c. and 1.0 in.w.c.). (ebm-papst, No. 52 at p. 1)

AHRI and Rheem were also concerned with the potential impacts that backward-inclined impellers could have on heat exchanger temperatures. AHRI and Rheem stated that the air distribution out of a blower housing with a forward-curved wheel is maximum at the outside edges of the wheel and decreases at the center of the wheel. The air distribution out of a blower housing with a backward-inclined wheel is maximum at the center of the wheel and tapers off at the outside edges. The modified air distribution out of the blower housing would require assessment of heat exchanger temperatures for reliability and safety, as temperature limits operation. (AHRI, No. 48 at p. 2; Rheem, No. 54 at p. 8)

Some commenters also argued that backward-inclined impellers may affect furnace fan utility, because the noise produced by this impeller type may limit product application. Utilities have claimed that a backward-inclined impeller, in combination with increased fan motor speeds to achieve higher efficiency, leads to amplified noise levels. (EEI, No. 60 at p. 3; SCE, No. 43 at p. 59) However, during its testing of HVAC products retrofitted with a backward-inclined impeller, ebm-papst expressed a contrary view, observing that noise levels produced by the backward-inclined impeller were not significantly different from forward-curved impellers. (ebm-papst Inc., No. 52 at p. 1)

DOE finds that there are multiple approaches to implementing backward-inclined impellers to reduce furnace fan energy consumption. DOE recognizes that one approach is to use a backward-inclined impeller that is larger than a standard forward-curved impeller, which may lead to larger HVAC products. Another approach is to pair the backward-inclined impeller with a motor that operates at increased RPM. Ebm-papst tests show a significant potential to reduce fan electrical energy consumption for a backward-inclined impeller assembly that uses existing motor technology at higher RPMs and is implemented in existing HVAC products (*i.e.*, no increase in product size required). Ebm-papst does not believe that achieving higher RPMs with existing motor technology is an obstacle for implementing this technology. DOE believes that this prototype represents a backward-inclined implementation approach that could achieve fan energy savings while avoiding the negative impacts listed by manufacturers. Consequently, DOE decided not to screen out the backward-inclined impeller technology option.

C. Engineering Analysis

In the engineering analysis (corresponding to chapter 5 of the NOPR TSD), DOE establishes the relationship between the manufacturer selling price (MSP) and improved residential furnace 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 efficiency of various efficiency-improving design changes to the baseline to model different levels of efficiency. The efficiency-level approach uses estimates of cost and efficiency at discrete levels of efficiency from publicly-available information, and information gathered in manufacturer interviews that is supplemented and verified through technology reviews. The reverse engineering approach involves testing products for efficiency and determining cost from a detailed bill of materials derived from reverse engineering representative products. The efficiency values range from that of a least-efficient furnace fan sold today (*i.e.*, the baseline) to the maximum technologically feasible efficiency level. For each efficiency level examined, DOE determines the MSP; this relationship is referred to as a cost-efficiency curve.

1. Efficiency Levels

In this rulemaking, DOE used an efficiency-level approach in conjunction with a design-option approach to identify incremental improvements in efficiency for each product class. An efficiency-level approach enabled DOE to identify incremental improvements in efficiency for efficiency-improving technologies that furnace fan manufacturers already incorporate in commercially-available models. A design-option approach enabled DOE to model incremental improvements in efficiency for technologies that are not commercially available in residential furnace fan applications. In combination with these approaches, DOE used a cost-assessment approach to determine the manufacturing production cost (MPC) at each efficiency level identified for analysis. This methodology estimates the incremental cost of increasing product efficiency. When analyzing the cost of each efficiency level, the MPC is not for the entire HVAC product, because furnace fans are a component of the HVAC product in which they are integrated. The MPC includes costs only for the components of the HVAC product that impact FER.

a. Baseline

During the preliminary analysis, DOE selected baseline units typical of the least-efficient furnace fans used in commercially-available, residential HVAC models that have a large number of annual shipments. This sets the starting point for analyzing potential technologies that provide energy efficiency improvements. Additional details on the selection of baseline units may be found in chapter 5 of the NOPR TSD. DOE compared the FER at higher energy efficiency levels to the FER of the baseline unit and compared baseline MPCs to the MPCs at higher efficiency levels.

DOE reviewed FER values that it calculated using test data and performance information from publicly-available product literature to determine baseline FER ratings.
Table IV.4 presents the baseline FER values identified in the preliminary analysis for each product class.

Table IV.4: Preliminary Analysis Baseline FER

Product Class	FER (W/1000 cfm)
Non-Weatherized, Non-condensing Gas Furnace Fan	380
Non-Weatherized, Condensing Gas Furnace Fan	393
Weatherized, Non-Condensing Gas Furnace Fan	333
Non-Weatherized, Non-Condensing Oil Furnace Fan	333
Electric Furnace / Modular Blower Fan	312
Manufactured Home Non-weatherized, Non-condensing Gas Furnace Fan	295
Manufactured Home Non-weatherized, Condensing Gas Furnace Fan	319
Manufactured Home Electric Furnace / Modular Blower Fan	243

Manufacturers asserted that the baseline FER values presented in the preliminary analysis were not representative of the furnace fans in the least-efficient residential HVAC models offered for sale today. Specifically, manufacturers stated that non-weatherized, non-condensing gas furnaces should be assigned a baseline FER of 451 instead of 380 and that non-weatherized, condensing gas furnaces should have an FER of 494 rather than 393. (AHRI, No. 48 at p. 5; Morrison, No. 58 at p. 6; Goodman, No. 50 at p. 5) Rheem also doubted that the difference in efficiency between non-condensing and condensing gas furnaces was only 13 points, a FER of 380 versus 393, as presented in the DOE's preliminary analysis. (Rheem, No. 43 at p. 96) Mortex calculated that their manufactured home, non-weatherized, non-condensing gas furnace had an FER of 420, not 295 as suggested by the DOE. Mortex also stated that published data used to calculate FER values were generated using ASHRAE Standard 103, not AMCA Standard 210, and that calculating FER based on published data may not be the best approach. (Mortex, No. 59 at p. 3; Mortex, No. 43 at p. 25) In contrast, Ingersoll Rand stated that the baseline FER presented in the preliminary analysis was consistent with the figures presented in AHRI Standard 210/240. (Ingersoll Rand, No. 57 at pp. A-7) Unico emphasized that the DOE should consider the broad range of designs fitting the "baseline" definition, lest the selected FER only be achievable by one manufacturer's design. (Unico, No. 43 at p. 79) Mortex disagreed with the DOE's key product approach, arguing that the selected product classes will have huge variation in efficiency (*i.e.*, baseline FER). (Mortex, No. 43 at p. 50) Manufacturers also provided additional baseline FER estimates during manufacturer interviews.

Some manufacturers also requested that DOE alter FER to better reflect unit capacity. Goodman suggested that DOE should consider using only one metric for all furnace fan capacities falling within the residential range (< 130 kBtuh) after making adjustments to the metric to include higher capacity units. (Goodman, No. 50 at p. 2) Alternatively, Mortex recommended that DOE should set maximum FER values for sub-product classes based on cooling capacity and cabinet size. (Mortex, No. 59 at p. 3) Similarly, AHRI stated that residential furnace fans having a 5-ton capacity also have higher FERs and recommended that DOE adjust baseline FER values to include the largest-capacity fan within a product class.

(AHRI, No. 48 at p. 2) Rheem calculated FER for 19 models of gas-fired furnaces that used the same blower housing design, and it found that FER was generally not dependent on capacity. A graphic summary of Rheem's results are available in the written comment that Rheem submitted.[26] (Rheem, No. 54 at p. 5).

DOE evaluated the feedback it received and used the data provided by interested parties to generate new FER values and to revise its baseline, intermediate efficiency levels, and max-tech FER estimates. DOE's revisions included FER results for furnace fan models that span the capacity range of residential products. After reviewing all of the available FER values based on new data, DOE concluded that FER can best be represented as a linear function of airflow capacity (*i.e.*, a first constant added to airflow multiplied by a second constant). The slope characterizes the change in FER for each unit of airflow capacity increase, and the y-intercept represents where the FER line intersects the y-axis (where airflow capacity is theoretically zero). DOE proposes to use such linear functions to represent FER for the different efficiency levels of the different product classes. A more detailed description of the analysis and the methodology DOE used to generate FER equations for each efficiency level can be found in chapter 5 of the NOPR TSD.

Table IV.5 shows the revised FER baseline efficiency levels estimates that DOE used for the NOPR.

Table IV.5: NOPR Baseline FER Estimates

Product Class	**FER*** **(W/1000 cfm)**

[26] Publically available at: http://www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0011-0054.

Non-Weatherized, Non-condensing Gas Furnace Fan	FER = 0.057 x Q_{Max} + 362
Non-Weatherized, Condensing Gas Furnace Fan	FER = 0.057 x Q_{Max} + 395
Weatherized Non-Condensing Gas Furnace Fan	FER = 0.057 x Q_{Max} + 271
Non-Weatherized, Non-Condensing Oil Furnace Fan	FER = 0.057 x Q_{Max} + 336
Electric Furnace / Modular Blower Fan	FER = 0.057 x Q_{Max} + 331
Manufactured Home Non-weatherized, Non-condensing Gas Furnace Fan	FER = 0.057 x Q_{Max} + 271
Manufactured Home Non-weatherized, Condensing Gas Furnace Fan	FER = 0.057 x Q_{Max} + 293
Manufactured Home Electric Furnace / Modular Blower Fan	FER = 0.057 x Q_{Max} + 211
Manufactured Home Weatherized Gas Furnace Fan	Reserved
Manufactured Home Non-Weatherized Oil Furnace Fan	Reserved

*Q_{Max} is the airflow, in cfm, at the maximum airflow-control setting measured using the proposed DOE test procedure. 78 FR 19606, 19627 (April 2, 2013).

b. Percent Reduction in FER

For the preliminary analysis, DOE determined average FER reductions for each efficiency level for a subset of key product classes and applied these reductions to all product classes. DOE found from manufacturer feedback and its review of publically-available product literature that manufacturers use similar furnace fan components and follow a similar technology path to improving efficiency across all product classes. DOE does not expect the percent reduction in FER associated with each design option, whether commercially available or prototype, to differ across product classes as a result. Table IV.6 includes DOE's preliminary analysis estimates for the percent reduction in FER from baseline for each efficiency level.

Table IV.6: Preliminary Analysis Estimates for Percent Reduction in FER from Baseline for Each Efficiency Level

Efficiency Level (EL)	**Design Option**	**Percent Reduction in FER from Baseline**
1	Improved PSC	2%
2	Inverter-Driven PSC	10%

3	Constant-Torque BPM Motor	45%
4	Constant-Airflow BPM Motor + Multi-Staging	59%
5	Premium Constant-Airflow BPM Motor + Multi-Staging + Backward-Inclined Impeller	63%*

*DOE estimates that implementing a backward-inclined impeller at EL 5 results in a 10% reduction in FER from EL 4. This is equivalent to a reduction of 4% percent of the baseline FER. The total percent reduction in FER from baseline for EL 5 includes the 59% reduction from EL 4 and the 4% net reduction of the backward-inclined impeller for a total percent reduction of 63% from baseline.

Interested parties questioned DOE's estimates for the FER reduction for high-efficiency motors. NMC commented that the company offers a special high-efficiency PSC motor line called PEP® that can achieve 10 points of efficiency improvement over standard PSC motors rather than 1.6-percent improvement shown in the preliminary analysis. (NMC, No. 60 at p. 1) Other interested parties provided similar estimates for improved PSC motors during manufacturer interviews. Unico noted that the high-efficiency BPM motor technology options in the Engineering Analysis (constant-torque or constant-air-flow BPM) do not improve fan efficiency as much as DOE's percent reduction in FER estimates suggest. (Unico, No. 43 at p. 109) Lennox suggested that a more accurate estimate of reduction in FER resulting from PSC to X13 motor conversions would be 30 percent as opposed to the 45 percent presented in the preliminary analysis. (Lennox, No. 47 at p. 2) Goodman provided a reference to a report from Advanced Energy of North Carolina[27] that stated that replacing PSC motors with full-ECM motors results in a 51-percent reduction in full-load efficiency. (Goodman, No. 50 at p. 3) Goodman would expect that the reduction in FER for X13 and ECM conversions be lower than

[27] Fitzpatrick and Murray, Residential HVAC Electronically Commutated Motor Retrofit Report (2012) (Available at: http://www.advancedenergy.org/ci/services/testing/files/Residential%20HVAC%20Electronically%20Commutated%20Motor%20Retrofit%20Final%20Report.pdf).

presented in the preliminary analysis such as 35-50 percent for X13s and 45-50 percent for ECM. (Goodman, No. 50 at p. 5)

DOE reviewed its estimates of percent reduction in FER from baseline for each efficiency level based on interested party feedback. In addition to the comments presented above, interested parties also provided FER values for higher-efficiency products in manufacturer interviews. DOE used these data to revise its percent reduction estimates. Table IV.7 shows DOE's revised estimates for the percent reduction in FER for each efficiency level that DOE used in the NOPR analyses. For a given product class, DOE applied the percent reductions below to both the slope and y-intercept of the baseline FER equation to generate FER equations to represent each efficiency level above baseline.

Table IV.7: NOPR Estimates for Percent Reduction in FER from Baseline for Each Efficiency Level

Efficiency Level (EL)	**Design Option**	**Percent Reduction in FER from Baseline**
1	Improved PSC	10%
2	Inverter-Driven PSC	25%
3	Constant-Torque BPM Motor	42%
4	Constant-Torque BPM Motor and Multi-Staging	50%
5	Constant-Airflow BPM Motor and Multi-Staging	53%
6	Premium Constant-Airflow BPM Motor and Multi-Staging + Backward-Inclined Impeller	57%*

*DOE estimates that implementing a backward-inclined impeller at EL 6 results in a 10% reduction in FER from EL 5. This is equivalent to a 4% percent reduction in FER from baseline. The total percent reduction in FER from baseline for EL 6 includes the 53% reduction from EL 5 and the 4% net reduction from the backward-inclined impeller for a total percent reduction of 57% from baseline.

DOE believes that these revised estimates are consistent with the comments received from interested parties. Note that EL 4 in the table above is a newly proposed efficiency level. As discussed in section IV.A.3, DOE analyzed multi-staging as a separate technology option. For the NOPR, DOE also has evaluated a separate efficiency level representing applying multi-staging to a furnace fans with a constant-torque BPM motor. DOE recognizes that the percent reduction in FER for inverter-driven PSC increased considerably. However, since the baseline FER values increased for the NOPR, DOE believes that the percent reductions cannot directly be compared to those proposed in the preliminary analysis. DOE notes that the cited reductions may not appear to be fully consistent with stakeholder comments in part because they are FER reductions rather than reductions in full-load electrical efficiency. DOE expects that FER reductions may be significantly higher than full-load input power reductions, especially for efficiency levels based on use of BPM motors, because FER includes electrical energy consumption at reduced operating modes, for which these motors achieve much greater power reduction than PSC designs.

2. Manufacturer Production Cost (MPC)

In the preliminary analysis, DOE estimated the manufacturer production cost associated with each efficiency level to characterize the cost-efficiency relationship of improving furnace fan performance. The MPC estimates are not for the entire HVAC product because furnace fans are a component of the HVAC product in which they are integrated. The MPC estimates includes costs only for the components of the HVAC product that impact FER, which DOE considered to be the:

- Fan motor and integrated controls;
- Primary control board (PCB);
- Multi-staging components;
- Impeller;
- Fan housing; and
- Components used to direct or guide airflow.

DOE separated the proposed product classes into high-volume and low-volume product classes and generated high-volume and low-volume MPC estimates to account for the increased purchasing power of high-volume manufacturers.[28]

a. Production Volume Impacts on MPC

Morrison stated that DOE's assumption that large manufacturers have the same purchasing power across product types, even when those products are low volume, may or may not be true, because low-volume products may run through different processes. (Morrison, No. 43 at p. 118) Rheem stated that, in some cases, it uses the same blower system in low-volume products that it uses in high-volume products. (Rheem, No. 43 at p. 118) Unico commented that it uses different manufacturing processes than those presented in DOE's analysis and recommended that a different metric should be used to evaluate technologies that differ by process. (Unico, No. 43 at p. 122) Mortex stated that the motor costs for smaller manufacturers can be 15-20 percent greater than for large manufacturers because they do not, as stated by NEMA, benefit from economies of scale. (Mortex, No. 59 at p. 3; NEMA, No. 43 at p. 113)

[28] High-volume and low-volume product classes are discussed further in chapter 5 of the NOPR TSD.

DOE recognizes that high-volume manufacturers may use different processes to manufacture low-volume products than to manufacture high-volume products. However, DOE finds that 94 percent of the MPC for furnace fans is attributed to materials (including purchased parts like fan motors), which are not impacted by process differences. DOE's estimates also already account for process differences between manufacturers for high-volume and low-volume products. The products that DOE evaluated to support calculation of MPC included furnace fans from various manufacturers, including both high-volume and low-volume models. Observed process differences are reflected in the bills of materials for those products. DOE agrees with Mortex that low-volume manufacturers experience higher costs for materials, such as motors. DOE believes that its approach to distinguish between high-volume and low-volume product classes accounts for the expected difference in MPC between high-volume and low-volume product classes.[29]

b. Inverter-Driven PSC Costs

In the preliminary analysis, DOE estimated that the MPC of inverter control for a PSC motor is $10-$12, depending on production volume. Ingersoll Rand stated that an inverter cannot be added to a PSC for only $10-$12. (Ingersoll Rand, No. 57 at pp. A-7) NMC also questioned the validity of the inverter controller cost estimate, stating that the cost of an inverter driven controller is significantly higher than $12, unless DOE is erroneously equating inverters to wave chopper technology, which is far less efficient. (NMC, No. 60 at p. 1)

[29] High-volume and low-volume product classes are discussed further in chapter 5 of the NOPR TSD.

DOE's preliminary analysis estimate for the MPC of an inverter-driven PSC was indeed based on a wave chopper drive. DOE finds that more sophisticated and costly inverters are required to achieve the efficiencies reflected in DOE's analysis. Consequently, DOE has adjusted its cost estimate for PSC inverter technology. DOE gathered more information about the cost of inverters that are suited for improving furnace fan efficiency. In addition to receiving cost estimates during manufacturer interviews, DOE also reviewed its cost estimates for inverter drives used in other residential applications, such as clothes washers. DOE finds that $30 for high-volume products and $42.29 for low-volume products are better estimates of the MPC for inverters used to drive PSC furnace fan motors. Accordingly, DOE has updated these values for the NOPR.

c. Furnace Fan Motor MPC

Manufacturers stated that DOE underestimated the incremental MPC to implement high-efficiency motors in HVAC products, other than oil furnaces. (Rheem, No. 54 at p. 10) Most manufacturers stated that the cost increase to switch from PSCs to more-efficient motor technologies was at least twice that of the DOE's estimate. (Lennox, No. 43 at p. 23, 113 and No. 47 at p. 1; Mortex, No. 43 at p. 25; Rheem, No. 43 at p. 112; Goodman, No. 50 at p. 3) AHRI and Morrison claimed incremental costs associated with an X13 motor should be $60, instead of the $22.73 reported by DOE and in the case of ECMs, $133 instead of the $91.95 reported by DOE. (AHRI, No. 48 at p. 6; Morrison, No. 58 at p. 6) Nidec, a motor manufacturer, commented that DOE should directly contact motor suppliers to confirm motor prices. (NMC, No. 43 at p. 112) Regal Beloit requested DOE review its assumption on motor horsepower range to explain why Rheem and other manufacturers claim their motors cost twice what is shown in DOE's preliminary analysis. (Regal Beloit, No. 52 at p. 242) DOE received additional feedback regarding its estimated motor prices during NOPR-phase manufacturer interviews.

Based upon the input received from interested parties, DOE adjusted its motor cost estimates. In general, DOE increased its estimates by approximately 10 to 15 percent, which is consistent with the feedback DOE received. Details regarding DOE's revised motor MPC estimates are provided in chapter 5 of the NOPR TSD.

d. Motor Control Costs

In the preliminary analysis, DOE estimated that the MPC of the primary control board (PCB) increases with each conversion to a more-efficient motor type (*i.e.*, from PSC to constant-torque BPM motor and from constant-torque to constant-airflow BPM motor). Both Lennox and Goodman confirmed that higher-efficiency motors require more sophisticated and costly controls. These manufacturers stated that control costs for an X13 motor application increase from 50-100 percent, as compared to controls for PSC motors. (Lennox, No. 47 at p. 8; Goodman, No. 50 at p. 2) Rheem stated that the controls of one of its modulating furnace models that uses a variable speed furnace fan are costly, although no quantified estimate was provided. (Rheem, No. 54 at p. 7) Rheem also responded that Regal Beloit's Evergreen[30] motors, which are designed as replacements for PSCs, may be used with the same primary controls developed for the original PSC motor.[31] (Rheem, No. 54 at p. 7) Ingersoll Rand stated

[30] Evergreen is a constant-airflow BPM motor that is meant to be installed as an on-site replacement of outdated PSC motors.
[31] The constant-airflow BPM motors that DOE analyzed for EL 5 and EL 6 cannot be used with the same primary controls for a PSC motor. See chapter 3 and chapter 5 of the NOPR TSD.

that boards supporting modulating motors and communication are the most costly. (Ingersoll Rand, No. 57 at pp. A-2) DOE also received feedback regarding the cost of the PCBs associated with each motor type during manufacturer interviews. In general, manufacturers commented that the PCBs used with constant-torque BPM motors are more costly. However, other manufacturer interview participants stated that the MPC of the PCB used with these motors should be equivalent or even less expensive than the PCBs used with PSC motors.

DOE agrees with interested parties that the MPC of the PCB needed for a constant-airflow BPM motor is higher than for the PCB paired with a PSC motor. DOE maintained this assumption for the NOPR. DOE estimates that the MPC of a PCB paired with a constant-airflow BPM motor is roughly twice as much as for a PCB paired with a constant-torque BPM motor or PSC. DOE also agrees with the interested parties that stated that the MPC for a PCB paired with a constant-torque BPM motor is equivalent to that of a PCB needed for a PSC motor. DOE revised its analysis to reflect this assumption in the NOPR as a result.

e. Backward-Inclined Impeller MPC

Interested parties commented that DOE's preliminary analysis estimate for the incremental MPC associated with implementing a backward-inclined impeller, in combination with a premium constant-airflow BPM motor and multi-staging, is too low. (AHRI, No. 48 at p. 2; Ingersoll Rand, No. 57 at p. 2) Morrison and AHRI commented that tighter tolerances and increased impeller diameter lead to increased material costs, as well as increased costs associated with motor mount structure and reverse forming fabrication processes. (AHRI, No. 48 at p. 3; Morrison, No. 43 at p. 120) Rheem and Morrison stated that the dimensional clearance for a backward-inclined impeller would be 0.04-0.05 inches instead of 0.24-0.5 for a forward-curved impeller. (Rheem, No. 54 at p. 8; Morrison, No. 58 at p. 3) This increase in product size and tolerance could lead to increased production costs. Ingersoll Rand, Morrison, and Rheem all cited increased material, assembly controls, reverse forming processes, and the strengthening of motor mounting systems (necessary at increased motor speeds) as potential costs associated with backward-inclined impellers. (Ingersoll Rand, No. 57 at pp. A-3; Morrison, No. 58 at p. 4; Rheem, No. 54 at p. 8)

DOE reviewed its manufacturer production cost estimates for the backward-inclined impeller technology option based on interested party comments. During manufacturer interviews, some manufacturers reiterated or echoed that DOE's estimated MPC for backward-inclined impellers is too low, but they did not provide quantification of the total MPC of backward-inclined impellers or the incremental MPC associated with the changes needed to implement them. Other manufacturers did quantify the MPC of backward-inclined impeller solutions and their estimates were consistent with DOE's preliminary analysis estimate. Consequently, DOE did not modify its preliminary analysis estimated MPC for backward-inclined impellers.

D. Markups Analysis

DOE uses manufacturer-to-consumer markups to convert the manufacturer selling price estimates from the engineering analysis to consumer prices, which are then used in the LCC and PBP analysis and in the manufacturer impact analysis. Before developing markups, DOE defines key market participants and identifies distribution channels. Generally, the furnace distribution chain (which is relevant to the residential furnace fan distribution chain) includes distributors, dealers, general contractors, mechanical contractors, installers, and builders. For the markups analysis, DOE combined mechanical contractors, dealers, and installers in a single category labeled "mechanical contractors," because these terms are used interchangeably by the industry. Because builders serve the same function in the HVAC market as general contractors, DOE included builders in the "general contractors" category.

In the preliminary analysis, DOE used the same distribution channels for furnace fans as it used for furnaces in the recent energy conservation standards rulemaking for those products. 76 FR 37408, 37464 (June 27, 2011). DOE believes that this is an appropriate approach, because the vast majority of the furnace fans covered in this rulemaking is a component of a furnace. Manufactured housing furnace fans in new construction have a separate distribution channel in which the furnace (and fan) go directly from the furnace manufacturer to the producer of manufactured homes.

In the preliminary analysis, DOE requested comment on whether the market for replacement fans is large enough to merit a separate distribution channel, and, if so, what would be an appropriate assumption for its market share. Goodman expressed their belief that there is no market for replacing and/or upgrading only the furnace fan component of the furnace. (Goodman, No. 50 at p. 3) Goodman and AHRI commented that they are opposed to field replacements and retrofits of motors and blowers because such practices could have product safety implications. (Goodman, No. 50 at p. 3; AHRI, No. 48 at p. 4) In contrast, Nidec recommended that DOE should consider a distribution channel for replacing furnace fans in already installed equipment. (Nidec, No. 60 at pp. 2-3)

DOE has tentatively concluded that there is insufficient evidence of a replacement market for furnace fans.

DOE develops baseline and incremental markups to transform the manufacturer selling price into a consumer product price. DOE uses the baseline markups, which cover all of a distributor's or contractor's costs, to determine the sales price of baseline models. Incremental markups are separate coefficients that DOE applies to reflect the incremental cost of higher-efficiency models.

AHRI and Morrison voiced concerns with DOE's approach to incremental markups. (AHRI, No. 48 at p. 6; Morrison, No. 58, at p. 7) These commenters stated that while the concept of profits constrained to the long-run cost of capital is a basic tenet of microeconomics, it has not been validated empirically and that there are enough exceptions and alternative concepts to question the use of that concept in a normative manner. AHRI also stated that DOE's basic theoretical framework requires that the relevant industry must be highly competitive, and AHRI believes that there are reasons to question this assumption in the context of residential furnace fans. Goodman concurred with the concerns noted by AHRI in regards to the markups analysis. (Goodman, No. 50 at p. 5)

DOE acknowledges that detailed information on actual distributor and contractor practices would be helpful in evaluating their markups on furnaces. However, DOE finds it implausible that profit per unit would increase in the medium and long run if the cost of goods sold increases due to efficiency standards. Thus, in the absence of evidence to the contrary, DOE continues to assume that markups would decline slightly, leaving profit unchanged, and, thus, it uses lower markups on incremental costs of higher-efficiency products. Regarding the competitiveness of the HVAC distribution industry and the HVAC contractor industry, DOE does not have any empirical measures of competitiveness, but its impression, based on experience with these industries, is that there is sufficient competition to validate DOE's assumptions with respect to the difficulty of distributors and contractors increasing profits as a result of standards.

AHRI and Morrison disagreed with DOE's prediction that margins should be going up over time as equipment prices decrease. (AHRI, No. 48 at p. 6; Morrison, No. 58, at p. 7) DOE did not project a decrease in furnace fan prices in the preliminary analysis, and the markups are assumed to remain the same over time.

Lennox believes that DOE's claim that incremental costs will be discounted on markups through the distribution chain by approximately 50 percent understates the amount of increased costs that manufacturers will seek to pass through to consumers. (Lennox, No. 47 at p. 1) DOE does not apply a separate markup on the incremental manufacturer selling price. DOE assumes that manufacturers will be able to pass on the full incremental costs of higher-efficiency furnace fans.

Morrison stated that the markups analysis does not accurately calculate the costs for installers/contractors. Morrison noted that with increase in efficiency standards, there will be added labor and an associated cost to assure the buyer of the efficiency gains; the added labor of installation and commissioning is not included in the markups analysis, and, thus, the final markup is too small. (Morrison, No. 58, at p. 6) In response, the labor for installation and commissioning, including specific costs for higher-efficiency furnace fans, is included in the LCC and PBP analysis, as DOE assumes that this cost is not part of the consumer cost of the furnace itself.

E. Energy Use Analysis

The purpose of the energy use analysis is to determine the annual energy consumption of residential furnace fans in representative U.S. homes and to assess the energy savings potential of increased furnace fan efficiency. In general, DOE estimated the annual energy consumption of furnace fans at specified energy efficiency levels across a range of climate zones. The annual energy consumption includes the electricity use by the fan, as well as the change in natural gas, liquid petroleum gas (LPG), electricity, or oil use for heat production as result of the change in the amount of useful heat provided to the conditioned space as a result of the furnace fan. The annual energy consumption of furnace fans is used in subsequent analyses, including the LCC and PBP analysis and the national impact analysis.

DOE used the existing DOE test procedures for furnaces and air conditioners to estimate heating and cooling mode operating hours for the furnace fan. The power consumption of the furnace fan is determined using the individual sample housing unit operating conditions (the pressure and airflow) at which a particular furnace fan will operate when performing heating, cooling, and constant-circulation functions. The methodology and the data are fully described in chapter 7 of the NOPR TSD.

DOE used the Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS)[32] to establish a sample of households using furnace fans for each furnace fan product class. RECS data provide information on the age of furnaces with furnace fans, as well as heating and cooling energy use in each household. The survey also includes household characteristics such as the physical characteristics of housing units, household demographics, information about other heating and cooling products, fuels used, energy consumption and expenditures, and other relevant data. DOE uses the household samples not only to determine furnace fan annual energy consumption, but also as the basis for conducting the LCC and PBP analysis.

For the NOPR, DOE used RECS 2009[33] heating and cooling energy use data to determine heating and cooling operating hours. DOE used data from RECS 2009, American Housing Survey (AHS) 2011,[34] and the Census Bureau[35] to project household weights in 2019, which is the anticipated compliance date of any new energy efficiency standard for residential furnace fans. These adjustments account for housing market changes since 2009, as well as for projected product and demographic changes.

[32] Energy Information Administration, 2009 Residential Energy Consumption Survey (Available at: http://www.eia.doe.gov/emeu/recs).
[33] See http://www.eia.gov/consumption/residential/data/2009/.
[34] See http://www.census.gov/housing/ahs/data/national.html.
[35] See http://www.census.gov/popest/.

The power consumption (and overall efficiency) of a furnace fan depends on the speed at which the motor operates, the external static pressure difference across the fan, and the airflow through the fan. To calculate furnace fan electricity consumption, DOE determined the operating conditions (the pressure and airflow) at which a particular furnace fan will operate in each RECS housing unit when performing heating, cooling, and constant-circulation functions.

DOE gathered field data from available studies and research reports to determine an appropriate distribution of external static pressure (ESP) values. DOE compiled over 1,300 field ESP measurements from several studies that included furnace fans in single-family and manufactured homes in different regions of the country. The average ESP value in the cooling operating mode from these studies results in an average 0.65 in. wc for single-family households and 0.30 in. wc for manufactured homes.

DOE determined furnace fan operating hours in heating mode by calculating the furnace burner operating hours and adjusting them for delay times between burner and fan operation. Burner operating hours are a function of annual house heating load, furnace efficiency, and furnace input capacity.

EEI stated that DOE should take into consideration the impact of more-stringent building energy codes when estimating energy use baselines and projected energy savings. (EEI, No. 65 at p. 4) In response, DOE's analysis accounts for the likelihood that, compared to recently-built homes in the RECS sample, new homes in the year of compliance will have both a lower heating load per square foot and more square footage using the building shell efficiency index from AEO 2012.

In the preliminary analysis, to estimate use of constant circulation in the sample homes, DOE evaluated the available studies, which include a 2010 survey in Minnesota[36] and a 2003 Wisconsin field monitoring of residential furnaces.[37] DOE did not use these data directly, however, because it believes they are not representative of consumer practices for the U.S. as a whole. In these northern States, many homes have low air infiltration, and there is a high awareness of indoor air quality issues, which could lead to significant use of constant circulation. To develop appropriate assumptions for other regions, DOE modified the data from these States using information from manufacturer product literature (which suggests very little use in humid climates) and consideration of climate conditions in other regions.

Several parties stated that DOE overestimated the use of constant-circulation mode, thereby overcounting the energy savings from higher-efficiency furnace fans. AHRI commented that continuous circulation is used significantly less than estimated in DOE's technical support document. In particular, AHRI pointed out that DOE's estimate of constant-circulation hours is based on surveys taken in only two States -- Wisconsin and Minnesota -- where there is high occurrence of indoor air quality issues that make use of the continuous fan feature more likely. To overcome this perceived deficiency, AHRI recommended a study of constant-circulation hours in areas of the country that do not have high occurrences of indoor air quality issues, leading to an allocation that is more representative of behavior in the U.S. (AHRI, No. 48 at p.

[36] Provided in CEE, No. 22 at pp. 1-2.
[37] Pigg, S., "Electricity Use by New Furnaces: A Wisconsin Field Study" (October 2003) (Available at http://www.doa.state.wi.us/docview.asp?docid=1812).

4) Ingersoll Rand also stated that Wisconsin is not a good representation of the full national population, noting that DOE partially acknowledges this by assuming that the North is different from the South in terms of the use of constant circulation. (Ingersoll Rand Residential Solutions, No. 57, at p. 8) Goodman concurred that the values proposed for constant-circulation hours are unrealistically high. Based on Goodman's experience, the commenter stated that a more typical value for the percentage of U.S. households that use the fan in constant-circulation mode would likely be in the low single digits. (Goodman, No. 50 at p. 3) Morrison also stated that allocation of a large percentage of furnace fan time in the circulatory mode (21 percent of total time) is excessive. (Morrison, No. 58, at p. 7)

In contrast, CA IOUs stated that constant-circulation mode on the air handler is a primary means for mechanical ventilation of homes. CA IOUs argued that as States increasingly adopt building codes that call for more airtight building envelopes, the need for mechanical ventilation increases as natural ventilation decreases. Based upon this reasoning, CA IOUs stated that 400 hours per year in constant-circulation mode (approximately the average that DOE estimated for non-weatherized gas furnace fans) would be a conservative estimate. (CA IOU's, No. 56, at p. 3) NEEA stated that based on recent trends in ventilation and in the sales of filtration systems, there is a substantial increase in the use of constant circulation, especially in new home construction. (Transcript, No. 43 at p. 193)

DOE acknowledges that it would be desirable to have additional data on the use of constant circulation in other parts of the country, but DOE was not able to conduct a study as suggested by AHRI for the NOPR analysis, nor did any commenter provide such data. DOE concurs with the CA IOUs that the use of constant circulation may increase in new homes. For the NOPR, DOE used the same assumptions for use of constant circulation as it did in the preliminary analysis, which are also used in the proposed DOE test procedure for furnace fans. 77 FR 28674 (May 15, 2012). The shares of homes using the various constant-circulation modes are presented in Table IV.8. However, DOE also performed a sensitivity analysis to estimate the effect on the LCC results if it assumed half as much use of constant circulation. These results are discussed in section V.B.1 of this notice.

Table IV.8 Constant-Circulation Proposed Test Procedure Assumptions Used for NOPR Analysis

Constant-Circulation Fan Use	Assumed Average Number of Hours	Estimated Share of Homes in North and South-Hot Dry Regions	Estimated Share of Homes in South-Hot Humid Region
No constant fan	0	84%	97%
Year-round	7290	7%	1%
During heating season	1097	2%	0.4%
During cooling season	541	2%	0.4%
Other (some constant fan)	365	5%	1%
Total	--	100%	100%

Commenting on the preliminary analysis, EEI stated that DOE should balance fan energy savings with the potential for additional fuel use of the HVAC product. (EEI, No. 65 at p. 3) With improved fan efficiency, there may be less heat from the motor, which means that the heating system needs to operate more and the cooling system needs to operate less. In response, DOE did account for the effect of improved furnace fan efficiency on the heating and cooling load of the sample homes. Goodman noted that DOE's assumptions are technically correct with regard to the effect on heating or cooling requirements from the change in fan energy consumption, and the adjustments appear to be appropriate. (Goodman, No. 50 at p. 4)

In the preliminary analysis, DOE recognized that the energy savings in cooling mode from higher-efficiency furnace fans used in some higher-efficiency CAC and heat pumps was already accounted for in the analysis related to the energy conservation standards for those products. To avoid double-counting, the analysis for furnace fans does not include furnace fan electricity savings that were counted in DOE's analysis for CAC and heat pump products.

AHRI and Morrison commented that the LCC analysis includes furnace fan operating hours and furnace fan power operation in the cooling mode in the total energy consumption calculation. AHRI and Morrison noted that regulated metrics such as SEER and Heating Seasonal Performance Factor (HSPF) already address fan energy consumption in air conditioners and heat pumps respectively. (AHRI, No. 48 at p. 6; Morrison, No. 58, at p. 8) Morrison commented that including this energy savings for this standard would result in the savings being counted under two regulatory standards. Mortex commented that: (1) the electricity used to circulate air in the summer is already being accounted for as part of the SEER metric for central air conditioners and heat pumps; (2) in the winter, the E_{AE} metric for furnaces accounts for all electricity being used, including by the furnace fan; and (3) for heat pumps, the electricity used to circulate air is accounted for in the winter heating mode by the HSPF metric. (Mortex, No. 59, at pp. 1-2) Ingersoll Rand stated that heating and cooling should not be combined, as it does not accurately portray the cooling performance for all possible capacities and duplicates the furnace fan inclusion in the SEER determination. (Ingersoll Rand Residential Solutions, No. 57, at p. 1)

The standards for CAC and heat pump products that will be effective in 2015 do not require a furnace with BPM motor-driven fan. However, DOE's rulemaking analysis for CAC and heat pump products included savings from those households purchasing a CAC or heat pump at SEER 15 or above, that would need to have an BPM motor-driven fan in their furnace to achieve that efficiency level. The base-case efficiency distribution of fans used in the current analysis includes the presence of those BMP motor-driven fans in homes with the higher-efficiency CAC or heat pumps. Because the energy savings from the considered fan efficiency levels are measured relative to the base-case efficiencies, any savings reported here for furnace fans are over and above those counted in the CAC and heat pump rulemaking.

Recognizing the possibility of consumers using higher-efficiency furnace fans more than baseline furnace fans, DOE included a rebound effect in its preliminary analysis. DOE used a 2009 program evaluation report from Wisconsin[38] to estimate the extent to which increased use of constant circulation under a standard requiring ECM furnace fans is likely to cancel out some of the savings from such a fan.

Commenters presented differing views on the likelihood of a rebound effect for furnace fans. Rheem believes that the Wisconsin study is reasonable in its estimate of the fraction of

[38] State of Wisconsin, Public Service Commission of Wisconsin, Focus on Energy Evaluation Semiannual Report, Final (April 8, 2009) (Available at: http://www.focusonenergy.com/files/document_management_system/evaluation/emcfurnaceimpactassessment_evaluationreport.pdf).

households that may switch to continuous circulation use under a standard requiring ECM furnace fans. (Rheem, No. 54, at p. 13) Goodman does not believe there has been a significant shift in terms of increased usage of continuous fan with customers that have an ECM product versus an X13 product versus a PSC product. (Goodman, No. 50 at p. 4) Ingersoll Rand commented that if there were any comfort basis for the use of continuous fan mode, more use might lead to a lower heating set-point and a higher cooling set-point, offsetting the added energy consumption for continuous fan. Ingersoll Rand commented that the rebound effect, if it exists, is uncertain in direction and magnitude and should be deleted from the analysis. (Ingersoll Rand Residential Solutions, No. 57, at p. 8)

DOE acknowledges that the magnitude of a rebound effect for furnace fans across the country is uncertain. However, because there is some evidence for the existence of a rebound effect, DOE prefers to include such an effect rather than risk overstating the energy savings from higher-efficiency furnace fans. The specific assumptions are described in chapter 7 of the NOPR TSD.

F. Life-Cycle Cost and Payback Period Analysis

In determining whether an energy conservation standard is economically justified, DOE considers the economic impact of potential standards on consumers. 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:

- Life-cycle cost (LCC) is the total consumer cost of an appliance or product, generally over the life of the appliance or product. The LCC calculation includes total installed cost (equipment manufacturer selling price, distribution chain markups, sales tax and installation cost), operating costs (energy, repair, and maintenance costs), equipment lifetime, and discount rate. Future operating costs are discounted to the time of purchase and summed over the lifetime of the product.
- Payback period (PBP) measures the amount of time it takes consumers to recover the assumed higher purchase price of a more energy-efficient product through reduced operating costs. Inputs to the payback period calculation include the installed cost to the consumer and first-year operating costs.

DOE analyzed the net effect of potential residential furnace fan standards on consumers by calculating the LCC and PBP for each efficiency level for each sample household. DOE performed the LCC and PBP analyses using a spreadsheet model combined with Crystal Ball (a commercially-available software program used to conduct stochastic analysis using Monte Carlo simulation and probability distributions) to account for uncertainty and variability among the input variables (*e.g.*, energy prices, installation costs, and repair and maintenance costs). It uses weighting factors to account for distributions of shipments to different building types and States to generate LCC savings by efficiency level. Each Monte Carlo simulation consists of 10,000 LCC and PBP calculations. The model performs each calculation using input values that are either sampled from probability distributions and household samples or characterized with single-point values. The analytical results include a distribution of points showing the range of LCC savings and PBPs for a given efficiency level relative to the base-case efficiency forecast.

The results of DOE's LCC and PBP analysis are summarized in section IV.F and described in detail in chapter 8 of the NOPR TSD.

1. Installed Cost

The installed cost at each efficiency level is based on the MSP, distribution chain markups, sales tax, and installation cost.

In the preliminary analysis, DOE found that the historic real (i.e., adjusted for inflation) producer price index (PPI) for integral horsepower electric motors has been relatively flat except for the last few years, and elected to use prices held constant at the 2011 level as the default price assumption to project future motor (and furnace fan) prices. Goodman commented that specifically looking at fractional motor (*i.e.*, the type used in furnace fans) instead of integral horsepower motors would provide a better comparison for furnace fans, and that prices of such motors will not remain flat, but will continue to grow in the trend from the last five years. (Goodman, No. 50 at p. 5)

For the NOPR, DOE evaluated the historic real PPI of fractional horsepower electric motors instead of integral horsepower electric motors. DOE found that this index has been decreasing except for the last few years, when it started to increase. Given the uncertainty about whether the recent trend will continue or instead revert to the historical mean, for the NOPR, DOE elected to continue using constant prices at the most recent level as the default price assumption to project future prices of furnace fans. Appendix 10-C of the NOPR TSD describes the historic PPI data.

In the preliminary analysis, DOE assumed that a fraction of ECM furnace fan installations will require up to an hour of extra labor. Goodman commented that based on its experience, at least two hours of extra labor will be required in the majority of ECM furnace fan installations. It notes this is particularly true in light of the fact that many regulatory authorities, such as California Energy Commission via Title 24, are requiring more verification of proper airflow, which may be more challenging with advanced technologies such as ECM motors. (Goodman, No. 50 at p. 5)

For the NOPR, DOE modified its approach and assumed that up to two hours of extra labor will be required for all ECM furnace fan installations. Details of the updated approach are available in chapter 8 of the NOPR TSD.

2. Operating Costs

In the preliminary analysis, DOE used the same maintenance costs for furnace fans at different efficiency levels. To estimate rates of fan motor failure, DOE developed a distribution of fan motor lifetime (expressed in operating hours) by motor size using data developed for DOE's small electric motors final rule (75 FR 10874 (March 9, 2010)).[39] DOE then paired these data with the calculated number of annual operating hours for each sample furnace, including constant circulation for some of the homes. Replacement motor costs were based on costs developed in the engineering analysis, and the labor time and costs were based on RS Means data.[40,41] DOE had no information indicating the extent to which consumers would replace a fan

[39] See: http://www1.eere.energy.gov/buildings/appliance_standards/commercial/sem_finalrule_tsd.html

[40] RS Means Company Inc., RS Means Residential Cost Data (2012).

PSC motor with an ECM, so it assumed that when replacement is necessary, consumers replace the failed motor with the same type of motor.

Nidec estimated that three percent of the motors operating the furnace fan fail each year. (Nidec, No. 60 at pp. 2-3) DOE agrees that the fan motor may fail and included motor replacement in the LCC and PBP analysis.

AHRI, Goodman, and Rheem commented that higher-efficiency motors have increased failure rates. AHRI and Rheem noted that the failure rate for a high-efficiency motor is typically higher than the failure rate of a PSC motor, because the electronics added to a high-efficiency motor introduce new failure modes associated with the life of electronic controls in damp, very cold, and very hot conditions. (AHRI, No. 48 at p. 6; Rheem, No. 54, at p. 14) Goodman commented that generally, more complex motors contain more components that can potentially break, which is true of the additional controls in X13 and ECM technologies. The commenter recommended that DOE estimate that service requirements will be 20 to 50 percent greater for higher-efficiency motors and related controls, and that the cost of such service will be more for X13 and ECM than for PSC motors. Goodman also suggested that DOE should use a reduced lifetime (by five to ten percent) for X13 and ECM furnace fan motors, as PSC motor technologies are very mature and X13 and ECM are relatively young. (Goodman, No. 50 at p. 6)

DOE agrees that the electronics of higher-efficiency motors are likely to have increased failure rates. For the NOPR, DOE included repair to electronics for PSC motors with controls, constant-torque BPM motors, and especially constant-airflow BPM motors. DOE added an extra

[41] RS Means Company Inc., Facilities Maintenance & Repair Cost Data (2012).

cost for the cases that require control updates for these efficiency levels. DOE also applied an additional labor hour to account for cases when it is necessary to replace the motors for the constant-torque BPM and constant-airflow BPM efficiency levels. See chapter 8 of the NOPR TSD for further details.

DOE did not have a firm basis for quantifying the degree to which constant-torque BPM motors and constant-airflow BPM motors have a shorter lifetime than PSC motors. Although DOE used the same motor lifetime for each fan efficiency level in terms of total operating hours, the lifetime in terms of years is lower for constant-torque BPM and constant-airflow BPM motors, because they are more frequently used in multi-stage heating mode. In addition, DOE included additional labor hours to repair constant-torque BPM and constant-airflow BPM motors, as well as higher equipment cost for the BPM motors. Thus, on average, consumers with constant-torque BPM motors or constant-airflow BPM motors have higher life-cycle repair costs.

Goodman commented that DOE excluded annual repair and maintenance costs from its payback analyses, and it believes those annualized costs should be included. (Goodman, No. 50 at p. 6) In response, DOE’s rulemaking analysis, and this NOPR, use a simple payback period, which does not account for changes in operating expense over time. This 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. Repair costs are generally most significant in the later years of a product’s lifetime. Thus, they are not necessarily relevant to the payback periods that consumers actually experience.

3. Other Inputs

DOE modeled furnace fan lifetime based on the distribution of furnace lifetimes developed for the recent energy conservation standards rulemaking for furnaces.[42] 76 FR 37408, 37476-77 (June 27, 2011). DOE used the same lifetime for furnace fans at different efficiency levels because there are no data that indicate variation of lifetime with efficiency. However, DOE modeled fan motor failure and replacement as a repair cost that affects a certain percentage of furnace fans, as discussed above. Ingersoll Rand commented that there should be no reason for an electric furnace to have a shorter lifetime than a fossil-fueled furnace. (Ingersoll Rand Residential Solutions, No. 57, at p. 9) For the NOPR analysis, DOE assumed that the lifetime for the fans installed in electric furnaces and gas furnaces is the same.

DOE used the same distribution of discount rates for furnace fans as it used in the recent energy conservation standards rulemaking for furnaces. For replacement furnaces, the average rate is 5.0 percent.

4. Base-Case Efficiency Distribution

To estimate the share of consumers that would be affected by an energy conservation standard at a particular efficiency level, DOE's LCC and PBP analysis considers the projected distribution (*i.e.*, market shares) of product efficiencies in the first compliance year under the base case (*i.e.*, the case without new or amended energy conservation standards). For the preliminary analysis, DOE found very limited data with which to estimate either current shares or recent trends. DOE requested comments on its estimate of the base-case efficiency

[42] Available at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/residential_furnaces_central_ac_hp_direct_final_rule_tsd.html.

distribution of furnace fans in 2019, as well as data that might support use of different assumptions.

Several parties commented that DOE's estimates of constant-torque BPM motor and constant-airflow BPM motor market growth seem overly optimistic. Ingersoll Rand commented that DOE overestimated the future market share of these motors. (Ingersoll Rand Residential Solutions, No. 57, at p. 2) Lennox stated that the preliminary TSD's market growth assumptions are overstated for both constant-torque and variable-speed (ECM) motors. Lennox believes other factors increased adoption of higher-efficiency products between 2009 and 2011, namely, that was the period when a $1,500 Federal tax credit was available for furnaces with an AFUE rate of 95 percent or more. (Lennox, No. 47 at p. 2) Morrison commented that the projections for ECM market penetration are based on information from 2010 that presents an overly positive picture for the growth absent incentives. It stated that the market share of ECM motors has fallen in 2012 and will likely remain around that level without additional incentives, although it noted that regional furnace and air conditioner standards would likely increase market penetration of ECM and X13 motors. (Morrison, No. 58 at p. 8) AHRI and Morrison conceded that DOE's regional standards for central air conditioners, heat pumps and furnaces may slightly increase the usage of ECM and X13 motors, but such an increase would still not match DOE's projected ECM market share. (AHRI, No. 48 at p. 4; Morrison, No. 58 at p. 8) Rheem presented a forecast from its procurement group that shows the share of variable-speed motors declining to the 20-25 percent range in 2012 and remaining at that level in 2013. (Rheem, No. 54, at p. 13) EEI stated that DOE should take into consideration the impact of tax incentives for the purchase of energy-efficient heating and cooling equipment when estimating energy use baselines and projected energy savings. (EEI, No. 65 at p. 4) AHRI included a chart showing a declining trend in the usage of ECM and X13 motors after the expiration of the Federal tax credits. (AHRI, No. 48 at p. 4)

AHRI commented that current trends suggest that the ECM and X13 market shares will be 25-30 percent and 10-15 percent respectively by 2019, assuming there are no further tax credit incentives in coming years. (AHRI, No. 48 at p. 4) Goodman commented that DOE's assumed market shares for X13 and ECM fans are significantly higher than Goodman's estimates, and that recent values are probably skewed as a result of Federal tax credits. Goodman estimates that about 70 percent of shipments in 2019 are expected to be PSC, and ECM motors are likely to be twice the volume of X13 motors (*i.e.*, 20 percent ECM and 10 percent X13). (Goodman, No. 50 at p. 4)

For the NOPR, DOE reviewed the information provided by the manufacturers and modified its estimate of market shares in 2019. The NOPR analysis assumes that the combined market share of constant-torque BPM fans and constant-airflow BPM fans will be 35 percent in 2019. The shares are 13 percent for constant-torque BPM fans and 22 percent for constant-airflow BPM fans. DOE estimated separate shares for replacement and new home applications.

The market shares of efficiency levels within the constant-torque BPM motor and constant-airflow BPM motor categories were derived from AHRI data on number of models.[43] No such data were available for the PSC fan efficiency levels, so DOE used the number of

[43] DOE used the AHRI Directory of Certified Furnace Equipment (Available at: http://www.ahridirectory.org/ahridirectory/pages/home.aspx) as well as manufacturer product literature.

models it tested or could measure using product literature to estimate that 40 percent of shipments are at the baseline level and 60 percent are improved PSC fans. There are currently no models of PSC with a controls design, so DOE assumed zero market share for such units. The details of DOE's approach are described in chapter 8 of the NOPR TSD.

5. Rebuttable Presumption Payback Period

As discussed in section III.E.2, EPCA provides that a rebuttable presumption is established 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. (42 U.S.C. 6295(o)(2)(B)(i)) The calculation of this so-called rebuttable presumption payback period uses the same inputs as the calculation of the regular PBP for each sample household, but it uses average values instead of distributions, and the derivation of energy consumption and savings only uses the parameters specified by the proposed DOE test procedure for furnace fans rather than the method applied in the energy use analysis (described in section IV.E), which considers the characteristics of each sample household.

DOE's LCC and PBP analyses generate values that calculate the payback period for consumers of potential energy conservation standards, which includes, but is not limited to, the three-year payback period contemplated under the rebuttable presumption test discussed above. However, DOE routinely conducts a full economic analysis that considers the full range of impacts, including those to the consumer, manufacturer, Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this 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).

G. Shipments Analysis

DOE uses forecasts of product shipments to calculate the national impacts of standards on energy use, NPV, and future manufacturer cash flows. DOE develops shipment projections based on historical data and an analysis of key market drivers for each product.

The vast majority of furnace fans are shipped installed in furnaces, so DOE estimated furnace fan shipments by projecting furnace shipments in three market segments: (1) replacements; (2) new housing; and (3) new owners in buildings that did not previously have a central furnace.

To project furnace replacement shipments, DOE developed retirement functions for furnaces from the lifetime estimates and applied them to the existing products in the housing stock. The existing stock of products is tracked by vintage and developed from historical shipments data. The shipments analysis uses a distribution of furnace lifetimes to estimate furnace replacement shipments.

To project shipments to the new housing market, DOE utilized projected new housing construction and historic saturation rates of various furnace and cooling product types in new housing. DOE used AEO 2012 for projections of new housing. Furnace saturation rates in new housing are provided by the U.S. Census Bureau's Characteristics of New Housing.[44]

DOE also included a small market segment consisting of households that become "new owners" of a gas furnace. This segment consists of households that have central air conditioning and non-central heating or central air conditioning and electric heating and choose to install a gas furnace.

Several parties stated that DOE's shipments estimates appear to be too high. (AHRI, No. 48 at p. 5; Goodman, No. 50 at p. 6; Rheem, No. 54, at p. 15; Ingersoll Rand Residential Solutions, No. 57, at p. 2; Morrison, No. 58 at p. 6) Goodman stated that DOE projects growth from approximately 3 million units in 2011 to more than 4 million in 2020, whereas Goodman estimates about 3.7 million units in 2020, or less if new energy conservation standards affect sales. (Goodman, No. 50 at p. 6) AHRI, Morrison, and Rheem stated that prior to 2006, the demand for large homes with multiple furnace systems was more common than it is today, and it is not clear that the demand for homes with multiple furnace systems can be projected into the future. These commenters also argued that the shipment projections do not show an echo effect loss in replacement sales for the drop in furnace sales in 2009-2013. (AHRI, No. 48 at p. 5; Morrison, No. 58 at p. 6; Rheem, No. 54 at p. 15) EEI stated that DOE's projected shipments of furnace fans do not appear consistent with other estimates of furnace shipments that EEI has observed. (EEI, No. 65 at p. 4) Lennox noted that DOE has projected significant market growth starting in 2012 and continuing forward, which does not appear to be supported by recent sales figures. (Lennox, No. 47 at p. 2)

[44] Available at: http://www.census.gov/const/www/charindex.html.

For the NOPR, DOE utilized more recent historical shipments data for gas-fired and oil-fired furnaces, which show a decline in 2012. DOE also reviewed and modified its projection of furnace shipments. The new projection (depicted in chapter 9 of the NOPR TSD) shows a lower level of replacement shipments in the 2025-30 period, which is a consequence (i.e., an echo) of the decline in historical shipments in 2007-2009. The NOPR projection for 2020 shows total shipments of 3.7 million, which is the same as the 3.7 million estimated by Goodman.

Regarding the comment from AHRI, Morrison, and Rheem, DOE's methodology does not presume that past demand for homes with multiple furnace systems will continue in the future. However, it does assume that furnaces installed in the past will be replaced, so the installation of multiple furnaces in the past would contribute to future growth in shipments.

In the preliminary analysis, DOE considered whether standards that require more-efficient furnace fans would have an impact on furnace shipments. Lennox stated that an overly-stringent standard for furnace fans would bring further increased costs to consumers, beyond the added product cost from tightened AFUE standards for furnaces, venting and drainage for condensing furnaces (required in northern States by regional standards), and standby mode and off mode power regulations. Lennox stated that higher purchase prices cause consumers to defer purchases, repair existing furnaces, and/or find less-efficient, higher-polluting alternate sources of heat. (Lennox, No. 47 at p. 3) Goodman commented that it would expect reduction in furnace sales after implementation of a new furnace fan standard, since many consumers will choose to repair instead of replacing products currently in their home, thereby avoiding the need to pay the initial cost of a more expensive, higher-efficiency product. (Goodman, No. 50 at p. 6) Morrison also commented that higher upfront costs could lead to consumer switching to less-efficient products and push consumers to repair rather than replace units. (Morrison, No. 58, at p. 9)

DOE agrees that it is reasonable to expect that energy conservation standards for residential furnace fans that result in higher furnace prices would have some dampening effect on sales. Some consumers might choose to repair their existing furnace rather than purchase a new one, or perhaps install an alternative space heating product. To estimate the impact on shipments of the price increase for the considered efficiency levels, DOE used the relative price elasticity approach that was applied in the 2011 furnace standards rulemaking.[45] 76 FR 37408, 37483 (June 27, 2011). This approach also gives some weight to the operating cost savings from higher-efficiency products. Chapter 9 in the NOPR TSD describes the method applied.

H. National Impact Analysis

The NIA assesses the NES and the NPV from a national perspective of total consumer costs and savings expected to result from new or amended energy conservation standards at specific efficiency levels. DOE determined the NPV and NES for the potential standard levels considered for the furnace fan product classes analyzed. To make the analysis more accessible and transparent to all interested parties, DOE prepared a computer spreadsheet that uses typical values (as opposed to probability distributions) as inputs. To assess the effect of input uncertainty on NES and NPV results, DOE has developed its spreadsheet model to conduct sensitivity analyses by running scenarios on specific input variables.

[45] Available at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/residential_furnaces_central_ac_hp_direct_final_rule_tsd.html.

Analyzing impacts of potential energy conservation standards for residential furnace fans requires comparing projections of U.S. energy consumption with new or amended energy conservation standards against projections of energy consumption without the standards. The forecasts include projections of annual appliance shipments, the annual energy consumption of new appliances, and the purchase price of new appliances.

A key component of DOE's NIA analysis is the energy efficiencies projected over time for the base case (without new standards) and each of the standards cases. The projected efficiencies represent the annual shipment-weighted energy efficiency of the products under consideration during the shipments projection period (*i.e.*, from the assumed compliance date of a new standard to 30 years after compliance is required).

In the preliminary analysis, DOE derived a growth rate in the market share of ECM fans by extrapolating the trend from 2005, when the ECM share was 10 percent, to 2010, when it was approximately 30 percent. In so doing, DOE considered the favorable cost-effectiveness of ECM fans and assumed that their market share would peak and level off at 79 percent.

AHRI and Rheem stated that DOE's assumption that the market share for furnace fans with ECM technology will increase to 75 percent is not supported by the industry data, especially since the Federal residential tax credits have expired. (AHRI, No. 48 at p 5; Rheem, No. 54, at p. 15) Goodman also stated that a 75 percent peak market penetration of ECM motors as estimated by DOE seems high. Goodman estimates a value in the range of 40-50 percent by mid-century. (Goodman, No. 50 at p. 4)

For the NOPR, DOE reviewed the information provided by the manufacturers and modified its estimate of the long-run trend in market shares of constant-torque BPM and constant-airflow BPM motor furnace fans. The NOPR analysis assumes a long-run trend that results in market share of the constant-torque BPM and constant-airflow BPM furnace fans reaching 45 percent in 2048.

For the preliminary analysis, DOE used a “roll up” scenario for estimating the impacts of the potential energy conservation standards for residential furnace fans. Under the “roll-up” scenario, DOE assumes: (1) product efficiencies in the base case that do not meet the standard level under consideration would “roll-up” to meet the new standard level; and (2) product efficiencies above the standard level under consideration would not be affected. To be consistent with the assumption regarding base-case efficiency after the compliance year, DOE assumed that for each standards case, the efficiency distribution in each product class remains unchanged after 2019. DOE used the same approach for the NOPR.

1. National Energy Savings Analysis

The national energy savings analysis involves a comparison of national energy consumption of the considered products in each potential standards case (TSL) with consumption in the base 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). Vintage represents the age of the product. DOE calculated annual NES based on the difference in national energy consumption for the base case (without new efficiency standards) and for each higher efficiency standard. DOE estimated energy consumption and savings based on site energy and converted the electricity consumption and savings to primary energy using annual conversion factors derived from the AEO 2012 version of the NEMS. Cumulative energy savings are the sum of the NES for each year over the timeframe of the analysis.

DOE has historically presented NES in terms of primary energy savings. 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 Science, 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). While DOE stated in that notice that it intended to use the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model to conduct the analysis, it also said it would review alternative methods, including the use of EIA's National Energy Modeling System (NEMS). After evaluating both models and the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in the Federal Register in which DOE explained its determination that NEMS is a more appropriate tool for this specific use. 77 FR 49701 (August 17, 2012). Therefore, DOE is using NEMS model to conduct FFC analyses.

Goodman questioned the introduction of FFC measures of energy use. It noted that, under 42 U.S.C. 6291(4), "energy use" is defined as "the quantity of energy directly consumed by a consumer product at point of use…" (Goodman, No. 50 at p. 4)

The definition of "energy use" cited by Goodman is intended to apply at the product level. This is apparent from the complete definition: "The term 'energy use' means the quantity of energy directly consumed by a consumer product at point of use, determined in accordance with test procedures under section 6293 of this title." (42 U.S.C. 6291(4)) The law also 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)) The term "energy" means electricity or fossil fuels. (42 U.S.C. 6291(3)) The FFC metric provides a more complete accounting of the fossil fuels saved by standards, and its use is in keeping with DOE's statutory authority. The approach used to derive FFC multipliers for today's NOPR is described in appendix 10-B of the NOPR TSD. DOE requests comment on the FCC multipliers and the assumptions made to derive the multipliers.

2. Net Present Value Analysis

The inputs for determining NPV are: (1) total annual installed cost; (2) total annual savings in operating costs; (3) a discount factor to calculate the present value of costs and savings; (4) present value of costs; and (5) present value of savings. DOE calculated net savings each year as the difference between the base case and each standards case in terms of total savings in operating costs versus total increases in installed costs. DOE calculated savings over the lifetime of products shipped in the forecast period. DOE calculated NPV as the difference between the present value of operating cost savings and the present value of total installed costs. DOE used a discount factor based on real discount rates of 3 and 7 percent to discount future costs and savings to present values.

For the NPV analysis, DOE calculates increases in total installed costs as the difference in total installed cost between the base case and standards case (*i.e.*, once the standards take effect).

DOE assumed no change in residential furnace fan prices over the 2019−2048 period. In addition, DOE conducted a sensitivity analysis using alternative price trends, specifically one in which prices decline over time, and another in which prices rise. These price trends are described in appendix 10-C of the NOPR TSD.

DOE expresses savings in operating costs as decreases associated with the lower energy consumption of products bought in the standards case compared to the base efficiency case. Total savings in operating costs are the product of savings per unit and the number of units of each vintage that survive in a given year.

DOE estimates 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.[46] The NPV results for the residential furnace fan TSLs are presented in section V.B.3 of this notice.

I. Consumer Subgroup Analysis

In the NOPR stage of a rulemaking, DOE conducts a consumer subgroup analysis. A consumer subgroup comprises a subset of the population that may be affected disproportionately by new or revised energy conservation standards (*e.g.*, low-income consumers, seniors). The purpose of a subgroup analysis is to determine the extent of any such disproportional impacts.

For today's NOPR, DOE evaluated impacts of potential standards on two subgroups: (1) senior-only households and (2) low-income households. DOE identified these households in the RECS sample and used the LCC spreadsheet model to estimate the impacts of the considered efficiency levels on these subgroups. The consumer subgroup results for the residential furnace fan TSLs are presented in section V.B.1 of this notice.

J. Manufacturer Impact Analysis

1. Overview

DOE performed an MIA to estimate the financial impact of new energy conservation standards on manufacturers of residential furnace fans and to calculate the potential impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects. The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model with inputs specific to this rulemaking. The key GRIM inputs are data on the industry cost structure, product costs,

[46] OMB Circular A-4 (Sept. 17, 2003), section E, "Identifying and Measuring Benefits and Costs."

shipments, and assumptions about markups and conversion expenditures. The key output is the industry net present value (INPV). Different sets of assumptions (markup scenarios) will produce different results. The qualitative part of the MIA addresses factors such as product characteristics, impacts on particular subgroups of firms, and important market and product trends. The complete MIA is outlined in chapter 12 of the NOPR TSD.

For this rulemaking, DOE considers the "furnace fan industry" to consist of manufacturers who assemble furnace fans as a component of the HVAC products addressed in this rulemaking.

DOE conducted the MIA for this rulemaking in three phases. In Phase 1 of the MIA, DOE prepared a profile of the residential furnace fans industry that includes a top-down cost analysis of manufacturers used to derive preliminary financial inputs for the GRIM (e.g., sales, general, and administration (SG&A) expenses; research and development (R&D) expenses; and tax rates). DOE used public sources of information, including company SEC 10-K filings,[47] corporate annual reports, the U.S. Census Bureau's Economic Census,[48] and Hoover's reports.[49]

In Phase 2 of the MIA, DOE prepared an industry cash-flow analysis to quantify the potential impacts of a new energy conservation standard. In general, energy conservation standards can affect manufacturer cash flow in three distinct ways: (1) create a need for

[47] U.S. Securities and Exchange Commission, Annual 10-K Reports (Various Years) (Available at: http://sec.gov).
[48] U.S.Census Bureau, Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries (Available at: http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t).
[49] Hoovers Inc. Company Profiles (Various Companies) (Available at: http://www.hoovers.com).

increased investment; (2) raise production costs per unit; and (3) alter revenue due to higher per-unit prices and possible changes in sales volumes.

In Phase 3 of the MIA, DOE conducted structured, detailed interviews with a representative cross-section of manufacturers. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM and to identify key issues or concerns. See section IV.J.4 for a description of the key issues manufacturers raised during the interviews.

Additionally, in Phase 3, DOE evaluated subgroups of manufacturers that may be disproportionately impacted by new standards or that may not be accurately represented by the average cost assumptions used to develop the industry cash-flow analysis. For example, small manufacturers, niche players, or manufacturers exhibiting a cost structure that largely differs from the industry average could be more negatively affected. DOE identified one subgroup (*i.e.*, small manufacturers) for a separate impact analysis.

DOE applied the small business size standards published by the Small Business Administration (SBA) to determine whether a company is considered a small business. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. To be categorized as a small business under North American Industry Classification System (NAICS) code 333415, "Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing," a residential furnace fan manufacturer and its affiliates may employ a maximum of 750 employees.

The 750-employee threshold includes all employees in a business's parent company and any other subsidiaries. Based on this classification, DOE identified at least 14 residential furnace fan manufacturers that qualify as small businesses. The residential furnace fan small manufacturer subgroup is discussed in chapter 12 of the NOPR TSD and in section V.B.2.d of this notice.

2. Government Regulatory Impact Model

DOE uses the GRIM to quantify the changes in cash flow due to new standards that result in a higher or lower industry value. The GRIM analysis uses a standard, annual cash-flow analysis that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. The GRIM models changes in costs, distribution of shipments, investments, and manufacturer margins that could result from new energy conservation standards. The GRIM spreadsheet uses the inputs to arrive at a series of annual cash flows, beginning in 2013 (the base year of the analysis) and continuing to 2048. DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. For residential furnace fan manufacturers, DOE used a real discount rate of 7.8 percent, which was derived from industry financials and then modified according to feedback received during manufacturer interviews.

The GRIM calculates cash flows using standard accounting principles and compares changes in INPV between a base case and each standards case. The difference in INPV between the base case and a standards case represents the financial impact of the new energy conservation standard on manufacturers. As discussed previously, DOE collected this information on the critical GRIM inputs from a number of sources, including publicly-available data and interviews with a number of manufacturers (described in the next section). The GRIM results are shown in section V.B.2.a. Additional details about the GRIM, the discount rate, and other financial parameters can be found in chapter 12 of the NOPR TSD.

a. Government Regulatory Impact Model Key Inputs

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 changes in the MPCs of the analyzed products can affect the revenues, gross margins, and cash flow of the industry, making these product cost data key GRIM inputs for DOE's analysis.

In the MIA, DOE used the MPCs for each considered efficiency level calculated in the engineering analysis, as described in section IV.C and further detailed in chapter 5 of the NOPR TSD. In addition, DOE used information from its teardown analysis, described in chapter 5 of the TSD, to disaggregate the MPCs into material, labor, and overhead costs. To calculate the MPCs for equipment above the baseline, DOE added the incremental material, labor, and overhead costs from the engineering cost-efficiency curves to the baseline MPCs. These cost breakdowns and product markups were validated and revised with manufacturers during manufacturer interviews.

Shipments Forecast

The GRIM estimates manufacturer revenues based on total unit shipment forecasts and the distribution of these values by efficiency level. Changes in sales volumes and efficiency mix over time can significantly affect manufacturer finances. For this analysis, the GRIM uses the NIA's annual shipment forecasts derived from the shipments analysis from 2013 (the base year) to 2048 (the end year of the analysis period). See chapter 9 of the NOPR TSD for additional details.

For the standards-case shipment forecast, the GRIM uses the NIA standards-case shipment forecasts. DOE assumes a new efficiency distribution in the standards case, in which product efficiencies in the base case that did not meet the standard under consideration would "roll up" to meet the new standard in the year that compliance is required.

Product and Capital Conversion Costs

New energy conservation standards would cause manufacturers to incur one-time conversion costs to bring their production facilities and product designs into compliance. DOE evaluated the level of conversion-related expenditures that would be needed to comply with each considered efficiency level in each product class. For the MIA, DOE classified these conversion costs into two major groups: (1) product conversion costs; and (2) capital conversion costs. Product conversion costs are one-time investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with the new energy conservation standard. Capital conversion costs are one-time investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new product designs can be fabricated and assembled.

To evaluate the level of capital conversion expenditures manufacturers would likely incur to comply with new energy conservation standards, DOE used manufacturer interviews to gather data on the anticipated level of capital investment that would be required at each efficiency level. DOE validated manufacturer comments through estimates of capital expenditure requirements derived from the product teardown analysis and engineering analysis described in chapter 5 of the TSD.

DOE assessed the product conversion costs at each considered efficiency level by integrating data from quantitative and qualitative sources. DOE considered market-share-weighted feedback regarding the potential costs of each efficiency level from multiple manufacturers to determine conversion costs such as R&D expenditures and certification costs. Manufacturer data were aggregated to better reflect the industry as a whole and to protect confidential information.

In general, DOE assumes that all conversion-related investments occur between the year of publication of the final rule and the year by which manufacturers must comply with the new standard. The investment figures used in the GRIM can be found in section IV.J.2 of this notice. For additional information on the estimated product and capital conversion costs, see chapter 12 of the NOPR TSD.

b. Government Regulatory Impact Model Scenarios

Shipment Scenarios

In the NIA, DOE modeled shipments with a roll-up scenario to represent possible standards-case efficiency distributions for the years beginning 2019 (the year that compliance with new standards is proposed to be required) through 2048 (the end of the analysis period). The roll-up scenario represents the case in which all shipments in the base case that do not meet the new standard would roll up to meet the new standard level, with the efficiency of products already at the new standard level remaining unchanged. Consumers in the base case who purchase products above the standard level are not affected as they are assumed to continue to purchase the same product in the standards case. See chapter 9 of the NOPR TSD for more information.

Markup Scenarios

As discussed above, MSPs include direct manufacturing production costs (i.e., labor, materials, and overhead estimated in DOE's MPCs) and all non-production costs (i.e., SG&A, R&D, and interest), along with profit. To calculate the MSPs in the GRIM, DOE applied non-production cost markups to the MPCs estimated in the engineering analysis for each product class and efficiency level. Modifying these markups in the standards case yields different sets of impacts on manufacturers. For the MIA, DOE modeled two standards-case markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of new energy conservation standards: (1) a preservation of gross margin percentage markup scenario; and (2) a preservation of operating profit markup scenario. These scenarios lead to different markups values that, when applied to the inputted MPCs, result in varying revenue and cash flow impacts.

Under the preservation of gross margin percentage scenario, DOE applied a single uniform "gross margin percentage" markup across all efficiency levels, which assumes that manufacturers would be able to maintain the same amount of profit as a percentage of revenues at all efficiency levels within a product class. As production costs increase with efficiency, this scenario implies that the absolute dollar markup will increase as well. Based on publicly-available financial information for manufacturers of residential furnace fans and comments from manufacturer interviews, DOE assumed the non-production cost markup—which includes SG&A expenses, R&D expenses, interest, and profit—to be the following for each residential furnace fan product class:

Table IV.9: Manufacturer Markup by Residential Furnace Fan Product Class

Product Class	Markup
NWG-NC	1.30
NWG-C	1.31
WG-NC	1.27
NWO-NC	1.35
EF/MB	1.19
MH-NWG-NC	1.25
MH-NWG-C	1.25
MH-EF/MB	1.15

Because this markup scenario assumes that manufacturers would be able to maintain their gross margin percentage markups as production costs increase in response to a new energy conservation standard, it represents a high bound to industry profitability.

In the preservation of operating profit scenario, manufacturer markups are set so that operating profit one year after the compliance date of the new energy conservation standard is the same as in the base case. Under this scenario, as the costs of production increase under a standards case, manufacturers are generally required to reduce their markups to a level that maintains base-case operating profit. The implicit assumption behind this markup scenario is that the industry can only maintain its operating profit in absolute dollars after compliance with the new standard is required. Therefore, operating margin in percentage terms is squeezed (reduced) between the base case and standards case. DOE adjusted the manufacturer markups in the GRIM at each TSL to yield approximately the same earnings before interest and taxes in the standards case as in the base case. This markup scenario represents a low bound to industry profitability under a new energy conservation standard.

3. Discussion of Comments

During the preliminary analysis public meeting, interested parties commented on the assumptions and results of the preliminary analysis TSD. Oral and written comments addressed several topics, including testing and certification burdens, cumulative regulatory burdens, compliance date, impacts on small businesses, and conversion costs.

a. Testing and Certification Burdens

Manufacturers expressed concerns about the potential testing and certification burdens that may be associated with a new furnace fan energy conservation standard. Ingersoll Rand commented that the rulemaking would result in additional burden from testing, certification, and compliance, leading to an increased cost for consumers. (Ingersoll Rand, No. 57 at p. 2) Rheem stated that, in the past, there has been no requirement for manufacturers to test and report furnace airflow data according to any industry or governmental standard. In addition, Rheem added that there have been no certification requirements that require the testing of multiple samples. Therefore, Rheem concluded that it is not reasonable to assume that manufacturers already have the data available to rate hundreds of current furnace models. For companies like Rheem, which have a large number of basic models, the commenter lamented that compliance with new testing requirements would create a significant burden. (Rheem, No. 54 at p. 3) In order to relieve some of the testing burden, Mortex recommended that DOE should allow manufacturers to use Alternative Efficiency Determination Methods (AEDMs). (Mortex, No. 43 at p. 25) Mortex also recommended that DOE should use an alternative test procedure that is integrated with AFUE testing so that all models do not have to be tested separately under the residential furnace fan test procedure. (Mortex, No. 59 at p. 3) Manufacturers were also concerned that the time needed to certify all their products would reduce investment in innovative technologies, because fewer resources would be available for R&D. (Rheem, No. 54 at p. 16)

DOE recognizes the concerns that manufacturers have regarding test burden. As discussed in section III.A, DOE proposed in the April 2, 2013 test procedure SNOPR to adopt a modified version of an alternative test method recommended by AHRI and other furnace fan manufacturers that aligns the residential furnace fan test procedure with the DOE test procedure for residential furnaces to significantly reduce burden on industry. 78 FR 19606. DOE also estimated the capital expenditure, time to test, and cost to test according to the proposed residential furnace fan test procedure in the SNOPR. DOE found that the proposed test procedure would not result in significant capital expenditures for manufacturers, because they would not have to acquire or use any test equipment beyond the equipment already used to conduct the test method specified in the DOE residential furnace test procedure (i.e., the AFUE test setup). DOE also found that the time to conduct a single furnace fan test according to its proposed furnace fan test procedure would be less than 3 hours and cost less than one percent of the manufacturer selling price of the product into which the furnace fan is integrated. Consequently, DOE does not find that testing furnace fans according to this proposed test procedure would be unduly burdensome. Id. at 19619-21

b. Cumulative Regulatory Burden

Interested parties expressed concern over the cumulative regulatory burden that would result from a residential furnace fan energy conservation standard. Morrison commented that the energy conservation standards that already apply to residential HVAC products, in combination with a standard for furnace fans, would significantly increase manufacturer burden. (Morrison, No. 43 at p. 23) Both AHRI and Morrison stated that DOE's current estimation of the incremental cost of testing furnace fans (at less than 2 percent of the manufacturer selling price) does not account for the additional burden placed on furnace manufacturers that must now also certify standby mode and off mode energy consumption, along with AFUE. (AHRI, No. 48 at p.7; Morrison, No. 58 at p. 10) Furthermore, Morrison commented that several of the manufacturers who are impacted by this residential furnace fans rulemaking face even greater cumulative regulatory burden, because they also produce other products regulated by DOE. (Morrison, No. 58 at p. 10)

Instead of creating a set of residential furnace fan standards through a separate energy conservation rulemaking, manufacturers and efficiency experts advocated for combining all furnace-related standards into one rulemaking or to have only one metric for all furnace-related products. CA IOU recommended that DOE should, in future iterations of furnace-related standards, combine CAC/HP, furnaces, and furnace fans into a single rulemaking, given their interrelated performance and energy consumption. (CA IOU, No. 56 at p. 2) Morrison and Rheem were also concerned that the cost of certifying furnace fan efficiency ratings would increase upfront costs for consumers and therefore lead them to choose less-efficient products (*e.g.*, space heaters) or repair HVAC units instead of replacing them. (Morrison, No. 58 at p. 9; Rheem, No. 54 at p. 16) Furthermore, Morrison believes a single combined metric would prevent consumer confusion that can arise from having multiple metrics assigned to a single product, and Morrison opined that such approach would also reduce the regulatory burden imposed on manufacturers. (Morrison, No. 43 at p. 24)

DOE realizes that the cumulative effect of multiple regulations on an industry may significantly increase the burden faced by manufacturers that need to comply with regulations and testing requirements from different organizations and levels of government. DOE takes into account the cumulative cost of multiple regulations on manufacturers in the cumulative regulatory burden section of its analysis. Additionally, DOE considers the cumulative regulatory burden as part of its decision process in setting proposed standards. Further information on cumulative regulatory burden can be found in section V.B.2.e of this notice and in chapter 12 of the NOPR TSD.

c. Compliance Date and Implementation Period

Efficiency advocates expressed support for a compliance date sooner than five years after publication of the final rule, because it would result in additional energy savings. Earthjustice commented that EPCA does not mandate a lead time of five years for furnace fans because furnace fans are not listed in section 325(m) (42 U.S.C. 6295(m)(4)(A)(ii)) as a product to which a 5-year lead time applies. (Earthjustice, No. 49 at p. 2) In a joint comment (hereinafter referred to as the joint comment), the Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, National Consumer Law Center, Natural Resources Defense Council, and Northwest Energy Efficiency Alliance encouraged DOE to consider a compliance date three years after publication of the final rule. According to the joint commenters, a three-year lead time for manufacturers is feasible, because the efficiency levels that DOE evaluated for the preliminary analysis are based on technologies that are already widely employed in current HVAC products – namely ECM and X13 motors. (ACEEE, *et al.*, No. 55 at p. 3) NEEP also recommended a compliance date three years after publication of the final rule. (NEEP, No. 51 at p. 3)

However, according to Goodman, EPCA mandates a lead time of greater than five years. Goodman commented that EPCA prohibits a manufacturer from being forced to apply new standards to a product that has had other new standards applied to it within a 6-year period. (42 U.S.C. 6295(m)(4)(B)) Therefore, the earliest effective date for new energy conservation standards for residential furnace fans, pursuant to EPCA, would be January 1, 2021 because a new AFUE standard will become effective on May 1, 2013 and a new SEER/HSPF standard will become effective January 1, 2015. (Goodman, No. 50 at p. 8)

In response to these comments regarding the appropriate compliance date for residential furnace fan standards, DOE agrees with the joint commenters' observation that under 42 U.S.C.

6295(m)(4)(A)(ii), EPCA does not specify furnace fans as a product with a 5-year lead time. DOE does not agree with Goodman's interpretation of 42 U.S.C. 6295(m)(4) as prohibiting a compliance date prior to January 2021. DOE has tentatively concluded that 42 U.S.C. 6295(m)(4) is only applicable to amendments to existing standards, and residential furnace fans are covered products that have not been previously regulated. Furnace fans are explicitly addressed only at 42 U.S.C. 6295(f)(4)(D), which does not specify any compliance dates. Therefore, since EPCA does not mandate a specific lead time for furnace fans, DOE considered the actions required by manufacturers to comply with the proposed standard to determine an appropriate lead-time. During manufacturer interviews, DOE found that standards would result in manufacturers' extending R&D beyond the furnace fan assembly to understand the impacts on the design and performance of the furnace or modular blower in which the furnace fan is integrated. To comply with the proposed standard, manufacturers may have to alter not only the designs and fabrication processes for the furnace fan assembly, but also for the furnace or modular blower into which the furnace fan is integrated. Similar products that require similar actions for compliance typically have lead times of five years. For these reasons, DOE selected a 5-year compliance date.

d. Small Businesses

DOE received comments regarding its analysis of small businesses. Mortex formally requested that DOE prepare a regulatory flexibility analysis since it believes that DOE has not certified that the amendments in the test procedure proposed rule do not have a significant economic impact on a substantial number of small entities. (Mortex, No. 59 at p. 3) During the preliminary analysis public meeting, Unico asked whether small manufacturers will be included in DOE's cost-benefit analysis. (Unico, No. 43 at p. 56) However, Ingersoll Rand is concerned that DOE limits the manufacturer analysis to only small manufacturers. (Ingersoll Rand, No. 57 at p. 2)

For the manufacturer impact analysis, DOE determined the impact of a new standard on the entire residential furnace fans industry, including manufacturers of all sizes. However, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by new standards. For this rulemaking, DOE identified small businesses as a subgroup and discusses the impacts on this subgroup in the initial regulatory flexibility analysis, which can be found in section VI.B of today's notice. DOE's decision to prepare a regulatory flexibility analysis for the residential furnace fans standards rulemaking NOPR is separate from its decision to not prepare a regulatory flexibility analysis for the residential furnace fans test procedures NOPR. DOE did previously certify to SBA that its proposed test procedure for residential furnace fans would not have a significant economic impact on a substantial number of small entities.

e. Conversion Costs

Several manufacturers expressed concerned as to the capital conversion costs that may be associated with a new standard. Rheem stated that stringent standards may require significant capital conversion costs and that this is a key issue for the MIA. (Rheem, No. 54 at p. 16) Morrison expressed a similar concern, stating that manufacturers may incur significant capital conversion costs at "overly burdensome" regulation levels. (Morrison, No. 58 at p. 9)

DOE acknowledges manufacturers' concerns regarding capital conversion costs and carefully took this matter into account in developing its proposal. During manufacturer interviews, DOE requested information about potential conversion costs at each efficiency level for each product class. DOE evaluated the information gathered during the interviews, as well as data from the engineering analysis, to determine capital conversion costs. Conversion costs are discussed in detail in section V.B.2.a of today's notice and in chapter 12 of the TSD.

4. Manufacturer Interviews

DOE considers the manufacturer of the HVAC product in which the residential furnace fan is integrated to be the furnace fan manufacturer. DOE is aware that HVAC product manufacturers purchase many of the components in the furnace fan assembly (*e.g.*, the motor and impeller) from separate component manufacturers. However, the HVAC product manufacturer determines the design requirements, selects the purchased components based on these requirements, and performs the final assembly and integration of the fan assembly into the HVAC product. For these reasons, DOE considers the HVAC product manufacturer to be the furnace fan manufacturer. Accordingly, DOE interviewed manufacturers representing approximately 90 percent of residential gas furnace and central air conditioner sales, approximately 15 percent of residential oil furnace sales, [50] over 85 percent of electric furnace/modular blower sales, and approximately 90 percent of manufactured home furnace sales. These interviews were in addition to those DOE conducted as part of the engineering analysis. The information gathered during these interviews enabled DOE to tailor the GRIM to reflect the unique financial characteristics of the residential furnace fan industry. All interviews

[50] DOE did reach out to a number of residential oil-fired furnace manufacturers, but most declined to be interviewed. However, DOE notes that fan assemblies and the processes by which they are fabricated do not change significantly across furnace type.

provided information that DOE used to evaluate the impacts of potential new energy conservation standards on manufacturer cash flows, manufacturing capacities, and employment levels.

During the manufacturer interviews, DOE asked manufacturers to describe their major concerns about this rulemaking. The following sections describe the most significant issues identified by manufacturers. DOE also considered all other concerns expressed by manufacturers in its analyses. However, manufacturer interviews are conducted under non-disclosure agreements (NDAs), so DOE does not document these discussions in the same way that it does public comments in the comment summaries and DOE's responses throughout the rest of this notice.

a. Testing and Certification Burdens

All interviewed manufacturers expressed concerns about testing and certification burdens. In particular, manufacturers were concerned about the additional time required to test products for compliance with the new standard. Because the test procedure proposed in the May 15, 2012 furnace fan test procedure NOPR (77 FR 28674) is different from testing methods that are currently being used for residential furnaces, manufacturers argued that a significant amount of time would need to be invested. Some manufacturers suggested that the testing burden could be reduced if the testing for FER could be coordinated with testing for AFUE. In general, manufacturers were more concerned about the additional time and labor required to conduct the testing rather than the cost of testing equipment and stations, which were expected to be minimal.

As explained in section IV.K.3.a, DOE recognizes the concerns that manufacturers have regarding test burden and has issued a test procedure SNOPR that would align the proposed residential furnace fan test procedure with the DOE test procedure for residential furnaces, thereby reducing the burden on manufacturers. 78 FR 19606 (April 2, 2013).

b. Market Size

During interviews, manufacturers raised concerns about the potential of new furnace fan energy conservations standards to cause the residential furnace fan market to contract. Manufacturers claimed that an increase in overall product costs, resulting from component changes or increased test burden, would lead to a reduced volume of furnace sales. They stated that higher costs could drive consumers to purchase refurbished or repaired units instead of new products. Higher costs might also push consumers towards using alternative heating technologies (*e.g.*, space heaters or radiant heat) which may be less efficient. One manufacturer also noted that the market for residential furnace fan products has already shrunk 6-7 percent and is expected to have slow growth over the next few years. Given that manufacturers expect slow or no growth in the near future for most of the product classes even without new energy conservation standards, the addition of new standards could lead to further market contraction.

Although the production costs for furnace fans are estimated to increase with higher efficiency levels, DOE does not expect overall shipments of furnaces to decrease due to an increase in standards. On the contrary, based on the shipments analysis, total shipments for the furnace fan industry are not expected to decrease in the years following the standards compliance year. Chapter 9 of the NOPR TSD provides more information on shipment estimates during the analysis period.

c. Cumulative Regulatory Burden

DOE identified a number of cumulative regulations that may affect residential furnace fan manufacturers. Interviewed manufacturers mentioned the following regulations as potentially having an impact and contributing to burden: (1) DOE Energy Conservation Standards for Furnaces and Central Air Conditioners and Heat Pumps; (2) DOE's Certification, Compliance, and Enforcement rulemaking; (3) DOE's Alternative Efficiency Determination Methods and Alternate Rating Methods rulemaking; (4) EPA's phaseout of Hydrochlorofluorocarbons (HCFCs); (5) EPA's Energy Star program; (6) State regulations such as California Title 24; (7) the South Coast Air Quality Management District Rule 1111; (8) Canadian energy efficiency regulations; and (9) ASHRAE Standard 90.1. Some manufacturers indicated that the largest portion of their research and development budget goes toward meeting the various DOE standards. One manufacturer also recommended that DOE standards should be spread apart by at least five year periods so that manufacturers can allocate appropriate time to meet standards and develop new products.

DOE also asked manufacturers under what circumstances they would be able to coordinate expenditures related to other regulations. Manufacturers emphasized the benefits of having fewer metrics to evaluate and limiting the scope of coverage for residential furnace fans to strictly those units housed in furnaces. In addition, manufacturers requested that DOE consider harmonizing with international standards to lessen the cumulative burden.

Manufacturers also requested that the compliance date for some standards be pushed out to allow enough time for product development and limit stranded assets.

DOE recognizes and takes into account the cumulative cost of multiple regulations on manufacturers in the cumulative regulatory burden section of its analysis. Further information on cumulative regulatory burden can be found in section V.B.2.e of this notice and in chapter 12 of the NOPR TSD.

d. Consumer Confusion

In addition to the regulatory burden imposed by multiple standards, manufacturers were concerned with issues arising from multiple metrics that all apply to a single product. Furnaces alone already have energy efficiency rating metrics for AFUE and standby power, so with an additional FER metric, furnaces would be labeled with three different metrics. Manufacturers stated during interviews that three metrics are too many for a single product, and that consumers who use these rating metrics to evaluate and compare product performance may get confused if multiple metrics are labeled on one furnace. Manufacturers recommended that DOE should focus on the thermal performance of the furnace and not the fan energy consumption, which is a small fraction of a furnace's overall energy use.

In response, DOE is required by EPCA to consider and establish energy conservation standards for residential furnace fans by December 31, 2013. (42 U.S.C. 6295(f)(4)(D)) DOE is also required to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product prior to the adoption of an energy conservation standard. (42 U.S.C. 6295(o)(3)(A) and (r)) Pursuant to these statutory requirements in EPCA, DOE proposes new energy conservation standards in this notice, based on its proposed rating metric (FER). DOE requests comment and information on the potential for significant consumer confusion regarding the FER metric for residential furnace fans.

e. Motors

Manufacturers questioned the use of X13 and ECM motors as a design option to improve furnace fan efficiency. As these motors employ more complex controls and have higher maintenance costs than PSC motors, it was suggested that long-term reliability may be an issue. Manufacturers expect that the number of warranty claims, as well as warranty-associated costs, would increase if use of X13s and ECMs increased. X13s and ECMs are also more-expensive components that would increase the initial cost of the products in which they are used. Since these motors would increase product price but reduce reliability, manufacturers anticipate more consumers seeking to repair or refurbish existing products rather than purchase new ones. Furthermore, manufacturers may face challenges in obtaining a sufficient supply of motors due to the potential supply limitations of ECMs.

DOE recognizes the concerns that manufacturers have about the reliability of ECM motors. However, DOE did not receive sufficient quantitative data from manufacturers regarding the failure rates and number of warranty claims for the different motor types to make any firm conclusions about their reliability. Consequently, DOE retained X13 and ECM motors as a design option for consideration.

K. Emissions Analysis

In the emissions analysis, DOE estimates the reduction in power sector emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and mercury (Hg) from potential energy conservation standards for the considered products. In addition to estimating impacts of standards on power sector emissions, DOE estimated emissions impacts in production activities (extracting, processing, and transporting fuels) that provide the energy inputs to power plants. These are referred to as "upstream" emissions. Together, these emissions account for the full-fuel-cycle. In accordance with DOE's FFC Statement of Policy (76 FR 51281 (August 18, 2011)), this FFC analysis also includes impacts on emissions of methane (CH_4) and nitrous oxide (N_2O), both of which are recognized as greenhouse gases.

DOE conducted the emissions analysis using emissions factors that were derived from data in EIA's AEO 2012, supplemented by data from other sources. DOE developed separate emissions factors for power sector emissions and upstream emissions. For residential furnace fans, DOE also calculated site and upstream emissions from the additional use of natural gas associated with some of the efficiency levels. The method that DOE used to derive emissions factors is described in chapter 13 of the NOPR TSD.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying the tons of the gas by the gas's global warming potential (GWP) over a 100-year time horizon. Based on the

Fourth Assessment Report of the Intergovernmental Panel on Climate Change,[51] DOE used GWP values of 25 for CH_4 and 298 for N_2O.

EIA prepares the Annual Energy Outlook using NEMS. Each annual version of NEMS incorporates the projected impacts of existing air quality regulations on emissions. AEO 2012 generally represents current legislation and environmental regulations, including recent government actions, for which implementing regulations were available as of December 31, 2011.

SO_2 emissions from affected electric generating units (EGUs) are subject to nationwide and regional emissions cap-and-trade programs. Title IV of the Clean Air Act sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous States and the District of Columbia (D.C.). SO_2 emissions from 28 eastern States and D.C. were also limited under the Clean Air Interstate Rule (CAIR; 70 FR 25162 (May 12, 2005)), which created an allowance-based trading program that operates along with the Title IV program.[52] On July 6, 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 D.C. Circuit issued a decision to vacate CSAPR, and ordered EPA to continue administering CAIR.[53]

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[51] Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn,G. Raga, M. Schulz and R. Van Dorland. 2007: Changes in Atmospheric Constituents and in Radiative Forcing. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller, Editors. 2007. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. p. 212.

[52] CAIR was remanded to the U.S. Environmental Protection Agency (EPA) by the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit) but it remained in effect. 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).

[53] . See EME Homer City Generation, LP v. EPA, 696 F.3d 7, 38 (D.C. Cir. 2012) *cert. granted*, 81 USLW 3567 (U.S. Jun. 24 2013) (No. 12-1182). .

AEO 2012 had been finalized prior to CSAPR being vacated. The AEO 2012 emissions factors used for today's NOPR assume the implementation of CSAPR. As a result, for the purpose of calculating emissions reductions of SO_2 and NO_X in this NOPR, DOE refers to impacts under CSAPR even though CSAPR is not currently in effect. This should not alter the accuracy of DOE's projections, however, because DOE expects that the impacts of energy conservation standards on SO_2 and NO_x emissions would be similar regardless of whether CAIR or CSAPR are in effect.[54]

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 2015, however, SO_2 emissions will fall as a result of the Mercury and Air Toxics Standards (MATS) for power plants, which were announced by EPA on December 21, 2011. 77 FR 9304 (Feb. 16, 2012). In the final MATS rule, EPA established a standard for

[54] This is because SO_2 emissions will be well below the cap under either rule, such that emissions reductions will be realized to the same extent; the caps on NO_X emissions in the 22 states regulated under both rules will have the same effect such that reductions in electricity generation from efficiency standards would result in little change in NO_X levels (as explained further below).

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 2012 assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent injection systems installed by 2015. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, NEMS shows a reduction in SO_2 emissions when electricity demand decreases (e.g., as a result of energy efficiency standards). Emissions will be far below the cap established by CSAPR, so it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by any regulated EGU. Therefore, DOE believes that efficiency standards will reduce SO_2 emissions in 2015 and beyond.

CSAPR established a cap on NO_x emissions in 28 eastern States and the District of Columbia. Energy conservation standards are expected to have little effect on NO_x emissions in those States covered by CSAPR 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 potential standards considered in today's NOPR for these States where emissions are not capped.

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. For this rulemaking, DOE estimated mercury emissions reduction using emissions factors based on AEO 2012, which incorporates the MATS.

Power plants may emit particulates from the smoke stack, which are known as direct particulate matter (PM) emissions. NEMS does not account for direct PM emissions from power plants. DOE is investigating the possibility of using other methods to estimate reduction in PM emissions due to standards. The great majority of ambient PM associated with power plants is in the form of secondary sulfates and nitrates, which are produced at a significant distance from power plants by complex atmospheric chemical reactions that often involve the gaseous emissions of power plants, mainly SO_2 and NO_x. The monetary benefits that DOE estimates for reductions in SO_2 and NO_x emissions resulting from standards are in fact primarily related to the health benefits of reduced ambient PM.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this NOPR, 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 considered efficiency levels. In order to make this calculation similar 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 efficiency level. This section summarizes the basis for the monetary values used for CO_2 and NO_X emissions and presents the values considered in this rulemaking.

For today's NOPR, DOE is relying on a set of values for the social cost of carbon (SCC) that was developed by an interagency process. A summary of the basis for those values is provided below, 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 carbon dioxide. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in carbon dioxide emissions, while a global SCC value is meant to reflect the value of damages worldwide.

Under section 1(b)(6) of Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (Oct. 4, 1993), agencies must, to the extent permitted by law, assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. The purpose of the SCC estimates presented here is to allow agencies to incorporate the monetized social benefits of reducing CO_2 emissions into cost-benefit analyses of regulatory actions that have small, or "marginal," impacts on cumulative global emissions. 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 the 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 carbon dioxide emissions, the analyst faces a number of serious challenges. A recent report from the National Research Council points out that any assessment will suffer from uncertainty, speculation, and lack of information about: (1) future emissions of greenhouse gases; (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 serious questions of science, economics, and ethics and should be viewed as provisional.

Despite the serious limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing carbon dioxide emissions. Most Federal regulatory actions can be expected to have marginal impacts on global emissions. For such policies, the agency can estimate the benefits from reduced emissions in any future year by multiplying the change in emissions in that year by the SCC value appropriate for that year. The net present value of the benefits can then be calculated by multiplying the future benefits by an appropriate discount factor and summing across all affected years. This approach assumes that the marginal damages from increased emissions are constant for small departures from the baseline emissions path, an approximation that is reasonable for policies that have effects on emissions that are small relative to cumulative global carbon dioxide emissions. For policies that have a large (non-marginal) impact on global cumulative emissions, there is a separate question of whether the SCC is an appropriate tool for calculating the benefits of reduced emissions. This concern is not applicable to this rulemaking, however.

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. Social Cost of Carbon Values Used in Past Regulatory Analyses

Economic analyses for Federal regulations have used a wide range of values to estimate the benefits associated with reducing carbon dioxide emissions. In the final model year 2011

CAFE rule, the U.S. Department of Transportation (DOT) used both a "domestic" SCC value of \$2 per metric ton of CO_2 and a "global" SCC value of \$33 per metric ton of CO_2 for 2007 emission reductions (in 2007\$), increasing both values at 2.4 percent per year. DOT also included a sensitivity analysis at \$80 per metric ton of CO_2.[55] A 2008 regulation proposed by DOT assumed a domestic SCC value of \$7 per metric ton of CO_2 (in 2006\$) for 2011 emission reductions (with a range of \$0–\$14 for sensitivity analysis), also increasing at 2.4 percent per year.[56] A regulation for packaged terminal air conditioners and packaged terminal heat pumps finalized by DOE in October of 2008 used a domestic SCC range of \$0 to \$20 per metric ton CO_2 for 2007 emission reductions (in 2007\$). 73 FR 58772, 58814 (Oct. 7, 2008). In addition, EPA's 2008 Advance Notice of Proposed Rulemaking on Regulating Greenhouse Gas Emissions Under the Clean Air Act identified what it described as "very preliminary" SCC estimates subject to revision. 73 FR 44354 (July 30, 2008). EPA's global mean values were \$68 and \$40 per metric ton CO_2 for discount rates of approximately 2 percent and 3 percent, respectively (in 2006\$ for 2007 emissions).

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 agencies, the Administration sought to develop a transparent and defensible method, specifically designed for the rulemaking process, to quantify avoided

[55] See Average Fuel Economy Standards Passenger Cars and Light Trucks Model Year 2011, 74 FR 14196 (March 30, 2009) (Final Rule); Final Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011-2015 at 3-90 (Oct. 2008) (Available at: http://www.nhtsa.gov/fuel-economy) (Last accessed December 2012).

[56] See Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011-2015, 73 FR 24352 (May 2, 2008) (Proposed Rule); Draft Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011-2015 at 3-58 (June 2008) (Available at: http://www.nhtsa.gov/fuel-economy) (Last accessed December 2012).

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

Since the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates. Specifically, 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. 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.

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 three integrated assessment models, at discount rates of 2.5 percent, 3 percent, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is 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, although preference is given to consideration of the global benefits of reducing CO_2 emissions. Table IV.10 presents the values in the 2010 interagency group report,[57] which is reproduced in appendix 14-A of the NOPR TSD.

[57] 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. http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf

Table IV.10 Annual SCC Values from 2010 Interagency Report, 2010–2050 (in 2007 dollars 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 today's notice were generated using the most recent versions of the three integrated assessment models that have been published in the peer-reviewed literature.[58] Table IV.11 shows the updated sets of SCC estimates in five-year increments from 2010 to 2050. Appendix 14-B of the NOPR TSD provides the full set of SCC estimates, as well as the 2013 report from the interagency group. 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.

[58] 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. http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf
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Table IV.11 Annual SCC Values from 2013 Interagency Update, 2010–2050 (in 2007 dollars per metric ton CO_2)

Year	Discount Rate %			
	5	3	2.5	3
	Average	Average	Average	95th Percentile
2010	11	33	52	90
2015	12	38	58	109
2020	12	43	65	129
2025	14	48	70	144
2030	16	52	76	159
2035	19	57	81	176
2040	21	62	87	192
2045	24	66	92	206
2050	27	71	98	221

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable since 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 above 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 concerns and problems that should be addressed by the research community, including research programs housed in many of the Federal agencies participating in the interagency process to estimate the SCC. The interagency group intends to periodically review and reconsider those estimates to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report, adjusted to 2012$ using the Gross Domestic Product price deflator. For each of the four cases specified, the values used for emissions in 2015 were $12.9, $40.8, $62.2, and $117 per metric ton avoided (values expressed in 2012$). 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.

AHRI agreed that the monetization of emission reductions is an important factor to consider, but it stated that DOE has no statutory responsibility to establish a monetary value for potential environmental benefits of appliance and equipment standards. It added that there is currently no consensus on any single estimate of the value of CO_2 emissions, and, therefore, DOE should not indulge in speculation to determine a value when it has no statutory obligation to do so. (AHRI, No. 48 at p. 7)

In response, it is noted that EPCA directs DOE to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) DOE determines whether a standard is economically justified by considering, to the greatest extent practicable, a number of factors. (42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII)) Among these factors is “other factors the Secretary [of Energy] considers relevant.” The Secretary considers the economic benefits that may accrue to society from reduction of CO_2 emissions a relevant factor. DOE further notes that the incorporation of environmental externalities, such as damage from climate change, is a well-established principle in cost-benefit analysis by Federal agencies. DOE acknowledges that the value to place on a ton of avoided CO_2 emissions in future years is very uncertain, and for this reason it uses a wide range of monetary values (from $12.9 per ton to $117 per ton for emissions avoided in 2015).

AHRI also stated that DOE should not allow evaluation of environmental impacts to negate or make moot what has always been, and should remain, the core analysis in appliance and equipment standards rulemakings: the consumer payback period and life-cycle cost analysis. (AHRI, No. 48 at p. 7) In response, DOE notes that environmental and other impacts associated with reduced emissions are but one of the factors that DOE considers in determining whether a standard is economically justified.

2. Valuation of Other Emissions Reductions

DOE investigated the potential monetary benefit of reduced NO_X emissions from the potential standards it considered. As noted above, DOE has taken into account how new energy conservation standards would reduce NO_X emissions in those 22 States not affected by the CSAPR. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today’s NOPR based on estimates found in the relevant scientific literature. Available estimates suggest a wide range of benefit per ton values for NO_x from stationary sources, ranging from \$468 to \$4,809 per ton in 2012\$.[59] DOE calculated the monetary benefits from NO_x reductions using an average benefit per ton value for NO_X and discount rates of 3 percent and 7 percent.[60]

DOE did not monetize Hg or SO_2 emission reductions for today's NOPR because it is currently evaluating appropriate valuation of reduction in these emissions.

M. Utility Impact Analysis

The utility impact analysis estimates several effects on the power generation industry that would result from the adoption of new or amended energy conservation standards. In the utility impact analysis, DOE analyzes the changes in electric installed capacity and generation that result for each trial standard level. The utility impact analysis uses a variant of NEMS, which is a public domain, multi-sectored, partial equilibrium model of the U.S. energy sector. DOE uses a variant of this model, referred to as NEMS-BT,[61] to account for selected utility impacts of new or amended energy conservation standards. DOE's analysis consists of a comparison between model results for the most recent AEO Reference Case and for cases in which energy use is decremented to reflect the impact of potential standards. The energy savings inputs associated with each TSL come from the NIA. Chapter 15 of the NOPR TSD describes the utility impact analysis in further detail.

[59] U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, 2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities (2006).
[60] OMB, Circular A-4: Regulatory Analysis (Sept. 17, 2003).
[61] DOE/EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because this analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on DOE/EIA assumptions, DOE refers to it by the name "NEMS-BT" ("BT" is DOE's Building Technologies Program, under whose aegis this work has been performed).

NEEP recommended estimating the value of capacity reduction due to appliance standards as part of the NOPR, because reducing the need for electricity capacity is an important benefit that minimum efficiency standards bring to the country and various regions. Noting that the NOPR provides estimates of the expected reduction in electricity capacity due to residential furnace fan standards, NEEP urged the Department to also include a financial benefit estimate associated with these capacity reductions. (NEEP, No. 51 at p. 3)

For the NOPR, DOE used NEMS-BT, along with EIA data on the capital cost of various power plant types, to estimate the reduction in national expenditures for electricity generating capacity due to potential residential furnace fan standards. The method used and the results are described in chapter 15 of the NOPR TSD.

DOE is evaluating whether parts of the cost reduction are a transfer and thus, according to guidance provided by OMB to Federal agencies, should not be included in the estimates of the benefits and costs of a regulation.[62] Transfer payments are monetary payments from one group to another that do not affect total resources available to society (*i.e.*, exchanges that neither decrease nor increase total welfare). Benefits occur when savings to consumers result from real savings to producers, which increases societal benefits. Cost savings from reduced or delayed capital expenditure on power plants are a benefit, and not a transfer, to the extent that the reduced expenditure provides savings to both producers and consumers without affecting other groups. There would be a transfer to the extent that the delayed construction caused some other group (*e.g.*, equipment suppliers or landowners who might have assets committed to the projects) to realize a lower return on those assets. DOE is evaluating these issues to determine the extent

[62] OMB Circular A-4 (Sept. 17, 2003), p. 38.

to which the cost savings from delayed capital expenditure on power plants are a benefit to society.[63]

EEI stated that as part of its analysis on the potential impact of new residential furnace fan efficiency standards on utilities, DOE should consider the impacts of increased demands on gas and oil systems, especially during peak fossil fuel demand days. (EEI, No. 65 at p. 2) In response, DOE has tentatively concluded that the increase in gas and oil use associated with higher furnace fan efficiency levels is expected to be very small in the context of overall gas and oil demand, and as such, DOE believes that the impact on gas and oil systems would be insignificant.

EEI stated that with respect to electric utilities, DOE should ensure that it does not overestimate the potential for residential furnace fan energy conservation standards to reduce peak load demand. According to EEI, the vast majority of electric utilities in the U.S. reach peak demand during the summer air conditioning season. (EEI, No. 65 at p. 2) In response, DOE's analysis with NEMS uses a demand load shape that approximates the daily and seasonal load of residential furnace fans. Thus, the resulting estimates of changes in generating capacity due to higher residential furnace fan efficiency are reasonable.

[63] Although delayed investment implies a savings in total cost, the savings may be less than the savings in capital cost because the delay may also cause increases in other costs. For example, if the delayed investment was the replacement of an existing facility with a larger, more-efficient facility, the increased cost of operating the old facility during the period of delay might offset much of the savings from delayed investment. That the project was delayed is evidence that doing so decreased overall cost, but it does not indicate that the decrease was equal to the entire savings in capital cost.

N. Employment Impact Analysis

Employment impacts from new or amended energy conservation standards include direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the products subject to standards; 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 jobs created or eliminated in the national economy due to: (1) reduced spending by end users on energy; (2) reduced spending on new energy supply by the utility industry; (3) increased consumer spending on the purchase of new products; 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). 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.[64] 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

[64] 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).

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, DOE believes net national employment may increase because of shifts in economic activity resulting from energy conservation standards for residential furnace fans.

For the standard levels considered in today's NOPR, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies version 3.1.1 (ImSET).[65] 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 the 187 sectors. ImSET's national economic I–O structure is based on a 2002 U.S. benchmark table, specially aggregated to the 187 sectors most relevant to industrial, commercial, and residential building energy use. DOE notes that ImSET is not a general equilibrium forecasting model, and understands the uncertainties involved in projecting employment impacts, especially changes in the later years of the analysis. Because ImSET does not incorporate price changes, the employment effects predicted by ImSET may over-estimate actual job impacts over the long run. For the NOPR, DOE used ImSET only to estimate short-term (2019 and 2024) employment impacts.

For more details on the employment impact analysis, see chapter 16 of the NOPR TSD.

[65] 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).

V. Analytical Results and Conclusions

This section addresses the results from DOE's analyses with respect to potential energy conservation standards for residential furnace fans. It addresses the TSLs examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for furnace fans, and the proposed standard levels that DOE sets forth in today's NOPR. Additional details regarding DOE's analyses are contained in the TSD supporting this notice.

A. Trial Standard Levels

DOE developed trial standard levels (TSLs) that combine efficiency levels for each product class of residential furnace fans. Table V.1 presents the efficiency levels for each product class in each TSL. TSL 6 consists of the max-tech efficiency levels. TSL 5 consists of those efficiency levels that provide the maximum NPV using a 7-percent discount rate (see section V.B.3 for NPV results). TSL 4 consists of those efficiency levels that provide the highest NPV using a 7-percent discount rate, and that also result in a higher percentage of consumers that receive an LCC benefit than experience an LCC loss (see section V.B.1 for LCC results). TSL 3 uses efficiency level 3 for all product classes. TSL 2 consists of efficiency levels that are the same as TSL 3 for non-weatherized gas furnace fans, weatherized gas furnace fans, and electric furnace fans, but are at efficiency level 1 for oil-fired furnace fans and manufactured home furnace fans. TSL 1 consists of the most common efficiency levels in the current market. In summary, Table V.1 presents the six TSLs which DOE has identified for residential furnace fans, including the efficiency level associated with each TSL, the technology options anticipated to achieve those levels, and the expected resulting percentage reduction in FER from the baseline corresponding to each efficiency level.

Table V.1 Trial Standard Levels for Residential Furnace Fans

Product Class	Trial Standard Levels (Efficiency Level)*					
	1	**2**	**3**	**4**	**5**	**6**
Non-Weatherized, Non-Condensing Gas Furnace Fan	1	3	3	4	4	6
Non-weatherized, Condensing Gas Furnace Fan	1	3	3	4	4	6
Weatherized Non-Condensing Gas Furnace Fan	1	3	3	4	4	6
Non-Weatherized, Non-Condensing Oil Furnace Fan	1	1	3	1	3	6
Non-weatherized Electric Furnace/Modular Blower Fan	1	3	3	4	4	6
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan	1	1	3	1	3	6
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan	1	1	3	1	3	6
Manufactured Home Electric Furnace/Modular Blower Fan	1	1	3	4	4	6

* Efficiency level (EL) 1 = Improved PSC (12 percent). (For each EL, the percentages given refer to percent reduction in FER from the baseline level.) EL 2 = Inverter-driven PSC (25 percent). EL 3 = Constant-torque BPM motor (38 percent). EL 4 = Constant-torque BPM motor + Multi-Staging (51 percent). EL 5 = Constant-airflow BPM motor (57 percent). EL 6 = Constant-airflow BPM motor + Multi-Staging (61 percent).

B. Economic Justification and Energy Savings

1. Economic Impacts on Consumers

a. Life-Cycle Cost and Payback Period

To evaluate the economic impact of the considered efficiency levels on consumers, DOE conducted an LCC analysis for each efficiency level. More-efficient residential furnace fans would affect these consumers in two ways: (1) annual operating expense would decrease; and (2) purchase price would increase. Inputs used for calculating the LCC include total installed costs (i.e., equipment price plus installation costs), operating expenses (i.e., energy costs, repair costs, and maintenance costs), product lifetime, and discount rates.

The output of the LCC model is a mean LCC savings (or cost) for each product class, relative to the base case efficiency distribution for residential furnace fans. The LCC analysis also provides information on the percentage of consumers for whom an increase in the minimum efficiency standard would have a positive impact (net benefit), a negative impact (net cost), or no impact.

DOE also performed a PBP analysis as part of the LCC analysis. The PBP is the number of years it would take for the consumer to recover the increased costs of higher-efficiency products as a result of energy savings based on the operating cost savings. The PBP is an economic benefit-cost measure that uses benefits and costs without discounting. Chapter 8 of the NOPR TSD provides detailed information on the LCC and PBP analyses.

DOE's LCC and PBP analyses provide five key outputs for each efficiency level above the baseline, as reported in Table V.2 through Table V.9 for the considered TSLs. (Results for all efficiency levels are reported in chapter 8 of the NOPR TSD.) These outputs include the proportion of residential furnace fan purchases in which the purchase of a furnace fan compliant with the new energy conservation standard creates a net LCC increase, no impact, or a net LCC savings for the consumer. Another output is the average LCC savings from standards-compliant products, as well as the median PBP for the consumer investment in standards-compliant products. Savings are measured relative to the base case efficiency distribution (see section IV.F.4), not the baseline efficiency level.

Table V.2 LCC and PBP Results for Non-Weatherized, Non-Condensing Gas Furnace Fans

Efficiency Level	TSL	Life-Cycle Cost 2012$			Life-Cycle Cost Savings				Median Payback Period years
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2012$	% of Consumers that Experience			
						Net Cost	No Impact	Net Benefit	
Baseline		$343	$2,146	$2,489	$0	0%	100%	0%	---
1	1	$354	$1,943	$2,297	$64	2%	68%	30%	1.34
2		$403	$1,649	$2,052	$253	25%	25%	50%	3.98
3	2, 3	$414	$1,389	$1,803	$442	18%	25%	57%	2.69
4	4, 5	$496	$1,273	$1,769	$474	33%	14%	53%	5.38
5		$662	$1,333	$1,995	$275	53%	12%	35%	11.53
6	6	$697	$1,260	$1,957	$313	58%	0%	42%	11.20

Table V.3 LCC and PBP Results for Non-Weatherized, Condensing Gas Furnace Fans

Efficiency Level	TSL	Life-Cycle Cost 2012$			Life-Cycle Cost Savings				Median Payback Period years
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2012$	% of Consumers that Experience			
						Net Cost	No Impact	Net Benefit	
Baseline		$339	$2,259	$2,598	$0	0%	100%	0%	---
1	1	$351	$2,066	$2,417	$49	1%	75%	24%	1.35
2		$398	$1,775	$2,173	$203	21%	41%	38%	4.13
3	2, 3	$408	$1,506	$1,914	$361	10%	41%	49%	2.73
4	4, 5	$490	$1,414	$1,904	$371	24%	34%	42%	5.39
5		$658	$1,488	$2,146	$199	45%	29%	27%	11.73
6	6	$692	$1,415	$2,107	$238	57%	0%	43%	11.03

Table V.4 LCC and PBP Results for Weatherized, Non-Condensing Gas Furnace Fans

Efficiency Level	TSL	Life-Cycle Cost 2012$			Life-Cycle Cost Savings				Median Payback Period years
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2012$	% of Consumers that Experience			
						Net Cost	No Impact	Net Benefit	
Baseline		$329	$1,944	$2,273	$0	0%	100%	0%	---
1	1	$340	$1,759	$2,099	$35	0%	81%	18%	1.27
2		$387	$1,549	$1,936	$104	13%	56%	31%	4.94
3	2, 3	$397	$1,276	$1,673	$228	7%	56%	37%	2.65
4	4, 5	$476	$1,170	$1,645	$247	25%	33%	41%	6.39
5		$636	$1,290	$1,926	$39	51%	27%	22%	15.53
6	6	$670	$1,228	$1,898	$67	63%	0%	37%	13.32

Table V.5 LCC and PBP Results for Non-weatherized, Non-Condensing Oil Furnace Fans

Efficiency Level	TSL	Life-Cycle Cost 2012$			Life-Cycle Cost Savings				Median Payback Period years
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2012$	% of Consumers that Experience			
						Net Cost	No Impact	Net Benefit	
Baseline		$387	$2,540	$2,927	$0	0%	100%	0%	---
1	1, 2, 4	$404	$2,389	$2,794	$40	12%	71%	18%	5.49
2	-	$470	$2,042	$2,512	$245	46%	28%	26%	12.33
3	3, 5	$482	$1,896	$2,378	$344	43%	28%	29%	6.97
4	-	$570	$1,833	$2,402	$326	49%	28%	23%	12.07
5	-	$798	$1,887	$2,685	$120	58%	28%	14%	27.47
6	6	$833	$1,840	$2,673	$132	79%	0%	21%	25.41

Table V.6 LCC and PBP Results for Non-Weatherized Electric Furnace/Modular Blower Fans

Efficiency Level	TSL	Life-Cycle Cost 2012$			Life-Cycle Cost Savings				Median Payback Period years
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2012$	% of Consumers that Experience			
						Net Cost	No Impact	Net Benefit	
Baseline		$241	$1,198	$1,439	$0	0%	100%	0%	---
1	1	$252	$1,100	$1,352	$21	5%	73%	21%	2.39
2	-	$295	$954	$1,249	$84	28%	37%	34%	6.16
3	2, 3	$294	$830	$1,124	$160	20%	37%	42%	3.15
4	4, 5	$315	$771	$1,086	$185	27%	25%	48%	3.55
5	-	$450	$855	$1,305	$18	52%	25%	23%	12.83
6	6	$482	$824	$1,306	$17	68%	0%	32%	13.45

Table V.7 LCC and PBP Results for Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fans

Efficiency Level	TSL	Life-Cycle Cost 2012$			Life-Cycle Cost Savings				Median Payback Period years
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2012$*	% of Consumers that Experience			
						Net Cost	No Impact	Net Benefit	
Baseline		$254	$1,144	$1,398	$0	0%	100%	0%	---
1	1, 2, 4	$265	$1,070	$1,335	$26	13%	56%	32%	3.35
2	-	$310	$955	$1,265	$97	62%	0%	38%	10.74
3	3, 5	$315	$901	$1,216	$146	58%	0%	42%	7.02
4	-	$391	$876	$1,267	$95	70%	0%	30%	13.10
5	-	$537	$927	$1,464	($102)	85%	0%	15%	26.22
6	6	$569	$909	$1,478	($116)	85%	0%	15%	26.73

*Parentheses indicate negative values.

Table V.8 LCC and PBP Results for Manufactured Home Non-Weatherized, Condensing Gas Furnace Fans

Efficiency Level	TSL	Life-Cycle Cost 2012$			Life-Cycle Cost Savings				Median Payback Period years
		Installed Cost	Discounted Operating Cost	LCC	Average Savings 2012$*	% of Consumers that Experience			
						Net Cost	No Impact	Net Benefit	
Baseline		$271	$1,355	$1,626	$0	0%	100%	0%	---
1	1, 2, 4	$282	$1,261	$1,543	$27	7%	68%	26%	2.73
2	-	$326	$1,123	$1,449	$96	43%	29%	28%	10.47
3	3, 5	$334	$1,039	$1,373	$152	38%	29%	32%	6.46
4	-	$410	$1,005	$1,416	$111	68%	4%	27%	14.82
5	-	$564	$1,053	$1,618	($82)	82%	4%	14%	34.31
6	6	$597	$1,025	$1,622	($86)	84%	0%	16%	32.23

*Parentheses indicate negative values.

Table V.9 LCC and PBP Results for Manufactured Home Electric Furnace/Modular Blower Fan

Efficiency Level	TSL	Life-Cycle Cost 2012$ Installed Cost	Discounted Operating Cost	LCC	Life-Cycle Cost Savings Average Savings 2012$*	% of Consumers that Experience Net Cost	No Impact	Net Benefit	Median Payback Period years
Baseline		$192	$663	$855	$0	0%	100%	0%	---
1	1, 2	$202	$608	$810	$14	8%	71%	21%	2.49
2	-	$243	$561	$804	$20	37%	38%	25%	9.99
3	3	$241	$499	$739	$64	28%	38%	34%	4.35
4	4, 5	$259	$464	$723	$78	34%	26%	40%	4.61
5	-	$382	$539	$921	($70)	59%	26%	15%	16.75
6	6	$412	$525	$937	($86)	82%	0%	18%	17.11

* Parentheses indicate negative values.

The results in the above tables reflect the assumptions for use of constant circulation in the proposed DOE test procedure for furnace fans. As discussed in section IV.E, DOE also performed a sensitivity analysis for non-weatherized gas furnace fans to estimate the effect on the LCC results if it assumed half as much use of continuous circulation.[66] Under this revised assumption, for non-weatherized, non-condensing gas furnace fans, the average LCC savings decline somewhat in the sensitivity analysis, and the share of consumers that experience an LCC benefit declines slightly (see Table V.10). The same changes occur for non-weatherized, condensing gas furnace fans, but the magnitude of the effect is somewhat larger than for non-condensing gas furnace fans (see Table V.11).

[66] Non-weatherized gas furnace fans account for the vast majority of furnace fans used in constant-circulation mode.

Table V.10 LCC and PBP Results for Non-Weatherized, Non-Condensing Gas Furnace Fans Under Alternative Constant-Circulation Scenarios

Efficiency Level	TSL	Constant-Circulation Scenario							
		Current Test Procedure Assumptions				Half of Current Test Procedure Assumptions			
		Average LCC Savings 2012$	% of Consumers that Experience			Average LCC Savings 2012$	% of Consumers that Experience		
			Net Cost	No Impact	Net Benefit		Net Cost	No Impact	Net Benefit
1	1	$64	2%	68%	30%	$59	2%	68%	29%
2	-	$253	25%	25%	50%	$189	27%	25%	48%
3	2, 3	$442	18%	25%	57%	$362	19%	25%	56%
4	4, 5	$474	33%	14%	53%	$376	34%	14%	51%
5	-	$275	53%	12%	35%	$173	55%	12%	33%
6	6	$313	58%	0%	42%	$204	60%	0%	40%

Table V.11 LCC and PBP Results for Non-Weatherized, Condensing Gas Furnace Fans Under Alternative Constant-Circulation Scenarios

Efficiency Level	TSL	Constant-Circulation Scenario							
		Current Test Procedure Assumptions				Half of Current Test Procedure Assumptions			
		Average LCC Savings 2012$	% of Consumers that Experience			Average LCC Savings 2012$	% of Consumers that Experience		
			Net Cost	No Impact	Net Benefit		Net Cost	No Impact	Net Benefit
1	1	$49	1%	75%	24%	$41	1%	75%	24%
2		$203	21%	41%	38%	$127	22%	41%	37%
3	2, 3	$361	10%	41%	49%	$266	11%	41%	48%
4	4, 5	$371	24%	34%	42%	$256	25%	34%	40%
5		$199	45%	29%	27%	$78	47%	29%	24%
6	6	$238	57%	0%	43%	$107	60%	0%	40%

b. Consumer Subgroup Analysis

DOE estimated the impacts of the considered efficiency levels (TSLs) on the following consumer subgroups: (1) senior-only households; and (2) low-income households. The results of the consumer subgroup analysis indicate that for residential furnace fans, senior-only households and low-income households experience lower average LCC savings and longer payback periods than consumers overall, with the difference being larger for low-income households. The difference between the two subgroups and all consumers is larger for non-weatherized, non-condensing gas furnace fans (see Table V.12) than for non-weatherized, condensing gas furnace fans (see Table V.13). Chapter 11 of the NOPR TSD provides more detailed discussion on the consumer subgroup analysis and results for the other product classes.

Table V.12 Comparison of Impacts for Consumer Subgroups with All Consumers, Non-Weatherized, Non-Condensing Gas Furnace Fans

	Average Life-Cycle Cost Savings 2012$				Median Payback Period years		
Efficiency Level	**TSL**	**Senior-Only**	**Low-Income**	**All Consumers**	**Senior-Only**	**Low-Income**	**All Consumers**
1	1	$47	$35	$64	1.8	2.1	1.3
2		$200	$123	$253	5.4	6.3	4.0
3	2, 3	$344	$232	$442	3.7	3.8	2.7
4	4, 5	$343	$206	$474	7.2	7.8	5.4
5		$142	$7	$275	15.6	17.2	11.5
6	6	$164	$14	$313	15.3	16.5	11.2

Table V.13 Comparison of Impacts for Consumer Subgroups with All Consumers, Non-Weatherized, Condensing Gas Furnace Fans

	Average Life-Cycle Cost Savings 2012$				Median Payback Period years		
Efficiency Level	**TSL**	**Senior-Only**	**Low-Income**	**All Consumers**	**Senior-Only**	**Low-Income**	**All Consumers**
1	1	$41	$32	$49	1.6	2.2	1.4
2		$173	$129	$203	5.1	6.6	4.1
3	2, 3	$313	$245	$361	3.2	4.0	2.7
4	4, 5	$301	$212	$371	6.6	8.5	5.4
5		$121	$35	$199	14.5	18.3	11.7
6	6	$151	$52	$238	12.2	16.4	11.0

c. Rebuttable Presumption Payback

As discussed in section IV.F.5, EPCA provides a rebuttable presumption that, in essence, 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. However, DOE routinely conducts a full economic analysis that considers the full range of impacts, including those to the consumer, manufacturer, Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this 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. For comparison with the more detailed analytical results, DOE calculated a rebuttable presumption payback period for each TSL. Table V.14 shows the rebuttable presumption payback periods for the residential furnace fans product classes.

Table V.14 Rebuttable Presumption Payback Periods for Residential Furnace Fan Product Classes

Product Class	Rebuttable Presumption Payback years					
	TSL 1	**TSL 2**	**TSL 3**	**TSL 4**	**TSL 5**	**TSL 6**
Non-Weatherized, Non-Condensing Gas Furnace Fan	1.13	1.65	1.65	3.08	3.08	6.21
Non-weatherized, Condensing Gas Furnace Fan	1.06	1.49	1.49	2.82	2.82	5.72
Weatherized Non-Condensing Gas Furnace Fan	1.41	2.02	2.02	3.78	3.78	7.62
Non-Weatherized, Non-Condensing Oil Furnace Fan	1.84	1.84	2.46	1.84	2.46	8.16
Non-weatherized Electric Furnace/Modular Blower Fan	1.14	1.60	1.60	1.80	1.80	4.97
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan	1.33	1.33	1.91	1.33	1.91	7.26
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan	1.25	1.25	1.79	1.25	1.79	6.85
Manufactured Home Electric Furnace/Modular Blower Fan	1.51	1.51	2.13	2.39	2.39	6.59

2. Economic Impact on Manufacturers

As noted above, DOE performed an MIA to estimate the impact of new energy conservation standards on manufacturers of residential furnace fans. The following section describes the expected impacts on manufacturers at each considered TSL. Chapter 12 of the NOPR TSD explains the analysis in further detail.

a. Industry Cash-Flow Analysis Results

Table V.15 and Table V.16 depict the financial impacts (represented by changes in INPV) of new energy standards on manufacturers of residential furnace fans, as well as the conversion costs that DOE expects manufacturers would incur for all product classes at each TSL. To evaluate the range of cash flow impacts on the residential furnace fans industry, DOE modeled two different mark-up scenarios using different assumptions that correspond to the range of anticipated market responses to potential new energy conservation standards: (1) the preservation of gross margin percentage; and (2) the preservation of operating profit. Each of these scenarios is discussed immediately below.

To assess the lower (less severe) end of the range of potential impacts, DOE modeled a preservation of gross margin percentage markup scenario, in which a uniform "gross margin percentage" markup is applied across all potential efficiency levels. In this scenario, DOE assumed that a manufacturer's absolute dollar markup would increase as production costs increase in the standards case.

To assess the higher (more severe) end of the range of potential impacts, DOE modeled the preservation of operating profit markup scenario, which assumes that manufacturers would be able to earn the same operating margin in absolute dollars in the standards case as in the base case. In this scenario, while manufacturers make the necessary investments required to convert their facilities to produce new standards-compliant products, operating profit does not change in absolute dollars and decreases as a percentage of revenue.

The set of results below shows potential INPV impacts for residential furnace fan manufacturers; Table V.15 reflects the lower bound of impacts, and Table V.16 represents the upper bound.

Each of the modeled scenarios 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 base case and each standards case that results from the sum of discounted cash flows from the base year 2013 through 2048, the end of the analysis period. To provide perspective on the short-run cash flow impact, DOE includes in the discussion of the results below a comparison of free cash flow between the base case and the standards case at each TSL in the year before new standards would take effect. This figure provides an understanding of the magnitude of the required conversion costs relative to the cash flow generated by the industry in the base case.

Table V.15 Manufacturer Impact Analysis for Residential Furnace Fans - Preservation of Gross Margin Percentage Markup Scenario*

	Units	**Base Case**	**Trial Standard Level**					
			1	**2**	**3**	**4**	**5**	**6**
INPV	2012$ Millions	252.2	252.9	265.7	265.1	286.0	286.5	310.4
Change in INPV	2012$ Millions	-	0.7	13.5	12.9	33.8	34.2	58.2
	(%)	-	0.3	5.3	5.1	13.4	13.6	23.1
Product Conversion Costs	2012$ Millions	-	1.1	2.8	2.9	3.1	3.2	9.3
Capital Conversion Costs	2012$ Millions	-	-	-	-	-	-	155.0
Total Conversion Costs	2012$ Millions	-	1.1	2.8	2.9	3.1	3.2	164.3
Free Cash Flow	2012$ Millions	12.12	11.78	11.28	11.25	11.17	11.15	(60.44)
Free Cash Flow (change from Base Case)	%	0.0	(2.82)	(6.94)	(7.21)	(7.85)	(8.02)	(598.66)

* Values in parentheses are negative values.

Table V.16 Manufacturer Impact Analysis for Residential Furnace Fans - Preservation of Operating Profit Markup Scenario*

	Units	Base Case	Trial Standard Level					
			1	**2**	**3**	**4**	**5**	**6**
INPV	2012$ Millions	252.2	249.2	225.5	223.6	197.8	196.7	82.1
Change in INPV	2012$ Millions	-	(3.0)	(26.7)	(28.6)	(54.4)	(55.5)	(170.1)
	(%)	-	(1.2)	(10.6)	(11.3)	(21.6)	(22.0)	(67.5)
Product Conversion Costs	2012$ Millions	-	1.1	2.8	2.9	3.1	3.2	9.3
Capital Conversion Costs	2012$ Millions	-	-	-	-	-	-	155.0
Total Conversion Costs	2012$ Millions	-	1.1	2.8	2.9	3.1	3.2	164.3
Free Cash Flow	2012$ Millions	12.12	11.78	11.28	11.25	11.17	11.15	(60.44)
Free Cash Flow (change from Base Case)	%	0.0	(2.82)	(6.94)	(7.21)	(7.85)	(8.02)	(598.66)

* Values in parentheses are negative values.

TSL 1 represents the most common efficiency levels in the current market for all product classes. At TSL 1, DOE estimates impacts on INPV for residential furnace fan manufacturers to range from -$3.0 million to $0.7 million, or a change in INPV of -1.2 percent to 0.3 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 2.8 percent to $11.78 million, compared to the base-case value of $12.12 million in the year before the compliance date (2018).

DOE anticipates no capital conversion costs at TSL 1, because manufacturers would be able to use a different motor type without making significant changes to their manufacturing equipment or production processes. DOE anticipates minor product conversion costs associated with redesigning products that are currently below the proposed efficiency level and updating product literature.

TSL 2 represents EL 1 for the oil and manufactured home product classes, and EL 3 for all other product classes. At TSL 2, DOE estimates impacts on INPV for residential furnace fan manufacturers to range from -$26.7 million to $13.5 million, or a change in INPV of -10.6 percent to 5.3 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 6.9 percent to $11.28 million, compared to the base-case value of $12.12 million in the year before the compliance date (2018).

DOE anticipates no capital conversion costs at TSL 2, because manufacturers would be able to use a different motor type without making significant changes to their manufacturing equipment or production processes. DOE anticipates product conversion costs at TSL 2 to be higher than those at TSL 1, because more products in the market (with the exception of oil furnaces and manufactured housing products) would need to be redesigned in order to meet the higher proposed efficiency levels. Additional product literature would also need to be updated for the redesigned products.

TSL 3 represents EL 3 for all product classes. At TSL 3, DOE estimates impacts on INPV for residential furnace fan manufacturers to range from -$28.6 million to $12.9 million, or a change in INPV of -11.3 percent to 5.1 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 7.2 percent to $11.25 million, compared to the base-case value of $12.12 million in the year before the compliance date (2018).

DOE anticipates no capital conversion costs at TSL 3, because manufacturers would be able to use a different motor type without making significant changes to their manufacturing equipment or production processes. DOE anticipates product conversion costs at TSL 3 to be slightly higher than those at TSL 2 because more manufactured housing products in the market would need to be redesigned in order to meet the higher proposed efficiency levels. Additional product literature would also need to be updated for the redesigned products.

TSL 4 represents the efficiency levels that provide the highest NPV using a 7-percent discount rate, and that also result in a higher percentage of consumers receiving an LCC benefit rather than an LCC loss. At TSL 4, DOE estimates impacts on INPV for residential furnace fan manufacturers to range from -$54.4 million to $33.8 million, or a change in INPV of -21.6 percent to 13.4 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 7.9 percent to $11.17 million, compared to the base-case value of $12.12 million in the year before the compliance date (2018).

DOE anticipates no capital conversion costs at TSL 4, because manufacturers would be able to use a different motor type without making significant changes to their manufacturing equipment or production processes. DOE anticipates product conversion costs at TSL 4 to be higher than those at TSL 3, because more products in the market (with the exception of oil furnaces) would need to be redesigned in order to meet the higher proposed efficiency levels. Additional product literature would also need to be updated for the redesigned products.

TSL 5 represents the efficiency levels that provide the maximum NPV using a 7-percent discount rate. At TSL 5, DOE estimates impacts on INPV for residential furnace fan manufacturers to range from -$55.5 million to $34.2 million, or a change in INPV of -22.0 percent to 13.6 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 8.0 percent to $11.15 million, compared to the base-case value of $12.12 million in the year before the compliance date (2018).

DOE anticipates no capital conversion costs at TSL 5, because manufacturers would be able to use a different motor type without making significant changes to their manufacturing equipment or production processes. DOE anticipates product conversion costs at TSL 5 to be slightly higher than those at TSL 4, because more oil furnaces and manufactured housing electric furnaces in the market would need to be redesigned in order to meet the higher proposed efficiency levels. Additional product literature would also need to be updated for the redesigned products.

TSL 6 represents the max-tech efficiency level for all product classes. At TSL 6, DOE estimates impacts on INPV for residential furnace fan manufacturers to range from -$170.1 million to $58.2 million, or a change in INPV of -67.5 percent to 23.1 percent. At this potential standard level, industry free cash flow is estimated to decrease by approximately 598.7 percent to -$60.44 million, compared to the base-case value of $12.12 million in the year before the compliance date (2018).

DOE anticipates very high capital conversion costs at TSL 6 because manufacturers would need to make significant changes to their manufacturing equipment and production processes in order to accommodate the use of backward-inclined impellers. This design option would require modifying, or potentially eliminating, current fan housings. DOE also anticipates high product conversion costs to develop new designs with backward-inclined impellers for all their products. Some manufacturers may also have stranded assets from specialized machines for building fan housing that can no longer be used.

b. Impacts on Employment

To quantitatively assess the impacts of energy conservation standards on direct employment in the residential furnace fan industry, DOE used the GRIM to estimate the domestic labor expenditures and number of employees in the base case and at each TSL from 2013 through 2048. DOE used statistical data from the U.S. Census Bureau's 2011 Annual Survey of Manufacturers (ASM),[67] 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 related to manufacturing 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. The total labor expenditures in each year are calculated by multiplying the MPCs by the labor percentage of MPCs.

The total labor expenditures in the GRIM were then converted to domestic production employment levels by dividing production labor expenditures by the annual payment per

[67] "Annual Survey of Manufactures (ASM)," U.S. Census Bureau (2011) (Available at: http://www.census.gov/manufacturing/asm/).

production worker (production worker hours times the labor rate found in the U.S. Census Bureau's 2011 ASM). The estimates of production workers in this section cover workers, including line-supervisors who are directly involved in fabricating and assembling a product within the manufacturing facility. Workers performing services that are closely associated with production operations, such as materials handling tasks using forklifts, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific products covered by this rulemaking.

The total direct employment impacts calculated in the GRIM are the sum of the changes in the number of production workers resulting from the new energy conservation standards for residential furnace fans, as compared to the base case.

For residential furnace fans, DOE does not expect significant changes in domestic employment levels from baseline to EL 5. One manufacturer commented during interviews that employment may be affected if their profit margins decreased due to a new standard, in which case consideration may be given to moving production facilities to another country, but changes in employment due to standards are generally not a major concern for manufacturers of residential furnace fans, because all efficiency levels from baseline to EL 5 can be achieved by substituting a higher-efficiency component for an existing component. DOE found during manufacturer interviews that the assembly processes for integrating the higher-efficiency components do not differ significantly from those used for existing components. For instance, manufacturers design their housings and motor mounts to be compatible with all motor types.

Consequently, no additional labor is required to integrate higher-efficiency motors and controls to reach EL 1 through EL 3, and labor costs will be equivalent to the baseline at those levels. The same is true for integration of components that enable multi-stage heating capabilities (in addition to higher-efficiency motors) to reach EL 4 and EL 5.

The only standard level at which significant changes in employment would possibly be expected to occur is at EL6, the max-tech level. At EL 6, DOE estimates increases in labor costs because backwards-inclined impeller assemblies are heavier and require more robust mounting approaches than are currently used for forward-curved impeller assemblies. The alternate mounting approaches needed to integrate backward-inclined impeller assemblies could require manufacturers to modify their current assembly processes, resulting in increased labor. However, DOE received limited feedback from manufacturers regarding the labor required to produce furnace fans with backward-curved impellers, because they generally do not have any experience in working with this design option.

DOE notes that the employment impacts discussed here are independent of the indirect employment impacts to the broader U.S. economy, which are documented in chapter 15 of the NOPR TSD.

c. Impacts on Manufacturing Capacity

According to the residential furnace fan manufacturers interviewed, the new energy conservation standards proposed in today's NOPR would not significantly affect manufacturers' production capacities. Some manufacturers mentioned that capacity could potentially be impacted by additional testing requirements and bottlenecks with sourcing if motor suppliers cannot keep up with demand, but concerns were not generally expressed about manufacturing capacity until max-tech levels. Thus, at the proposed TSL, DOE believes manufacturers would be able to maintain manufacturing capacity levels and continue to meet market demand under new energy conservation standards.

d. Impacts on Subgroups of Manufacturers

Small manufacturers, niche equipment manufacturers, and manufacturers exhibiting a cost structure substantially different from the industry average could be affected disproportionately. As discussed in section IV.J using average cost assumptions developed for an industry cash-flow estimate is inadequate to assess differential impacts among manufacturer subgroups.

For the residential furnace fans industry, DOE identified and evaluated the impact of new energy conservation standards on one subgroup, specifically small manufacturers. The SBA defines a "small business" as having 750 employees or less for NAICS 333415, "Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing." Based on this definition, DOE identified 14 manufacturers in the residential furnace fans industry that qualify as small businesses. For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VI.B of this notice and chapter 12 of the NOPR TSD.

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. In addition to energy conservation standards, other regulations can significantly affect manufacturers' financial operations. 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 an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

During previous stages of this rulemaking, DOE identified a number of requirements in addition to new energy conservation standards for residential furnace fans. The following section briefly summarizes those identified regulatory requirements and addresses comments DOE received with respect to cumulative regulatory burden, as well as other key related concerns that manufacturers raised during interviews.

DOE Certification, Compliance, and Enforcement (CC&E) Rule

This notice proposes CC&E requirements for residential furnace fans. In addition, the April 2, 2013 test procedure SNOPR included proposed sampling requirements for CC&E testing of residential furnace fans that mandate that, unless otherwise specified, a minimum of two units need to be tested for each basic model. 78 FR 19606, 19625.

Manufacturers indicated during interviews that the regulatory burden from certification and compliance testing is one of the biggest problems they face. One manufacturer stated that it could potentially shut down the industry due to the large number of basic models that need to be tested. DOE recognizes that the CC&E requirements contribute to cumulative regulatory burden. However, for the reasons discussed in section IV.J.3, DOE does not find that testing furnace fans according to its proposed test procedure would be unduly burdensome.

DOE Energy Conservation Standards for Furnaces and Central Air Conditioners and Heat Pumps

On June 27, 2011, DOE published a direct final rule in the Federal Register to amend the energy conservation standards for residential furnaces, central air conditioners, and heat pumps (the "HVAC rule"). 76 FR 37408. In addition to setting a base national standard, the June 27, 2011 direct final rule also implemented regional standard levels, where the minimum efficiency level for a product is determined by the geographic region in which it is sold. (DOE subsequently confirmed adoption of these standards through publication of a notice of effective date and compliance dates for this rulemaking in the Federal Register on October 31, 2011. 76 FR 67037.) Compliance with these standards was required on May 1, 2013 for non-weatherized furnaces and will be required on January 1, 2015 for weatherized furnaces, central air conditioners, and heat pumps.[68]

[68] DOE notes that the American Public Gas Association (APGA) brought a lawsuit challenging the energy conservation standards pertaining to non-weatherized gas furnaces, and that lawsuit is currently pending before the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit). There is also a settlement agreement before the Court regarding this matter. On May 1, 2013, the D.C. Circuit granted a motion requesting a stay of the May 1, 2013 compliance date for non-weatherized gas furnaces. In its order, the Court stayed the compliance deadline for six months following the issuance of any opinion by the Court in this case upholding the standards.

Since furnace fan manufacturers are also manufacturers of the HVAC product in which the furnace fan is used, furnace fan manufacturers are subject to the amended energy conservation standards for residential furnaces, central air conditioners, and heat pumps. At the minimum energy efficiency levels selected for the direct final rule, DOE estimated that the total industry investment required to meet the amended energy conservation standards would be $28 million (in 2009$). At the minimum energy efficiency levels selected for this notice of proposed rulemaking, DOE estimates that the total industry investment would be $3.1 million. Manufacturers of furnace fans face product conversion costs related to standards for furnace fans, as well as product and capital conversion costs related to standards for residential furnaces, central air conditioners, and heat pumps.

The direct final rule for energy conservation standards for residential furnaces, central air conditioners, and heat pumps includes standards for energy efficiency as well as standards for standby mode and off mode energy consumption. DOE has completed a test procedure final rule for standby mode and off mode energy consumption in residential furnaces. 77 FR 76831 (Dec. 31, 2012). DOE is also preparing a test procedure for standby mode and off mode energy consumption in residential central air conditioners and heat pumps.

EPA Phaseout of Hydrochlorofluorocarbons (HCFCs)

The U.S. is obligated under the Montreal Protocol to limit production and consumption of HCFCs through incremental reductions, culminating in a complete phaseout of HCFCs by 2030. On December 15, 2009, EPA published the "2010 HCFC Allocation Rule," which allocates production and consumption allowances for HCFC-22 for each year between 2010 and 2014. 74

FR 66412. On January 4. 2012, EPA published the "2012 HCFC Allocation Proposed Rule," which proposes to lift the regulatory ban on the production and consumption of HCFC-22 (following a court decision[69] in August 2010 to vacate a portion of the "2010 HCFC Allocation Rule") by establishing company-by-company HCFC-22 baselines and allocating allowances for 2012-2014. 77 FR 237.

HCFC-22, which is also known as R-22, is a popular refrigerant that is commonly used in air-conditioning products. Manufacturers of residential furnace fans who also manufacture residential central air conditioners must comply with the allowances established by the allocation rule, thereby facing a cumulative regulatory burden.

EPA ENERGY STAR

During interviews, some manufacturers stated that ENERGY STAR specifications for residential furnaces, central air conditioners, and heat pumps would be a source of cumulative regulatory burden. ENERGY STAR specifications are as follows:

Table V.17: ENERGY STAR Specifications for HVAC Products that Use Furnace Fans

Gas Furnaces	Rating of 90% AFUE or greater for U.S. South gas furnaces Rating of 95% AFUE or greater for U.S. North gas furnaces Less than or equal to 2.0% furnace fan efficiency*
Oil Furnaces	Rating of 85% AFUE or greater Less than or equal to 2.0% furnace fan efficiency*
Air-Source Heat Pumps	>= 8.2 HSPF/ >=14.5 SEER/ >=12 EER for split systems >= 8.0 HSPF/ >=14 SEER/ >=11 EER for single-package equipment
Central Air Conditioners	>=14.5 SEER/ >=12 EER for split systems >=14 SEER/ >=11 EER for single-package equipment

[69] See Arkema v. EPA, 618 F.3d 1 (D.C. Cir. 2010).

* Furnace fan efficiency in this context is furnace fan electrical consumption as a percentage of total furnace energy consumption in heating mode.

DOE realizes that the cumulative effect of several regulations on an industry may significantly increase the burden faced by manufacturers that need to comply with multiple regulations and certification programs from different organizations and levels of government. However, DOE notes that certain standards, such as ENERGY STAR, are optional for manufacturers. Furthermore, for certain products listed in the table above, ENERGY STAR standards are equivalent to the standards set in DOE's June 27, 2011 direct final rule for energy conservation standards for residential furnaces, central air conditioners, and heat pumps.

Canadian Energy Efficiency Regulations

In June 2010, the Office of Energy Efficiency of National Resources Canada (NRCan) published a bulletin to announce the proposal of new electricity reporting requirements for air handlers used in residential central heating and cooling systems that are imported into Canada for sale or lease.[70] In November 2011, NRCan published a regulatory update which stated that NRCan intends to apply reporting requirements to only air handlers used in residential gas furnaces, and that requirements for air handlers used in other heating and cooling systems would be expanded in a future regulatory amendment.[71] In this update, NRCan proposed to use Canadian Standards Association (CSA) C823-11 (Performance of air handlers in residential space conditioning systems) as the test method for determining efficiency. Consequently,

[70] *Air Handlers – June 2010*, Natural Resources Canada (Available at: http://oee.nrcan.gc.ca/regulations/bulletins/14551) (Last accessed May 6, 2013).
[71] *Regulatory Update - November 2011*, Natural Resources Canada (Available at: http:// http://oee.nrcan.gc.ca/regulations/bulletins/17839) (Last accessed May 6, 2013).

manufacturers of furnace fans used in residential gas furnaces may face additional reporting requirements if they sell their products in Canada.

California Title 24

Title 24, Part 6, of the California Code of Regulations includes building energy efficiency standards for residential and nonresidential buildings. The California Energy Commission (CEC) published new standards in 2008, which became effective January 1, 2010, that include watts per cubic foot per minute (W/CFM) limits for fans used in central, residential HVAC systems.[72]

ASHRAE Standard 90.1

ASHRAE Standard 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings," sets minimum efficiency standards for buildings, except low-rise residential buildings. On May 16, 2012, DOE published the final rule in the Federal Register for Energy Conservation Standards and Test Procedures for Commercial Heating, Air-Conditioning, and Water-Heating Equipment, through which DOE adopted the efficiency levels specified in ASHRAE Standard 90.1–2010. 77 FR 28928.

Included in the ASHRAE standards are minimum efficiency levels for commercial heating, air-conditioning, and water-heating equipment. Several manufacturers of residential furnace fans also manufacture this equipment.

[72] *Building Energy Efficiency Program*, California Energy Commission (Available at: < http://www.energy.ca.gov/title24/>) (Last accessed May 6, 2013).

Low-NO_X requirements

Rule 1111 of the South Coast Air Quality Management District (AQMD) currently requires residential furnaces installed in the District to meet a NO_X emission limit of 40 nanograms per joule (ng/J) of heat output.[73] The development of this rule is an ongoing process to evaluate low-NO_X technologies for combustion equipment. In 1983, the rule was amended to limit applicability to furnaces with a heat input of less than 175,000 Btu per hour, or for combination heating and cooling units, a cooling rate of less than 65,000 Btu per hour.[74] However, the rule was again amended in 2009 to establish a new limit of 14 ng/J for non-condensing, condensing, weatherized, and mobile home furnaces, with the following compliance schedule:[75]

Table V.18: Low NO_X Compliance Schedule

Compliance Date	Furnace Type
Oct 1, 2014	Condensing Furnace
Oct 1, 2015	Non-condensing Furnace
Oct 1, 2016	Weatherized Furnace
Oct 1, 2018	Mobile Home Furnace

The Proposed Amended Rule (PAR) 1111 affects manufacturers, distributors, wholesalers, builders, and installers of residential furnaces. AHRI indicates that, although there are currently no manufacturers of fan-type gas-fired residential furnaces within the AQMD jurisdiction, some of these manufacturers do sell and distribute products installed in this District.

[73] *South Coast AQMD List of Current Rules*, California Environmental Protection Agency Air Resouorces Board (Available at: http://www.arb.ca.gov/drdb/sc/cur.htm) (Last accessed May 6, 2013).
[74] See https://aqmd.gov/hb/attachments/2011-2015/2013Mar/2013-Mar1-019.pdf.
[75] See http://www.arb.ca.gov/DRDB/SC/CURHTML/R1111.pdf.

PAR 1111 also provides manufacturers with an alternative compliance option. For any furnace type, a manufacturer may request a delayed compliance date of up to three years if they submit a plan and pay an emission mitigation fee.

DOE discusses these and other requirements, and includes the full details of the cumulative regulatory burden analysis, in chapter 12 of the NOPR TSD. DOE also discusses the impacts on the small manufacturer subgroup in the regulatory flexibility analysis in section VI.B of this NOPR.

3. National Impact Analysis

a. Significance of Energy Savings

For each TSL, DOE projected energy savings for residential furnace fans purchased in the 30-year period that begins in the first full year of compliance with amended standards (2019-2048). The savings are measured over the entire lifetime of products purchased in the 30-year period. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between each standards case and the base case. Table V.19 presents the estimated primary energy savings for each considered TSL, and Table V.20 presents the estimated FFC energy savings for each considered TSL. The energy savings in the tables below are net savings that reflect the subtraction of the additional gas or oil used by the furnace associated with higher-efficiency furnace fans. With improved fan efficiency, there is less heat from the motor, which means that the furnace needs to operate more. The approach for estimating national energy savings is further described in section IV.H.1.

The difference between primary energy savings and FFC energy savings for all TSLs is small (less than 1%), because the upstream energy savings associated with the electricity savings are partially (or fully, for TSL 2 and 3) offset by the upstream energy use from the additional gas or oil used by the furnace due to higher-efficiency furnace fans. The ranking of TSLs is not impacted by the use of FFC energy savings.

Table V.19 Cumulative National Primary Energy Savings for Trial Standard Levels for Residential Furnace Fans Sold in 2019-2048

Product Class	**Trial Standard Level**					
	1	2	3	4	5	6
	quads					
Non-Weatherized, Non-Condensing Gas Furnace Fan	0.254	1.021	1.021	1.861	1.861	2.404
Non-weatherized, Condensing Gas Furnace Fan	0.276	0.877	0.877	2.003	2.003	2.793
Weatherized Non-Condensing Gas Furnace Fan	0.032	0.138	0.138	0.264	0.264	0.338
Non-Weatherized, Non-Condensing Oil Furnace Fan	0.005	0.005	0.025	0.005	0.025	0.051
Non-weatherized Electric Furnace/Modular Blower Fan	0.042	0.202	0.202	0.357	0.357	0.451
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan	0.010	0.010	0.039	0.010	0.039	0.089
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan	0.002	0.002	0.008	0.002	0.008	0.022
Manufactured Home Electric Furnace/Modular Blower Fan	0.009	0.009	0.034	0.060	0.060	0.073
Total – All Classes	**0.631**	**2.265**	**2.344**	**4.562**	**4.617**	**6.221**

Note: Components may not sum to total due to rounding.

Table V.20 Cumulative National Full-Fuel-Cycle Energy Savings for Trial Standard Levels for Residential Furnace Fans Sold in 2019-2048

Product Class	**Trial Standard Level**					
	1	2	3	4	5	6
	quads					
Non-Weatherized, Non-Condensing Gas Furnace Fan	0.256	1.021	1.021	1.870	1.870	2.421
Non-weatherized, Condensing Gas Furnace Fan	0.277	0.866	0.866	2.005	2.005	2.802

Weatherized Non-Condensing Gas Furnace Fan	0.032	0.138	0.138	0.266	0.266	0.340
Non-Weatherized, Non-Condensing Oil Furnace Fan	0.005	0.005	0.024	0.005	0.024	0.050
Non-weatherized Electric Furnace/Modular Blower Fan	0.042	0.202	0.202	0.357	0.357	0.452
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan	0.010	0.010	0.039	0.010	0.039	0.089
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan	0.002	0.002	0.008	0.002	0.008	0.022
Manufactured Home Electric Furnace/Modular Blower Fan	0.010	0.010	0.034	0.061	0.061	0.074
Total – All Classes	**0.635**	**2.254**	**2.332**	**4.576**	**4.629**	**6.250**

Note: Components may not sum to total due to rounding.

OMB Circular A-4[76] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A-4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using 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.[77] We would note that the review timeframe established in EPCA generally does not overlap with the product lifetime, product manufacturing cycles, or other factors specific to residential furnace fans. Thus, such results are

[76] U.S. Office of Management and Budget, "Circular A-4: Regulatory Analysis" (Sept. 17, 2003) (Last accessed September 17, 2013 from http://www.whitehouse.gov/omb/circulars_a004_a-4/).

[77] EPCA requires DOE to review its energy conservation 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. (42 U.S.C. 6295(m))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.

presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The NES results based on a 9-year analytical period are presented in Table V.21. The impacts are counted over the lifetime of products purchased in 2019–2027.

Table V.21 Cumulative National Primary Energy Savings for Trial Standard Levels for Residential Furnace Fans Sold in 2019-2027

Product Class	**Trial Standard Level**					
	1	2	3	4	5	6
	quads					
Non-Weatherized, Non-Condensing Gas Furnace Fan	0.085	0.348	0.348	0.642	0.642	0.846
Non-weatherized, Condensing Gas Furnace Fan	0.076	0.239	0.239	0.545	0.545	0.755
Weatherized Non-Condensing Gas Furnace Fan	0.010	0.046	0.046	0.086	0.086	0.111
Non-Weatherized, Non-Condensing Oil Furnace Fan	0.002	0.002	0.009	0.002	0.009	0.021
Non-weatherized Electric Furnace/Modular Blower Fan	0.012	0.058	0.058	0.102	0.102	0.130
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan	0.003	0.003	0.013	0.003	0.013	0.030
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan	0.001	0.001	0.002	0.001	0.002	0.006
Manufactured Home Electric Furnace/Modular Blower Fan	0.003	0.003	0.012	0.020	0.020	0.025
Total – All Classes	**0.193**	**0.700**	**0.727**	**1.402**	**1.421**	**1.924**

Note: Components may not sum to total due to rounding.

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 residential furnace fans. In accordance with OMB's guidelines on regulatory analysis,[78] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. Table V.22 shows the consumer NPV results for each TSL considered for residential furnace fans. In each case, the impacts cover the lifetime of products purchased in 2019-2048.

Table V.22 Cumulative Net Present Value of Consumer Benefit for Trial Standard Levels for Residential Furnace Fans Sold in 2019-2048

Product Class	Discount Rate %	Trial Standard Level					
		1	2	3	4	5	6
		billion 2012$*					
Non-Weatherized, Non-Condensing Gas Furnace Fan	3%	1.46	9.86	9.86	11.09	11.09	8.28
Non-weatherized, Condensing Gas Furnace Fan		1.49	11.16	11.16	12.23	12.23	9.20
Weatherized Non-Condensing Gas Furnace Fan		0.17	1.12	1.12	1.30	1.30	0.49
Non-Weatherized, Non-Condensing Oil Furnace Fan		0.02	0.02	0.19	0.02	0.19	0.10
Non-weatherized Electric Furnace/Modular Blower Fan		0.15	1.05	1.05	1.29	1.29	0.12
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan		0.04	0.04	0.25	0.04	0.25	(0.06)
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan		0.01	0.01	0.05	0.01	0.05	(0.02)
Manufactured Home Electric Furnace/Modular Blower Fan		0.03	0.03	0.13	0.17	0.17	(0.17)
Total – All Classes		**3.37**	**23.30**	**23.81**	**26.16**	**26.57**	**17.95**
Non-Weatherized, Non-Condensing Gas Furnace Fan	7%	0.53	3.52	3.52	3.71	3.71	1.98
Non-weatherized, Condensing Gas Furnace Fan		0.51	3.78	3.78	3.91	3.91	2.11
Weatherized Non-Condensing Gas Furnace Fan		0.06	0.39	0.39	0.41	0.41	(0.01)
Non-Weatherized, Non-Condensing Oil Furnace Fan		0.01	0.01	0.07	0.01	0.07	0.01

[78] OMB Circular A-4, section E (Sept. 17, 2003) (Available at: http://www.whitehouse.gov/omb/circulars_a004_a-4).

Non-weatherized Electric Furnace/Modular Blower Fan		0.05	0.33	0.33	0.40	0.40	(0.20)
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan		0.02	0.02	0.08	0.02	0.08	(0.09)
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan		0.00	0.00	0.02	0.00	0.02	(0.02)
Manufactured Home Electric Furnace/Modular Blower Fan		0.01	0.01	0.04	0.05	0.05	(0.13)
Total – All Classes		**1.19**	**8.07**	**8.23**	**8.51**	**8.64**	**3.65**

* Numbers in parentheses indicate negative NPV.

The NPV results based on the aforementioned 9-year analytical period are presented in Table V.23. The impacts are counted over the lifetime of products purchased in 2019–2027. As mentioned previously, this information is presented for informational purposes only and is not indicative of any change in DOE's analytical methodology or decision criteria.

Table V.23 Cumulative Net Present Value of Consumer Benefit for Trial Standard Levels for Residential Furnace Fans Sold in 2019-2027

Product Class	**Discount Rate %**	**Trial Standard Level**					
		1	**2**	**3**	**4**	**5**	**6**
		billion 2012$*					
Non-Weatherized, Non-Condensing Gas Furnace Fan	3%	0.63	4.32	4.32	4.88	4.88	3.75
Non-weatherized, Condensing Gas Furnace Fan		0.55	4.11	4.11	4.51	4.51	3.51
Weatherized Non-Condensing Gas Furnace Fan		0.07	0.48	0.48	0.56	0.56	0.27
Non-Weatherized, Non-Condensing Oil Furnace Fan		0.01	0.01	0.09	0.01	0.09	0.07
Non-weatherized Electric Furnace/Modular Blower Fan		0.05	0.39	0.39	0.48	0.48	0.04
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan		0.02	0.02	0.11	0.02	0.11	(0.01)
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan		0.00	0.00	0.02	0.00	0.02	0.00

Manufactured Home Electric Furnace/Modular Blower Fan		0.01	0.01	0.06	0.07	0.07	(0.07)
Total – All Classes		**1.35**	**9.36**	**9.59**	**10.53**	**10.72**	**7.55**
Non-Weatherized, Non-Condensing Gas Furnace Fan	7%	0.29	1.98	1.98	2.09	2.09	1.17
Non-weatherized, Condensing Gas Furnace Fan		0.26	1.87	1.87	1.94	1.94	1.11
Weatherized Non-Condensing Gas Furnace Fan		0.03	0.22	0.22	0.23	0.23	0.02
Non-Weatherized, Non-Condensing Oil Furnace Fan		0.00	0.00	0.04	0.00	0.04	0.02
Non-weatherized Electric Furnace/Modular Blower Fan		0.02	0.17	0.17	0.20	0.20	(0.10)
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan		0.01	0.01	0.05	0.01	0.05	(0.05)
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan		0.00	0.00	0.01	0.00	0.01	(0.01)
Manufactured Home Electric Furnace/Modular Blower Fan		0.01	0.01	0.02	0.03	0.03	(0.07)
Total – All Classes		**0.63**	**4.26**	**4.35**	**4.50**	**4.58**	**2.09**

* Numbers in parentheses indicate negative NPV.

As noted in section IV.H.2, DOE assumed no change in residential furnace fan prices over the 2019−2048 period. In addition, DOE conducted a sensitivity analysis using alternative price trends: one in which prices decline over time, and one in which prices increase over time. These price trends, and the NPV results from the associated sensitivity cases, are described in Appendix 10-C of the NOPR TSD.

c. Indirect Impacts on Employment

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

The results suggest that the proposed standards would be likely to have 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 more detailed results about anticipated indirect employment impacts.

4. Impact on Product Utility or Performance

DOE has tentatively concluded that the standards it is proposing in this NOPR would not lessen the utility or performance of residential furnace fans.

5. Impact of Any Lessening of Competition

DOE has also considered any lessening of competition that is likely to result from new and amended 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. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (ii))

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

6. Need of the Nation to Conserve Energy

An improvement in the energy efficiency of the products subject to this rule is likely to improve the security of the nation's energy system by reducing overall demand for energy. Reduction in the growth of electricity demand resulting from energy conservation standards may also improve the reliability of the electricity system. Reductions in national electric generating capacity estimated for each considered TSL are reported in chapter 15 of the NOPR TSD.

Energy savings from standards for the residential furnace fan products covered in today's NOPR could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table V.24 provides DOE's estimate of cumulative emissions reductions projected 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.

As discussed in section IV.K, DOE did not include NO_X emissions reduction from power plants in States subject to CSAPR, because an energy conservation standard would not affect the overall level of NO_X emissions in those States due to the emissions caps mandated by CSAPR. For SO_2, projected emissions will be far below the cap established by CSAPR, so it is unlikely that excess SO_2 emissions allowances resulting from the lower electricity demand would be needed or used to permit offsetting increases in SO_2 emissions by any regulated EGU. Therefore, DOE believes that efficiency standards will reduce SO_2 emissions.

Table V.24 Cumulative Emissions Reduction for Potential Standards for Residential Furnace Fans

	TSL					
	1	**2**	**3**	**4**	**5**	**6**
Primary Energy Emissions*						
CO_2 (million metric tons)	57.12	214.17	221.76	416.41	421.74	563.75
SO_2 (thousand tons)	31.17	117.04	121.28	227.23	230.23	307.77
NO_X (thousand tons)	30.66	122.38	126.31	227.18	229.86	303.72
Hg (tons)	0.24	0.95	0.98	1.76	1.79	2.36
N_2O (thousand tons)	0.67	2.65	2.75	4.96	5.03	6.66
CH_4 (thousand tons)	4.65	18.24	18.91	34.24	34.72	46.01
Upstream Emissions						
CO_2 (million metric tons)	1.88	5.99	6.11	13.37	13.42	18.50
SO_2 (thousand tons)	12.18	38.30	39.17	86.23	86.63	119.61
NO_X (thousand tons)	0.50	2.00	2.04	3.72	3.75	4.95
Hg (tons)	0.00	0.00	0.00	0.01	0.01	0.01
N_2O (thousand tons)	0.02	0.09	0.09	0.16	0.17	0.22
CH_4 (thousand tons)	127.91	352.80	365.71	879.41	887.59	1249.3
Total Emissions						
CO_2 (million metric tons)	59.01	220.16	227.87	429.78	435.16	582.25
SO_2 (thousand tons)	43.36	155.34	160.44	313.46	316.86	427.38
NO_X (thousand tons)	31.16	124.38	128.35	230.90	233.60	308.67
Hg (tons)	0.24	0.95	0.99	1.77	1.80	2.38
N_2O (thousand tons)	0.70	2.74	2.84	5.12	5.19	6.88
N_2O thousand tons CO_2eq**	207.2	816.0	845.0	1527.0	1547.7	2049.3
CH_4 (thousand tons)	132.56	371.04	384.62	913.65	922.31	1295.3
CH_4 million tons CO_2eq**	3.314	9.276	9.616	22.84	23.06	32.38

* Includes emissions from additional gas use associated with more-efficient furnace fans.

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

As part of the analysis for this NOPR, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X estimated for each of the TSLs considered for residential furnace fans. As discussed in section IV.L, for CO_2, DOE used four sets of values for the SCC developed by an interagency process. Three sets of values are based on the average SCC from three integrated assessment models, at discount rates of 2.5 percent, 3 percent, and 5 percent. The fourth set represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate. The SCC values for CO_2 emissions reductions in 2015, expressed in 2012$, are $12.9/ton, $40.8/ton, $62.2/ton, and $117/ton. The values for later years are higher due to increasing damages as the magnitude of projected climate change increases. Table V.25 presents the global value of CO_2 emissions reductions at each TSL. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in chapter 14 of the NOPR TSD.

Table V.25 Global Present Value of CO_2 Emissions Reduction for Potential Standards for Residential Furnace Fans

TSL	SCC Case*			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
	million 2012$			
Primary Energy Emissions**				
1	298.5	1531.1	2498.9	4724.6
2	1121.1	5746.8	9377.5	17732.7
3	1161.1	5951.3	9710.9	18363.5
4	2177.1	11165.3	18221.5	34451.9
5	2205.1	11308.6	18455.1	34893.8
6	2943.6	15103.4	24651.6	46603.0
Upstream Emissions				
1	9.9	50.5	82.4	155.9
2	31.3	160.5	261.9	495.0
3	32.0	163.9	267.5	505.7
4	70.0	358.6	585.1	1106.2
5	70.3	360.1	587.6	1110.8
6	97.0	496.6	810.1	1531.5
Total Emissions				
1	308.3	1581.7	2581.3	4880.5
2	1152.4	5907.3	9639.4	18227.7
3	1193.1	6115.2	9978.5	18869.2

4	2247.2	11524.0	18806.6	35558.1
5	2275.5	11668.7	19042.7	36004.6
6	3040.6	15599.9	25461.7	48134.5

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.9, $40.8, $62.2, and $117 per metric ton (2012$). The values are for CO_2 only (i.e., not CO_2eq of other greenhouse gases).

** Includes site emissions from additional use of natural gas associated with more-efficient furnace fans.

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other greenhouse gas (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 in this rulemaking on reducing CO_2 emissions 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 NOPR the most recent values and analyses resulting from the interagency review process.

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from standards for the residential furnace fan products that are the subject of this NOPR. The dollar-per-ton values that DOE used are discussed in section IV.L. Table V.26 presents the present value of cumulative NO_X emissions reductions for each TSL calculated using the average dollar-per-ton values and 7-percent and 3-percent discount rates.

Table V.26 Present Value of NO_X Emissions Reduction for Potential Standards for Residential Furnace Fans

TSL	3% Discount Rate	7% Discount Rate
	million 2012$	
Power Sector and Site Emissions*		
1	31.0	10.7
2	116.4	40.0
3	120.7	41.4
4	226.2	77.8
5	229.2	78.8
6	306.1	105.3
Upstream Emissions		
1	12.4	4.4
2	39.0	13.9
3	39.9	14.3
4	88.0	31.6
5	88.4	31.7
6	122.3	44.0
Total Emissions**		
1	43.4	15.1
2	155.4	53.9
3	160.5	55.7
4	314.2	109.4
5	317.6	110.6
6	428.3	149.3

* Includes site emissions from additional use of natural gas associated with more-efficient furnace fans.

** Components may not sum to total due to rounding.

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.27 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced full-fuel-cycle CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL considered in this rulemaking, at both a 7-percent and a 3-percent discount rate. The CO_2 values used in the columns of each table correspond to the four scenarios for the valuation of CO_2 emission reductions discussed above.

Table V.27 Potential Standards for Residential Furnace Fans: 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:			
	SCC Case \$12.9/metric ton CO_2* and Low Value for NO_X**	SCC Case \$40.8/metric ton CO_2* and Medium Value for NO_X**	SCC Case \$62.2/metric ton CO_2* and Medium Value for NO_X**	SCC Case \$117/metric ton CO_2* and High Value for NO_X**
	billion 2012$			
1	3.7	5.0	6.0	8.3
2	24.5	29.4	33.1	41.8
3	25.0	30.1	34.0	43.0
4	28.5	38.0	45.3	62.3
5	28.9	38.6	45.9	63.2
6	21.1	34.0	43.8	66.9
TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Case \$12.9/metric ton CO_2* and Low Value for NO_X**	SCC Case \$40.8/metric ton CO_2* and Medium Value for NO_X**	SCC Case \$62.2/metric ton CO_2* and Medium Value for NO_X**	SCC Case \$117/metric ton CO_2* and High Value for NO_X**
	billion 2012$			
1	1.5	2.8	3.8	6.1
2	9.2	14.0	17.8	26.4
3	9.4	14.4	18.3	27.2
4	10.8	20.1	27.4	44.3
5	10.9	20.4	27.8	44.8
6	6.7	19.4	29.3	52.1

* These label values represent the global SCC in 2015, in 2012$.
** Low Value corresponds to \$468 per ton of NO_X emissions. Medium Value corresponds to \$2,639 per ton, and High Value corresponds to \$4,809 per ton.

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating cost savings are domestic U.S. consumer 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 quite different time frames for analysis. The national operating cost savings is measured for the lifetime of products shipped in 2019–2048. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one metric ton of CO_2 in each year. Because of the long residence time of CO_2 in the atmosphere, these impacts continue well beyond 2100.

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)(VI)) No other factors were considered in this analysis.

C. Proposed Standards

When considering proposed standards, the new or amended energy conservation standard that DOE adopts for any type (or class) of covered product shall 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 today’s NOPR, DOE considered the impacts of standards 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 in understanding the benefits and/or burdens of each TSL, tables in this section summarize the quantitative analytical results for each TSL, based on the assumptions and methodology discussed herein. The efficiency levels contained in each TSL are described in section V.A. 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. Section V.B.1.b presents the estimated impacts of each TSL for these subgroups. DOE discusses the impacts on direct employment in residential furnace fan manufacturing in section V.B.2.b, and discusses the indirect employment impacts in section V.B.3.c.

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, renter versus owner or builder versus purchaser). Other literature indicates that with less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off at a higher than expected rate between current consumption and uncertain future energy cost savings. This undervaluation suggests that regulation that promotes energy efficiency can produce significant net private gains (as well as producing social gains by, for example, reducing pollution).

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 a purchase of a product in the standards case, this decreases sales for product manufacturers and the cost to manufacturers 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 standard decreases the number of products purchased by consumers, this decreases the potential energy savings from an energy conservation standard. DOE provides estimates of changes in the volume of product purchases in chapter 9 of the NOPR TSD. 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 (Reiss and White, 2005).[79]

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

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

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 standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[80] 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.

1. Benefits and Burdens of Trial Standard Levels Considered for Residential Furnace Fans

Table V.28 through Table V.30 summarize the quantitative impacts estimated for each TSL for residential furnace fans. The national impacts are measured over the lifetime of furnace fans purchased in the 30-year period that begins in the first full year of compliance with amended standards (2019-2048). The energy savings, emissions reductions, and value of emissions reductions refer to full-fuel-cycle results. Results that refer to primary energy savings are presented in chapter 10 of the NOPR TSD.

Table V.28 Summary of Analytical Results for Residential Furnace Fan Standards: National Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
National Full-Fuel-Cycle Energy Savings quads						
	0.635	2.254	2.332	4.576	4.629	6.250
NPV of Consumer Benefits 2012$ billion						
3% discount rate	3.37	23.30	23.81	26.16	26.57	17.95
7% discount rate	1.19	8.07	8.23	8.51	8.64	3.65
Cumulative Emissions Reduction (Total FFC Emissions)						

[80] Alan Sanstad, Notes on the Economics of Household Energy Consumption and Technology Choice. Lawrence Berkeley National Laboratory (2010) (Available at: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf (Last accessed May 3, 2013).

CO_2 million metric tons	59.01	220.2	227.9	429.8	435.2	582.3
SO_2 thousand tons	43.36	155.3	160.4	313.5	316.9	427.4
NO_X thousand tons	31.16	124.4	128.4	230.9	233.6	308.7
Hg tons	0.24	0.95	0.99	1.77	1.80	2.38
N_2O thousand tons	0.70	2.74	2.84	5.12	5.19	6.88
N_2O thousand tons CO_2eq*	207.2	816.0	845.0	1527.0	1547.7	2049.3
CH_4 thousand tons	132.6	371.0	384.6	913.7	922.3	1295
CH_4 million tons CO_2eq*	3.314	9.276	9.616	22.84	23.06	32.38
Value of Emissions Reduction (Total FFC Emissions) 2012$ billion						
CO_2 **	0.308 to 4.880	1.152 to 18.23	1.193 to 18.87	2.247 to 35.56	2.275 to 36.01	3.041 to 48.13
NO_X – 3% discount rate	0.043	0.155	0.161	0.314	0.318	0.428
NO_X – 7% discount rate	0.015	0.054	0.056	0.109	0.111	0.149

* 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 interagency estimates of the global benefit of reduced CO_2 emissions.

Table V.29 Summary of Analytical Results for Residential Furnace Fan Standards: Manufacturer and Average or Median Consumer Impacts*

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Manufacturer Impacts						
Industry NPV 2012$ million	(3.0) to 0.7	(26.7) to 13.5	(28.6) to 12.9	(54.4) to 33.8	(55.5) to 34.2	(170.1) to 58.2
Industry NPV % change	(1.2) to 0.3	(10.6) to 5.3	(11.3) to 5.1	(21.6) to 13.4	(22.0) to 13.6	(67.5) to 23.1
Consumer Average LCC Savings 2012$						
Non-weatherized, Non-condensing Gas Furnace Fan	$64	$442	$442	$474	$474	$313
Non-weatherized, Condensing Gas Furnace Fan	$49	$361	$361	$371	$371	$238
Weatherized Non-Condensing Gas Furnace Fan	$35	$228	$228	$247	$247	$67
Non-Weatherized, Non-Condensing Oil Furnace Fan	$40	$40	$344	$40	$344	$132
Non-weatherized Electric Furnace/Modular Blower Fan	$21	$160	$160	$185	$185	$17
Manufactured Home Non-weatherized, Non-	$26	$26	$146	$26	$146	($116)

condensing Gas Furnace Fan						
Manufactured Home Non-weatherized, Condensing Gas Furnace Fan	$27	$27	$152	$27	$152	($86)
Manufactured Home Electric Furnace/Modular Blower Fan	$14	$14	$64	$78	$78	($86)
Consumer Median PBP years						
Non-weatherized, Non-condensing Gas Furnace Fan	1.34	2.69	2.69	5.38	5.38	11.20
Non-weatherized, Condensing Gas Furnace Fan	1.35	2.73	2.73	5.39	5.39	11.03
Weatherized Non-Condensing Gas Furnace Fan	1.27	2.65	2.65	6.39	6.39	13.32
Non-Weatherized, Non-Condensing Oil Furnace Fan	5.49	5.49	6.97	5.49	6.97	25.41
Non-weatherized Electric Furnace/Modular Blower Fan	2.39	3.15	3.15	3.55	3.55	13.45
Manufactured Home Non-weatherized, Non-condensing Gas Furnace Fan	3.35	3.35	7.02	3.35	7.02	26.73
Manufactured Home Non-weatherized, Condensing Gas Furnace Fan	2.73	2.73	6.46	2.73	6.46	32.23
Manufactured Home Electric Furnace/Modular Blower Fan	2.49	2.49	4.35	4.61	4.61	17.11

*Parentheses indicate negative values.

Table V.30 Summary of Analytical Results for Residential Furnace Fan Standards: Distribution of Consumer LCC Impacts

Product Class	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5	TSL 6
Non-Weatherized, Non-Condensing Gas Furnace Fan						
Net Cost	2%	18%	18%	33%	33%	58%
No Impact	68%	25%	25%	14%	14%	0%
Net Benefit	30%	57%	57%	53%	53%	42%
Non-weatherized, Condensing Gas Furnace Fan						
Net Cost	1%	10%	10%	24%	24%	57%
No Impact	75%	41%	41%	34%	34%	0%
Net Benefit	24%	49%	49%	42%	42%	43%
Weatherized Non-Condensing Gas Furnace Fan						
Net Cost	0%	7%	7%	25%	25%	63%
No Impact	81%	56%	56%	33%	33%	0%
Net Benefit	18%	37%	37%	41%	41%	37%
Non-Weatherized, Non-Condensing Oil Furnace Fan						
Net Cost	12%	12%	43%	12%	43%	79%
No Impact	71%	71%	28%	71%	28%	0%
Net Benefit	18%	18%	29%	18%	29%	21%
Non-weatherized Electric Furnace/Modular Blower Fan						
Net Cost	5%	20%	20%	27%	27%	68%
No Impact	73%	37%	37%	25%	25%	0%
Net Benefit	21%	42%	42%	48%	48%	32%
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan						
Net Cost	13%	13%	58%	13%	58%	85%
No Impact	56%	56%	0%	56%	0%	0%
Net Benefit	32%	32%	42%	32%	42%	15%
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan						
Net Cost	7%	7%	38%	7%	38%	84%
No Impact	68%	68%	29%	68%	29%	0%
Net Benefit	26%	26%	32%	26%	32%	16%
Manufactured Home Electric Furnace/Modular Blower Fan						
Net Cost	8%	8%	28%	34%	34%	82%
No Impact	71%	71%	38%	26%	26%	0%
Net Benefit	21%	21%	34%	40%	40%	18%

Note: Components may not sum to total due to rounding.

First, DOE considered TSL 6, which would save an estimated total of 6.25 quads of energy, an amount DOE considers significant. TSL 6 has an estimated NPV of consumer benefit of $3.65 billion using a 7-percent discount rate, and $17.95 billion using a 3-percent discount rate.

The cumulative CO_2 emissions reduction at TSL 6 is 582.3 million metric tons. The estimated monetary value of the CO_2 emissions reductions ranges from $3.041 billion to $48.13 billion. The other emissions reductions are 427.4 thousand tons of SO_2, 308.7 thousand tons of NO_X, 2.38 tons of Hg, 6.88 thousand tons of N_2O, and 1.295 thousand tons of CH_4.

At TSL 6, the average LCC savings are positive for Non-weatherized, Non-condensing Gas Furnace Fans, Non-weatherized, Condensing Gas Furnace Fans, Weatherized Non-Condensing Gas Furnace Fan , Non-Weatherized, Non-Condensing Oil Furnace Fan, and Non-weatherized Electric Furnace/Modular Blower Fans. The LCC savings are negative for Manufactured Home Non-weatherized, Non-condensing Gas Furnace Fans, Manufactured Home Non-weatherized, Condensing Gas Furnace Fans, and Manufactured Home Electric Furnace/Modular Blower Fans. The median payback period is lower than the median product lifetime (which is 22.6 years for gas and electric furnace fans) for all of the product classes. The share of consumers experiencing an LCC cost (increase in LCC) is higher than the share experiencing an LCC benefit (decrease in LCC) for all of the product classes.

At TSL 6, manufacturers may expect diminished profitability due to large increases in product costs, stranded assets, capital investments in equipment and tooling, and expenditures related to engineering and testing. The projected change in INPV ranges from a decrease of $170.1 million to an increase of $58.2 million based on DOE’s manufacturer markup scenarios.

The upper bound of $58.2 million is considered an optimistic scenario for manufacturers because it assumes manufacturers can fully pass on substantial increases in product costs. DOE recognizes the risk of large negative impacts on industry if manufacturers' expectations concerning reduced profit margins are realized. TSL 6 could reduce INPV in the residential furnace fan industry by up to 67.5 percent if impacts reach the lower bound of the range.

Accordingly, the Secretary tentatively concludes that at TSL 6 for residential furnace fans, the benefits of significant energy savings, positive NPV of consumer benefit, emission reductions and the estimated monetary value of the CO_2 emissions reductions, as well as positive average LCC savings for most product classes would be outweighed by the high percentage of consumers that would experience an LCC cost in all of the product classes, and the substantial reduction in INPV for manufacturers. Consequently, DOE has concluded that TSL 6 is not economically justified.

Next, DOE considered TSL 5, which would save an estimated total of 4.629 quads of energy, an amount DOE considers significant. TSL 5 has an estimated NPV of consumer benefit of $8.64 billion using a 7-percent discount rate, and $26.57 billion using a 3-percent discount rate.

The cumulative CO_2 emissions reduction at TSL 5 is 435.2 million metric tons. The estimated monetary value of the CO_2 emissions reductions ranges from $2.275 billion to $36.01 billion. The other emissions reductions are 316.9 thousand tons of SO_2, 233.6 thousand tons of NO_X, 1.80 tons of Hg, 5.19 thousand tons of N_2O, and 922.3 thousand tons of CH_4.

At TSL 5, the average LCC savings are positive for all of the product classes. The median payback period is lower than the average product lifetime for all of the product classes. The share of consumers experiencing an LCC benefit (decrease in LCC) is higher than the share experiencing an LCC cost (increase in LCC) for five of the product classes (Non-Weatherized, Non-Condensing Gas Furnace Fans, Non-weatherized, Condensing Gas Furnace Fans, Weatherized Non-Condensing Gas Furnace Fans, Non-weatherized Electric Furnace/Modular Blower Fans, and Manufactured Home Electric Furnace/Modular Blower Fans), but lower for the other three product classes.

At TSL 5, the projected change in INPV ranges from a decrease of $55.5 million to an increase of $34.2 million. At TSL 5, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the lower bound of the range of impacts is reached, as DOE expects, TSL 5 could result in a net loss of 22.0 percent in INPV for residential furnace fan manufacturers.

Accordingly, the Secretary tentatively concludes that at TSL 5 for residential furnace fans, the benefits of significant energy savings, positive NPV of consumer benefit, positive average LCC savings for all of the product classes, emission reductions and the estimated monetary value of the CO_2 emissions reductions, would be outweighed by the high percentage of consumers that would be negatively impacted for some of the product classes, and the substantial reduction in INPV for manufacturers. Consequently, DOE has concluded that TSL 5 is not economically justified.

Next, DOE considered TSL 4, which would save an estimated total of 4.576 quads of energy, an amount DOE considers significant. TSL 4 has an estimated NPV of consumer benefit of $8.51 billion using a 7-percent discount rate, and $26.16 billion using a 3-percent discount rate.

The cumulative CO_2 emissions reduction at TSL 4 is 429.8 million metric tons. The estimated monetary value of the CO_2 emissions reductions ranges from $2.247 billion to $35.56 billion. The other emissions reductions are 313.5 thousand tons of SO_2, 230.9 thousand tons of NO_X, 1.77 tons of Hg, 5.12 thousand tons of N_2O, and 913.7 thousand tons of CH_4.

At TSL 4, the average LCC savings are positive for all of the product classes. The median payback period is lower than the average product lifetime for all of the product classes. The share of consumers experiencing an LCC benefit (decrease in LCC) is higher than the share experiencing an LCC cost (increase in LCC) for all of the product classes.

At TSL 4, the projected change in INPV ranges from a decrease of $54.4 million to an increase of $33.8 million. At TSL 4, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the lower bound of the range of impacts is reached, as DOE expects, TSL 4 could result in a net loss of 21.6 percent in INPV for residential furnace fan manufacturers.

After considering the analysis and weighing the benefits and the burdens, the Secretary tentatively concludes that at TSL 4 for residential furnace fans, the benefits of significant energy savings, positive NPV of consumer benefit, positive average LCC savings for all of the product classes, emission reductions and the estimated monetary value of the CO_2 emissions reductions would outweigh the reduction in INPV for manufacturers. The Secretary has tentatively concluded that TSL 4 would save a significant amount of energy and is technologically feasible and economically justified. Therefore, DOE today proposes to adopt the energy conservation standards for residential furnace fans at TSL 4. Table V.31 presents the proposed energy conservation standards for residential furnace fans.

Table V.31 Proposed Energy Conservation Standards for Residential Furnace Fans

Product Class	Proposed Standard: FER* (W/1000 cfm)
Non-Weatherized, Non-Condensing Gas Furnace Fan	FER = 0.029 x Q_{Max} + 180
Non-weatherized, Condensing Gas Furnace Fan	FER = 0.029 x Q_{Max} + 196
Weatherized Non-Condensing Gas Furnace Fan	FER = 0.029 x Q_{Max} + 135
Non-Weatherized, Non-Condensing Oil Furnace Fan	FER = 0.051 x Q_{Max} + 301
Non-weatherized Electric Furnace / Modular Blower Fan	FER = 0.029 x Q_{Max} + 165
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan	FER = 0.051 x Q_{Max} + 242
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan	FER = 0.051 x Q_{Max} + 262
Manufactured Home Electric Furnace/Modular Blower Fan	FER = 0.029 x Q_{Max} + 105
Manufactured Home Weatherized Non-Condensing Gas Furnace Fan	Reserved
Manufactured Home Non-Weatherized Non-Condensing Oil Furnace Fan	Reserved

*Q_{Max} is the airflow, in cfm, at the maximum airflow-control setting measured using the proposed DOE test procedure. 78 FR 19606, 19627 (April 2, 2013).

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

The benefits and costs of today's 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 2012$, of the benefits from operating products that meet the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase costs, which is another way of representing consumer NPV), and (2) the monetary value of the benefits of emission reductions, including CO_2 emission reductions.[81] The value of the CO_2 reductions, otherwise known as the Social Cost of Carbon (SCC), is calculated using a range of values per metric ton of CO_2 developed by a recent interagency process.

Although combining the values of operating savings and CO_2 reductions provides a useful perspective, 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 while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and SCC are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of products shipped in 2019–2048. The SCC values, on the other hand, reflect the present value of future climate-

[81] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2013, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates. From the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in 2013, that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined would be a steady stream of payments.

related impacts resulting from the emission of one metric ton of CO_2 in each year over a very long period.

Table V.32 shows the annualized values for the proposed standards for residential furnace fans. The results under the primary estimate are as follows. (All monetary values below are expressed in 2012$.) 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 SCC series corresponding to a value of $40.8/ton in 2015), the cost of the residential furnace fan standards proposed in today's rule is $231 million per year in increased equipment costs, while the benefits are $872 million per year in reduced equipment operating costs, $571 million in CO_2 reductions, and $8.24 million in reduced NO_X emissions. In this case, the net benefit amounts to $1,220 million per year.

Using a 3-percent discount rate for all benefits and costs and the SCC series corresponding to a value of $40.8/ton in 2015, Table V.32 shows the cost of the residential furnace fans standards proposed in today's rule is $290 million per year in increased equipment costs, while the benefits are $1585 million per year in reduced operating costs, $571 million in CO_2 reductions, and $15.56 million in reduced NO_X emissions. In this case, the net benefit amounts to $1,882 million per year.

Table V.32 Annualized Benefits and Costs of Proposed Standards (TSL 4) for Residential Furnace Fans

	Discount Rate	Primary Estimate*	Low Net Benefits Estimate	High Net Benefits Estimate
		million 2012$/year		
Benefits				
Operating Cost Savings	7%	872	710	1082
	3%	1585	1264	2011
CO_2 Reduction Monetized Value ($12.9/t case)**	5%	139	117	171
CO_2 Reduction Monetized Value ($40.8/t case)**	3%	571	477	702
CO_2 Reduction Monetized Value ($62.2/t case)**	2.5%	877	732	1079
CO_2 Reduction Monetized Value ($117/t case)**	3%	1761	1471	2167
NO_X Reduction Monetized Value (at $2,639/ton)**	7%	8.24	6.97	9.99
	3%	15.56	13.03	19.09
Total Benefits†	7% plus CO_2 range	1,019 to 2,641	834 to 2,188	1,263 to 3,259
	7%	1,451	1,194	1,794
	3% plus CO_2 range	1,740 to 3,362	1,394 to 2,748	2,201 to 4,197
	3%	2,172	1,754	2,732
Costs				
Incremental Product Costs	7%	231	273	201
	3%	290	346	250
Net Benefits				
Total†	7% plus CO_2 range	788 to 2,410	561 to 1,915	1,062 to 3,058
	7%	1,220	921	1,593
	3% plus CO_2 range	1,450 to 3,072	1,047 to 2,402	1,951 to 3,947
	3%	1,882	1,407	2,482

* This table presents the annualized costs and benefits associated with residential furnace fans shipped in 2019−2048. These results include benefits to consumers which accrue after 2048 from the products purchased in 2019−2048. Costs incurred by manufacturers, some of which may be incurred in preparation for the rule, are not directly included, but are indirectly included as part of incremental equipment costs. The Primary, Low Benefits, and High Benefits Estimates utilize projections of energy prices and housing starts from the AEO 2012 Reference case, Low Estimate, and High Estimate, respectively. Incremental product costs reflect a constant product price trend in the Primary Estimate, an increasing price trend in the Low Benefits Estimate, and a decreasing price trend in the High Benefits Estimate.

** The CO_2 values represent global values of the SCC, in 2012$, in 2015 under several scenarios. The first three cases use the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The fourth case represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The SCC values increase over time. The value for NO_X (in 2012$) is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to SCC value of $40.8/t in 2015. In the rows labeled "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Orders 12866 and 13563

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

(1) There is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the home appliance market.

(2) There is asymmetric information (one party to a transaction has more and better information than the other) and/or high transactions costs (costs of gathering information and effecting exchanges of goods and services).

(3) There are external benefits resulting from improved energy efficiency of residential furnace fans that are not captured by the users of such equipment. These benefits include externalities related to environmental protection and energy security that are not reflected in energy prices, such as reduced emissions of greenhouse gases.

In addition, DOE has determined that today's regulatory action is an "economically significant regulatory action" under section 3(f)(1) of Executive Order 12866. Accordingly, section 6(a)(3) of the Executive Order requires that DOE prepare a regulatory impact analysis (RIA) on today's rule and that the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) review this rule. DOE presented to OIRA for review the draft rule and other documents prepared for this rulemaking, including the RIA, and has included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 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, the Office of Information and Regulatory Affairs 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 today's NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (August

16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's website (http://energy.gov/gc/office-general-counsel). DOE has prepared the following IRFA for the products that are the subject of this rulemaking.

1. Description and Estimated Number of Small Entities Regulated

a. Methodology for Estimating the Number of Small Entities

For the manufacturers of residential furnace fans, the Small Business Administration (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. 65 FR 30836, 30848 (May 15, 2000), as amended at 65 FR 53533, 53544 (Sept. 5, 2000) and codified at 13 CFR part 121. The size standards are listed by NAICS code and industry description and are available at: www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf. Residential furnace fan manufacturing is classified under NAICS 333415, "Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment 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 business manufacturers of products covered by this rulemaking, DOE conducted a market survey using available public information to identify potential small manufacturers. DOE's research involved industry trade association membership directories (including AHRI), public databases (*e.g.*, AHRI Directory,[82] the SBA Database[83]), individual company websites, and market research tools (*e.g.*, Hoovers reports) to create a list of companies that manufacture or sell products covered by this rulemaking. DOE also asked stakeholders and industry representatives if they were aware of any other small manufacturers during manufacturer interviews and at DOE public meetings. DOE reviewed publicly-available data and contacted select companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered residential furnace fans. DOE screened out companies that do not offer products covered by this rulemaking, do not meet the definition of a "small business," or are foreign owned and operated.

DOE initially identified at least 40 potential manufacturers of residential furnace fan products sold in the U.S. DOE then determined that 26 were large manufacturers, manufacturers that are foreign owned and operated, or manufacturers that do not produce products covered by this rulemaking. DOE was able to determine that approximately 14 manufacturers meet the SBA's definition of a "small business" and manufacture products covered by this rulemaking.

b. Manufacturer Participation

Before issuing this NOPR, DOE attempted to contact all the small business manufacturers of residential furnace fans it had identified. One of the small businesses consented to being interviewed during the MIA interviews. DOE also obtained information about small business impacts while interviewing large manufacturers.

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[82] See www.ahridirectory.org/ahriDirectory/pages/home.aspx.

[83] See http://dsbs.sba.gov/dsbs/search/dsp_dsbs.cfm.

c. Industry Structure

The 14 identified domestic manufacturers of residential furnace fans that qualify as small businesses under the SBA size standard account for a small fraction of industry shipments. Generally, manufacturers of furnaces are also manufacturers of furnace fan products. The market for domestic gas furnaces is almost completely held by seven large manufacturers, and small manufacturers in total account for only 1 percent of the market. These seven large manufacturers also control 97 percent of the market for central air conditioners. The market for manufactured home furnaces is primarily held by one large manufacturer. In contrast, the market for domestic oil furnaces is almost entirely comprised of small manufacturers.

d. Comparison Between Large and Small Entities

The proposed standards for residential furnace fans could cause small manufacturers to be at a disadvantage relative to large manufacturers. One way in which small manufacturers could be at a disadvantage is that they may be disproportionately affected by product conversion costs. Product redesign, testing, and certification costs tend to be fixed and do not scale with sales volume. For each product model, small businesses must make investments in research and development to redesign their products, but because they have lower sales volumes, they must spread these costs across fewer units. In addition, because small manufacturers have fewer engineers than large manufacturers, they would need to allocate a greater portion of their available resources to meet a standard. Since engineers may need to spend more time redesigning and testing existing models as a result of the new standard, they may have less time to develop new products.

Furthermore, smaller manufacturers may lack the purchasing power of larger manufacturers. For example, since motor suppliers give discounts to manufacturers based on the number of motors they purchase, larger manufacturers may have a pricing advantage because they have higher volume purchases. This purchasing power differential between high-volume and low-volume orders applies to other furnace fan components as well, including the impeller fan blade, transformer, and capacitor.

2. Description and Estimate of Compliance Requirements

Since the proposed standard for residential furnace fans could cause small manufacturers to be at a disadvantage relative to large manufacturers, DOE cannot certify that the proposed standards would not have a significant impact on a significant number of small businesses, and consequently, DOE has prepared this IRFA.

At TSL 4, the level proposed in today's notice, DOE estimates no capital conversion costs and product conversion costs of $0.014 million for a typical small manufacturer, compared to product conversion costs of $0.431 million for a typical large manufacturer. These costs and their impacts are described in detail below.

To estimate how small manufacturers would be potentially impacted, DOE used the market share of small manufacturers to estimate the annual revenue, earnings before interest and tax (EBIT), and research and development (R&D) expense for a typical small manufacturer. DOE then compared these costs to the required product conversion costs at each TSL for both an average small manufacturer and an average large manufacturer (see Tables VI.1 and Table VI.2). In the following tables, TSL 4 represents the proposed standard.

Although conversion costs can be considered substantial for all companies, the impacts could be relatively greater for a typical small manufacturer because of much lower production volumes and the relatively fixed nature of the R&D resources required per model. Small manufacturers also have less engineering staff and lower R&D budgets. As a result, the product conversion costs incurred by a small manufacturer would likely be a larger percentage of its revenues, R&D expenses, and EBIT, than those for a large manufacturer. Table VI.1 shows the product conversion costs for a typical large manufacturer versus those of a typical small manufacturer. Table VI.2 compares the total conversion costs of a typical large manufacturer as a percentage of annual R&D expense, annual revenue, and EBIT to those of a typical small manufacturer.

Table VI.1: Comparison of a Typical Small and Large Residential Furnace Fan Manufacturer's Product Conversion Costs

	Product Conversion Costs for a Typical Large Manufacturer (2012$ millions)	Product Conversion Costs for a Typical Small Manufacturer (2012$ millions)
Baseline	$0.000	$0.000
TSL 1	$0.154	$0.007
TSL 2	$0.378	$0.012
TSL 3	$0.391	$0.014
TSL 4	$0.431	$0.014
TSL 5	$0.438	$0.019
TSL 6	$1.261	$0.045

Table VI.2: Comparison of a Typical Small and Large Residential Furnace Fan Manufacturer's Product Conversion Costs to Annual R&D Expense, Annual Revenue, and EBIT

	Large Manufacturer			Small Manufacturer		
	Product Conversion Costs as a Percentage of Annual R&D Expense	Product Conversion Costs as a Percentage of Annual Revenue	Product Conversion Costs as a Percentage of Annual EBIT	Product Conversion Costs as a Percentage of Annual R&D Expense	Product Conversion Costs as a Percentage of Annual Revenue	Product Conversion Costs as a Percentage of Annual EBIT
Baseline	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TSL 1	14.7%	0.3%	4.0%	137.9%	2.6%	37.4%
TSL 2	36.1%	0.7%	9.8%	226.3%	4.3%	61.4%
TSL 3	37.3%	0.7%	10.1%	267.7%	5.1%	72.7%
TSL 4	41.1%	0.8%	11.2%	267.7%	5.1%	72.7%
TSL 5	41.8%	0.8%	11.3%	368.4%	7.0%	100.0%
TSL 6	120.4%	2.3%	32.7%	850.6%	16.2%	230.9%

Based on the results in Table VI.1 and Table VI.2, DOE understands that the potential product conversions costs faced by small manufacturers may be proportionally greater than those faced by larger manufacturers. However, the total cost at TSL 4 of approximately $14,000 per small manufacturer is still a small percentage of a small manufacturer's total annual revenues (5.1 percent) and product conversion costs would also only be a one-time expense. Furthermore, TSLs lower than the proposed TSL would not result in significantly lower product conversion costs for small manufacturers.

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 rule being proposed today.

4. Significant Alternatives to the Rule

The discussion above analyzes impacts on small businesses that would result from the other TSLs DOE considered. Although TSLs lower than the proposed TSLs would be expected to reduce the impacts on small entities, DOE is required by EPCA to establish standards that achieve the maximum improvement in energy efficiency that is technically feasible and economically justified, and result in a significant conservation of energy. Thus, DOE rejected the lower TSLs.

In addition to the other TSLs being considered, the NOPR TSD includes a regulatory impact analysis in chapter 17. For residential furnace fans, this report discusses the following policy alternatives: (1) no standard, (2) consumer rebates, (3) consumer tax credits, (4) manufacturer tax credits, and (5) early replacement. DOE does not intend to consider these alternatives further because they are either not feasible to implement without authority and funding from Congress, or are expected to result in energy savings that are much smaller (ranging from less than 1 percent to approximately 33 percent) than those that would be achieved by the proposed energy conservation standards.

DOE continues to seek input from small businesses that would be affected by this rulemaking and will consider comments received in the development of any final rule.

C. Review Under the Paperwork Reduction Act of 1995

1. Description of the Requirements

DOE is developing regulations to implement reporting requirements for energy conservation, water conservation, and design standards, and to address other matters including compliance certification, prohibited actions, and enforcement procedures for covered consumer products and commercial and industrial equipment covered by EPCA, including furnace fans. . DOE will send an information collection approval to OMB under Control Number 1910-1400.

2. Method of Collection

DOE is proposing that respondents must submit electronic forms using DOE's on-line Compliance Certification Management System (CCMS) system.

3. Data

The following are DOE estimates of the total annual reporting and recordkeeping burden imposed on manufacturers of residential furnace fans subject to the proposed certification provisions in this notice. These estimates take into account the time necessary to develop testing documentation, maintain all the documentation supporting the development of the certified rating for each basic model, complete the certification, and submit all required documents to DOE electronically.

OMB Control Number: 1910-1400.

Form Number: None.

Type of Review: Regular submission.

Affected Public: Manufacturers of residential furnace fans covered by this rulemaking.

Estimated Number of Respondents: 37.

Estimated Time per Response: Certification reports, 20 hours.

Estimated Total Annual Burden Hours: 740.

Estimated Total Annual Cost to the Manufacturers: $55,000 in recordkeeping/reporting costs.

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 that 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 today's 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, Executive Order 13132 requires no further action.

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

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

Although today's proposed rule, which proposes new energy conservation standards for residential furnace fans, does not contain a Federal intergovernmental mandate, it may require annual 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, including: (1) investment in research and development and in capital expenditures by residential furnace fans 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 residential furnace 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 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(f) and (o), today's proposed rule would establish energy conservation standards for residential furnace 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 TSD for today's 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 today's 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 today's regulatory action, which sets forth proposed energy conservation standards for residential furnace 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 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. As explained in the **ADDRESSES** section, foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE of this fact as soon as possible by contacting Ms. Brenda Edwards to initiate the necessary procedures.

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 website at:

http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/42. Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Requests to Speak and Prepared General Statements For Distribution

Any person who has an interest in the topics addressed in this notice, or who is representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation at the public meeting. Such persons may hand-deliver requests to speak to the address shown in the **ADDRESSES** section at the beginning of this notice between 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays. Requests may also be sent by mail or email to: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW, Washington, DC 20585-0121, or Brenda.Edwards@ee.doe.gov. Persons who wish to speak should include with their request a computer diskette or CD-ROM in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format that briefly describes the nature of their interest in this rulemaking and the topics they wish to discuss. Such persons should also provide a daytime telephone number where they can be reached.

DOE requests persons scheduled to make an oral presentation to submit an advance copy of their statements at least one week before the public meeting. DOE may permit persons who cannot supply an advance copy of their statement to participate, if those persons have made advance alternative arrangements with the Building Technologies Program. As necessary, requests to give an oral presentation should ask for such alternative arrangements.

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 website. 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 website 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 which 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. Additional FER value data that are generated using the DOE residential furnace fans test procedure proposed in the April 2, 2013 SNOPR (78 FR 19606), as well as the product class, measured airflow capacity in the maximum airflow control setting, and technology options of the model for which each FER value is calculated.

2. DOE's methodology for accounting for the relationship between FER and airflow capacity, and the resulting efficiency levels that are represented by equations for FER as a function of airflow capacity. (See Chapter 5 of the NOPR TSD)

3. The reasonableness of the values that DOE used to characterize the rebound effect with higher-efficiency residential furnace fans.

4. DOE's estimate of the base-case efficiency distribution of residential furnace fans in 2018.

5. The long-term market penetration of higher-efficiency residential furnace fans.

6. DOE performed physical teardowns on a selection of units currently on the market. From the bills of materials and cost model developed using this teardown data, DOE calculated an estimate of the manufacturer production cost for each covered product class in the engineering analysis. DOE also developed estimates of the costs for components that affect energy consumption, namely those it considered as design options. These estimates

were obtained from a combination of sources, including publicly available prices from vendors and confidential estimates provided by manufacturers. These price data are aggregated for use in the engineering analysis. DOE seeks comment and data regarding the manufacturer production costs for furnace fan equipment and components and the technological feasibility of applying technologies identified in the engineering analysis to meet the proposed standards.

7. To estimate the impact on shipments of the price increase for the considered efficiency levels, DOE used the relative price elasticity approach that was applied in the 2011 energy conservation standards rulemaking for residential furnaces. DOE welcomes stakeholder input and estimates on the effect of amended standards on future furnace fan equipment shipments. DOE also welcomes input and data on the demand elasticity estimates used in the analysis.

8. DOE requests comment on whether there are features or attributes of the more energy-efficient furnace fans that manufacturers would produce to meet the standards in this proposed rule that might affect how they would be used by consumers. DOE requests comment specifically on how any such effects should be weighed in the choice of standards for furnace fans for the final rule.

9. For this rulemaking, DOE analyzed the effects of this proposal assuming that the furnace fans would be available to purchase for 30 years, and it undertook a sensitivity analysis using 9 years rather than 30 years of product shipments. The choice of a 30-year

period of shipments is consistent with the DOE analysis for other products and commercial equipment. 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. We are seeking input, information and data on whether there are ways to refine the analytic timeline further.

10. DOE defines lifetime as the age at which residential furnace fan equipment is retired from service. DOE modeled furnace fan lifetime based on the distribution of furnace lifetimes developed for the recent energy conservation standards rulemaking for residential furnaces. DOE welcomes further input on the average equipment lifetimes for the LCC analysis and NIA.

11. DOE solicits comment on the application of the new SCC values used to determine the social benefits of CO_2 emissions reductions over the rulemaking analysis period. The rulemaking analysis period covers from 2017 to 2046 plus an additional 50 years to account for the lifetime operation of the equipment purchased in that period. In particular, the agency solicits comment on its derivation of SCC values after 2050, where the agency applied the average annual growth rate of the SCC estimates in 2040−2050 associated with each of the four sets of values.

12. The agency also seeks input on the cumulative regulatory burden that may be imposed on industry either from recently implemented rulemakings for these products or other rulemakings that affect the same industry.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's notice of proposed rulemaking.

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Commercial equipment, Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 430

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

Issued in Washington, DC, on
September 30, 2013.

David T. Danielson
Assistant Secretary
Energy Efficiency and Renewable Energy

For the reasons stated in the preamble, DOE proposes to amend parts 429 and 430 of chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

PART 429— CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

a. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291-6317.

2. Section 429.12 is amended by:

a. Amending paragraph (d) table, first column, second row (i.e., for products with a submission deadline of May 1st) by removing the word "and" and by adding "and Residential furnace fans" at the end of the listed products.

b. Removing in paragraph (b)(13) "429.54" and adding in its place 429.58"; and

c. Adding paragraph (i)(5).

The addition reads as follows:

§ 429.12 General requirements applicable to certification reports.

* * * * *

(i) Compliance dates. * * *

(5) Reserved;

(6) Residential furnace fans, [*date five years after publication of the final rule*].

3. Section 429.58 is added to read as follows:

§ 429.58 Furnace fans.

(a) Sampling plan for selection of units for testing. [Reserved]

(b) Certification reports.

(1) The requirements of §429.12 are applicable to residential furnace fans; and

(2) Pursuant to §429.12(b)(13), a certification report shall include the following public product-specific information: The fan energy rating (FER) in watts per thousand cubic feet per minute (W/1000 cfm); the calculated maximum airflow at the reference system external static pressure (ESP) in cubic feet per minute (cfm); the control system configuration for achieving the heating and constant-circulation airflow-control settings required for determining FER as specified in the furnace fan test procedure (10 CFR part 430, subpart B, appendix AA); the measured steady-state gas, oil, or electric heat input rate (Q_{IN}) in the heating setting required for determining FER; and for modular blowers, the manufacturer and model number of the electric heat resistance kit with which it is equipped for certification testing.

PART 430 - ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

5. Section 430.32 is amended by adding paragraph (y) to read as follows:

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

*   *   *   *   *

(y) Residential furnace fans. Residential furnace fans manufactured on or after (*date five years after date of final rule publication in the Federal Register*), shall have a fan energy rating (FER) value that meets or is less than the following values:

Product Class	**FER[*] (Watts/cfm)**
Non-Weatherized, Non-Condensing Gas Furnace Fan (NWG-NC)	FER = 0.029 x Q_{Max} + 180
Non-Weatherized, Condensing Gas Furnace Fan (NWG-C)	FER = 0.029 x Q_{Max} + 196
Weatherized Non-Condensing Gas Furnace Fan (WG-NC)	FER = 0.029 x Q_{Max} + 135
Non-Weatherized, Non-Condensing Oil Furnace Fan (NWO-NC)	FER = 0.051 x Q_{Max} + 301
Non-Weatherized Electric Furnace / Modular Blower Fan (NWEF/NWMB)	FER = 0.029 x Q_{Max} + 165
Manufactured Home Non-Weatherized, Non-Condensing Gas Furnace Fan (MH-NWG-NC)	FER = 0.051 x Q_{Max} + 242
Manufactured Home Non-Weatherized, Condensing Gas Furnace Fan (MH-NWG-C)	FER = 0.051 x Q_{Max} + 262
Manufactured Home Electric Furnace / Modular Blower Fan (MH-EF/MB)	FER = 0.029 x Q_{Max} + 105
Manufactured Home Non-Weatherized Oil Furnace Fan (MH-NWO)	Reserved
Manufactured Home Weatherized Gas Furnace Fan (MH-WG)	Reserved

[*]Q_{Max} is the airflow, in cfm, at the maximum airflow-control setting.

*   *   *   *   *