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[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EERE–2014–BT–STD–0031]

RIN: 1904–AD20

Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces

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

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

SUMMARY: The Energy Policy and Conservation Act of 1975 (EPCA), as amended, prescribes energy conservation standards for various consumer products and certain commercial and industrial equipment, including residential furnaces. EPCA also requires the U.S. Department of Energy (DOE) to periodically determine whether more-stringent, amended standards would be technologically feasible and economically justified, and would save a significant amount of energy. In this notice, DOE proposes amended energy conservation standards for residential non-weatherized gas furnaces and mobile home furnaces, in partial fulfillment of a court-ordered remand of DOE's 2011 rulemaking for these products. 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 Thursday, March 26, 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 90 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 or tablet 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 Furnaces, and provide docket number EERE-2014–BT–STD–0031 and/or regulatory information number (RIN) number 1904–AD20. 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: ResFurnaces2014STD0031@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 on encryption.
3. Postal Mail: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Office, Mailstop EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. If possible, please submit all items on a compact disc (CD), in which case it is not necessary to include printed copies.
4. Hand Delivery/Courier: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC, 20024. Telephone: (202) 586-2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this proposed rule may be submitted to Office of Energy Efficiency and Renewable Energy through the methods listed above and by 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, which includes Federal Register notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at www.regulations.gov. All documents in the docket are listed in the www.regulations.gov index. However, some documents listed in the index may not be publically available, such as those containing information that is exempt from public disclosure.

A link to the docket webpage can be found at: http://www.regulations.gov/#!docketDetail;D=EERE-2014-BT-STD-0031. This webpage contains a link to the docket for this notice on the www.regulations.gov site. The www.regulations.gov webpage 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. John Cymbalsky, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Office, EE-5B, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. Telephone: (202) 287-1692. E-mail: residential_furnaces_and_boilers@ee.doe.gov.

Mr. Eric Stas or Ms. Johanna Hariharan, U.S. Department of Energy, Office of the General Counsel, GC-71, 1000 Independence Avenue, SW., Washington, DC 20585-0121. Telephone: (202) 586-9507 or (202) 287-6307. E-mail: Eric.Stas@hq.doe.gov or Johanna.Hariharan@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.[2] These products include non-weatherized gas furnaces (NWGFs) and mobile home gas furnaces (MHGFs), the subject of this notice.

Pursuant to EPCA, any new or amended energy conservation standard must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must result in a significant conservation of energy. (42 U.S.C. 6295(o)(3)(B)) EPCA specifically provides that DOE must conduct a second round of energy conservation standards rulemaking for NWGFs and MHGFs. (42 U.S.C. 6295(f)(4)(C)) The statute also provides that not later than 6 years after issuance of any final rule establishing or amending a standard, DOE must publish either a notice of determination that standards for the product do not need to be amended, or a notice of proposed rulemaking including new proposed energy conservation standards. (42 U.S.C. 6295(m)(1)) Once complete, this rulemaking will satisfy both statutory provisions.

In accordance with these and other statutory provisions discussed in this notice, DOE proposes amended energy conservation standards for NWGFs and MHGFs. The

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

proposed standards, which are expressed as minimum annual fuel utilization efficiencies (AFUE), are shown in Table I.1. Table I.2 shows the proposed standards for standby mode and off mode. These proposed standards, if adopted, would apply to all products listed in Table I.1 and Table I.2 and manufactured in, or imported into, the United States on or after the date 5 years after the publication of the final rule for this rulemaking.

Table I.1 Proposed AFUE Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces (TSL 3)

Product Class	Proposed Standard: AFUE %
Non-Weatherized Gas-Fired Furnaces	92
Mobile Home Gas-Fired Furnaces	92

Table I.2 Proposed Standby Mode and Off Mode Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Electrical Energy Consumption (TSL 3)

Product Class	Proposed Standby Mode Standard: $P_{W,SB}$ Watts	Proposed Off Mode Standard: $P_{W,OFF}$ Watts
Non-Weatherized Gas-Fired Furnaces	8.5	8.5
Mobile Home Gas-Fired Furnaces	8.5	8.5

A. Benefits and Costs to Consumers

Table I.3 and Table I.4 present DOE's evaluation of the economic impacts of the proposed AFUE and standby and off mode standards on consumers of NWGFs and MHGFs, as measured by the average life-cycle cost (LCC) savings and the simple payback period (PBP).[3] In both cases, the average LCC savings are positive for all

[3] The average LCC savings are measured relative to the base-case efficiency distribution, which depicts the furnace market in the compliance year (see section IV.F.3.f). The simple PBP, which is designed to compare specific furnace AFUE and standby and off mode efficiency levels, is measured relative to the baseline furnace AFUE and standby and off mode (see sectionIV.C.1.a). The AFUE standard results include the projected fuel switching as described in chapter 8 of the NOPR TSD.

product classes. The PBP for each product class falls well below the average furnace lifetime, which is approximately 22 years.[4]

Table I.3 Impacts of Proposed AFUE Energy Conservation Standards on Consumers of Residential Furnaces (TSL 3)

Product Class	Average LCC Savings 2013$	Simple Payback Period years
Non-Weatherized Gas-Fired Furnaces	$305	7.2
Mobile Home Gas-Fired Furnaces	$691	2.2

Table I.4 Impacts of Proposed Standby Mode and Off Mode Electrical Energy Consumption Energy Conservation Standards on Consumers of Residential Furnaces (TSL 3)

Product Class	Average LCC Savings 2013$	Median Payback Period years
Non-Weatherized Gas Furnace	$13	6.6
Mobile Home Gas Furnace	$1	5.9

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 of the MIA analysis through the end of the analysis period (2014 to 2050). Using a real discount rate of 6.4 percent, DOE estimates that the INPV for manufacturers of NWGF and MHGF is $1055.13 million in 2013$. DOE analyzed the impacts of AFUE energy conservation standards and standby/off mode electrical energy consumption energy conservation standards on manufacturers independently. Under the proposed AFUE standards, DOE expects the change in INPV to range from -7.93 percent to 0.62 percent. Under the proposed standby mode and off mode standards,

[4] See appendix 8G of the NOPR TSD for details of the derivation of the average furnace lifetime.

DOE expects the change in INPV will range from -1.1 to 0.2 percent. Industry total conversion costs are expected to total $55 million as a result of the proposed standard.

A key consideration in DOE's selection of the proposed standard was the cumulative regulatory burden associated with the residential furnace fan final rule, 79 FR 38130 (July 3, 2014). Today's proposed standard and the furnace fans standard impact the same products (i.e., residential furnaces), affect the same group of manufacturers, and go into effect in a similar timeframe. Based on currently available information, DOE assumes the regulatory impact of these two rules to be largely additive with limited opportunity for cost savings to be achieved through coordinating the expenditures of the two rules. Thus, when considering the total conversion costs of the furnace fans final rule ($40.6 million), manufacturers could incur a combined total of $95.6 million conversion costs in the years leading up to the 2019 furnace fans and the projected 2021 residential furnaces effective dates.

DOE selected the proposed standard levels in today's proposal in such a way as to reduce the cumulative burden on manufacturers that result from the additive effects of the two rules, although higher standard levels for residential furnaces may have been justified based solely on the analytical results presented in this NOPR. See Sections V.B.2.e and V.C.1 for a more detail discussion of cumulative regulatory burden.

C. National Benefits[5]

DOE's analyses indicate that the proposed AFUE energy conservation standards for NWGFs and MHGFs would save a significant amount of energy. The lifetime energy savings for NWGFs and MHGFs purchased in the 30-year period that begins in the first full year of compliance with amended standards (2021-2050) amount to 2.78 quads[6] of full-fuel-cycle energy. This is a savings of 1.1 percent relative to the energy use of these products in the base case without amended standards.

The cumulative net present value (NPV) of total consumer costs and savings for the proposed NWGF and MHGF AFUE standards ranges from $3.1 billion to $16.1 billion at 7-percent and 3-percent discount rates, respectively. This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased installed product costs for NWGFs and MHGFs purchased in 2021-2050.

In addition, the proposed NWGF and MHGF AFUE standards would have significant environmental benefits. The proposed standards would result in cumulative emission reductions of 137 million metric tons (Mt)[7] of carbon dioxide (CO_2), 3,424 thousand tons of methane (CH_4), and 816 thousand tons of nitrogen oxides (NO_X).[8] Projected emissions show an increase of 203 thousand tons of sulfur dioxide (SO_2), 2.61 thousand tons of nitrous oxide (N_2O), and 0.629 tons of mercury (Hg). The increase is

[5] Energy savings in this section refer to full-fuel-cycle savings (see section IV.H for discussion).
[6] A quad is equal to 10^{15} British thermal units (Btu).
[7] A metric ton is equivalent to 1.1 short tons. Results for emissions other than CO_2 are presented in short tons.
[8] DOE calculated emissions reductions relative to the Annual Energy Outlook 2014 (AEO 2014) Reference case, which generally represents current legislation and environmental regulations, including recent government actions for which implementing regulations were available as of October 31, 2013.

due to projected switching from NWGFs to electric heat pumps and electric furnaces under the proposed standards. The cumulative reduction in CO_2 emissions through 2030 amounts to 4.2 Mt, which is a savings of 0.2 percent relative to the CO_2 emissions in the base case without amended standards.

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by a recent Federal interagency process.[9] The derivation of the SCC values is discussed in section IV.L. Using discount rates appropriate for each set of SCC values, DOE estimates the present monetary value of the CO_2 emissions reduction is between $0.7 billion and $11.7 billion. Additionally, DOE estimates the present monetary value of the NO_X emissions reduction to be $0.32 billion to $0.88 billion at 7-percent and 3-percent discount rates, respectively.[10]

Table I.5 summarizes the national economic benefits and costs expected to result from the proposed AFUE standards for NWGFs and MHGFs.

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

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

Table I.5 Summary of National Economic Benefits and Costs of Proposed AFUE Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces (TSL 3)*

Category	Present Value Billion 2013$	Discount Rate %
Benefits		
Consumer Operating Cost Savings	8.9	7
	27.7	3
CO_2 Reduction Monetized Value ($12.0/t case)**	0.7	5
CO_2 Reduction Monetized Value ($40.5/t case)**	3.8	3
CO_2 Reduction Monetized Value ($62.4/t case)**	6.1	2.5
CO_2 Reduction Monetized Value ($119/t case)**	11.7	3
NO_X Reduction Monetized Value (at $2,684/ton)**	0.3	7
	0.9	3
Total Benefits†	13.0	7
	32.4	3
Costs		
Consumer Incremental Installed Costs	5.8	7
	11.6	3
Total Net Benefits		
Including Emissions Reduction Monetized Value†	7.2	7
	20.8	3

* This table presents the costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the products purchased in 2021-2050. 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 2013$, 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 95^{th} 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 high and low values found in the literature.
† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to average SCC with a 3-percent discount rate ($40.5/t in 2015).

For the proposed standby mode and off mode standards, the lifetime energy savings for NWGFs and MHGFs purchased in the 30-year period that begins in the first full year of compliance with amended standards (2021-2050) amount to 0.28 quads of energy. This is a savings of 15.9 percent relative to the standby energy use of these products in the base case without amended standards.

The cumulative net present value (NPV) of total consumer costs and savings for the proposed NWGF and MHGF standby mode and off mode standards ranges from $1.0 billion to $3.3 billion at 7-percent and 3-percent discount rates, respectively. This NPV expresses the estimated total value of future operating-cost savings minus the estimated increased product costs for NWGFs and MHGFs purchased in 2021-2050.

In addition, the proposed standby mode and off mode standards would have significant environmental benefits. The energy savings would result in cumulative emission reductions of 15.6 Mt of CO_2, 75 thousand tons of CH_4, 0.22 thousand tons of N_2O, 13.0 thousand tons of SO_2, 24.3 thousand tons of NO_X, and 0.04 tons of Hg. The cumulative reduction in CO_2 emissions through 2030 amounts to 1.5 Mt.

As noted above, the value of the CO_2 reductions is calculated using a range of SCC values developed by a recent Federal interagency process. Using discount rates appropriate for each set of SCC values, DOE estimates the present monetary value of the CO_2 emissions reduction is between $0.09 billion and $1.37 billion. Additionally, DOE estimates the present monetary value of the NO_X emissions reduction to be $0.01 billion to $0.03 billion at 7-percent and 3-percent discount rates, respectively.

Table I.6 summarizes the national economic benefits and costs expected to result from the proposed standby mode and off mode standards for NWGFs and MHGFs.

Table I.6 Summary of National Economic Benefits and Costs of Proposed Standby Mode and Off Mode Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces (TSL 3)*

Category	Present Value Billion 2013$	Discount Rate %
Benefits		
Consumer Operating Cost Savings	1.4	7
	3.9	3
CO_2 Reduction Monetized Value ($12.0/t case)**	0.1	5
CO_2 Reduction Monetized Value ($40.5/t case)**	0.4	3
CO_2 Reduction Monetized Value ($62.4/t case)**	0.7	2.5
CO_2 Reduction Monetized Value ($119/t case)**	1.4	3
NO_X Reduction Monetized Value (at $2,684/ton)**	0.01	7
	0.03	3
Total Benefits†	1.8	7
	4.4	3
Costs		
Consumer Incremental Installed Costs	0.33	7
	0.67	3
Total Net Benefits		
Including Emissions Reduction Monetized Value†	1.5	7
	3.7	3

* This table presents the costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the products purchased in 2021-2050. 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 2013$, 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 high and low values found in the literature.
† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to average SCC with a 3-percent discount rate ($40.5/t in 2015).

The benefits and costs of the proposed energy conservation standards, for NWGFs and MHGFs products sold in 2021-2050, can also be expressed in terms of annualized values. Benefits and costs for the AFUE standards are considered separately from benefits and costs for the standby mode and off mode electrical consumption standards, because it was not feasible to develop a single, integrated standard. As discussed in the October 20, 2010 test procedure final rule, DOE concluded that due to the magnitude of the active mode energy consumption as compared to the standby mode and off mode electrical consumption, an integrated metric would not be feasible because the standby and off mode electrical consumption would be a de minimis portion of the overall energy consumption. 75 FR 64621, 64627. Thus, an integrated metric could not be used to effectively regulate the standby mode and off mode energy consumption. 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 new or amended standards (consisting primarily of operating cost savings from using less energy, minus increases in product 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.[11]

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

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 NWGFs and MHGFs shipped in 2021-2050. 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.

Estimates of annualized benefits and costs of the proposed AFUE standards are shown in Table I.**7**. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the cost of the NWGFs and MHGFs standards proposed in this rule is $701 million per year in increased equipment costs, while the estimated benefits are $1,074 million per year in reduced equipment operating costs, $231 million per year in CO_2 reductions, and $39 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $642 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs standards proposed in this rule is $709 million per year in increased equipment costs, while the estimated benefits are $1,690 million per year in reduced equipment operating costs, $231 million per year in CO_2 reductions, and $54 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $1,264 million per year.

Table I.7 Annualized Benefits and Costs of Proposed AFUE Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces (TSL 3)

	Discount Rate %	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		million 2013$/year		
Benefits				
Consumer Operating Cost Savings	7	1,074	903	1,174
	3	1,690	1,383	1,887
CO_2 Reduction Monetized Value ($12.0/t case)**	5	64	59	72
CO_2 Reduction Monetized Value ($40.5/t case)**	3	231	211	260
CO_2 Reduction Monetized Value ($62.4/t case)**	2.5	340	311	384
CO_2 Reduction Monetized Value ($119/t case)**	3	715	654	805
NO_X Reduction Monetized Value (at $2,684/ton)**	7	38.50	35.68	42.48
	3	53.52	49.26	59.53
Total Benefits†	7 plus CO_2 range	1,177 to 1,828	998 to 1,593	1,288 to 2,022
	7	1,343	1,150	1,476
	3 plus CO_2 range	1,807 to 2,458	1,491 to 2,087	2,018 to 2,751
	3	1,974	1,643	2,206
Costs				
Consumer Incremental Installed Costs	7	701	750	683
	3	709	766	689
Net Benefits				
Total†	7 plus CO_2 range	476 to 1,127	248 to 843	605 to 1,339
	7	642	400	793
	3 plus CO_2 range	1,098 to 1,749	725 to 1,320	1,329 to 2,062
	3	1,264	877	1,517

* This table presents the annualized costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the products purchased in 2021-2050. 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 from the AEO 2014 Reference case, Low Estimate, and High Estimate, respectively. In addition, incremental product costs reflect a modest decline rate for projected product price trends in the Primary Estimate, a constant rate in the Low Benefits Estimate, and a higher decline rate in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.1.
** The CO_2 values represent global monetized values of the SCC, in 2013$, 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 high and low values found in the literature.
† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with a 3-percent discount rate ($40.5/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.

Estimates of annualized benefits and costs of the proposed standby mode and off mode standards are shown in Table I.8. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs standby mode and off mode standards proposed in this rule is $40.4 million per year in increased equipment costs, while the estimated benefits are $165.4 million per year in reduced equipment operating costs, $26.9 million per year in CO_2 reductions, and $1.1 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $153.0 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs standby mode and off mode standards proposed in this rule is $41.0 million per year in increased equipment costs, while the estimated benefits are $240.2 million per year in reduced equipment operating costs,

$26.9 million per year in CO_2 reductions, and $1.6 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $227.6 million per year.

Table I.8 Annualized Benefits and Costs of Proposed Standby Mode and Off Mode Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces (TSL 3)

	Discount Rate %	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		million 2013$/year		
Benefits				
Consumer Operating Cost Savings	7	165.4	149.7	190.8
	3	240.2	214.9	281.5
CO_2 Reduction Monetized Value ($12.0/t case)**	5	7.65	6.94	8.60
CO_2 Reduction Monetized Value ($40.5/t case)**	3	26.87	24.31	30.28
CO_2 Reduction Monetized Value ($62.4/t case)**	2.5	39.46	35.68	44.50
CO_2 Reduction Monetized Value ($119/t case)**	3	83.18	75.26	93.76
NO_X Reduction Monetized Value (at $2,684/ton)**	7	1.14	1.04	1.27
	3	1.59	1.44	1.78
Total Benefits†	7 plus CO_2 range	174 to 250	158 to 226	201 to 286
	7	193.4	175.0	222.4
	3 plus CO_2 range	249 to 325	223 to 292	292 to 377
	3	268.6	240.7	313.5
Costs				
Consumer Incremental Installed Costs	7	40.35	45.01	36.86
	3	41.02	46.13	37.19
Net Benefits				
Total†	7 plus CO_2 range	134 to 209	113 to 181	164 to 249
	7	153.0	130.0	185.5
	3 plus CO_2 range	208 to 284	177 to 246	255 to 340
	3	227.6	194.6	276.3

* This table presents the annualized costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the products purchased in 2021-2050. 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 from the AEO 2014 Reference case, Low Estimate, and High Estimate, respectively.

** The CO_2 values represent global monetized values of the SCC, in 2013$, 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 high and low values found in the literature.
† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with a 3-percent discount rate ($40.5/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.

Estimates of the combined annualized benefits and costs of the proposed AFUE and standby mode and off mode standards are shown in Table I.9. The results under the primary estimate are as follows. Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs AFUE and standby mode and off mode standards proposed in this rule is $741.2 million per year in increased equipment costs, while the estimated benefits are $1,240 million per year in reduced equipment operating costs, $257.4 million per year in CO_2 reductions, and $39.6 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $795.5 million per year. Using a 3-percent discount rate for all benefits and costs and the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs AFUE and standby mode and off mode standards proposed in this rule is $750.5 million per year in increased equipment costs, while the estimated benefits are $1,930 million per year in reduced equipment operating costs, $257.4 million per year in CO_2 reductions, and $55.1 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $1,492 million per year.

Table I.9 Annualized Benefits and Costs of Proposed AFUE and Standby Mode and Off Mode Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces (TSL 3)

	Discount Rate %	Primary Estimate*	Low Net Benefits Estimate*	High Net Benefits Estimate*
		million 2013$/year		
Benefits				
Consumer Operating Cost Savings	7	1,240	1,053	1,365
	3	1,930	1,598	2,168
CO_2 Reduction Monetized Value ($12.0/t case)**	5	71.49	65.60	80.15
CO_2 Reduction Monetized Value ($40.5/t case)**	3	257.4	235.2	290.0
CO_2 Reduction Monetized Value ($62.4/t case)**	2.5	379.6	346.6	428.0
CO_2 Reduction Monetized Value ($119/t case)**	3	798.1	729.2	898.9
NO_X Reduction Monetized Value (at $2,684/ton)**	7	39.64	36.72	43.75
	3	55.11	50.70	61.31
Total Benefits†	7 plus CO_2 range	1,351 to 2,077	1,155 to 1,819	1,489 to 2,308
	7	1,537	1,325	1,699
	3 plus CO_2 range	2,057 to 2,783	1,715 to 2,378	2,310 to 3,128
	3	2,243	1,884	2,519
Costs				
Consumer Incremental Installed Costs	7	741.2	795.0	719.9
	3	750.5	812.4	726.3
Net Benefits				
Total†	7 plus CO_2 range	609.6 to 1,336	360.3 to 1,024	768.9 to 1,588
	7	795.5	529.8	978.7
	3 plus CO_2 range	1,306 to 2,033	0,902 to 1,566	1,583 to 2,402
	3	1,492	1,072	1,793

* This table presents the annualized costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the products purchased in 2021-2050. 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 from the AEO 2014 Reference case, Low Estimate, and High Estimate, respectively.

** The CO_2 values represent global monetized values of the SCC, in 2013$, 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 high and low values found in the literature.
† Total Benefits for both the 3% and 7% cases are derived using the series corresponding to the average SCC with a 3-percent discount rate ($40.5/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 (for AFUE as well as standby mode and off mode) represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. DOE further notes that products achieving these standard levels are already commercially available for all product classes covered by this proposal. Based on the analyses described above, DOE has tentatively concluded that the benefits of the proposed standards to the Nation (energy savings, positive NPV of consumer benefits, consumer LCC savings, and emission reductions) would outweigh the burdens (loss of INPV for manufacturers and LCC increases for some consumers).

DOE also considered more-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 amended standards for residential non-weatherized gas furnaces and mobile home gas furnaces.

A. Authority

Title III, Part B 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"). These products include the residential furnaces that are the subject of this rulemaking. (42 U.S.C. 6292(a)(5)) EPCA, as amended, prescribed energy conservation standards for these products (42 U.S.C. 6295(f)(1) and (2)), and directed DOE to conduct further rulemakings to determine whether to amend these standards (42 U.S.C. 6295(f)(4)). Under 42 U.S.C. 6295(m), the agency must periodically review established energy conservation standards for a covered product; under this requirement, such review must be conducted no later than 6 years from the issuance of any final rule establishing or amending a standard for a covered product.

Pursuant to EPCA, DOE's energy conservation program for covered products consists essentially of four parts: (1) testing; (2) labeling; (3) establishing Federal energy conservation standards; and (4) certification and enforcement procedures. The Federal Trade Commission (FTC) is primarily responsible for labeling, and DOE implements the remainder of the program. Subject to certain criteria and conditions, DOE is required to conduct a second round of rulemaking under 42 U.S.C. 6295(f)(4)(C) to consider amended energy conservation standards for residential furnaces, and DOE is also required to consider amended standards under 42 U.S.C. 6295(m)(1) by June 27, 2017 (*i.e.*, with either: (1) a NOPR with proposed standards, or (2) a notice of determination not to amend the standards within six years of issuance of the last final rule for residential furnaces). DOE is further 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 a new or amended 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)) The DOE test procedures for residential furnaces appear at title 10 of the Code of Federal Regulations (CFR) part 430, subpart B, appendix N. In 2012, DOE initiated a rulemaking to review the residential furnace and boiler test procedure. Details on this rulemaking are discussed in section III.B.

DOE must follow specific statutory criteria for prescribing amended standards for covered products, including residential furnaces. As indicated above, any 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 furnaces, 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. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must make this determination 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 amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. (42 U.S.C. 6295(o)(1)) Also, the Secretary may not prescribe an amended or new standard if interested persons have established by a preponderance of evidence that the standard is likely to result in the unavailability in the United States of any covered product type (or class) of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4))

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

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

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

Pursuant to amendments contained in the Energy Independence and Security Act of 2007 (EISA 2007), Pub. L. 110-140, DOE may consider the establishment of regional energy conservation standards for furnaces (except boilers). (42 U.S.C. 6295(o)(6)(B)) Specifically, in addition to a base national standard for a product, DOE may establish for furnaces a single more-restrictive regional standard. (42 U.S.C. 6295(o)(6)(B)) The regions must include only contiguous States (with the exception of Alaska and Hawaii, which may be included in regions with which they are not contiguous), and each State may be placed in only one region (i.e., an entire State cannot simultaneously be placed in two regions, nor can it be divided between two regions). (42 U.S.C. 6295(o)(6)(C)) Further, DOE can establish the additional regional standards only: (1) where doing so would produce significant energy savings in comparison to a single national standard; (2) if the regional standards are economically justified; and (3) after considering the impact of these standards on consumers, manufacturers, and other market participants, including product distributors, dealers, contractors, and installers. (42 U.S.C. 6295(o)(6)(D))

Finally, pursuant to other amendments contained in EISA 2007, 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)) DOE's current test procedures for residential furnaces address standby mode and off mode energy use. In this rulemaking, DOE intends to adopt separate energy conservation standards to address standby mode and off mode energy use.

B. Background

1. Current Standards

EPCA established the energy conservation standards that apply to most residential furnaces currently being manufactured. The original standards, which are still in place for a number of product classes (including all product classes except for non-weatherized oil-fired furnaces), consisted of a minimum AFUE of 75 percent for mobile home furnaces and a minimum AFUE of 78 percent for all other furnaces, except "small" gas furnaces (those having an input rate of less than 45,000 Btu per hour), for which DOE was directed to prescribe a separate standard. (42 U.S.C. 6295(f)(1)-(2); 10 CFR 430.32(e)(1)(i)) The standard for mobile home furnaces has applied to products manufactured for sale in the United States, or imported into the United States, since September 1, 1990, and the standard for most other furnaces has applied to products manufactured or imported since January 1, 1992. Id. On November 17, 1989, DOE published a final rule in the Federal Register adopting the current standard for "small" gas furnaces, which consists of a minimum AFUE of 78 percent that has applied to products manufactured or imported since January 1, 1992. 54 FR 47916.

EPCA also required DOE to conduct two rounds of rulemaking to consider amended standards for residential furnaces (42 U.S.C. 6295(f)(4)(B)-(C)), a requirement subsequently expanded to encompass a six-year look back review of all covered products

(42 U.S.C. 6295(m)(1)). In a final rule published on November 19, 2007 (November 2007 final rule), DOE prescribed amended energy conservation standards for residential furnaces manufactured on or after November 19, 2015. 72 FR 65136. The November 2007 final rule revised the energy conservation standards for non-weatherized gas furnaces to 80 percent AFUE, weatherized gas furnaces to 81 percent AFUE, mobile home gas furnaces to 80 percent AFUE, and non-weatherized oil-fired furnaces to 82 percent AFUE. Id. at 65169. Subsequently, on October 31, 2011, DOE published a notice of effective date and compliance dates (76 FR 67037) to confirm amended energy conservation standards and compliance dates contained in a June 27, 2011 direct final rule (76 FR 37408) for residential central air conditioners and residential furnaces. These two rulemakings represented the first and the second, respectively, of the two rulemakings required under 42 U.S.C. 6295(f)(4)(B)-(C) to consider amending the standards for furnaces.

The June 2011 direct final rule and October 2011 notice of effective date and compliance dates amended, in relevant part, the energy conservation standards and compliance dates for three product classes of residential furnaces (*i.e.*, non-weatherized gas furnaces, mobile home gas furnaces, and non-weatherized oil furnaces) The existing standards were left in place for three classes of residential furnaces (*i.e.*, weatherized oil-fired furnaces, mobile home oil-fired furnaces, and electric furnaces). For one class of residential furnaces (weatherized gas furnaces), the existing standard was left in place, but the compliance date was amended. Electrical standby mode and off mode energy consumption standards were established for non-weatherized gas and oil-fired furnaces (including mobile home furnaces) and electric furnaces. Compliance with the energy conservation standards promulgated in the June 2011 direct final rule was to be required on May 1, 2013 for non-weatherized furnaces and on January 1, 2015 for weatherized furnaces. 76 FR 37408, 37547-48 (June 27, 2011); 76 FR 67037, 67051 (Oct. 31, 2011). The amended energy conservation standards and compliance dates in the June 2011 direct final rule would have superseded those standards and compliance dates promulgated by the November 2007 final rule for non-weatherized gas furnaces, mobile home gas furnaces, non-weatherized oil furnaces. Similarly, the amended compliance date for weatherized gas furnaces in the June 2011 direct final rule supersedes the compliance date in the November 2007 final rule.

After publication of the October 2011 notice, the American Public Gas Association (APGA) sued DOE[12] in the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit) to invalidate the rule as it pertained to non-weatherized gas furnaces (as discussed further in section II.B.2). Petition for Review, American Public Gas Association, et al. v. Department of Energy, et al., No. 11-1485 (DC Cir. filed Dec. 23, 2011). The parties to the litigation engaged in settlement negotiations which ultimately led to filing of an unopposed motion on March 11, 2014, seeking to vacate DOE's rule in part and to remand to the agency for further rulemaking. On April 24, 2014, the Court granted the motion and ordered that the standards established for non-weatherized gas furnaces and mobile home gas furnaces be vacated and remanded to DOE for further rulemaking. As a result, only the standards for non-weatherized oil-fired

[12] After APGA filed its petition for review on December 23, 2011, various entities subsequently intervened.

furnaces and weatherized gas furnaces established in the June 2011 direct final rule will go into effect as stated in that final rule. The standards established by the June 2011 direct final rule for the non-weatherized gas furnaces and mobile home gas furnaces will not go into effect, and thus, the standards established for these products in the November 2007 final rule will require compliance beginning on November 19, 2015. As stated previously, the standards for weatherized oil-fired furnaces, mobile home oil-fired furnaces, and electric furnaces were unchanged, and as such, the original standards for those product classes will remain in effect. The standards for all residential furnaces, including the two product classes being analyzed in today's NOPR, are set forth in DOE's regulations at 10 CFR 430.32(e)(1)(ii). Table II.1 below shows the upcoming standards for product classes that have been previously amended (either by the November 2007 final rule or June 2011 direct final rule) and the existing standards for the product classes where there AFUE standard has not been amended.

Table II.1 Federal Energy Conservation Standards for Residential Furnaces

Product Class	Minimum Annual Fuel Utilization Efficiency %	Compliance Date
Non-weatherized Gas-Fired*	80	11/19/2015
Mobile Home Gas-Fired*	80	11/19/2015
Weatherized Gas-Fired	81	1/1/2015
Non-weatherized Oil-Fired	83	5/1/2013
Mobile Home Oil-Fired	75	9/1/1990
Weatherized Oil-Fired	78	1/1/1992
Electric	78	1/1/1992

*Only non-weatherized gas-fired and mobile home gas-fired furnaces are being analyzed for this current rulemaking.

2. History of Standards Rulemaking for Residential Furnaces

Given the somewhat complicated interplay of recent DOE rulemakings and statutory provisions related to residential furnaces, DOE provides the following regulatory history as background leading to the present rulemaking. Amendments to EPCA in the National Appliance Energy Conservation Act of 1987 (NAECA; Pub. L. 100-12) established EPCA's original energy conservation standards for furnaces, consisting of the minimum AFUE levels described above for mobile home furnaces and for all other furnaces except "small" gas furnaces. (42 U.S.C. 6295(f)(1)-(2)) Pursuant to 42 U.S.C. 6295(f)(1)(B), in November 1989, DOE adopted a mandatory minimum AFUE level for "small" furnaces. 54 FR 47916 (Nov. 17, 1989). The standards established by NAECA and the November 1989 final rule for "small" gas furnaces are still in effect for all residential product classes except for non-weatherized oil-fired furnaces, for which the standards adopted in the June 2011 direct final rule are in effect.

Pursuant to EPCA, DOE was required to conduct two rounds of rulemaking to consider amended energy conservation standards for furnaces. (42 U.S.C. 6295(f)(4)(B) and (C)) In satisfaction of this first round of amended standards rulemaking under 42 U.S.C. 6295(f)(4)(B), as noted above, DOE published a final rule in the Federal Register on November 19, 2007 (the November 2007 Rule) that revised these standards for most furnaces, but left them in place for two product classes (i.e., mobile home oil-fired furnaces and weatherized oil-fired furnaces; there standards were to apply to furnaces manufactured or imported on and after November 19, 2015). 72 FR 65136. The energy conservation standards in the November 2007 final rule consist of a minimum AFUE level for each of the six classes of furnaces. Id. at 65169.

Following DOE's adoption of the November 2007 final rule, several parties jointly sued DOE in the United States Court of Appeals for the Second Circuit (Second Circuit) to invalidate the rule. Petition for Review, State of New York, et al. v. Department of Energy, et al., Nos. 08– 0311–ag(L); 08–0312–ag(con) (2d Cir. filed Jan. 17, 2008). The petitioners asserted that the standards for residential furnaces promulgated in the November 2007 Rule did not reflect the ''maximum improvement in energy efficiency'' that ''is technologically feasible and economically justified,'' as required under 42 U.S.C. 6295(o)(2)(A). On April 16, 2009, DOE filed with the Court a motion for voluntary remand that the petitioners did not oppose. The motion did not state that the November 2007 rule would be vacated, but indicated that DOE would revisit its initial conclusions outlined in the November 2007 Rule in a subsequent rulemaking action. DOE also agreed that the final rule would address both regional standards for furnaces, as well as the effects of alternate standards on natural gas prices. The Second Circuit granted DOE's motion on April 21, 2009.

On June 27, 2011 DOE published a direct final rule (June 2011 DFR) revising the energy conservation standards for residential furnaces pursuant to the voluntary remand in State of New York, et al. v. Department of Energy, et al. 76 FR 37408. In the June 2011 DFR, DOE considered the amendment of the same six product classes considered in the November 2007 final rule analysis plus electric furnaces. As discussed in section II.B.1, the June 2011 DFR amended the existing energy conservation standards for non-weatherized gas furnaces, mobile home gas furnaces, and non-weatherized oil furnaces, and amended the compliance date (but left the existing standards in place) for weatherized gas furnaces. The June 2011 DFR also established electrical standby mode and off mode standards for non-weatherized gas furnaces, non-weatherized oil furnaces, and electric furnaces. DOE confirmed the standards and compliance dates promulgated in the June 2011 final rule in a notice of effective date and compliance dates published on October 31, 2011. 76 FR 67037. As noted earlier, following DOE's adoption of the June 2011 DFR, APGA filed a petition for review with the United States Court of Appeals for the District of Columbia Circuit to invalidate the DOE rule as it pertained to non-weatherized natural gas furnaces. Petition for Review, American Public Gas Association, et al. v. Department of Energy, et al., No. 11-1485 (DC Cir. filed Dec. 23, 2011). On April 24, 2014, the Court granted a motion that approved a settlement agreement that was reached between DOE, APGA, and the various intervenors in the case, in which DOE agreed to a remand of the non-weatherized gas furnace and mobile home gas furnace portions of the June 2011 direct final rule in order to conduct further notice-and-comment rulemaking. Accordingly, the Court's order vacated the June 2011 DFR in part (*i.e.*, those portions relating to non-weatherized gas furnaces and mobile home gas furnaces) and remanded to the agency for further rulemaking.

As part of the settlement, DOE has agreed to issue a notice of public rulemaking within one year of the remand, and to issue a final rule within the later of two years of the issuance of remand or one year of the issuance of the proposed rule, including at least a ninety-day public comment period. Due to the extensive and recent rulemaking history for residential furnaces, as well as the associated opportunities for notice and comment described above, DOE is foregoing the typical earlier rulemaking stages (e.g., framework document, preliminary analysis) and has instead developed this NOPR. DOE has tentatively concluded that there has been a sufficient recent exchange of information between interested parties and DOE regarding the energy conservation standards for residential furnaces such as to allow for this proceeding to move directly to the NOPR stage. Moreover, DOE notes that under 42 U.S.C. 6295(p), DOE is only required to publish a notice of proposed rule and accept public comments before amending energy conservation standards in a final rule (i.e., DOE is not required to conduct the earlier rulemaking stages).

DOE has initiated this rulemaking in partial fulfillment of the remand in American Public Gas Association, et al. v. Department of Energy, et al. and pursuant to its authority under 42 U.S.C. 42 U.S.C. 6295(f)(4)(C), which requires DOE to conduct a second round of amended standards rulemaking for residential non-weatherized gas furnaces and mobile home gas furnaces. EPCA, as amended by EISA 2007, also requires that not later than 6 years after issuance of any final rule establishing or amending a standard, DOE must publish either a notice of the determination that standards for the product do not need to be amended, or a notice of proposed rulemaking including proposed energy conservation standards. (42 U.S.C. 6295(m)(1)) This rulemaking will satisfy both statutory provisions.

Furthermore, EISA 2007 amended EPCA to require that any new or amended energy conservation standard adopted after July 1, 2010, shall address standby mode and off mode energy consumption pursuant to 42 U.S.C. 6295(o). (42 U.S.C. 6295(gg)(3)) If feasible, the statute directs DOE to incorporate standby mode and off mode energy consumption into a single standard with the product's active mode energy use. If a single standard is not feasible, DOE may consider establishing a separate standard to regulate standby mode and off mode energy consumption. Consequently, DOE will consider standby mode and off mode energy use as part of this rulemaking for residential furnaces.

III. General Discussion

A. Product Classes and Scope of Coverage

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 of the feature to the consumer and other factors DOE deems appropriate. (42 U.S.C. 6295(q))

As previously noted in section II.B.2, DOE agreed to the partial vacatur of the June 2011 final rule as it relates to energy conservation standards for non-weatherized gas-fired furnaces and mobile home gas-fired furnaces in the settlement agreement to resolve the litigation in American Public Gas Association, et al. v. Department of Energy, et al. Therefore, for this rulemaking, DOE has only considered amending the energy conservation standards for these two product classes of residential furnaces (i.e., non-weatherized gas-fired furnaces and mobile home gas-fired furnaces). This rulemaking considers energy conservation standards for electrical power consumption in standby mode and off mode, as well as the annual fuel utilization efficiency standards for both product classes. More information relating to the scope of coverage is described in section IV.A of this proposed rule.

B. Test Procedure

DOE's current energy conservation standards for residential furnaces are expressed in terms of annual fuel utilization efficiency for fossil fuel consumption (see 10 CFR 430.32(e)(1)). AFUE is an annualized fuel efficiency metric that fully accounts for fuel consumption in active, standby, and off modes. The existing DOE test procedure for determining the AFUE of residential furnaces is located at 10 CFR part 430, subpart B, appendix N. The current DOE test procedure for residential furnaces was originally established by a May 12, 1997 final rule, which incorporates by reference the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/American National Standards Institute (ANSI) Standard 103-1993, Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers (1993). 62 FR 26140, 26157.

On October 20, 2010, DOE updated its test procedures for residential furnaces in a final rule published in the Federal Register (October 2010 test procedure rule). 75 FR 64621. This rule amended DOE's test procedure for residential furnaces and boilers to establish a method for measuring the electrical energy use in standby mode and off mode for gas-fired, oil-fired, and electric furnaces pursuant to requirements established by EISA 2007. These test procedure amendments were primarily based on and incorporate by reference provisions of the International Electrotechnical Commission (IEC) Standard 62301 (First Edition), ''Household electrical appliances—Measurement of standby power." On December 31, 2012, DOE published a final rule in the Federal Register which updated the incorporation by reference of the standby mode and off mode test procedure provisions to refer to the latest edition of IEC Standard 62301 (Second Edition). 77 FR 76831.

On July 10, 2013, DOE published a final rule in the Federal Register (July 2013 final rule) that modified the existing testing procedures for residential furnaces and boilers. 78 FR 41265. The modification addressed the omission of equations needed to calculate AFUE for two-stage and modulating condensing furnaces and boilers that are tested using an optional procedure provided by section 9.10 of ASHRAE 103-1993 (incorporated by reference into DOE's test procedure), which allows the test engineer to omit the heat-up and cool-down tests if certain conditions are met. Specifically, the DOE test procedure allows condensing boilers and furnaces to omit the heat-up and cool-down tests provided that the units have no measurable airflow through the combustion chamber and heat exchanger during the burner off period and have post-purge period(s) of less than 5 seconds. For two-stage and modulating condensing furnaces and boilers, ASHRAE 103-1993 (and by extension the DOE test procedure) does not contain the necessary equations to calculate the heating seasonal efficiency (which contributes to the ultimate calculation of AFUE) when the option in section 9.10 is selected. The July 2013 final rule adopted two new equations needed to account for the use of section 9.10 for two-stage and modulating condensing furnaces and boilers. Id.

EPCA, as amended by EISA 2007, requires that DOE must review test procedures for all covered products at least once every 7 years. (42 U.S.C 6293(b)(1)(A)) Accordingly, DOE must complete the residential furnaces and boiler test procedure rulemaking no later than December 19, 2014 (i.e., 7 years after the enactment of EISA 2007), which is before the expected completion of this energy conservation standards rulemaking. In February 2015, DOE issued a notice of proposed rulemaking for the test procedure (February 2015 Test Procedure NOPR), a necessary step toward fulfillment of the requirement under 42 U.S.C. 6293(b)(1)(A) for residential furnaces and boilers. DOE must base the analysis of amended energy conservation standards on the most recent version of its test procedures, and accordingly, DOE will use any amended test procedure when considering product efficiencies, energy use, and efficiency improvements in its analyses. Major changes proposed in the February 2015 Test Procedure NOPR that relate to residential furnaces included proposals to:

- Adopt ANSI/ASHRAE 103-2007 by reference in place of the existing reference to ANSI/ASHRAE 103-1993;
- Modify the requirements for the measurement of condensate under steady-state conditions;
- Update references to installation manuals;
- Update the auxiliary electrical consumption calculation to include additional measurements of electrical consumption;
- Adopt a method for qualifying the use of the minimum draft factor.

C. Technological Feasibility

1. General

In each energy conservation standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology 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 furnaces, 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 technical support document (TSD).

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt an amended standard for a type or class of covered product, it must determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible for such product. (42 U.S.C. 6295(p)(1)) Accordingly, in the engineering analysis, DOE determined the maximum technologically feasible (max-tech) improvements in energy efficiency for NWGFs and MHGFs, 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 year of compliance with amended standards (2021–2050).[13] The savings are measured over the entire lifetime of products purchased in the 30-year analysis period.[14] 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

[13] DOE also presents a sensitivity analysis that considers impacts for products shipped in a 9-year period.
[14] 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.

energy consumption in the absence of amended energy conservation standards, and it considers market forces and policies that affect demand for more-efficient products.

DOE used its national impact analysis (NIA) spreadsheet model to estimate energy savings from potential amended 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. For electricity, DOE reports national energy savings on an annual basis in terms of primary (source) energy savings, which is the savings in the energy that is used to generate and transmit the site electricity. To calculate the primary energy savings, DOE derives annual conversion factors from the model used to prepare the Energy Information Administration's (EIA) most recent Annual Energy Outlook (AEO).

DOE has begun to also estimate full-fuel-cycle energy savings, as discussed in DOE's statement of policy and notice of policy amendment. 76 FR 51282 (August 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 energy efficiency standards. DOE's approach is based on the calculation of an FFC multiplier for each of the energy types used by covered equipment. For more information on FFC energy savings, see section IV.H.3.

2. Significance of Savings

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

E. Economic Justification

1. Specific Criteria

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

a. Economic Impact on Manufacturers and Consumers

In determining the impacts of a potential amended standard on manufacturers, DOE conducts a manufacturer impact analysis (MIA), as discussed in section IV.J. DOE first uses an annual cash-flow approach to determine the quantitative impacts. This step includes both a short-term assessment—based on the cost and capital requirements during the period between when a regulation is issued and when entities must comply with the regulation—and a long-term assessment over a 30-year period. The industry-wide impacts analyzed include: (1) 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. Finally, DOE takes into account cumulative impacts of various DOE regulations and other regulatory requirements on manufacturers.

For individual consumers, measures of economic impact include the changes in LCC and PBP associated with new or amended standards. These measures are discussed further in the following section. For consumers in the aggregate, DOE also calculates the national net present value of the economic impacts applicable to a particular rulemaking. DOE also evaluates the LCC impacts of potential standards on identifiable subgroups of consumers that may be affected disproportionately by a national standard.

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

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

The LCC is the sum of the purchase price of a product (including its installation) and the operating expense (including energy, maintenance, and repair expenditures) discounted over the lifetime of the product. The LCC analysis requires a variety of inputs, such as product prices, product energy consumption, energy prices, maintenance and repair costs, product lifetime, and consumer discount rates. To account for uncertainty and variability in specific inputs, such as product lifetime and discount rate, DOE uses a distribution of values, with probabilities attached to each value. For its analysis, DOE assumes that consumers will purchase the covered products in the first year of compliance with amended standards.

The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more-efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost due to a more-stringent standard by the change in annual operating cost for the year that standards are assumed to take effect.

The LCC savings for the considered efficiency levels are calculated relative to a base case that reflects projected market trends in the absence of amended standards. 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. In contrast, the PBP is measured relative to the baseline product.

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

e. Impact of Any Lessening of Competition

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

f. Need for National Energy Conservation

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

New or amended 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 conducts an emissions analysis to estimate how standards may affect these emissions, as discussed in section IV.K. DOE reports the emissions impacts from the proposed standards, and from each TSL it considered, in section V.B.6 of this notice. DOE also estimates the economic value of emissions reductions resulting from the considered TSLs, as discussed in section IV.L.

g. Other Factors

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

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first year's energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values used to calculate the effects that proposed energy conservation standards would have on the payback period for consumers. These analyses include, but are not limited to, the 3-year payback period contemplated under the rebuttable-presumption test. In addition, DOE routinely conducts an economic analysis that considers the full range of impacts to consumers, manufacturers, the Nation, and the environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE's evaluation of the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section V.B.1 of this proposed rule.

F. Regional Standards

As discussed in section II.A, EISA 2007 amended EPCA to allow for the establishment of a single more-restrictive regional standard in addition to the base national standard for furnaces. (42 U.S.C. 6295(o)(6)(B)) The regions must include only contiguous States (with the exception of Alaska and Hawaii, which can be included in regions with which they are not contiguous), and each State may be placed in only one region (*i.e.*, a State cannot be divided among or otherwise included in two regions). (42 U.S.C. 6295(o)(6)(C))

Further, EPCA mandates that a regional standard must produce significant energy savings in comparison to a single national standard, and provides that DOE must determine that the additional standards are economically justified and consider the impact of the additional regional standards on consumers, manufacturers, and other market participants, including product distributors, dealers, contractors, and installers. (42 U.S.C. 6295(o)(6)(D)) For this rulemaking, DOE has considered the above-delineated impacts of regional standards in addition to national standards.

Where appropriate, DOE has addressed the potential impacts from considered regional standards in the relevant analyses, including the mark-ups to determine product price, the LCC and payback period analysis, the national impact analysis (NIA), and the manufacturer impact analysis (MIA). DOE's approach for addressing regional standards is included in the methodology section corresponding to each individual analysis (see section IV of this notice), and in the NOPR TSD, specifically Chapter 8 (LCC and PBP Analysis) and Chapter 10 (National Impact Analysis). For certain phases of the analysis, additional regional analysis is not required. For example, technologies for improving product efficiency generally do not vary by region, and thus, DOE did not perform any additional regional analysis for the technology assessment and screening analysis. Similarly, DOE did not examine the impacts of having two regions in the engineering analysis, since the technologies and manufacturer processes are the same under both a national and regional standard.

To evaluate regional standards for residential furnaces, DOE maintained the same regions analyzed in the June 2011 direct final rule, which are shown in Table III.1 and Figure III.1. The allocation of individual States to the regions was largely based on whether a State's annual heating degree day (HDD)[15] average is above or below 5,000, which offers a rough threshold point at which space heating demands are significant enough to require longer operation of heating systems, thereby providing a basis for utilization of higher-efficiency systems.

[15] DOE used the population weighted state HDD as determined by the National Oceanic and Atmospheric Administration (NOAA) in its 1971-2000 United States Climate Normals report, available at http://hurricane.ncdc.noaa.gov/climatenormals/hcs/HCS_51.pdf (last accessed July 28, 2014).

Table III.1 National Standard and Regional Standard (By State) for Analysis of Furnace Standards

National Standard*	Northern Region Standard	
Alabama	Alaska	Pennsylvania
Arizona	Colorado	Rhode Island
Arkansas	Connecticut	South Dakota
California	Idaho	Utah
Delaware	Illinois	Vermont
District of Columbia	Indiana	Washington
Florida	Iowa	West Virginia
Georgia	Kansas	Wisconsin
Hawaii	Maine	Wyoming
Kentucky	Massachusetts	
Louisiana	Michigan	
Maryland	Minnesota	
Mississippi	Missouri	
Nevada	Montana	
New Mexico	Nebraska	
North Carolina	New Hampshire	
Oklahoma	New Jersey	
South Carolina	New York	
Tennessee	North Dakota	
Texas	Ohio	
Virginia	Oregon	

* DOE analyzes an approach whereby the agency would set a base National standard, as well as a more-stringent standard in the Northern region. Because compliance with the regional standard would also meet the National standard, Table III.1 categorizes States in terms of the most stringent standard applicable to that State.

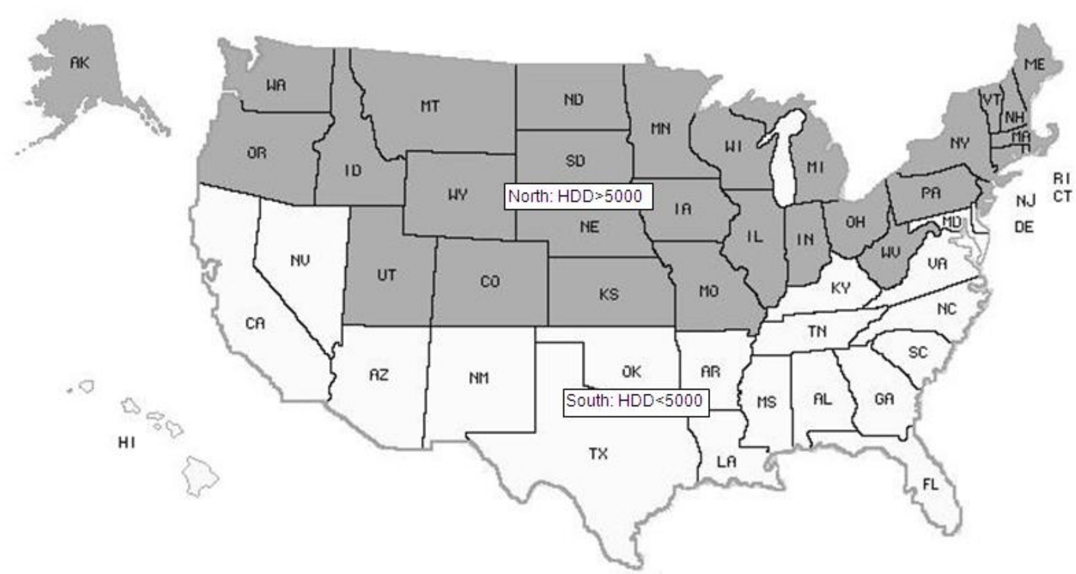

Figure III.1 Map of the Regions for the Analysis of Furnace Standards

G. Compliance Date

EPCA establishes a lead time between the publication of amended energy conservation standards and the date by which manufacturers must comply with the amended standards for residential furnaces. Specifically, EPCA dictated an eight-year period between the rulemaking publication date and compliance date for the first round of amended residential furnace standards, and a five-year period for the second round of amended residential furnace standards. (42 U.S.C. 6295(f)(4)(B)-(C)) DOE notes that the first remand agreement for residential furnaces (resulting from the Petition for Review, State of New York, et al. v. Department of Energy, et al., Nos. 08– 0311–ag(L); 08–0312–ag(con) (2d Cir. filed Jan. 17, 2008)) did not vacate the November 2007 Rule for furnaces and boilers. Therefore, DOE has concluded that the November 2007 final rule completed the first round of rulemaking for amended energy conservation standards for furnaces, thereby satisfying the requirements of 42 U.S.C. 6295(f)(4)(B). The June 2011 direct final rule satisfied the second round of rulemaking for amended energy conservation standards for furnaces; however, the settlement resulting from the APGA lawsuit (Petition for Review, American Public Gas Association, et al. v. Department of Energy, et al., No. 11-1485 (DC Cir. filed Dec. 23, 2011) vacated the standards for non-weatherized gas furnaces and mobile home gas furnaces. As a result, the June 2011 direct final rule completed the second round of rulemaking for the furnace product classes for which it was not vacated, and the current rulemaking constitutes the second round of rulemaking for amended energy conservation standards for non-weatherized gas and mobile home gas furnaces, as required under 42 U.S.C. 6295(f)(4)(C). This provision prescribes a five-year period between the standard's publication date and compliance date. Accordingly, in its analysis of amended energy conservation standards for NWGFs and MHGFs, DOE used a 5-year lead time between the publication of the final rule and the compliance date for the standard.

H. Standby Mode and Off Mode

As discussed in section II.A of this NOPR, any final rule for amended or new energy conservation standards that is published on or after July 1, 2010 must address standby mode and off mode energy use. (42 U.S.C. 6295(gg)(3)) As a result, DOE has analyzed and is proposing new energy conservation standards for the standby mode and off mode electrical energy consumption for residential non-weatherized gas furnaces and mobile home gas furnaces.

AFUE, the statutory metric for residential furnaces, does not incorporate standby mode or off mode use of electricity, although it already fully addresses the fossil fuel use of gas-fired furnaces when operating in standby mode and off mode. In the October 2010 test procedure final rule for residential furnaces and boilers, DOE determined that incorporating standby mode and off mode electricity consumption into a single standard for residential furnaces and boilers is not technically feasible. 75 FR 64621, 64626-27 (Oct. 20, 2010). DOE concluded that a metric that integrates standby mode and off mode electricity consumption into AFUE is not technically feasible, because the standby mode and off mode energy usage, when measured, is essentially lost in practical terms due to rounding conventions for certifying furnace compliance with Federal energy conservation standards. Id. Therefore, in this notice, DOE is adopting amended furnace standards that are AFUE levels, which exclude standby mode and off mode electricity use, and DOE is also adopting separate standards that are maximum wattage (W) levels to address the standby mode ($P_{W,SB}$) and off mode ($P_{W,OFF}$) electrical energy use of furnaces. DOE also presents corresponding trial standard levels (TSLs) for energy consumption in standby mode and off mode. DOE has decided to use a maximum wattage requirement to regulate standby mode and off mode for furnaces. DOE believes using an annualized metric could add unnecessary complexities, such as trying to estimate an assumed number of hours that a furnace typically spends in standby mode. Instead, DOE believes that a maximum wattage standard is the most straightforward metric for regulating standby mode and off mode energy consumption of furnaces and will result in the least amount of industry and consumer confusion.

DOE is using the metrics just described – AFUE, $P_{W,SB}$, and $P_{W,OFF}$ – in the amended energy conservation standards it is proposing in this rulemaking for furnaces. This approach satisfies the mandate of 42 U.S.C. 6295(gg)(3) that amended standards address standby mode and off mode energy use. The various analyses performed by DOE to evaluate minimum standards for standby mode and off mode electrical energy consumption for furnaces are discussed further in section IV.E.2 of this NOPR.

IV. Methodology

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

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).[16]

Additionally, DOE estimated the impacts on utilities and the environment that would be likely to result from potential standards for residential furnaces. DOE used published output from the AEO 2014 version of Energy Information Administration's (EIA) National Energy Modeling System (NEMS) for both the utility and the environmental analyses. NEMS projects the production, imports, conversion, consumption, and prices of energy, subject to assumptions on macroeconomic and financial factors, world energy markets, resource availability and costs, behavioral and technological choice criteria, cost and performance characteristics of energy

[16] All three spreadsheet tools are available online at the rulemaking portion of DOE's website at the following address: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/72

technologies, and demographics.[17] 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 their impact on the economy as a whole.

A. Market and Technology Assessment

In conducting 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. These activities include both quantitative and qualitative assessments, based primarily on publicly-available information. The issues covered in the market and technology assessment for this residential furnaces rulemaking include: (1) a determination of the scope of the rulemaking and product classes; (2) manufacturers and industry structure; (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.[18]

[17] For more information on NEMS, refer to the U.S. Department of Energy, Energy Information Administration documentation. See, e.g., Energy Info. Admin., The National Energy Modeling System: An Overview DOE/EIA-0581(2009), available at http://www.eia.gov/oiaf/aeo/overview/.
[18] See chapter 3 of the NOPR TSD for further discussion of the market and technology assessment.

1. Definition and Scope of Coverage

EPCA defines a "furnace" as "a product which utilizes only single-phase electric current, or single-phase electric current or DC current in conjunction with natural gas, propane, or home heating oil, and which:

(1) is designed to be the principal heating source for the living space of a residence;

(2) is not contained within the same cabinet with a central air conditioner whose rated cooling capacity is above 65,000 Btu per hour;

(3) is an electric central furnace, electric boiler, forced-air central furnace, gravity central furnace, or low pressure steam or hot water boiler; and

(4) has a heat input rate of less than 300,000 Btu per hour for electric boilers and low pressure steam or hot water boilers and less than 225,000 Btu per hour for forced-air central furnaces, gravity central furnaces, and electric central furnaces." (42 U.S.C. 6291(23))

DOE has incorporated this definition into its regulations in the Code of Federal Regulations (CFR) at 10 CFR 430.2.

EPCA's definition of a "furnace" covers the following types of products: (1) gas furnaces (non-weatherized and weatherized); (2) oil-fired furnaces (non-weatherized and weatherized); (3) mobile home furnaces (gas and oil-fired); (4) electric resistance furnaces; (5) hot water boilers (gas and oil-fired); (6) steam boilers (gas and oil-fired); and (7) combination space/water heating appliances (water-heater/fancoil combination units and boiler/tankless coil combination units). In accordance with the April 24th, 2014 court order in the American Public Gas Association, et al. v. Department of Energy, et al., case, which granted the unopposed joint motion for a voluntary remand (see section II.B), DOE only analyzed potential amended energy conservation standards for non-weatherized gas-fired and mobile home gas-fired furnace product classes of furnaces in this rulemaking.

2. Product Classes

When evaluating and establishing energy conservation standards, DOE divides covered products into product classes by the type of energy used, by capacity, or by 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 factors such as the utility to the consumer of the feature and other factors DOE determines are appropriate. (42 U.S.C. 6295(q)) DOE has viewed utility as an aspect of the product that is accessible to the layperson and is based on user operation, rather than performing a theoretical function. This interpretation has been implemented consistently in DOE's previously determining utility through the value the item brings to the consumer, rather than through analyzing more complicated design features, or costs that anyone, including the consumer, manufacturer, installer, or utility companies may bear. This approach is consistent with EPCA requiring a separate and extensive analysis of economic justification for the adoption of any new or amended energy conservation standard (see 42 U.S.C. 6295(o)(2)(A)-(B) and (3)).

Under EPCA, DOE has typically addressed consumer utility by establishing separate product classes or otherwise taken action when a consumer may value a product feature based on the consumer's everyday needs. For instance, DOE has determined that it would be impermissible under 42 U.S.C. 6295(o)(4) to include elimination of oven door windows as a technology option to improve the energy efficiency of cooking products.[19] DOE reached this conclusion based upon how consumers typically use the product: peering through the oven window to judge if an item is finished cooking, as opposed to checking the timer and/or indicator light or simply opening the oven door to see if the item is finished cooking. DOE has also determined that consumers may value other qualities such as ability to self-clean,[20] size,[21] and configuration.[22] This determination, however, can change depending on the technology and the consumer, and it is conceivable that certain products may disappear from the market entirely due to shifting consumer demand. DOE determines such value on a case-by-case basis through its own research as well as public comments received, the same approach that DOE employs in all other parts of its energy conservation standards rulemaking.

As a cautionary note, disparate products may have very different consumer utilities, thereby making direct comparisons difficult and potentially misleading. For instance, in a 2011 rulemaking, DOE created separate product classes for vented and ventless residential clothes dryers based on DOE's recognition of the "unique utility" that

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[19] 63 FR 48038, 48041 (Sept. 8, 1998).
[20] 73 FR 62034, 62048 (Oct. 17, 2008) (separating standard ovens and self-cleaning ovens into different product classes).
[21] 77 FR 32307, 32319 (May 31, 2012) (creating a separate product class for compact front-loading residential clothes washers).
[22] 75 FR 59469, 59487 (Sept. 27, 2010) (creating a separate product class for refrigerators with bottom-mounted freezers).

ventless clothes dryers offer to consumers. 76 FR 22454, 22485 (April 21, 2011). This utility could be characterized as the ability to have a clothes dryer in a living area where vents are impossible to install (i.e., an apartment in a high-rise building). As explained in that April 2011 direct final rule technical support document, ventless dryers can be installed in locations where venting dryers would be precluded due to venting restrictions.

But in another rulemaking, DOE found that water heaters that utilize heat pump technology did not need to be put in a separate product class from conventional types of hot water heaters that utilize electric resistance technology, even though water heaters utilizing heat pumps require the additional installation of a condensate drain that a hot water heater utilizing electric resistance technology does not require. 74 FR 65852, 65871 (Dec. 11, 2009). DOE found that regardless of these installation factors, the heat pump water heater and the conventional water heater still had the same utility to the consumer: providing hot water. Id. In both cases, DOE made its finding based on consumer type and utility type, rather than product design criteria that impact product efficiency. These distinctions in both the consumer type and the utility type are important because, as DOE has previously pointed out, taken to the extreme, each design differential could be designated a different "product class" and, therefore, require different energy conservation standards.

Tying the concept of "feature" to a specific technology would effectively lock-in the currently existing technology as the ceiling for product efficiency and eliminate

DOE's ability to address technological advances that could yield significant consumer benefits in the form of lower energy costs while providing the same functionality for the consumer. DOE is very concerned that determining features solely on product technology could undermine the Department's Appliance Standards Program. If DOE is required to maintain separate product classes to preserve less-efficient technologies, future advancements in the energy efficiency of covered products would become largely voluntary, an outcome which seems inimical to Congress's purposes and goals in enacting EPCA.

Turning to the product at issue in this rulemaking, residential furnaces are currently divided into several product classes. For example, furnaces are separated into product classes based on their fuel source (gas, oil, or electricity), which is required by statute. As discussed in section IV.A.1, for this rulemaking, DOE is analyzing only two product classes for residential furnaces: (1) non-weatherized gas-fired furnaces (NWGFs) and (2) mobile home gas-fired furnaces (MHGFs). DOE does not additionally separate NWGFs and MHGFs into condensing and non-condensing product classes because they provide the same utility to the consumer (i.e.¸ both are vented appliances that provide heat to a consumer).

DOE has tentatively concluded that the methods by which a furnace is vented do not provide any separate performance-related impacts, and, therefore, DOE has no statutory basis for defining a separate class based on venting and drainage characteristics. NWGF and MHGF venting methods do not provide unique utility to consumers beyond the basic function of providing heat, which all furnaces perform. The possibility that installing a non-condensing furnace may be less costly than a condensing furnace due to the difference in venting methods does not justify separating the two types of NWGFs into different product classes. Unlike the consumers of ventless dryers, which DOE has determined to be a performance-related feature based on the impossibility of venting in certain circumstances (e.g., high-rise apartments), consumers of condensing NWGFs are homeowners that may either use their existing venting or have a feasible alternative to obtain heat, which is the furnace's singular utility to the consumer. In other words, homeowners will still be able to obtain heat regardless of the venting. In contrast, a resident of a high-rise apartment or condominium building that is not architecturally designed to accommodate vented clothes dryers would have no option in terms of installing and enjoying the utility of a dryer in their home unless he uses a ventless dryer.

As explained above, the utility of a furnace involves providing heat to a consumer. Such utility is provided by any type of furnace, but to the extent that a consumer has a preference for a particular fuel type (e.g., gas), improvements in venting technology may soon allow a consumer to obtain the efficiency of a condensing furnace using the existing venting in a residence by sharing venting space with water heaters. This update in technology significantly reduces the cost burden associated with installing condensing furnaces and reduces potential instances of "orphaned" water heaters, where the furnace and water heater can no longer share the same venting (due to one unit being condensing and the other noncondensing). In other words, this technology allows consumers to switch from a non-condensing furnace to a condensing furnace in a greater variety of applications, such as urban row houses. For more information, see appendix 8L of the NOPR TSD.

3. Technology Options

DOE identified 12 technology options that would be expected to improve the AFUE of residential furnaces, as measured by the DOE test procedure: (1)using a condensing secondary heat exchanger; (2) increasing the heat exchanger area; (3) heat exchanger baffles; (4) heat exchanger surface feature improvements; (5) two-stage modulating combustion; (6) step-modulating combustion; (7) pulse combustion; (8) low NO_X premix burners; (9) burner de-rating; (10) insulation improvements; (11) off-cycle dampers; and (12) direct venting. In addition, DOE identified three technologies that would reduce the standby mode and off mode energy consumption of residential furnaces: (1) Low-loss transformer (LLTX); (2) switching mode power supply; and (3) control relay for models with brushless permanent magnet (BPM) motors.

After identifying potential technology options for improving the efficiency of residential furnaces, DOE performed the screening analysis (see section IV.B of this NOPR or chapter 4 of the TSD) on these technologies to determine which could be considered further in the analysis and which should be eliminated.

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 DOE determines that mass production, 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 excluded from further consideration in the engineering analysis. The reasons for eliminating certain technologies are discussed below.

1. Screened-Out Technologies

DOE decided to screen the use of pulse combustion from further analysis. Based on manufacturer feedback received during the analysis for the June 2011 direct final rulemaking, pulse combustion furnaces have had reliability and safety issues in the past, and therefore, manufacturers do not consider their use a viable option to improve efficiency. In addition, manufacturers can attain similar or greater efficiencies through the use of other technologies. For these reasons, DOE is not including pulse combustion as a technology option, as its reliability and safety issues could reduce consumer utility.

DOE also decided to screen out burner de-rating. Burner de-rating reduces the burner firing rate while maintaining the same heat exchanger geometry/surface area and fuel-air ratio, which increases the ratio of heat transfer surface area to the energy input, which increases efficiency. However, the lower energy input means that less heat is provided to the user than is provided using conventional burner firing rates. As a result of the decreased heat output of furnaces with de-rated burners, DOE has screened out burner de-rating as a technology option, as it could reduce consumer utility.

In addition, DOE is screening low-NO_X premix burners from further analysis. Premix burners eliminate the need for secondary air in the combustion process by completely mixing heating fuel with primary air prior to ignition. This raises the overall flame temperature, which improves heat transfer and AFUE. In-shot burners that are commonly used in residential furnaces, on the other hand, cannot entrain sufficient primary air to completely premix the air and gas. As a result, premix burner design incorporates a fan to ensure sufficient and complete mixing of the air and fuel prior to combustion and does so by delivering the air to the fuel at positive pressure. To the extent of DOE's knowledge, and based on manufacturer feedback during the manufacturer interviews, low-NO_X premix burners have not yet been successfully incorporated into a residential furnace design that is widely available on the market. DOE is aware that low-NO_X premix burners have been incorporated into boilers, but boilers have significantly different heat exchangers and burners, allowing for the integration of premix burner technology in those products. Incorporating this technology into furnaces on a large scale will require further research and development due to the technical constraints imposed by current furnace burner and heat exchanger design.

Among the standby and off mode technologies, DOE decided to screen out using a control relay to depower BPM motors due to feedback received during the manufacturer interviews conducted for both this NOPR and the residential furnace June 2011 direct final rule, which indicated that using a control relay to depower brushless permanent magnet motors could reduce the lifetime of the motors (the reason for this reduction in product lifetime is further explained in Chapter 4 of the TSD). DOE believes that this reduction in lifetime would lead to a reduction in utility of the product. For this reason, DOE is not including control relays for models with brushless permanent magnet motors as a technology option, as it could reduce consumer utility.

2. Remaining Technologies

Through a review of each technology, DOE found that all of the other identified technologies met all four screening criteria and consequently, are suitable for further examination in DOE's analysis. In summary, DOE did not screen out the following technology options to improve AFUE: (1) condensing secondary heat exchanger; (2) increased heat exchanger face area; (3) heat exchanger baffles; (4) heat exchanger surface feature improvements; (5) two-stage modulating combustion; (6) step-modulating combustion; (7) insulation improvements; (8) off-cycle dampers; and (9) direct venting. DOE also maintained the following technology options to improve standby mode and off mode energy consumption: (1) low-loss transformer; and (2) switching mode power supply. 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. Therefore, all of the trial standard levels evaluated in this notice are technologically feasible. DOE also found 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). For additional details, please see chapter 4 of the NOPR TSD.

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 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 distinct levels of efficiency from publicly-available information, as well as 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 (BOM) derived from reverse engineering representative products. The efficiency values range from that of a least-efficient furnace sold today (i.e., the baseline) to the maximum technologically feasible efficiency level. At each efficiency level examined, DOE determines the manufacture production cost (MPC) and MSP; the relationship between efficiency levels and MPC is referred to as a cost-efficiency curve.

DOE conducted the engineering analysis for residential furnaces using a combination of the efficiency-level and the reverse-engineering approach. More specifically, DOE identified the efficiency levels for analysis and then used the reverse-engineering approach to determine the technologies used and the associated manufacturing costs at those levels. In the residential furnace market, manufacturers may use slight variations on designs to achieve a given efficiency level. The benefit of using the efficiency level approach is that it allows DOE to examine products at each efficiency level regardless of the specific design options that manufacturers use to achieve that level, so the analysis can account for variations in design. Using the reverse-engineering approach to estimate a product cost at each efficiency level allows DOE to analyze actual models as the basis for developing the MPCs.

For the standby mode and off mode analyses, DOE adopted a design option approach, which allowed for the calculation of incremental costs through the addition of specific design options to a baseline model. DOE decided on this approach because it did not have sufficient data to execute an efficiency-level analysis, as manufacturers typically do not rate or publish data on the standby mode and/or off mode energy consumption of their products. As such, DOE was not able to conduct a reverse-engineering approach due to a lack of definitive knowledge of the electrical energy consumption of products on the market. Also, the design options used to obtain higher efficiencies were composed of purchased parts, so obtaining price quotes on these electrical components was more accurate than attempting to determine their manufacturing costs via a reverse-engineering analysis.

See chapter 5 of the NOPR TSD for additional details about the engineering analysis.

1. Efficiency Levels

As noted above, for analysis of amended AFUE standards, DOE used an efficiency-level approach in combination with a reverse-engineering approach to identify the technology options needed to reach incrementally higher efficiency levels. DOE physically tore down newly manufactured furnaces for its analysis. Prior to teardown, all of the furnaces were tested to verify their AFUE ratings and determine their standby mode and off mode power consumption (in watts). From the market analysis, DOE was able to identify the most common AFUE ratings of NWGF and MHGF on the market and used this information to select AFUE efficiency levels for analysis. After identifying AFUE efficiency levels for analysis, DOE used the reverse-engineering approach (section IV.A.2) to determine the MPC at each AFUE efficiency level identified for analysis.

For the analysis of amended standby mode and off-mode energy conservation standards, DOE used a design-option approach to identify the efficiency levels that would result from implementing certain design options for reducing power consumption in standby mode and off mode.

a. Baseline Efficiency Level and Product Characteristics

DOE selected baseline units typical of the least-efficient commercially-available residential furnaces. DOE selected baseline units as reference points for both NWGF and MHGF, against which it measured changes resulting from potential amended energy conservation standards. The baseline unit in each product class represents the basic characteristics of products in that class. Additional details on the selection of baseline units may be found in chapter 5 of the NOPR TSD.

DOE uses the baseline unit for comparison in several phases of the analyses, including the engineering analysis, LCC analysis, PBP analysis, and the NIA. To determine energy savings that will result from an amended energy conservation standard, DOE compares energy use at each of the higher energy efficiency levels to the energy consumption of the baseline unit. Similarly, to determine the changes in price to the consumer that will result from an amended energy conservation standard, DOE compares the price of a baseline unit to the price of a unit at each higher efficiency level.

When calculating the price of a baseline furnace and comparing it to the price of units at each higher efficiency level, DOE factored in future changes to the indoor blower motor baseline design option resulting from the 2014 furnace fans rulemaking,[23] which sets new baseline efficiency levels for furnace fans requiring compliance in the year 2019. Specifically, a level effectively requiring constant torque brushless permanent magnet (BPM) motors as the minimum standard indoor blower motor technology option for NWGF units, and improved primary split capacitor (PSC) motors as the minimum standard technology option for MHGF units, will be enforced beginning in 2019. As such, when compliance is required for this rulemaking, constant torque BPM motors will be the baseline design feature for NWGF units, and improved PSC motors will be the baseline design feature for MHGF units. DOE has included constant torque BPM motors

[23] For more information on the Furnace Fans Rulemaking, see the DOE Furnace Fans Rulemaking webpage at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/41.

and improved PSC motors in the MPCs for NWGF and MHGF units, respectively. The current and expected baseline motor types are listed in Table IV.1.

Table IV.1 Baseline Blower Motor Types (Current and Expected in 2019)

Product Class	**Current Typical Baseline Blower Motor Type**	**Expected Typical Baseline Blower Motor Type Starting in 2019**
NWGF	PSC	Constant-Torque BPM
MHGF	PSC	Improved PSC

Currently, the baseline indoor blower motor design option for all residential furnace types is a PSC motor. From here, the next step up is an improved PSC motor, which consumes less energy during fan operation than a standard PSC motor. As compared to PSC motors, BPM motors offer further efficiency improvements. BPM motors feature a completely redesigned inner drive mechanism, as compared to PSC motors, which significantly reduces electricity wasted as heat during fan operation. The basic type of BPM motor is a constant torque BPM motor, which accepts a specified number of torque commands from an outside control source. A second type of BPM motor is a constant airflow BPM motor, which is similar to a constant torque BPM motor, but allows for more precise operational commands. Constant airflow BPM motors accept precise airflow commands from an outside control source, which allow it to adjust the building airflow to a wide range of operational demands.

Table IV.2 presents the baseline AFUE levels identified for each product class of furnaces. The baseline AFUE levels analyzed represent the minimum AFUE standards that will be required starting on November 19, 2015, as a result of the November 2007 final rule.

Table IV.2 Baseline Residential Furnace AFUE Efficiency Levels

Product Class	AFUE %
Non-Weatherized Gas-Fired	80
Mobile Home Gas-Fired	80

For the standby mode and off-mode analysis, DOE identified baseline components as those that consume the most electricity during the operation of those modes. Since it would not be practical for DOE to test every furnace on the market to determine the baseline efficiency, and since manufacturers do not currently report standby mode and off mode energy consumption, DOE "assembled" the most consumptive baseline components from the models tested to model the electrical system of a furnace with the expected maximum system standby mode and off mode power consumption observed during testing of furnaces. The baseline standby mode and off-mode consumption levels used in the NOPR analysis are presented in Table IV.3.

Table IV.3 Baseline Standby Mode and Off Mode Power Consumption for NWGF and MHGF

Component	Standby Mode and Off-Mode Power Consumption (watts)
Transformer	4
ECM Blower Motor (includes controls)	3
Controls/Other	4
Total (watts)	**11**

b. Other Energy Efficiency Levels

Table IV.4 through Table IV.5 show the efficiency levels DOE selected for analysis of amended AFUE standards, along with a description of the typical technological change at each level.

Table IV.4 AFUE Efficiency Levels for Non-Weatherized Gas-Fired Furnaces

Efficiency Level EL	AFUE %	Technology Options
0 – Baseline	80	Baseline
1	90	EL0 + Secondary condensing heat exchanger
2	92	EL1 + Increased heat exchanger area
3	95	EL2 + Increased heat exchanger area
4 – Max-Tech	98	EL3 + Step-modulating combustion + Increased heat exchanger area

Table IV.5 AFUE Efficiency Levels for Mobile Home Furnaces

Efficiency Level	AFUE %	Technology Options
0 – Baseline	80	Baseline
1	92	EL0 + Secondary condensing heat exchanger +
2	95	EL1 + Increased heat exchanger area
3 – Max-Tech	97	EL2 + Step-modulating combustion + Increased heat exchanger area

In addition to the technology options listed in Table IV.4 and Table IV.5, DOE considered certain enhanced design features that may be chosen for consumer comfort or to reduce electrical energy consumption during furnace operating periods. These enhancements are listed in Table IV.6.

Table IV.6 Design features not directly included in analysis of AFUE efficiency levels

Design Feature	Baseline option*	Enhanced Option
NWGF Indoor Blower Motor	Constant Torque brushless permanent magnet (BPM) motor	Constant Speed motor
MHGF Indoor Blower Motor	Improved PSC Motor	Constant Torque BPM motor
		Constant Airflow BPM motor
Combustion system	Single stage combustion	two-stage modulating combustion (includes two-stage gas valve, 2-speed inducer assembly, upgraded pressure switch, and additional controls and wiring)

*The baseline design options listed for NWGF and MHGF indoor blower motors will not become effective until 2019 when the 2014 furnace fan rulemaking mandates new efficiency standards for furnace fans.

Indoor blower motors can be either improved PSC motors, constant torque BPM motors, or constant airflow BPM motors. As compared to constant torque BPM and improved PSC motors, which operate at design-specific torque settings, constant airflow BPM motors can operate at a wide range of specific speed commands. As a result, constant airflow BPM motors can adjust airflow to different building conditions better than constant torque BPM and improved PSC motors, and may be chosen for enhanced consumer comfort. Constant airflow BPM motors are also the current standard motor type at the max-tech AFUE level for both NWGF and MHGF units. This is because precise airflow adjustments are needed in order to match the wide range of heating rates offered by modulating combustion systems, which are used to reach the max-tech AFUE levels in both NWGF and MHGF units.

The combustion system baseline design feature for mobile home gas furnaces is a single-stage combustion system, which includes a single-stage gas valve and a 1-speed inducer fan assembly. During building warm-up periods, there may be a delay between when the target building temperature is reached, and when the thermostat detects this condition and sends a signal to the furnace to switch off. As a result, the furnace operates for a longer amount of time than needed and warms the building beyond the target temperature, which is uncomfortable for the building occupants and consumes more energy than is necessary. To improve comfort and save energy, a two-stage modulating combustion system can be used in place of a 1-stage combustion system. A two-stage combustion system includes a two-stage gas valve paired with a 2-speed combustion inducer fan, both of which serve to decrease the heating rate as the target temperature is approached. This decrease in heating rate can diminish any overshoot of the target building temperature, should the thermostat delay signaling the furnace to switch off once the proper temperature has been reached. By stabilizing the heating rate during warm-up, the furnace is able to achieve the target temperature more precisely, which improves comfort and reduces extraneous energy consumption. Because the furnace fans energy conservation standards will likely require that NWGF incorporate two-stage performance, DOE has included two-stage as the design for NWGF in this analysis.

Two-stage modulating combustion system design was one of the technology options DOE considered in the engineering analysis for improving AFUE, although this has been shown in some products to have a minor to negligible effect. In addition to improving AFUE, two-stage combustion allows the furnace to reduce its heating load when approaching the target indoor air temperature, which helps to prevent the conditioned space from becoming too hot, thus improving the comfort of building occupants. Based on market analysis, DOE determined that two-stage combustion is a common design feature in residential furnaces. However, due to its high cost relative to other technologies that can improve AFUE, DOE determined it is primarily offered to consumers as a comfort feature rather than for its efficiency benefits.

In addition to analyzing efficiency levels based on design options, DOE considered whether changes to the residential furnaces and boilers test procedure, as proposed by the February 2015 test procedure NOPR would necessitate changes to the AFUE levels being analyzed. The primary change proposed in the test procedure included updating the incorporation by reference to ASHRAE 103-2007. As discussed in the February 2015 test procedure NOPR, adopting ASHRAE 103-2007 would not be expected to change the AFUE rating for single-stage products and would result in a de minimis increase in the AFUE ratings for two-stage and modulating non-condensing products. Adopting ASHRAE 103-2007 provisions was assessed to have no statistically significant impact on the AFUE for condensing products. DOE has tentatively determined that this amendment to the test procedure would not be substantial enough to merit a revision of the proposed AFUE efficiency levels for residential furnaces.

Table IV.7 shows the efficiency levels DOE selected for the analysis of standby mode and off mode standards, along with a description of the typical technological change at each level.

"Standby mode" and "off mode" power consumption are defined in the DOE test procedure for residential furnaces and boilers. DOE defines "standby mode" as "the condition during the heating season in which the furnace or boiler is connected to the power source, and neither the burner, electric resistance elements, nor any electrical auxiliaries such as blowers or pumps, are activated." (10 CFR part 430, subpart B, appendix N, section 2.8) "Off mode" is defined as "the condition during the non-heating season in which the furnace or boiler is connected to the power source, and neither the burner, electric resistance elements, nor any electrical auxiliaries such as the blowers or pumps, are activated." (10 CFR part 430, subpart B, appendix N, section 2.6) A "seasonal off switch" is defined as "the switch on the furnace or boiler that, when activated, results in a measurable change in energy consumption between the standby and off modes." (10 CFR part 430, subpart B, appendix N, section 2.7.)

Through reviewing product literature and discussing with manufacturers, DOE has found that furnaces generally do not have a seasonal off switch that would be used to turn the product off during the off season. Manufacturer stated that if a switch is included with a product, it is left in the on position during the non-heating season because the indoor blower motor in the furnace is needed to move air for the AC side of the home's HVAC system and that the switch is typically used only as a service or repair switch. Therefore, DOE assumed that the standby mode and the off mode power consumption for residential furnaces are equal. DOE requests comment on the efficiency levels analyzed for standby mode and off mode, and on the assumption that standby mode and off mode energy consumption (as defined by DOE) would be equal. This is identified as issue 1 in section VII.E, "Issues on Which DOE Seeks Comment."

Table IV.7 Standby Mode and Off Mode Efficiency Levels for Non-Weatherized and Mobile Home Gas-Fired furnaces

Efficiency Level EL	Standby Mode and Off Mode Power Consumption (W)	Technology Options
0 – Baseline	11	Linear Power Supply
1	9.5	Linear Power Supply with Low-Loss Transformer (LLTX)
2	9.2	Switching Mode Power Supply
3 – Max-Tech	8.5	Switching Mode Power Supply with LLTX

2. Cost-Assessment Methodology

At the start of the engineering analysis, DOE identified the energy efficiency levels associated with residential furnaces on the market using data gathered in the market assessment. DOE also identified the technologies and features that are typically incorporated into products at the baseline level and at the various energy efficiency levels analyzed above the baseline. Next, DOE selected products for physical teardown analysis having characteristics of typical products on the market at the representative input capacity. DOE gathered information by performing a physical teardown analysis (see section IV.C.2.a) to create detailed BOMs, which included all components and processes used to manufacture the products. DOE used the BOMs from the teardowns as an input to a cost model, which was then used to calculate the MPC for products at various efficiency levels spanning the full range of efficiencies from the baseline to the maximum technology achievable ("max-tech") level.

During the development of the engineering analysis, DOE held interviews with manufacturers to gain insight into the residential furnace industry, and to request feedback on the engineering analysis and assumptions that DOE used. DOE used the information gathered from these interviews, along with the information obtained through the teardown analysis, to refine the assumptions and data used in the cost model for this rulemaking. Next, DOE derived manufacturer markups using publicly-available residential furnace industry financial data in conjunction with manufacturers' feedback. The markups were used to convert the MPCs into MSPs. Further information on the analytical methodology is presented in the subsections below. For additional detail, see chapter 5 of the NOPR TSD.

a. Teardown Analysis

To assemble BOMs and to calculate the manufacturing costs for the different components in residential furnaces, DOE disassembled multiple units into their base components and estimated the materials, processes, and labor required for the manufacture of each individual component, a process referred to as a "physical teardown." Using the data gathered from the physical teardowns, DOE characterized each component according to its weight, dimensions, material, quantity, and the manufacturing processes used to fabricate and assemble it.

DOE also used a supplementary method, called a "virtual teardown," which examines published manufacturer catalogs and supplementary component data to estimate the major physical differences between a product that was physically disassembled and a similar product that was not. For supplementary virtual teardowns, DOE gathered product data such as dimensions, weight, and design features from publicly-available information, such as manufacturer catalogs. The NOPR teardown analysis included a total of 62 physical and virtual teardowns of residential furnaces. These teardowns are broken down among equipment classes in Table IV.8.

Table IV.8 Residential Furnace Teardowns by Equipment Class

Equipment Class	Physical	Virtual
Non-weatherized Gas-Fired	26	32
Mobile Home Gas-Fired	6	0

The teardown analysis allowed DOE to identify the technologies that manufacturers typically incorporate into their products, along with the efficiency levels associated with each technology or combination of technologies. The end result of each teardown is a structured BOM, which DOE developed for each of the physical and virtual teardowns. The BOMs incorporate all materials, components, and fasteners (classified as either raw materials or purchased parts and assemblies), and characterize the materials and components by weight, manufacturing processes used, dimensions, material, and quantity. The BOMs from the teardown analysis were then used as inputs to the cost model to calculate the MPC for each product that was torn down. The MPCs resulting from the teardowns were then used to develop an industry average MPC for each efficiency level of each product class analyzed.

More information regarding details on the teardown analysis can be found in chapter 5 of the NOPR TSD.

b. Cost Model

The cost model is a spreadsheet that converts the materials and components in the BOMs into dollar values based on the price of materials, average labor rates associated with manufacturing and assembling, and the cost of overhead and depreciation, as determined based on manufacturer interviews and DOE expertise. To convert the information in the BOMs to dollar values, DOE collected information on labor rates, tooling costs, raw material prices, and other factors. For purchased parts, the cost model estimates the purchase price based on volume-variable price quotations and detailed discussions with manufacturers and component suppliers. For fabricated parts, the prices of raw metal materials[24] (e.g., tube, sheet metal) are estimated on the basis of 5-year averages (from 2009 to 2014). The cost of transforming the intermediate materials into finished parts is estimated based on current industry pricing.[25]

[24] American Metals Market, available at http://www.amm.com/ (last accessed August 19, 2014).
[25] U.S. Department of Labor, Bureau of Labor Statistics, Produce Price Indices, available at http://www.bls.gov/ppi/ (last accessed July 28, 2014).

c. Manufacturing Production Costs

Once the cost estimates for all the components in each teardown unit were finalized, DOE totaled the cost of materials, labor, and direct overhead used to manufacture a product in order to calculate the MPC. The total cost of the product was broken down into two main costs: (1) the full MPC; and (2) the non-production cost, which includes selling, general, and administration (SG&A) expenses, the cost of research and development, and interest from borrowing for operations or capital expenditures. DOE estimated the MPC at each efficiency level considered for each product class, from the baseline through the max-tech. After incorporating all calculations and determinations into the cost model, DOE calculated the percentages attributable to each element of total production cost (i.e., materials, labor, depreciation, and overhead). These percentages are used to validate the assumptions by comparing them to manufacturers' actual financial data published in annual reports, along with feedback obtained from manufacturers during interviews. DOE uses these production cost percentages in the manufacturer impact analysis (MIA) (see section IV.J).

In estimating the MPC, DOE took into account the various furnace design enhancements offered for consumer comfort or to reduce electrical energy consumption during furnace operating periods (see Table IV.6 in section IV.C.1.b of this NOPR). In order to accommodate these additional design features into the MPC estimates, DOE calculated MPC estimates both with and without these added design features.

All of the furnaces torn down during the teardown analysis used PSC indoor blower motors, except for at the max-tech efficiency level, where constant airflow BPM motors were used. As discussed previously, constant torque BPM indoor blower motors were considered the baseline design for NWGF units since the 2014 furnace fans rule will set a level[26] that effectively requires the use of this technology before the compliance date of this residential furnaces rulemaking. Similarly, improved PSC indoor blower motors were considered as the baseline design feature for MHGF units as a result of the requirements set in the 2014 furnace fans rulemaking[26]. DOE used the results of the furnace fans rulemaking to calculate the increase in furnace MPC needed to accommodate constant torque BPM and improved PSC indoor blower motors into NWGF and MHGF units, respectively, in place of the PSC motors present in the tear down units. In addition, DOE considered the increases in MPC needed to accommodate constant airflow BPM indoor blower motors. Motor type was assigned in the LCC analysis based on the market penetration of each type of motor at different efficiency levels. At the max-tech efficiency levels for both NWGF and MHGF units, DOE determined that constant airflow BPM motors are a required technology option. As such, the incremental MPC changes of using a constant airflow BPM indoor blower motor in place of a PSC motor were included in the MPCs for NWGF and MHGF units at their respective max-tech AFUE levels.

[26] The Furnace Fans rule set a mandatory fan energy rating (FER) of .044*Qmax + 182 for NWGF units, .071*Qmax + 222 for non-condensing MHGF units, and .071*Qmax + 240 for condensing MHGF units, where Qmax equals the airflow through the furnace at the maximum airflow-control setting operating point. For more information, see the furnace fans rulemaking webpage at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/41.

In addition to estimating the impacts on MPC of different blower motor design features, DOE also estimated the impact on MPC of switching from a single-stage to a two-stage combustion system. The cost to change from a single-stage to a two-stage combustion system includes the cost of a two-stage gas valve, a two-speed inducer assembly, upgraded pressure switch, and additional controls and wiring. Generally, these costs are completely independent of input capacity and AFUE. As such, for two-stage combustion, DOE developed a single cost adder to apply to the MPCs for all furnace input capacities and efficiency levels.

Table IV.9 and Table IV.10 present DOE's estimates of the MPCs by AFUE efficiency level at the representative input capacity (80,000 Btu/hr) for both the NWGF and MHGF furnaces in this rulemaking. The MPCs presented incorporate the appropriate design characteristics of NWGF and MHGF furnaces at each efficiency level. These design characteristics include a single-stage gas valve (and corresponding single-stage components) for all MHGF efficiency levels, a two-stage gas valve (and corresponding components) for all NWGF levels (except for the max-tech level, which incorporates a fully modulating (or "step modulating") design), a constant-torque BPM blower motor for NWGF (except for the max-tech level, where the blower motor is a constant-airflow BPM motor), and an improved permanent split capacitor (PSC) blower motor for all MHGF efficiency levels. Further discussion of the MPCs that incorporate other design options (e.g., two-stage modulating combustion and constant airflow BPM motors) is included in chapter 5 of the TSD.

Table IV.9 Manufacturer Production Cost for Non-Weatherized Gas-Fired Furnaces

Efficiency Level	Efficiency Level (AFUE) %	MPC* $	Incremental Cost Above Baseline $
Baseline	80	360	-
EL1	90	443	83
EL2	92	451	91
EL3	95	505	145
EL4	98	616	256

*The MPC for efficiency levels from Baseline through EL3 are for two-stage operation and incorporate a constant-torque BPM indoor blower motor. At EL4 DOE has determined that modulating operation and a constant-airflow BPM blower motor are present for NWGF furnaces.

Table IV.10 Manufacturer Production Cost for Mobile Home Gas-Fired Furnaces

Efficiency Level	Efficiency Level (AFUE) %	MPC $	Incremental Cost Above Baseline $
Baseline	80	323	-
EL1	92	420	97
EL2	95	476	153
EL3	97	542	219

*The MPC for efficiency levels from Baseline through EL2 are for single-stage operation and incorporate an improved PSC indoor blower motor. At EL 3 DOE has determined that single stage operation and an improved PSC blower motor are present for MHGF furnaces.

Table IV.11 presents DOE's estimates of the incremental MPCs of each standby mode and off mode efficiency level for this rulemaking.

Table IV.11 Incremental Manufacturer Production Cost for Non-Weatherized Gas-Fired and Mobile Home Gas-Fired Furnaces Standby Mode and Off Mode

Efficiency Level	Standby Mode and Off Mode Power Consumption (W)	Incremental MPC $
Baseline	11	0
EL1	9.5	1.00
EL2	9.2	10.47
EL3	8.5	11.12

Chapter 5 of the NOPR TSD presents more information regarding the development of DOE's estimates of the MPCs for this rulemaking.

d. Cost-Efficiency Relationship

DOE's engineering analysis results may be portrayed as a cost-efficiency relationship. DOE created cost-efficiency curves representing the cost-efficiency relationships for both product classes that it examined (i.e., NWGF and MHGF). To develop the cost-efficiency relationships for residential furnaces, DOE first calculated a market-share-weighted baseline MPC representative of all baseline residential furnaces torn down in the teardown analysis. DOE then took the calculated MPCs of all of the furnaces at efficiency levels above the baseline that were torn down, and subtracted the cost of the manufacturer-specific baseline counterpart that was torn down in order to develop a data set of the incremental costs for each manufacturer to get from the baseline efficiency level to each higher efficiency level for which one of their furnaces was torn down. DOE developed an average incremental cost for each efficiency level analyzed from the incremental data, and then added the average incremental costs to the market-share-weighted baseline MPC to calculate the market-share-weighted-average MPCs for the higher efficiency levels. Additional details on how DOE developed the cost-efficiency relationships and related results are available in chapter 5 of the NOPR TSD, which also presents these cost-efficiency curves in the form of energy efficiency versus MPC.

The results indicate that cost-efficiency relationships are nonlinear. In other words, as efficiency increases, manufacturing becomes more difficult and more costly. A large cost increase is evident between the non-condensing (80% AFUE) and condensing (90% AFUE) efficiency levels due to the requirement for a heat exchanger that can withstand corrosive condensate, which is typically achieved through the addition of a secondary heat exchanger in condensing furnaces. A significant cost increase also occurs between the 95% and 98% AFUE levels due to the need for modulating combustion components paired with a constant airflow BPM motor at 98% AFUE.

e. Manufacturer Markup

To account for manufacturers' non-production costs and profit margin, DOE applies a non-production cost multiplier (the manufacturer markup) to the full MPC. The resulting MSP is the price at which the manufacturer can recover all production and non-production costs and earn a profit. To meet new or amended energy conservation standards, manufacturers typically introduce design changes to their product lines that increase manufacturer production costs. Depending on the competitive environment for these particular products, some or all of the increased production costs may be passed from manufacturers to retailers and eventually to consumers in the form of higher purchase prices. As production costs increase, manufacturers typically incur additional overhead. The MSP should be high enough to recover the full cost of the product (i.e., full production and non-production costs) and yield a profit.

The manufacturer markup has an important bearing on profitability. A high markup under a standards scenario suggests manufacturers can readily pass along the increased variable costs and some of the capital and product conversion costs (the one-time expenditures) to consumers. A low markup suggests that manufacturers will not be able to recover as much of the necessary manufacturing investments.

To calculate the manufacturer markups, DOE used 10-K reports[27] submitted to the U.S. Securities and Exchange Commission (SEC) by six publicly-owned residential furnace companies. The financial figures necessary for calculating the manufacturer markup are net sales, costs of sales, and gross profit. For furnaces, DOE averaged the financial figures spanning the years 2009 to 2013 in order to calculate the markups. DOE used this approach because amended standards may transform high-efficiency products (which currently are considered premium products) into typical products. DOE acknowledges that numerous residential furnace manufacturers are privately-held companies and do not file SEC 10-K reports. In addition, while the publicly-owned companies file SEC 10-K reports, the financial information summarized may not be exclusively for the residential furnace portion of their business and can also include financial information from other product sectors, whose margins could be quite different from the residential furnace industries. DOE discussed the manufacturer markup with manufacturers during interviews, and used product specific feedback on market share, markups and cost structure from manufacturers to adjust the markup calculated through

[27] U.S. Securities and Exchange Commission, Annual 10-K Reports (various years between 2009 and 2013), available at http://sec.gov.

review of SEC 10-K reports. See chapter 12 of the NOPR TSD for more details about the manufacturer markup calculation.

f. Manufacturer Interviews

Throughout the rulemaking process, DOE has sought and continues to seek feedback and insight from interested parties that would improve the information used in its analyses. DOE interviewed manufacturers representing 35% of the product listings on the NWGF market and 50% of the product listings on the MHGF market as a part of the NOPR manufacturer impact analysis (see section IV.J.3). During the interviews, DOE sought feedback on all aspects of its analyses for residential furnaces. DOE discussed the analytical assumptions and estimates, cost model, and cost-efficiency curves with residential furnace manufacturers. DOE considered all the information manufacturers provided when refining the cost model and assumptions. However, DOE incorporated equipment and manufacturing process figures into the analysis as averages in order to avoid disclosing sensitive information about individual manufacturers' products or manufacturing processes. More details about the manufacturer interviews are contained in chapter 12 of the NOPR TSD.

D. Markups Analysis

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

DOE characterized two distribution channels to describe how NWGFs and MHGFs pass from manufacturers to residential consumers: replacement market and new construction. The replacement market channel is characterized as follows:

Manufacturer → Wholesaler → Mechanical contractor → Consumer

The new construction distribution channel is characterized as follows:

Manufacturer → Wholesaler → Mechanical contractor → General contractor → Consumer

For NWGFs and MHGFs installed in commercial buildings,[28] DOE understands that, in general, the on-site contractor staff purchases equipment directly from the wholesaler and performs the installation. Therefore, DOE used a distribution channel in which the product goes from the manufacturer to a wholesaler and then to the commercial consumer through a national account:

Manufacturer → Wholesaler → Consumer

The derivation of the manufacturer markup is discussed in section IV.C. To develop markups for the parties involved in the distribution of the product, DOE utilized

[28] DOE estimates that three percent of NWGFs are installed in commercial buildings. See section IV.E for further discussion.

several sources, including: (1) the Heating, Air-Conditioning & Refrigeration Distributors International (HARDI) 2013 Profit Report[29] (to develop wholesaler markups); (2) the Air Conditioning Contractors of America's (ACCA) 2005 financial analysis on the heating, ventilation, air-conditioning, and refrigeration (HVACR) contracting industry[30] (to develop mechanical contractor markups); and (3) U.S. Census Bureau 2007 Economic Census data[31] on the residential and commercial building construction industry (to develop general contractor markups).

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

In addition to the markups, DOE derived state and local taxes from data provided by the Sales Tax Clearinghouse.[32] These data represent weighted average taxes that include county and city rates. DOE derived shipment-weighted average tax values for each region considered in the analysis.

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[29] Heating, Air Conditioning & Refrigeration Distributors International 2013 Profit Report, available at http://www.hardinet.org/Profit-Report (last accessed Aug. 19, 2014).
[30] Air Conditioning Contractors of America (ACCA), Financial Analysis for the HVACR Contracting Industry (2005), available at http://www.acca.org/store/ (last accessed Aug. 19, 2014)
[31] U.S. Census Bureau, 2007 Economic Census Data, available at: http://www.census.gov/econ/ (last accessed April 10, 2014).
[32] Sales Tax Clearinghouse Inc., State Sales Tax Rates Along with Combined Average City and County Rates (2014) available at http://thestc.com/STrates.stm (last accessed May 27, 2014).

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

E. Energy Use Analysis

The purpose of the energy use analysis is to assess the energy requirements of residential furnaces at different efficiencies in representative U.S. single-family homes, multi-family residences, and commercial buildings, and to assess the energy savings potential of increased furnace efficiency. DOE estimated the annual energy consumption of NWGFs and MHGFs at specified energy efficiency levels across a range of climate zones, building characteristics, and heating applications. The annual energy consumption includes the natural gas, liquid petroleum gas (LPG), and electricity used by the furnace.

DOE's analysis estimated the energy use of NWGFs and MHGFs in the field (i.e., as they are actually used by consumers). In contrast to the DOE test procedure, which provides standardized results that can serve as the basis for comparing the performance of different appliances used under the same conditions, the energy use analysis seeks to capture the range of operating conditions for NWGFs and MHGFs.

To determine the field energy use of residential furnaces used in homes, DOE established a sample of households using NWGFs and MHGFs from the Energy Information Administration's (EIA) 2009 Residential Energy Consumption Survey (RECS 2009).[33] DOE assumed that furnaces in residential buildings smaller than 11,250 sq. ft. are residential furnaces and that each building has one furnace. The RECS data

[33] U.S. Department of Energy: Energy Information Administration, Residential Energy Consumption Survey: 2009 RECS Survey Data (2013), available at: http://www.eia.gov/consumption/residential/data/2009/ (last accessed July 29, 2014).

provide information on the vintage of the home, as well as heating energy use in each household. DOE used the household samples not only to determine furnace annual energy consumption, but also as the basis for conducting the LCC and PBP analysis. DOE projected household weights and household characteristics in 2021, the first full year of compliance with any amended energy conservation standards for NWGFs and MHGFs. To characterize future new homes, DOE used a subset of homes that were built after 1990.

To determine the field energy use of NWGFs used in commercial buildings, DOE established a sample of buildings using NWGFs from EIA's 2003 Commercial Building Energy Consumption Survey (CBECS 2003),[34] which is the most recent such survey that is currently available. DOE assumed that 80 percent of furnaces in commercial buildings smaller than 10,000 sq. ft are residential non-weatherized gas furnaces and each building has one or more furnaces.

1. Active Mode

To estimate the annual energy consumption in active mode of furnaces meeting the considered efficiency levels, DOE first calculated the house heating load based on the RECS estimates of household furnace annual energy consumption.[35] DOE estimated the house heating load by reference to the existing furnace's characteristics, specifically its

[34] U.S. Department of Energy: Energy Information Administration, Commercial Buildings Energy Consumption Survey (2003), available at http://www.eia.gov/consumption/commercial/data/2003/index.cfm?view=microdata) (last accessed July 29, 2014).

[35] EIA estimated the equipment's annual energy consumption from the household's utility bills using conditional demand analysis.

capacity[36] and efficiency (AFUE), as well as by the heat generated from the electrical components. The analysis assumes that homes with more than 5,000 square feet (about 10 percent of the sample) have two furnaces, with the heating load split evenly between them. This assumption decreases the energy use per furnace. The AFUE of the existing furnaces was determined using the furnace vintage (the year of installation of the product) from RECS and historical data on the market share of furnaces by AFUE (see section IV.E). DOE then used the house heating load to calculate the burner operating hours at each considered efficiency level, which are needed to calculate the fuel consumption and electricity consumption based on the DOE residential furnace test procedure.

DOE adjusted the energy use estimated for 2009 to "normal" weather by using long-term heating degree-day (HDD) data for each geographical region.[37] DOE also accounted for future climate trends based on Annual Energy Outlook 2014 (AEO 2014) projections of HDD.[38] This adjustment results in approximately three percent lower building heating load from 2014 to 2021.

DOE accounted for change in building shell characteristics and building size (square footage) between 2009 and 2021 by applying the building shell indexes in the

[36] DOE's analysis accounts for the over-sizing of furnace capacity because the furnace capacity assignment is a function of historical shipments by furnace capacity, which reflects actual practice, as well as heating square footage and the outdoor design temperature for heating (i.e., the temperature that is exceeded by the 30-year minimum average temperature 1 percent of the time).
[37] National Oceanic and Atmospheric Administration (NOAA), NNDC Climate Data Online (2009), available at http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp (last accessed July 29, 2014).
[38] The LCC and PBP analysis uses the climate projected for 2021, the first full year of compliance with potential amended furnace standards.

National Energy Modeling System (NEMS) associated with Annual Energy Outlook 2014.[39] The indexes consider projected improvements in building thermal efficiency due to improvement in home insulation and other thermal efficiency practices, as well as projected increases in square footage. Application of the index results in nine percent lower building heating load from 2009 to 2021. EIA provides separate indexes for new buildings and existing buildings.

To calculate furnace fan electricity consumption, DOE accounted for field data from several sources (as described in chapter 8 of the NOPR TSD) on static pressures of duct systems, as well as airflow curves for furnace blowers from manufacturer literature. As noted in section IV.C, the furnace designs incorporate furnace fans that meet the standard that will take effect in 2019.[40]

To calculate electricity consumption for the inducer fan, ignition device, gas valve and controls, DOE used the calculation approach described in DOE's test procedure[41] as well as 2013 AHRI Directory of Certified Furnace Equipment and manufacturer product literature.[42]

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[39] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2014, available at http://www.eia.gov/forecasts/aeo/pdf/0383(2014).pdf (last accessed July 29, 2014).
[40] See Table 1 at: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/42.
[41] Found in 10 CFR Pt. 430, subpart B, appendix N.
[42] AHRI Directory of Certified Furnace Equipment, February 2013 (Available at: http://www.ahridirectory.org/ahridirectory/pages/home.aspx).

Once annual energy use had been calculated, DOE disaggregated the total into monthly amounts, as described in chapter 8 of the NOPR TSD. This allows DOE to apply monthly energy prices in the LCC and PBP analysis.

Higher-efficiency furnaces reduce the operating costs for a consumer, which can lead to greater use of the furnace. A direct rebound effect occurs when a piece of equipment that is made more efficient is used more intensively, such that the expected energy savings from the efficiency improvement may not fully materialize. For the NOPR analysis, DOE examined a 2009 review of empirical estimates of the rebound effect for various energy-using products.[43] This review concluded that the econometric and quasi-experimental studies suggest a mean value for the direct rebound effect for household heating of around 20 percent. DOE also examined a 2012 ACEEE paper[44] and a 2013 paper by Thomas and Azevedo.[45] Both of these publications examined the same studies that were reviewed by Sorrell, as well as Greening et al,[46] and identified methodological problems with some of the studies. The studies, believed to be most reliable by Thomas and Azevedo, show a direct rebound effect for heating products in the 1-percent to 15-percent range, while Nadel concludes that a more likely range is 1 to 12 percent, with rebound effects sometimes higher than this range for low-income households who could not afford to adequately heat their homes prior to weatherization.

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[43] Steven Sorrell, et. al, Empirical Estimates of the Direct Rebound Effect: A Review, 37 Energy Pol'y 1356–71 (2009).

[44] Steven Nadel, "The Rebound Effect: Large or Small?" ACEEE White Paper (August 2012) (Available at: http://www.aceee.org/white-paper/rebound-effect-large-or-small).

[45] Brinda Thomas &Ines Azevedo, Estimating Direct and Indirect Rebound Effects for U.S. Households with Input–Output Analysis, Part 1: Theoretical Framework, 86 Ecological Econ. 199–201 (2013), available at http://www.sciencedirect.com/science/article/pii/S0921800912004764.

[46] Lorna A. Greening, et. al., Energy Efficiency and Consumption—The Rebound Effect—A Survey, 28 Energy Pol'y 389–401 (2002).

Based on DOE's review of these recent assessments (see chapter 10 of the NOPR TSD), DOE used a 15 percent rebound effect for NWGFs and MHGFs in this NOPR. Although a lower value might be warranted, DOE prefers to be conservative and not risk understating the rebound effect. DOE welcomes comment on its assessment of this effect on today's rulemaking.

2. Standby Mode and Off Mode

DOE calculated furnace standby mode and off mode electricity consumption for each technology option identified in the engineering analysis by multiplying the power consumption at each efficiency level by the number of standby mode and off mode hours. To calculate the annual number of standby mode and off mode hours for each sample household, DOE subtracted the estimated total furnace fan operating hours from the total hours in a year (8,760). The total furnace fan operating hours includes the furnace fan operating hours during heating, cooling and continuous fan modes.

See chapter 7 in the NOPR TSD for additional detail on the energy analysis for furnace standby mode and off mode operation.

F. Life-Cycle Cost and Payback Period Analysis

In determining whether an energy efficiency standard is economically justified, DOE considers the economic impact of potential standards on consumers. The effect of new or amended standards on individual consumers usually includes a reduction in operating cost and an increase in purchase cost. DOE used the following two metrics to measure consumer impacts:

- LCC (life-cycle cost) is the total consumer cost of an appliance or product, generally over the life of the appliance or product, including purchase and operating costs. The latter costs consist of maintenance, repair, and energy costs. Future operating costs are discounted to the time of purchase and summed over the lifetime of the appliance or product.
- PBP (payback period) 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.

For any given efficiency level, DOE measures the change in LCC relative to an estimate of the base-case efficiency level. The base-case estimate reflects the market in the absence of amended energy conservation standards, including market trends for equipment that exceeds the current energy conservation standards.

DOE analyzed the net effect of potential amended furnace standards on consumers by calculating the LCC and PBP for each household by efficiency level. Inputs to the LCC calculation include the installed cost to the consumer (purchase price, including sales tax where appropriate, plus installation cost), operating costs (energy expenses, repair costs, and maintenance costs), the lifetime of the product, and a discount rate. Inputs to the payback period calculation include the installed cost to the consumer and first-year operating costs.

DOE performed the LCC and PBP analyses using a spreadsheet model combined with Crystal Ball[47] to account for uncertainty and variability among the input variables. Each Monte Carlo simulation consists of 10,000 LCC and PBP calculations 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 10,000 data points showing the range of LCC savings for a given efficiency level relative to the base case efficiency forecast. In performing an iteration of the Monte Carlo simulation for a given consumer, product efficiency is chosen based on its probability. If the chosen product efficiency is greater than or equal to the efficiency of the standard level under consideration, the LCC and PBP calculation reveals that a consumer is not impacted by the standard level. By accounting for consumers who already purchase more-efficient products, DOE avoids overstating the potential benefits from increasing product efficiency.

EPCA establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy (and, as applicable, water) savings during the first year that

[47] Crystal Ball is a commercial software program developed by Oracle and used to conduct stochastic analysis using Monte Carlo simulation A Monte Carlo simulation uses random sampling over many iterations of the simulation to obtain a probability distribution of results. Certain key inputs to the analysis are defined as probability distributions rather than single-point values.

the consumer will receive as a result of the standard, as calculated under the test procedure in place for that standard. (42 U.S.C. 6295(o)(B)(ii)) For each considered efficiency level, DOE determines the value of the first year's energy savings by calculating the quantity of those savings in accordance with the applicable DOE test procedure, and multiplying that amount by the average energy price forecast for the year in which compliance with the amended standards would be required.

As discussed in section IV.E, DOE developed nationally-representative household samples from 2009 RECS, and a sample of commercial buildings using CBECS 2003. For each sampled building, DOE determined the energy consumption of the furnace and the appropriate energy prices in the area where the building is located.

DOE calculated the LCC and PBP for all furnace consumers as if the consumers were to purchase the product in the year that compliance with amended standards is required. At the time of preparation of the NOPR analysis, the expected issuance date for the final rule was in January 2016. EPCA also prescribes a five-year period between the standard's publication date and the compliance date, which leads to a compliance date of January 2021. (42 U.S.C. 6295(f)(4)(C)) For purposes of its analysis, DOE modelled furnaces purchased on or after this date as if they operated for a full year, beginning on January 1, 2021, and continuing thereafter.

1. Inputs to Installed Cost

The primary inputs for establishing the total installed cost are the baseline consumer product price, standard-level consumer price increases, and installation costs (labor and material cost). Baseline consumer prices and standard-level consumer price increases were determined by applying markups to manufacturer selling price estimates, including sales tax where appropriate. The installation cost is added to the consumer price to produce a total installed cost.

The manufacturer selling price estimated in the engineering analysis refers to the current price. Economic literature and historical data suggest that the real prices of many products may trend downward over time according to "learning" or "experience" curves. Experience curve analysis focuses on entire industries and aggregates over many causal factors that may not be well characterized. [48] For example, experience curve analysis implicitly includes factors such as efficiencies in labor, capital investment, automation, materials prices, distribution, and economies of scale at an industry-wide level. An experience curve relates the product price to the cumulative production of the product. Using a given set of historical data, DOE derived an experience rate that expresses the percentage reduction in price for each doubling of cumulative production.

For the default price trend for residential furnaces, DOE derived an experience rate based on an analysis of long-term historical data. As a proxy for manufacturer price,

[48] Margaret Taylor & Sydny K. Fujita, Accounting for Technological Change in Regulatory Impact Analyses: The Learning Curve Technique. (Lawrence Berkeley Nat'l Lab., 2013) available at: http://eetd.lbl.gov/publications/accounting-for-technological-change-0.

DOE used Producer Price Index (PPI) data for warm-air furnace equipment from the Bureau of Labor Statistics for 1990 through 2013.[49] An inflation-adjusted PPI was calculated using the implicit price deflators for GDP for the same years. To calculate an experience rate, DOE performed a least-squares power-law fit on the inflation-adjusted PPI versus cumulative shipments of residential furnaces, based on a corresponding series for total shipments of residential furnaces (see section IV.G of this notice for discussion of shipments data). A detailed discussion of DOE's derivation of the experience rate is provided in appendix 8C of the NOPR TSD.

DOE then derived a price factor index, with the price in 2013 equal to 1, to forecast prices in 2021 for the LCC and PBP analysis, and, for the NIA, for each subsequent year through 2050. The index value in each year is a function of the experience rate and the cumulative production through that year. To derive the latter, DOE combined the historical shipments data with projected shipments from the base-case projection made for the NIA (see section IV.H of this notice). Application of the index results in prices that decline 6 percent from 2013 to 2021.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the equipment.

[49] U.S. Department of Labor, Bureau of Labor Statistics, Produce Price Indices Series ID PCU333415333415C, available at http://www.bls.gov/ppi/ (last accessed July 28, 2014).

DOE conducted a detailed analysis of installation costs when a non-condensing gas furnace is replaced with a condensing gas furnace, with particular attention to venting issues in replacement applications. DOE gave separate consideration to the cost of installing a condensing gas furnace in new homes. As part of its analysis, DOE used information in the 2009 RECS to estimate the location of the furnace in each of the sample homes.

First, DOE estimated basic installation costs that are applicable to both replacement and new home applications. These costs, which apply to both condensing and non-condensing gas furnaces, include putting in place and setting up the furnace, gas piping, ductwork, electrical hookup, permit and removal/disposal fees, and where applicable, additional labor hours for an attic installation.

For replacement applications, DOE then included a number of additional costs ("adders") for a fraction of the sample households. For non-condensing gas furnaces, these additional costs included updating flue vent connectors, vent resizing, and chimney relining. For condensing gas furnaces, DOE included new adders for flue venting (PVC), combustion air venting (PVC), concealing vent pipes, addressing an orphaned water heater (by updating flue vent connectors, vent resizing, or chimney relining), and condensate removal. Freeze protection is accounted for in the cost of condensate removal. Table IV.12 shows the fraction of installations impacted and the average cost for each of the adders. The estimate of the fraction of installations impacted was based on the furnace location (primarily derived from information in the 2009 RECS) and a number of other sources that are described in chapter 8 of the NOPR TSD. The costs were based on 2013 RS Means data.[50] Chapter 8 of the NOPR TSD describes in detail how DOE estimated the cost for each installation item.

Table IV.12 Additional Installation Costs for Non-Weatherized Gas Furnaces in Replacement Applications

Installation Cost Adder	Replacement Installations Impacted	Average Cost (2013$)
Non-Condensing Furnaces		
Updating Flue Vent*	2%	$555.95
Condensing Furnaces		
New Flue Venting (PVC)	100%	$296.12
Combustion Air Venting (PVC)	59%	$295.36
Concealing Vent Pipes	9%	$360.25
Orphaned Water Heater	19%	$672.09
Condensate Removal	100%	$70.06

* For a fraction of installation, this cost includes the commonly vented water heater vent connector, relining chimney, and vent resizing.

DOE also included installation adders for new construction installations. For non-condensing furnaces, the only adder is a new flue vent (metal, including a fraction with stainless steel venting). For condensing gas furnaces, the adders include a new flue vent, combustion air venting for direct vent installations, accounting for a commonly vented water heater, and condensate removal. Table IV.13 shows the estimated fraction of new home installations impacted and the average cost for each of the adders. For details, see chapter 8 of the NOPR TSD.

Table IV.13 Additional Installation Costs for Non-Weatherized Gas Furnaces in New Home Applications

Installation Cost Adder	New Construction	Average Cost

[50] RS Means Company Inc., RS Means Residential Cost Data. Kingston, MA (2013).

	Installations Impacted	(2013$)
Non-Condensing Furnaces		
New Flue Vent (Metal)*	100%	$1,273.78
Condensing Furnaces		
New Flue Venting (PVC)	100%	$207.83
Combustion Air Venting (PVC)	60%	$205.77
Concealing Vent Pipes	6%	$125.28
Orphaned Water Heater	45%	$987.60
Condensate Removal	100%	$47.46

* For a fraction of installation, this cost includes the commonly vented water heater vent connector.

DOE included basic installation costs for mobile home gas furnaces similar to those described above for non-weatherized gas furnaces. DOE also included costs for venting and condensate removal. Freeze protection is accounted for in the cost of condensate removal. In addition, DOE considered the cost of dealing with space constraints that could be encountered when a condensing furnace is installed.

3. Inputs to Operating Costs

a. Energy Consumption

For each sample household, DOE determined the energy consumption for a furnace at different efficiency levels using the approach described above in section IV.E.

As discussed in section IV.E, DOE is taking into account the rebound effect associated with more-efficient residential furnaces. The take-back in energy consumption associated with the rebound effect provides consumers with increased value (e.g., enhanced comfort associated with a cooler or warmer indoor environment). The increased comfort has a cost that is equal to the monetary value of the higher energy use.

DOE could reduce the energy cost savings to account for the rebound effect, but then it would have to add the value of increased comfort in order to conduct a proper economic analysis. The approach that DOE uses – not reducing the energy cost savings to account for the rebound effect and not adding the value of increased comfort – assumes that the value of increased comfort is equal to the monetary value of the higher energy use. Although DOE cannot measure the actual value of increased comfort to the consumers, the monetary value of the higher energy use represents a lower bound for this quantity.

b. Energy Prices

Using the most current data from EIA on average energy prices in various States and regions,[51,52,53] DOE assigned an appropriate energy price to each household or commercial building in the sample, depending on its location (see chapter 8 of the NOPR TSD for details). Average electricity and natural gas prices from the EIA data were adjusted using seasonal marginal price factors to derive monthly marginal electricity and natural gas prices. For a detailed discussion of the development of marginal energy price factors, see appendix 8F of the NOPR TSD.

[51] U.S. Department of Energy-Energy Information Administration, Form EIA-826 Database Monthly Electric Utility Sales and Revenue Data (2013) available at*:* http://www.eia.doe.gov/cneaf/electricity/page/eia826.html
[52] U.S. Department of Energy-Energy Information Administration, Natural Gas Navigator (2013), available at: http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm).
[53] U.S. Department of Energy-Energy Information Administration, 2012 State Energy Consumption, Price, and Expenditure Estimates (SEDS) (2013), available at: http://www.eia.doe.gov/emeu/states/_seds.html.

To estimate future prices, DOE used the projected annual changes in average residential and commercial natural gas, LPG, and electricity prices in the Reference case projection in AEO 2014.[54]

c. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing components that have failed, whereas maintenance costs are associated with maintaining the proper operation of the equipment. DOE estimated the frequency of annual maintenance using data from RECS 2009 survey on the frequency with which owners of different types of furnaces perform maintenance.

DOE estimated maintenance and repair costs for residential furnaces at each considered efficiency level using a variety of sources, including 2013 RS Means,[55] manufacturer literature, and information from expert consultants.

d. Product Lifetime

Product lifetime is the age at which an appliance is retired from service. DOE conducted an analysis of furnace lifetimes using a combination of data on shipments and the furnace stock (see section IV.G) and RECS data on the age of the furnaces in the homes. The data allowed DOE to develop a survival function, which provides a range from minimum to maximum lifetime as well as an average lifetime. The average

[54] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2014, Table 3, available at http://www.eia.gov/forecasts/aeo/data.cfm#enprisec (last accessed July 29, 2014).
[55] RS Means Company Inc., RS Means Facilities Maintenance & Repair Cost Data. Kingston, MA (2013).

lifetimes estimated for the NOPR are 21.5 years for NWGFs and MHGFs. In addition, DOE reviewed a number of sources to validate the derived furnace lifetimes, including American and European research studies and field data reports.[56] Chapter 8 of the NOPR TSD provides further details on the methodology and sources DOE used to develop furnace lifetimes.

e. Discount Rates

In the calculation of LCC, DOE applies discount rates to estimate the present value of future operating costs. The discount rate used in the LCC analysis represents the rate from an individual consumer's perspective.

To establish discount rates for residential consumers, DOE identified all relevant household debt or asset classes in order to approximate a consumer's opportunity cost of funds related to appliance energy cost savings and maintenance costs. DOE estimated the average percentage shares of the various types of debt and equity by household income group using data from the Federal Reserve Board's Survey of Consumer Finances (SCF) for 1995, 1998, 2001, 2004, 2007, and 2010. DOE then developed a distribution of rates for each type of debt and asset by income group to represent the discount rates that may apply in the year in which amended standards would take effect. DOE assigned each sample household a specific discount rate drawn from one of the distributions. The average residential discount rate across all types of household debt and equity and income groups, weighted by the shares of each class, is 4.5 percent.

[56] See appendix 8-F of the NOPR TSD for a listing of the sources.

To establish discount rates for commercial consumers, DOE estimated the cost of capital for the types of companies that purchase NWGFs and MHGFs. The weighted average cost of capital is commonly used to estimate the present value of cash flows from a typical company project or investment. Most companies use both debt and equity capital to fund investments, so their cost of capital is the weighted average of the cost to the firm of equity and debt financing. DOE estimated the weighted average cost of capital using financial data for publicly traded firms in the sectors that purchase residential furnaces.[57]

See chapter 8 in the NOPR TSD for further details on the development of discount rates for the LCC analysis.

f. Base-Case Efficiency

To estimate the share of consumers affected by a potential standard at a particular efficiency level, DOE's LCC and PBP analysis considers the projected distribution (i.e., market shares) of product efficiencies that consumers will purchase in the first compliance year, without amended energy conservation standards (base case).

DOE considered incentives and other market forces that have increased the sales of high-efficiency furnaces to estimate base-case efficiency distributions for the considered products. DOE started with data provided by AHRI on historical shipments for each product class. For non-weatherized gas furnaces, DOE reviewed AHRI data

[57] Damodaran Online, Data Page: Costs of Capital by Industry Sector (2012), http://pages.stern.nyu.edu/~adamodar/ (last accessed July 29, 2014).

from 1992 to 2009, detailing the market shares of non-condensing (80 percent AFUE) and condensing (90 percent AFUE and greater) furnaces by region.[58] DOE also compiled data on the national market shares of non-condensing and condensing gas furnaces from 2010 to 2012 from the ENERGY STAR program.[59] With these data, DOE derived historic trends for the North and South regions.

To project trends from 2011 to 2021, DOE only used the trends from 1993 to 2004 because from 2005 to 2011, there was a sharp increase in the share of condensing furnaces primarily due to Federal tax credits, which was followed by a sharp decrease in 2012. DOE determined that excluding these years provides a more reasonable projection. The maximum share of condensing shipments for each region is assumed to be 95 percent. In other words, at least five percent of NWGF and MHGF furnace shipments will be non-condensing.

DOE used data on the distribution of models in AHRI's Directory of Certified Product Performance[60] to disaggregate the condensing-level shipments among condensing efficiency levels. Based on stakeholder input, DOE assumed that for furnace replacements, the fraction of 95 percent AFUE and above shipments in the replacement market would be double the fraction in the new construction market. DOE also assumed that the fraction of 95 percent AFUE and above shipments would be higher in the North

[58] The market share of furnaces with AFUE between 80 and 90 percent is well below 1 percent due to the very high installed cost of 81-percent AFUE furnaces, compared with condensing designs, and concerns about safety of operation.
[59] ENERGY STAR Unit Shipment Data (2012), https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data.
[60] Air Conditioning, Heating, and Refrigeration Institute, Directory of Certified Performance: Furnaces (2013), http://www.ahridirectory.org/.

compared to the South, because the ENERGY STAR level in the North is 95 percent AFUE compared to 90 percent in the South.

Table IV.14 and Table IV.15 show the estimated AFUE base-case efficiency distributions in 2021 for NWGFs and MHGFs. For further information on DOE's estimation of the base-case efficiency distributions for non-weatherized gas furnaces, see chapter 8 of the NOPR TSD.

Table IV.14 Current and Base-Case AFUE Distribution for Non-Weatherized Gas Furnaces

Efficiency, AFUE	2021 Market share in percent				
	National	North, Repl	North, New	South, Repl	South, New
80%	53.4%	33.0%	34.7%	77.6%	70.4%
90%	5.2%	5.5%	8.8%	3.4%	5.5%
92%	17.9%	15.8%	32.4%	13.9%	20.2%
95%	23.0%	44.9%	23.6%	4.9%	3.8%
98%	0.5%	0.8%	0.6%	0.1%	0.2%

Table IV.15 Current and Base-Case AFUE Distribution for Mobile Home Gas Furnaces

Efficiency, AFUE	2021 Market share in percent				
	National	North, Repl	North, New	South, Repl	South, New
80%	73.9%	65.8%	64.3%	87.2%	89.2%
92%	12.1%	6.1%	21.2%	9.6%	9.6%
95%	13.8%	27.7%	14.3%	3.2%	1.2%
97%	0.2%	0.4%	0.2%	0.0%	0.0%

DOE also estimated base-case efficiency distributions for furnace standby mode and off mode power. As shown in Table IV.16, DOE estimated that 61 percent of the affected market would be at the baseline level in 2021 based on data from 18 furnace models from field study conducted in Wisconsin[61] and data from DOE laboratory tests (see appendix 8I). In addition, for MHGFs, DOE assumed that all PSC furnace fan motor models would have lower standby power than the max tech efficiency level.

Table IV.16 Standby Mode and Off Mode Base-Case Efficiency Distribution in 2021 for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces

Efficiency Level	Standby/Off Mode Watts	NWGF Market Share in percent	MHGF Market Share in percent
Baseline	11.0	61	5
1	9.5	0	0
2	9.2	17	1
3	8.5	22	94

4. Accounting for Product Switching Under Potential Standards

Because home builders are sensitive to the cost of heating equipment, a standard level that significantly increases purchase price may induce some builders to switch to a different heating system than they would have otherwise installed (i.e., in the base case). Such an amended standard level may also induce some home owners to replace their existing furnace at the end of its useful life with a different type of heating product, although in this case, switching may incur additional costs to accommodate the different product. The decision to switch is also affected by the prices of the energy sources for competing equipment.

For this NOPR, DOE developed a consumer choice model to estimate the response of builders and home owners to potential amended furnace standards. The

[61] Scott Pigg, Electricity Use by New Furnaces: A Wisconsin Field Study (Energy Center of Wis. 2003), available at http://www.ecw.org/publications/electricity-use-new-furnaces-wisconsin-field-study.

model considers the options available to each sample household, which are to purchase and install: (1) the furnace that meets a particular standard level, (2) a heat pump, or (3) an electric furnace. In addition, DOE allowed for the possibility that households for which installation of a condensing furnace would leave an "orphaned" gas water heater that would require expensive re-sizing of the vent system might choose instead to purchase an electric water heater when they choose any of the above three options. DOE did not include a repair option in the consumer choice model and associated analysis. Current data collected by DOE suggests that repair in the case of major equipment failure, such as a furnace, would be minimal, unless the furnace is relatively new. For option 2, purchase a heat pump, DOE takes into consideration the age of the existing central air conditioner, if one exists, because if the air conditioner is not very old, it is unlikely that the consumer would opt to install a heat pump to provide both heating and cooling.

The consumer choice model uses the installed cost of each option, as would be likely for each sample household, and the operating costs, taking into account the space heating load and the water heating load for each household and the energy prices it will pay over the equipment lifetime of the available product options. DOE also accounted for the cooling load of each relevant household that might switch from gas furnace and CAC to a heat pump.

For heat pumps, DOE used efficiency and consumer prices for models that meet the energy conservation standards due to take effect on January 1, 2015 (10 CFR

430.32(c)(3)),and for water heaters, it used efficiency and consumer prices for models that meet the standards due to take effect on April 16, 2015. (10 CFR 430.32(d)) For electric furnaces, DOE used an efficiency of 98 percent and a consumer price based on RS Means.[62] For situations where a household with a gas furnace might switch to electric space heating, DOE used the installed cost of the electric heating options, including a separate circuit up to 100 amps that would need to be installed to power the electric resistance heater within an electric furnace or heat pump, as well as a cost for upgrading the electrical service panel for a fraction of households. For all installations, DOE used regional labor rates from RS Means.[63]

Electric furnaces are estimated to have the same lifetime as NWGFs, but heat pumps have an estimated average lifetime of 19 years, which is 2.5 years less than the estimated average lifetime of NWGFs (21.5 years). To ensure comparable accounting, DOE annualized the installed cost of a second heat pump and multiplied the annualized cost by the difference in years between the heat pump and a gas furnace in a particular switching situation.

The decision criteria in the model are based on proprietary data from Decision Analysts,[64] which identified for a representative sample of consumers their willingness to purchase more-efficient space-conditioning systems. Each of the four surveys that DOE used, which span the period 2006 to 2013, involved approximately 30,000 homeowners.

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[62] RS Means Company Inc., RS Means Facilities Maintenance & Repair Cost Data (2013).
[63] RS Means Company Inc., RS Means Residential Cost Data. Kingston, MA (2013).
[64] Decision Analysts, 2006, 2008, 2010, and 2013 American Home Comfort Studies. Available at http://www.decisionanalyst.com/Syndicated/HomeComfort.dai

The surveys asked respondents the maximum price they would be willing to pay for a product that was 25 percent more efficient than their existing product, which DOE assumed is equivalent to a 25-percent decrease in annual energy costs. DOE also used Decision Analyst data for consumer choice model in the June 27, 2011 direct final rule for residential central air conditioners and residential furnaces. 76 FR 37408. From these data, DOE deduced that consumers would expect a payback period of 3.5 years or less for a more-expensive but more-efficient product (see appendix 8J of the NOPR TSD for further discussion). This reflects that, in general, consumers place a relatively high importance on the first cost differences.

The consumer choice model estimates the PBP between the higher efficiency NWGF in each standards case compared to the electric heating options using the total installed cost and first year operating cost as estimated for each sample household or building. For switching to occur, the total installed cost of the electric option has to be less than the NWGF standards case option. The model assumes that there will be switching to an electric heating option if the PBP of the NWGF relative to the electric heating option is greater than 3.5 years or the PBP is negative. In the case of switching to an electric heating option, the model selects the most economically beneficial case.

In addition to the default estimate, DOE conducted sensitivity analyses assuming higher and lower amounts of switching. Whereas the default estimate uses a consumer decision metric involving expectation of a payback period of 3.5 years or less for a more-expensive but more-efficient product, the sensitivity analyses use payback periods that are one year higher or lower than 3.5 years (i.e., 2.5 years and 4.5 years).

Key results of the consumer choice model are presented in section V.B.1 of today's notice.

5. Inputs to Payback Period Analysis

The payback period is the amount of time it takes the consumer to recover the additional installed cost of more efficient products, compared to baseline products, through energy cost savings. The simple payback period does not account for changes in operating expense over time or the time value of money. Payback periods that exceed the life of the product mean that the increase in total installed cost is not recovered in reduced operating expenses.

The inputs to the PBP calculation are the total installed cost of the equipment to the customer for each efficiency level and the average annual operating expenditures for each efficiency level. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed. The results of DOE's PBP analysis are presented in section V.B.1.

For the rebuttable presumption PBP, for each considered efficiency level, DOE determined the value of the first year's energy savings by calculating the quantity of those savings in accordance with the applicable DOE test procedure, and multiplying that amount by the average energy price forecast for the year in which compliance with the amended standard would be required.

G. Shipments Analysis

1. Overview

DOE uses forecasts of product shipments to calculate the national impacts of potential amended energy conservation 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. DOE estimated furnace shipments by projecting shipments in three market segments: (1) replacements; (2) new housing; and (3) new owners in buildings that did not previously have a NWGF. DOE also considered whether standards that require more-efficient furnaces would have an impact on furnace shipments.

First, DOE assembled historic shipments data for NWGFs and MHGFs from Appliance[65] and AHRI.[66] To project furnace replacement shipments, DOE developed retirement functions from the furnace lifetime estimates and applied them to the existing products in the housing stock, which are tracked by vintage.

To project shipments to the new housing market, DOE utilized a forecast of new housing construction and historic saturation rates of furnace product types in new

[65] Appliance Historical Statistical Review: 1954-2012, Appliance Mag. (2014), available at http://www.appliancemagazine.com/marketresearch/editorial.php?article=2476.
[66] Air-Conditioning, Heating, & Refrigeration Institute. Monthly Shipments (2010-2013), available at http://www.ahrinet.org/site/498/Resources/Statistics/Monthly-Shipments).

housing. DOE used AEO 2014 for forecasts of new housing.[67] DOE estimated future furnace saturation rates in new housing based on a weighted-average of U.S. Census Bureau's Characteristics of New Housing[68] values from1990 through 2013.

To project shipments to new owners of NWGF, DOE used data in the American Home Comfort Survey[69] to estimate that the annual total amounts to five percent of replacement shipments.

DOE developed base-case shipments forecasts for each of the four Census regions that, in turn, were aggregated to produce regional and national forecasts. DOE estimated that the fraction of residential NWGFs shipped to the commercial sector is approximately three percent.[70]

For details on the shipments analysis, see chapter 9 of the NOPR TSD.

2. Impact of Potential Standards on Shipments: Accounting for Product Switching

To estimate the impacts of potential standards on furnace shipments, DOE applied the consumer choice model described in section IV.F.4. The options available to each

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[67] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2014, Table 20, available at http://www.eia.gov/forecasts/aeo/data.cfm?filter=macroeconomic#macroeconomic (last accessed July 29, 2014).
[68] U.S. Census Bureau, Characteristics of New Housing, http://www.census.gov/const/www/charindex.html (last accessed Aug. 19, 2014).
[69] Decision Analysts, 2008 American Home Comfort Study: Online Database Tool, available at http://www.decisionanalyst.com/Syndicated/HomeComfort.dai.
[70] The results derived from RECS 2009 and CBECS 2003 show there are 45.6 and 1.2 million residential furnaces in residential and commercial buildings, respectively. DOE assumed that the share of shipments is similar to the share in the stock.

sample household are to purchase and install: (1) the furnace that meets a particular standard level, (2) a heat pump, or (3) an electric furnace.[71]

As applied in the LCC and PBP analysis, the model considers equipment prices in the compliance year and energy prices over the lifetime of equipment installed in that year. The shipments model considers the switching that might occur in each year of the considered 2021-2050 forecast period. To do so, DOE estimated the switching in the final year of the shipments period (2050), and derived trends from 2021 to 2050. First, DOE applied the furnace product price trend described above to project prices in 2050. DOE used the appropriate energy prices over the lifetime of equipment installed in that year. Although the inputs vary, the decision criteria, as described in section IV.F.4, are the same in each year.

For each considered standard level, the number of gas furnaces shipped in each year is equal to the base shipments minus the number of gas furnace buyers who switched to either a heat pump or an electric furnace. The shipments model also tracks the number of additional heat pumps and electric furnaces shipped in each year.

Because measures to limit standby mode and off mode power consumption have a very small impact on the total installed cost and do not impact consumer utility, and thus have a minimal effect on consumer purchase decisions, DOE assumed that base-case

[71] DOE also accounted for situations when installing a condensing furnace could leave an "orphaned" gas water heater that would require expensive re-sizing of the vent system. Rather than incurring this cost, the consumer could choose to purchase an electric water heater along with a new furnace.

product shipments would be unaffected by standards to limit standby mode and off mode power consumption.

For details on DOE's shipments analysis of product and fuel switching, see chapter 9 of the NOPR TSD.

H. National Impact Analysis

The NIA assesses the national energy savings (NES) and the net present value (NPV) from a national perspective of total consumer costs and savings expected to result from new or amended energy conservation standards at specific efficiency levels. DOE determined the NPV and NES for the efficiency levels considered for the furnace product classes analyzed.

To make the analysis more accessible and transparent to all interested parties, DOE used a spreadsheet model to calculate the energy savings and the national consumer costs and savings from each TSL.[72] The NIA calculations are based on the annual energy consumption and total installed cost data from the energy use analysis and the LCC analysis. In the NIA, DOE forecasted the energy savings, energy cost savings and installed product costs for each product class over the lifetime of products sold from 2021 through 2050.

[72] DOE's use of spreadsheet models provides interested parties with access to the models within a familiar context. In addition, the TSD and other documentation that DOE provides during the rulemaking help explain the models and how to use them, and interested parties can review DOE's analyses by changing various input quantities within the spreadsheet.

1. Efficiency in the Base Case and Standards Cases

A key component of the NIA is the trend in energy efficiency forecasted for the base case (without amended standards) and each of the standards cases. Section IV.F.3.f describes how DOE developed a base-case energy efficiency distribution for each of the considered product classes for the first full year of compliance (2021). To project base-case efficiency over the 30-year shipments period, DOE extrapolated the historical trends in efficiency that were described in section IV.F.3.f. DOE estimated that the national market share of condensing products would grow from 45 percent in 2021 to 61 percent by 2050 for NWGFs, and from 23 percent to 29 percent for MHGFs. The market shares of the different condensing efficiency levels (i.e., 90-, 92-, 95-, and 98-percent AFUE for NWGF and 92-, 95-, and 97-percent AFUE for MHGF) are maintained in the same proportional relationship as in 2021.

Due to the lack of historical efficiency data for standby mode and off mode power consumption, DOE estimated that the efficiency distribution would remain the same throughout the forecast period.

To estimate the impact that amended energy conservation standards may have in the year compliance becomes required, DOE used a "roll-up" scenario: products with efficiencies in the base case that do not meet a potential amended standard level "roll up" to meet that standard level, and products at efficiencies above the standard level under consideration would not be affected. DOE believes that the roll-up approach provides a conservative estimate of the potential energy savings in the standards cases. For the standards case with a 90-percent AFUE national standard, DOE estimated that many consumers will purchase a 92-percent AFUE furnace rather than a 90-percent AFUE furnace because the extra installed cost is minimal.

After the year of compliance, DOE estimated growth in efficiency in the standards cases, except in the max-tech standards case. The estimated growth accounts for potential changes in ENERGY STAR criteria and the response of manufacturers to minimum standards in the condensing range. For the TSLs requiring 90-, 92-, and 95-percent AFUE, DOE projected growth in the market shares of 95-percent AFUE and 98-percent AFUE furnaces. For the proposed NWGF AFUE standards (TSL 3, requiring 92-percent AFUE), the share of 95-percent AFUE furnaces increases from 24 to 56 percent from 2021 to 2050, and the share of 98-percent AFUE furnaces increases from 0.5 to 8.4 percent. For the proposed MHGF AFUE standards (TSL 3, requiring 92-percent AFUE), the share of 95-percent furnaces increases from 11 percent to 34 percent, and the share of 97-percent AFUE furnaces increases from 0.1 percent to 2.6 percent.

DOE did not have a basis on which to predict a change in efficiency trend for standby mode and off mode power consumption, so DOE assumed that the efficiency distribution would not change after the first full year of compliance.

Details on how the efficiency trends were developed are in chapter 10 of the NOPR TSD.

2. Product Cost Trend

As discussed in section IV.F.1, DOE used an experience curve method to project future product price trends. Application of the price index results in a decline of 22 percent in furnace prices from 2021 to 2050. In addition to the default trend described in section IV.F.1, which shows a modest rate of decline, DOE performed price trend sensitivity calculations in the NIA to examine the dependence of the analysis results on different analytical assumptions. The price trend sensitivity analysis considered a trend with a greater rate of decline than the default trend and a trend with constant prices. The derivation of these trends is described in appendix 10C of the NOPR TSD.

3. Product Switching

As discussed in section IV.F.4, DOE estimated the extent of switching from NWGFs to electric heating equipment that might occur in each year of the considered 2021-2050 forecast period in response to potential amended standards. In addition to the default estimate, DOE conducted sensitivity analyses assuming higher and lower amounts of switching.

4. National Energy Savings

To develop the NES, DOE calculated annual energy consumption for the base case and the standards cases. DOE calculated the annual energy consumption for each case using the appropriate per-unit annual energy use data multiplied by the projected NWGF or MHGF shipments for each year. The per-unit annual energy use is adjusted with the building shell improvement index, which results in a decline of 12 percent in the heating load from 2021 to 2050, and the climate index, which results in a decline of 6.5 percent in the heating load.

In the standards cases, there are fewer shipments of NWGFs or MHGFs compared to the base case because of product switching, but there are additional shipments of heat pumps, electric furnaces and electric water heaters. DOE incorporated the per-unit annual energy use of the heat pumps and electric furnaces that was calculated in the LCC and PBP analysis (based on the specific sample households that switch to these products) into the NIA model.

As explained in section IV.E.1, DOE incorporated a rebound effect for NWGFs and MHGFs by reducing the site energy savings in each year by 15 percent.

To estimate the national energy savings expected from amended appliance standards, DOE used a multiplicative factor to convert site electricity consumption (at the home or commercial building) into primary energy consumption (the energy required to convert and deliver the site electricity). These conversion factors account for the energy used at power plants to generate electricity and energy losses during transmission and distribution. The factors vary over time due to changes in generation sources (i.e., the power plant types projected to provide electricity to the country) projected in AEO 2014.[73] The factors that DOE developed are marginal values, which represent the

[73] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2014, available at http://www.eia.gov/forecasts/aeo/data.cfm (last accessed July 29, 2014)

response of the electricity sector to an incremental decrease in consumption associated with potential appliance standards.

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, in 2011 DOE announced its intention to use full-fuel-cycle (FFC) measures of energy use and greenhouse gas and other emissions in the national impact analyses and emissions analyses included in future energy conservation standards rulemakings. 76 FR 51281 (August 18, 2011). After evaluating the approaches discussed in the August 18, 2011 notice, DOE published a statement of amended policy in the Federal Register in which DOE explained that NEMS is the most appropriate tool for its FFC analysis and DOE intended to use NEMS for that purpose. 77 FR 49701 (August 17, 2012). The FFC factors incorporates losses in production and delivery in the case of natural gas (including fugitive emissions) and additional energy used to produce and deliver the various fuels used by power plants. The approach used for this NOPR is described in more detail in appendix 10B of the NOPR TSD.

5. Net Present Value of Consumer Benefit

To develop the national NPV of consumer benefits from potential energy conservation standards, DOE calculated projected annual operating costs (energy costs and repair and maintenance costs) and annual installation costs for the base case and the standards cases. DOE calculated annual energy expenditures from annual energy consumption using forecasted energy prices in each year. DOE calculated annual product expenditures by multiplying the price per unit times the projected shipments in each year.

As mentioned above, in the standards cases there are fewer shipments of NWGFs or MHGFs than in the base case because of product switching, but there are additional shipments of heat pumps and electric furnaces. For these products, the appropriate annual operating costs and installed costs that were calculated in the LCC and PBP analysis were incorporated into the NIA model.

The aggregate difference each year between operating cost savings and increased installation costs is the net savings or net costs. DOE multiplies the net savings in future years by a discount factor to determine their present value. DOE estimates the NPV of consumer benefits using both a 3-percent and a 7-percent real discount rate, in accordance with guidance provided by the Office of Management and Budget (OMB) to Federal agencies on the development of regulatory analysis.[74] The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the "societal rate of time preference," which is the rate at which society discounts future consumption flows to their present value. The discount rates for the determination of NPV differ from the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective

[74] Office of Management and Budget, OMB Circular A-4, section E, Identifying and Measuring Benefits and Costs (2003), available at http://www.whitehouse.gov/omb/memoranda/m03-21.html.

As noted above, in determining national energy savings, DOE is accounting for the rebound effect associated with more-efficient furnaces.[75] Because consumers have foregone a monetary savings in energy expenses, it is reasonable to conclude that the value of the increased utility is equivalent to the monetary value of the energy savings that would have occurred without the rebound effect. Therefore, the economic impacts on consumers with or without the rebound effect, as measured in the NPV, are the same.

I. Consumer Subgroup Analysis

In analyzing the potential impacts of new or amended standards on consumers, DOE evaluated the impacts on two identifiable subgroups of consumers, low-income consumers and senior citizens, that may be disproportionately affected by a national standard. DOE analyzed the LCC impacts and PBP for those particular consumers from alternative standard levels. The analysis used subsets of the RECS 2009 sample comprised of households that meet the criteria for the two subgroups for both non-weatherized gas furnaces and mobile home gas furnaces.

Chapter 11 of the NOPR TSD describes the consumer subgroup analysis and its results.

J. Manufacturer Impact Analysis

[75] As previously discussed in section IV.F, the rebound effect provides consumers with increased utility (e.g., a more comfortable indoor environment).

1. Overview

DOE performed a manufacturer impact analysis (MIA) to determine the financial impact of amended energy conservation standards on residential furnace manufacturers and to estimate 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 industry cost structure data, shipment data, product costs, markups, and conversion costs. The key output is the industry net present value (INPV). The INPV is the sum of the discounted cash flows for the industry over the MIA analysis period and provides a valuation of the industry. The GRIM applies standard accounting principles to calculate industry cash flows and to estimate changes in INPV between a base case and various TSLs (the standards case). The difference in INPV between the base case and standards cases represents the financial impact of amended energy conservation standards on residential furnace manufacturers. DOE used different sets of assumptions (markup scenarios) to represent the uncertainty surrounding potential impacts on prices and manufacturer profitability as a result of amended standards. These different assumptions produce a range of INPV results.

The qualitative part of the MIA addresses the proposed standard's potential impacts on manufacturing capacity and industry competition, as well as differential impacts the proposed standard may have on any particular sub-group of manufacturers. DOE also assesses the cumulative regulatory burden stemming from the combined effects of several recent or impending regulations, and considers opportunities to align future rulemakings to reduce burden to industry (see section V.B.2.e). The complete MIA is outlined in chapter 12 of the NOPR TSD.

DOE conducted the MIA for this rulemaking in three phases. In the first phase of the MIA, DOE prepared an industry characterization based on the market and technology assessment and publicly available information. As part of its profile of the residential furnace industry, DOE also conducted a top-down cost analysis of manufacturers in order 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,[76] corporate annual reports, the U.S. Census Bureau's Economic Census,[77] and Hoover's reports[78] to conduct this analysis.

In the second phase of the MIA, DOE prepared an industry cash-flow analysis to quantify the potential impacts of amended energy conservation standards. In general, energy conservation standards can affect manufacturer cash flow in three distinct ways. These include: (1) creating a need for increased investment; (2) raising production costs

[76] U.S. Securities and Exchange Commission, Annual 10-K Reports (Various Years), available at: http://www.sec.gov/edgar/searchedgar/companysearch.htm (last accessed August 1, 2014).
[77] U.S. Census Bureau, Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries (2011), available at: http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.
[78] Hoovers Inc. Company Profiles, Various Companies, available at: http://www.hoovers.com.

per unit; and (3) altering revenue due to higher per-unit prices and possible changes in sales volumes. DOE estimated industry cash flows in the GRIM at various potential standard levels using industry financial parameters derived in the first phase and the shipment scenario used in the NIA. The GRIM modeled both impacts from the AFUE energy conservation standards and impacts from standby mode and off mode energy conservation standards (i.e., standards based on standby mode and off mode wattage). The GRIM results from the two standards were evaluated independent of one another.

In the third phase of the MIA, DOE conducted structured, detailed interviews with manufacturers that account for approximately 35% of NWGF product listings and 50% of MHGF product listings. During these interviews, DOE discussed engineering, manufacturing, procurement, and financial topics to validate assumptions used in the GRIM. DOE also solicited information about manufacturers' views of the industry as a whole and their key concerns regarding this rulemaking. See section IV.J.3 for a description of the key issues manufacturers raised during the interviews.

Additionally, in the third phase, DOE also evaluated subgroups of manufacturers that may be disproportionately impacted by amended 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 by amended energy conservation standards. DOE identified one subgroup (small manufacturers) for a separate impact analysis.

To identify small businesses for this 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 manufacturer and its affiliates may employ a maximum of 750 employees. The 750-employee threshold includes all employees in a business' parent company and any other subsidiaries. Based on this classification, DOE identified three residential furnace companies that qualify as small businesses. The residential furnace small manufacturer subgroup is discussed in section VI.B of this notice and in chapter 12 of the NOPR TSD.

2. Government Regulatory Impact Model

DOE used the GRIM to quantify the potential changes in cash flow due to amended standards that result in a higher or lower industry value. The GRIM was designed to conduct an annual cash-flow analysis using standard accounting principles that incorporates manufacturer costs, markups, shipments, and industry financial information as inputs. DOE calculated a series of annual cash flows, beginning in 2014 (the base year of the analysis) and continuing to 2050 (the end of the analysis period). DOE calculated INPVs by summing the stream of annual discounted cash flows during this period. DOE applied a discount rate of 6.4 percent, which was derived from industry financials and feedback received during manufacturer interviews. More information about the derivation of the manufacturers' discount rate can be found in chapter 12 of the TSD.

After calculating industry cash flows and INPV, DOE compared changes in INPV between the base case and each standards case. The difference in INPV between the base case and a standards case represents the financial impact of the amended energy conservation standard on the industry at a particular TSL. As discussed previously, DOE collected this information on GRIM inputs from a number of sources, including publicly-available data and confidential interviews with a number of manufacturers.

For consideration of standby mode and off mode regulations, DOE modeled the impacts of the technology options for reducing electricity usage discussed in the engineering analysis (chapter 5 of the TSD). The GRIM analysis incorporates the increases in MPC and changes in markups the results from the standby mode and off mode requirements. Due to the small cost of standby mode and off mode components relative to the overall cost of a residential furnace, DOE assumed that standby mode and off mode standards alone would not impact product shipment numbers. In general, the impacts of the standby and off mode standard are significantly smaller than the impacts of the AFUE standard. For this reason, the analysis of employment, capacity constraints, and sub-group impacts focus on the AFUE standard.

The GRIM results for both the AFUE standard and the standby mode and off mode standard are discussed in section V.B.2. 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 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 products at and above the baseline, DOE performed teardowns and cost modeling that allowed DOE to estimate the incremental material, labor, and overhead costs for products above the baseline. These cost breakdowns and product markups were validated and revised with input from manufacturers during manufacturer interviews.

Shipments Forecast

DOE used the GRIM to estimate 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, DOE used the NIA's annual shipment forecasts derived from the shipments analysis from 2014 (the base year) to 2050 (the end year of the analysis period). In the shipments analysis, DOE estimates the distribution of efficiencies in the base case for all equipment classes. See section IV.G for additional details.

For the standards-case shipment forecast, the GRIM uses the shipments analysis standards case forecasts. To account for regional standards, shipments values inputted to the GRIM are break out the north and the "rest of country" for TSL 1 and TSL 2. The NIA assumes that product efficiencies in the base case that do not meet the energy conservation standard in the standards case either "roll up" to meet the amended standard or switch to another product such as a heat pump or electric furnace. In other words, the market share of products that are below the energy conservation standard is added to the market share of products at the minimum energy efficiency level allowed under each standard case. The market share of products above the energy conservation standard is assumed to be unaffected by the standard in the compliance year. (See section IV.H.1 for further details on the roll-up and product switching methodology).

Product and Capital Conversion Costs

Amended 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) capital conversion costs; and (2) product conversion costs. Capital conversion costs are one-time investments in property, plant, and equipment necessary to adapt or change existing production facilities such that new compliant product designs can be fabricated and assembled. Product conversion costs are one-time investments in research, development, testing, marketing, and other non-capitalized costs necessary to make product designs comply with amended energy conservation standards.

To evaluate the level of capital conversion expenditures manufacturers would likely incur to comply with amended AFUE 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. Based on the manufacturer feedback, DOE developed a market-share weighted average capital expenditure per manufacturer. DOE then scaled up this number to estimate the industry capital conversion cost. DOE validated manufacturer comments with estimates of capital expenditure requirements derived from the product teardown analysis and engineering analysis described in chapter 5 of the NOPR TSD.

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

DOE separately calculated the conversion costs for the standby mode and off mode standard. DOE anticipated that manufacturers would incur minimal capital conversion costs, as the engineering analysis indicates that all the design options to improve standby and off mode performance are component swaps which would not require new investments along production lines. However, the standby and off mode standard may require product conversion costs related to the specification and testing of a new components, as well as one-time updates to marketing literature for standby mode and off mode. DOE estimated these product conversion costs based on the engineering analysis and feedback collected in manufacturer interviews.

In general, DOE assumed 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 amended standards. The conversion cost figures used in the GRIM can be found in section V.B.2 of this notice. For additional information on the estimation of product and capital conversion costs, see chapter 12 of the NOPR TSD.

b. Government Regulatory Impact Model Scenarios

Manufacturer Markup Scenarios

As discussed in the previous section, 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 yielded 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 amended energy conservation standards: (1) a preservation of gross margin percentage markup scenario; (2) a preservation of per-unit operating profit markup scenario; and (3) a three-tier markup. These scenarios lead to different markup values that, when applied to the inputted MPCs, resulted in varying revenue and cash-flow impacts. The analytic results in section V.B.2 presents the upper and lower bound markup scenarios, which are the preservation of gross margin percentage and three-tier markup scenarios for AFUE standard and the preservation of gross margin percentage and per-unit preservation of operating profit markup scenarios for standby and off mode standard.

Under the preservation of gross margin percentage markup scenario, DOE applied a single uniform "gross margin percentage" markup across all efficiency levels, which assumes that following amended standards, manufacturers would be able to maintain the same amount of profit as a percentage of revenue 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 residential furnace manufacturers, as well as comments from manufacturer interviews, DOE assumed the average non-production cost markup—which includes SG&A expenses, R&D expenses, interest, and profit—to be 1.34 for non-weatherized gas furnaces and 1.27 for mobile home gas furnaces. Manufacturers do not believe they could maintain the same gross margin percentage markup as their production costs increase. Therefore, DOE assumes that this markup scenario represents the upper bound of the residential furnace industry's profitability in the standards case because manufacturers are able to fully pass through additional costs due to standards to consumers.

In the per-unit preservation-of-operating-profit scenario, as the cost of production goes up under a standards case, manufacturers are generally required to reduce their markups to a level that maintains base-case operating profit. In this scenario, the industry can only maintain its operating profit in absolute dollars after the standard (but not on a percentage basis, as seen in the preservation of gross margin markup scenario). Manufacturer markups are set so that operating profit one year after the compliance date of amended energy conservation standards is the same as in the base case on a per-unit basis. In other words, manufacturers are not able to garner additional operating profit from the higher production costs and the investments that are required to comply with the amended standards, but, they are able to maintain the same operating profit in the standards case that was earned in the base case. Therefore, in percentage terms, the operating margin is reduced between the base case and standards case.

DOE also modeled a three-tiered markup scenario, which reflects the industry's "good, better, best" pricing structure. DOE implemented the three-tiered markup scenario because multiple manufacturers stated in interviews that they offer multiple tiers of equipment lines that are differentiated, in part, by efficiency level. The higher efficiency tiers typically earn premiums (for the manufacturer) over the baseline efficiency tier. Several manufacturers suggested that amended standards would lead to a reduction in premium markups and reduce the profitability of higher efficiency products. During the MIA interviews, manufacturers provided information on the range of typical efficiency levels in those tiers and the change in profitability at each level. DOE used this information to estimate markups for residential gas-fired furnaces under a three-tier pricing strategy in the base case. In the standards case, DOE modeled the situation in which standards result in less product differentiation, compression of the markup tiers, and an overall reduction in profitability.

3. Manufacturer Interviews

DOE interviewed manufacturers representing 35 percent of the product listings in the NWGF market and 50 percent of the product listings in the MHGF market for this analysis. DOE contractors endeavored to conduct interviews with a representative cross section of manufacturers (including large and small manufacturers, covering all equipment classes and product offerings). DOE contractors reached out to all the small business manufacturers that were identified as part of the analysis, as well as larger manufacturers that have significant market share in the residential furnace market. The information gathered during these interviews enabled DOE to tailor the GRIM to reflect the unique financial characteristics of the residential furnace industry. All interviews provided information that DOE used to evaluate the impacts of potential amended energy conservation standards on manufacturer cash flows, manufacturing capacities, and employment levels.

In interviews, DOE asked manufacturers to describe their concerns with the rulemaking regarding residential gas-fired furnace products. The following section highlights manufacturer responses that helped shape DOE's understanding of potential impacts of an amended standard on the industry. 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.

Replacement Market

Multiple manufacturers noted that an energy conservation standard set at 90% AFUE or above would make it difficult for substantial portions of the install base to replace their existing residential furnaces. They noted that some consumers may be faced with significant installation or home renovation costs when for replacing non-condensing furnaces with new condensing units due to the challenges of disposing of condensate from furnaces with efficiencies above 80% AFUE.

Product Switching

Several manufacturers stated that gas-fired furnaces may not be economically justified for certain customers, depending on the level of the amended energy conservation standard for residential furnaces. These customers may be forced to seek more alternatives with lower upfront costs. Manufacturers expressed concern that customers may opt to buy alternative products, such as heat pumps, water heater systems, or electric furnaces. Such substitutions could decrease shipments of gas-fired furnaces, which in turn would reduce industry revenue.

Regional Enforcement

Several manufacturers expressed concern about the potential complications of implementing and enforcing regional standards. Without a clear enforcement plan for regional standards, manufacturers were concerned about the potential burdens and impacts on their residential furnace product lines. The manufacturers noted that any amended standard should provide enough lead-in time between the announcement date and effective date to comply with the increased burden of regional standard.

Negative Impacts on Industry Profitability

During interviews, all manufacturers agreed that if DOE set amended energy conservation standards too high, increased standards could limit their ability to differentiate residential furnace products based on efficiency. As the standard approaches max tech, manufacturers stated that there would be fewer performance differences and operating cost savings between baseline and premium products. They were concerned the drop in differentiation would lead to an erosion of markups for top efficiency products. Thus, the manufacturers' profitability would decrease with compressed product offerings and markups.

K. Emissions Analysis

In the emissions analysis, DOE estimated the impacts on site and power sector emissions of carbon dioxide (CO_2), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and mercury (Hg) from potential amended energy conservation standards for residential furnaces. In addition, DOE estimated emissions impacts in production activities (extracting, processing, and transporting fuels) that provide energy to power plants or building sites. These are referred to as "upstream" emissions. Together, these emissions account for the full-fuel-cycle (FFC). In accordance with DOE's FFC Statement of Policy (76 FR 51281 (Aug. 18, 2011) as amended at 77 FR 49701 (August 17, 2012)), the 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 primarily conducted the emissions analysis using emissions factors for CO_2 and most of the other gases derived from data in AEO 2014. Combustion emissions of CH_4 and N_2O were estimated using emissions intensity factors published by the Environmental Protection Agency (EPA) in its GHG Emissions Factors Hub. [79] Site emissions of CO_2 and NO_X were estimated using emissions intensity factors from a

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

separate EPA publication.[80] DOE developed separate emissions factors for power sector emissions and upstream emissions. The method that DOE used to derive emissions factors is described in chapter 13 of the NOPR TSD.

For CH_4 and N_2O, DOE calculated emissions reduction in tons and also in terms of units of carbon dioxide equivalent (CO_2eq). Gases are converted to CO_2eq by multiplying each ton of the greenhouse gas by the gas's global warming potential (GWP) over a 100-year time horizon. Based on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,[81] DOE used GWP values of 28 for CH_4 and 265 for N_2O.

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.). (42 U.S.C. 7651 et seq.) 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. CAIR was remanded to the U.S. Environmental Protection Agency (EPA) by the U.S. Court of Appeals for the District of Columbia

[80] U.S. Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources (1998), available at http://www.epa.gov/ttn/chief/ap42/index.html).

[81] IPCC, Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press, 2013).

Circuit, but it remained in effect.[82] In 2011, EPA issued a replacement for CAIR, the Cross-State Air Pollution Rule (CSAPR). 76 FR 48208 (August 8, 2011). On August 21, 2012, the D.C. Circuit issued a decision to vacate CSAPR.[83] The court ordered EPA to continue administering CAIR. The emissions factors used for today's NOPR, which are based on AEO 2014, assume that CAIR remains a binding regulation through 2040.[84]

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Beginning in 2016, however, SO_2 emissions will decline significantly as a result of the Mercury and Air Toxics Standards (MATS) for power plants. 77 FR 9304 (Feb. 16, 2012). In the final MATS rule, EPA established a standard for hydrogen chloride as a surrogate for acid gas hazardous air pollutants (HAP), and also established a standard for SO_2 (a non-HAP acid gas) as an alternative equivalent surrogate standard for acid gas HAP. The same controls are used to reduce HAP and non-HAP acid gas; thus, SO_2 emissions will be reduced as a result of the control technologies installed on coal-fired power plants to comply with the MATS requirements for acid gas. AEO 2014 assumes that, in order to continue operating, coal plants must have either flue gas desulfurization or dry sorbent

[82] 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).
[83] See EME Homer City Generation, LP v. EPA, 696 F.3d 7, 38 (D.C. Cir. 2012), cert. granted, 81 U.S.L.W. 3567, 81 U.S.L.W. 3696, 81 U.S.L.W. 3702 (2013) (No. 12-1182).
[84] On April 29, 2014, the U.S. Supreme Court reversed the judgment of the D.C. Circuit and remanded the case for further proceedings consistent with the Supreme Court's opinion. The Supreme Court held in part that EPA's methodology for quantifying emissions that must be eliminated in certain States due to their impacts in other downwind States was based on a permissible, workable, and equitable interpretation of the Clean Air Act provision that provides statutory authority for CSAPR. See EPA v. EME Homer City Generation, No 12-1182, slip op. at 32 (April 29, 2014). On October 23, 2014, the D.C. Circuit lifted the stay of CSAPR and CSAPR went into effect (and the CAIR sunset) in January 1, 2015. Because DOE is using emissions factors based on AEO 2013 for today's NOPR, the NOPR assumes that CAIR, not CSAPR, is the regulation in force. The difference between CAIR and CSAPR is not relevant for the purpose of DOE's analysis of SO_2 emissions.

injection systems installed by 2016. Both technologies, which are used to reduce acid gas emissions, also reduce SO_2 emissions. Under the MATS, emissions will be far below the cap established by CAIR, so it is likely that the increase in electricity demand associated with the highest residential furnace efficiency levels would increase SO_2 emissions.

CAIR established a cap on NO_X emissions in 28 eastern States and the District of Columbia.[85] Thus, it is unlikely that the increase in electricity demand associated with the considered residential furnace efficiency levels would increase NO_X emissions in those States covered by CAIR. However, these efficiency levels would be expected to increase NO_X emissions in the States not affected by the caps, so DOE estimated NO_X emissions increases for these States.

The MATS limit mercury emissions from power plants, but they do not include emissions caps and, as such, the increase in electricity demand associated with the residential furnace efficiency levels would be expected to increase mercury emissions. DOE estimated mercury emissions using emissions factors based on AEO 2014, which incorporates the MATS.

L. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this proposed rule, DOE considered the estimated monetary benefits from the reduced emissions of CO_2 and NO_X that are expected to result

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

from each of the TSLs considered. 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 equipment shipped in the forecast period for each TSL. This section summarizes the basis for the monetary values used for each of these emissions and presents the values considered in this rulemaking.

To make these calculations, DOE is relying on a set of values for the social cost of carbon (SCC) that was developed by a Federal interagency process. A summary of the basis for these 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 CO2 emissions into cost-benefit analyses of regulatory actions. The estimates are presented with an acknowledgement of DOE acknowledges that there are many uncertainties involved in the estimates 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 challenges. A recent report from the National

Research Council[86] 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 questions of science, economics, and ethics, and should be viewed as provisional.

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

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

[86] National Research Council. Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use (2009).

b. Development of Social Cost of Carbon Values

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

c. Current Approach and Key Assumptions

After the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates. 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 (IPCC). Each model was given equal weight in the SCC values that were developed.

Each model takes a slightly different approach to model how changes in emissions result in changes in economic damages. A key objective of the interagency process was to enable a consistent exploration of the three models, while respecting the different approaches to quantifying damages taken by the key modelers in the field. An extensive review of the literature was conducted to select three sets of input parameters for these models: climate sensitivity, socio-economic and emissions trajectories, and discount rates. A probability distribution for climate sensitivity was specified as an input into all three models. In addition, the interagency group used a range of scenarios for the socio-economic parameters and a range of values for the discount rate. All other model features were left unchanged, relying on the model developers' best estimates and judgments.

In 2010, the interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from 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.[87] Table IV.17 presents the values in the 2010 interagency group report,[88] which is reproduced in appendix 14A of the NOPR TSD.

Table IV.17 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. Table IV.18 shows the updated sets of SCC estimates from the 2013 interagency update[89] in five-year increments from 2010 to 2050. Appendix 14B of the

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

[88] Interagency Working Group on Social Cost of Carbon, Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (2010), available at http://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.

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

NOPR TSD provides the full set of values. The central value that emerges is the average SCC across models at a 3-percent discount rate. However, for purposes of capturing the uncertainties involved in regulatory impact analysis, the interagency group emphasizes the importance of including all four sets of SCC values.

Table IV.18 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	32	51	89
2015	11	37	57	109
2020	12	43	64	128
2025	14	47	69	143
2030	16	52	75	159
2035	19	56	80	175
2040	21	61	86	191
2045	24	66	92	206
2050	26	71	97	220

The interagency group recognizes 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 describes tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of analytical challenges that are being addressed by the research community, including research programs housed in many of the Federal agencies participating in the interagency process to estimate the

SCC. The interagency group intends to periodically review and reconsider those estimates to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the values from the 2013 interagency report, adjusted to 2013$ using the Gross Domestic Product price deflator. For each of the four SCC cases specified, the values used for emissions in 2015 were $12.0, $40.5, $62.4, and $119 per metric ton avoided (values expressed in 2013$). DOE derived values after 2050 using the relevant growth rates for the 2040-2050 period in the interagency update.

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

2. Valuation of Other Emissions Reductions

As noted above, DOE has taken into account how amended energy conservation standards would reduce site NO_X emissions nationwide and increase power sector NO_X emissions in those 22 States not affected by the CAIR. DOE estimated the monetized value of net NO_X emissions reductions resulting from each of the TSLs considered for today's NOPR based on estimates found in the relevant scientific literature. Estimates of monetary value for reducing NO_X from stationary sources range from $476 to $4,893 per ton in 2013$.[90] DOE calculated monetary benefits using a medium value for NO_X emissions of $2,684 per short ton (in 2013$), and real discount rates of 3 percent and 7 percent.

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

M. Utility Impact Analysis

The utility impact analysis estimates several effects on the 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 installed electrical capacity and generation that would result for each trial standard level. The analysis is based on published output from NEMS, which is a public domain, multi-sectored, partial equilibrium model of the U.S. energy sector. Each year, NEMS is updated to produce the AEO reference case as well as a number of side cases that estimate the economy-wide impacts of changes to energy supply and demand. DOE uses those published side cases that incorporate efficiency-related policies to estimate the marginal impacts of reduced energy demand on the utility sector. The output of this analysis is a set of time-dependent coefficients that capture the change in electricity generation, primary fuel consumption,

[90] 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), available at http://www.whitehouse.gov/sites/default/files/omb/assets/omb/inforeg/2006_cb/2006_cb_final_report.pdf.

installed capacity and power sector emissions due to a unit reduction in demand for a given end use. These coefficients are multiplied by the stream of electricity savings calculated in the NIA to provide estimates of selected utility impacts of new or amended energy conservation standards. Chapter 15 of the NOPR TSD describes the utility impact analysis in further detail.

N. Employment Impact Analysis

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, other than in the manufacturing sector being regulated, 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.[91] There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital-intensive and less labor-intensive than other sectors. Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (i.e., the utility sector) to more labor-intensive sectors (e.g., the retail and service sectors). Thus, based on the BLS data alone, DOE believes net national employment may increase because of shifts in economic activity resulting from amended standards for NWGFs and MHGFs.

For the amended standard levels considered in this 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).[92] 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

[91] See Bureau of Economic Analysis, "Regional Multipliers: A Handbook for the Regional Input-Output Modeling System (RIMS II)," U.S. Department of Commerce (1992).
[92] M.J. Scott, et. al., ImSET 3.1: Impact of Sector Energy Technologies, PNNL-18412, (2009), available at www.pnl.gov/main/publications/external/technical_reports/PNNL-18412.pdf.

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 (through 2023) employment impacts.

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

V. Analytical Results and Conclusions

The following section addresses the results from DOE's analyses with respect to potential energy conservation standards for the products examined as part of this rulemaking. It addresses the trial standard levels examined by DOE, the projected impacts of each of these levels if adopted as energy conservation standards for furnaces, and the standards levels that DOE is proposing to adopt in this NOPR. Additional details regarding the analyses conducted by DOE are contained in the publicly-available NOPR TSD supporting this notice.

A. Trial Standard Levels

DOE developed two sets of trial standard levels (TSLs) that combine efficiency levels for NWGFs and MHGFs, one for AFUE and one for standby mode and off mode power.

1. TSLs for AFUE[93]

Table V.1 presents the AFUE levels in each TSL that DOE has identified for potential NWGF and MHGF standards. TSL 5 consists of the max-tech efficiency levels. TSL 4 consists of the efficiency levels that provide the maximum NES with an NPV greater than zero using a 7-percent discount rate. TSL 3 consists of the 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 2 consists of the efficiency levels that represent 95-percent AFUE for the Northern region for each product class, and the baseline non-condensing efficiency level for the rest of the country. TSL 1 consists of the baseline condensing efficiency level for the North and the baseline non-condensing efficiency level for the rest of the country for each product class.

[93] In the context of presenting TSLs and results for each of them, DOE uses the term "AFUE standard" to refer to potential standards on AFUE throughout section V of this notice. TSLs for standby mode and off mode are addressed separately.

Table V.1 AFUE Trial Standard Levels for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces

	Trial Standard Level (AFUE)				
Product Class	**1**	**2**	**3**	**4**	**5**
Non-Weatherized Gas Furnaces	North: 90% Rest: 80%	North: 95% Rest: 80%	92%	95%	98%
Mobile Home Gas Furnaces	North: 92% Rest: 80%	North: 95% Rest: 80%	92%	95%	97%

2. TSLs for Standby Mode and Off Mode Power

Table V.2 presents the TSLs and the corresponding product class efficiency levels (expressed in watts) that DOE considered for NWGF and MHGF standby mode and off mode power consumption. For each product class, DOE considered three efficiency levels.

Table V.2 Standby Mode and Off Mode Trial Standard Levels for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces

	Trial Standard Level (watts)		
Product Class	**1**	**2**	**3**
Non-Weatherized Gas Furnaces	9.5	9.2	8.5
Mobile Home Gas Furnaces	9.5	9.2	8.5

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

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

a. Life-Cycle Cost and Payback Period

To evaluate the net economic impact of potential amended energy conservation standards on consumers of NWGFs and MHGFs, DOE conducted LCC and PBP analyses for each TSL. In general, higher-efficiency products would affect consumers in two ways: (1) purchase price would increase, and (2) annual operating expense would decrease. In addition, some consumers may choose to switch to an alternative heating system rather than purchase and install a NWGF if they judge the economics to be favorable. DOE estimated the extent of switching at each TSL using the consumer choice model discussed in section IV.F.4.

Inputs used for calculating the LCC and PBP include total installed costs (i.e., product price plus installation costs) and operating costs (i.e., annual energy savings, energy prices, energy price trends, repair costs, and maintenance costs). The LCC calculation also uses product lifetime and discount rates. In cases where consumers are predicted to switch, the inputs include the total installed costs, operating costs, and product lifetime for the chosen heating system.

The key outputs of the LCC analysis are a mean LCC savings (or cost) and a median PBP relative to the base-case efficiency distribution for each product class of residential NWGFs and MHGFs, as well as the percentage of consumers for whom the LCC under an amended standard would decrease (net benefit), increase (net cost), or exhibit no change (no impact).

DOE also performed a PBP analysis as part of the consumer impact analysis. The PBP is the number of years it would take for the consumer to recover the increased costs of higher-efficiency product 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.

The simple payback is measured relative to the baseline product. In contrast, the LCC savings are measured relative to the base-case efficiency distribution in the compliance year. No impacts occur when the base-case efficiency for a specific consumer equals or exceeds the efficiency at a given TSL; a standard would have no effect because the product installed would be at or above that standard level without amended standards.

For NWGFs, the LCC and PBP results at each efficiency level include consumers that would purchase and install a NWGF at that level, and also consumers that would choose to switch to alternative heating equipment rather than pay the cost of installing a furnace at that level.[94] The impacts for consumers that switch depend on the product that they choose (heat pump or electric furnace) and the NWGF that they would purchase in the base case. The extent of projected product switching (in 2021) is shown in Table V.3 for each TSL for NWGFs. As expected, the degree of switching increases at higher-

[94] DOE did not analyze switching for MHGFs because the installation cost differential is small between condensing and non-condensing equipment, so the incentive for switching is fairly small.

efficiency TSLs where the installed cost of a NWGF is very high for some consumers. As discussed in section IV.F.4, DOE also conducted sensitivity analysis using high and low switching estimates (based on paybacks of 2.5 and 4.5 years, respectively around the reference value of 3.5 years). Tables similar to Table V.3 for the high and low switching estimates are shown in appendix 8J of the NOPR TSD.

Table V.3 Results of Consumer Choice Model for Non-Weatherized Gas Furnaces

Consumer Option	TSL 1**	TSL 2**	TSL 3	TSL 4	TSL 5
Purchase NWGF at Standard Level	97.8%	97.4%	90.6%	88.6%	84.7%
Switch to Heat Pump*	1.6%	1.9%	6.8%	8.6%	12.0%
Switch to Electric Furnace*	0.6%	0.6%	2.5%	2.8%	3.3%
Total	100%	100%	100%	100%	100%

*Includes switching from a gas water heater to an electric water heater.
** Results at TSLs 1 and 2 refer to the Northern region. For the Rest of Country, the proposed standard levels at TSLs 1 and 2 are at the baseline, so no consumers are affected.

Table V.4 through Table V.7 provide key results for the AFUE TSLs. Results for all efficiency levels are reported in chapter 8 of the NOPR TSD. The LCC and PBP results for NWGF include both residential and commercial users. For NWGFs, similar results for the high and low switching estimates are shown in appendix 8J of the NOPR TSD. For the proposed standards for AFUE (TSL 3), the average LCC savings are $253 using high switching estimates, and $329 using low switching estimates. These values compare to the default LCC savings of $305 (see Table V.5).

Table V.4. Average LCC and PBP Results for Non-Weatherized Gas Furnace AFUE Standards

TSL	Region	AFUE	Average Costs <u>2013$</u>				Simple Payback <u>years</u>	Average Lifetime <u>years</u>
			Installed Cost	First Year's Operating	Lifetime Operating Cost	LCC		

				Cost				
1	North	90%	$2,985	$737	$11,761	$14,746	8.3	21.5
	Rest of Country	80%	$2,003	$456	$7,374	$9,376	--	21.5
2	North	95%	$3,133	$706	$11,251	$14,385	7.2	21.5
	Rest of Country	80%	$2,003	$456	$7,374	$9,376	--	21.5
3	National	92%	$2,669	$579	$9,228	$11,897	7.2	21.5
4	National	95%	$2,788	$565	$8,985	$11,773	7.4	21.5
5	National	98%	$2,948	$554	$8,771	$11,718	8.3	21.5

Note: The results for each TSL are calculated assuming that all consumers use products with that efficiency level. The PBP is measured relative to the baseline product.

Table V.5 Average LCC Savings Relative to the Base Case Efficiency Distribution for Non-Weatherized Gas Furnace AFUE Standards

TSL	Region	AFUE	Life-Cycle Cost Savings	
			% of Consumers that Experience Net Cost	Average Savings* 2013$
1	North	90%	11%	$208
	Rest of Country	80%	0%	--
2	North	95%	14%	$374
	Rest of Country	80%	0%	--
3	National	92%	20%	$305
4	National	95%	24%	$388
5	National	98%	40%	$441

* The calculation includes households with zero LCC savings (no impact).

Table V.6. Average LCC and PBP Results for Mobile Home Gas Furnace AFUE Standards

TSL	Region	AFUE	Average Costs 2013$				Simple Payback years	Average Lifetime years
			Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
1	North	92%	$1,760	$740	$11,415	$13,175	1.8	21.5
	Rest of Country	80%	$1,489	$489	$7,762	$9,251	--	21.5
2	North	95%	$1,902	$719	$11,103	$13,005	2.8	21.5
	Rest of Country	80%	$1,489	$489	$7,762	$9,251	--	21.5
3	National	92%	$1,721	$623	$9,694	$11,415	2.2	21.5
4	National	95%	$1,864	$607	$9,440	$11,304	3.3	21.5
5	National	97%	$1,979	$599	$9,319	$11,298	4.2	21.5

Note: The results for each TSL are calculated assuming that all consumers use products with that efficiency level. The PBP is measured relative to the baseline product.

Table V.7 Average LCC Savings Relative to the Base Case Efficiency Distribution for Mobile Home Gas Furnace AFUE Standards

TSL	Region	AFUE	Life-Cycle Cost Savings	
			% of Consumers that Experience Net Cost	Average Savings* 2013$
1	North	92%	4%	$770
	Rest of Country	80%	0%	--
2	North	95%	8%	$902
	Rest of Country	80%	0%	--
3	National	92%	7%	$691
4	National	95%	13%	$778
5	National	97%	25%	$784

* The calculation includes households with zero LCC savings (no impact).

Table V.8 through Table V.11 show the national LCC and PBP results for standby mode and off mode TSLs. DOE did not consider regional standards for standby mode and off mode. The LCC and PBP results for NWGFs include both residential and commercial users.

Table V.8. Average LCC and PBP Results for Non-Weatherized Gas Furnace Standby Mode and Off Mode Standards

TSL	Efficiency Level	Average Costs 2013$				Simple Payback years	Average Lifetime years
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	$0	$11	$159	$159	--	21.5
1	1	$2	$9	$137	$139	1.3	21.5
2	2	$17	$9	$133	$150	9.7	21.5
3	3	$18	$8	$123	$141	7.5	21.5

Note: The results for each TSL are calculated assuming that all consumers use products with that efficiency level. The PBP is measured relative to the baseline product.

Table V.9 Average LCC Savings Relative to the Base-Case Efficiency Distribution for Non-Weatherized Gas Furnace Standby Mode and Off Mode Standards

TSL	Efficiency Level	Life-Cycle Cost Savings	
		% of Consumers that Experience Net Cost	Average Savings* 2013$
1	1	2%	$12
2	2	15%	$6
3	3	9%	$13

* The calculation includes households with zero LCC savings (no impact).

Table V.10. Average LCC and PBP Results for Mobile Home Gas Furnace Standby Mode and Off Mode Standards

TSL	Efficiency Level	Average Costs 2013$				Simple Payback years	Average Lifetime years
		Installed Cost	First Year's Operating Cost	Lifetime Operating Cost	LCC		
--	Baseline	$0	$10	$155	$155	--	21.5
1	1	$2	$9	$134	$136	1.2	21.5
2	2	$16	$9	$130	$145	9.2	21.5
3	3	$17	$8	$120	$137	7.1	21.5

Note: The results for each TSL are calculated assuming that all consumers use products with that efficiency level. The PBP is measured relative to the baseline product.

Table V.11 Average LCC Savings Relative to the Base-Case Efficiency Distribution for Mobile Home Gas Furnace Standby Mode and Off Mode Standards

TSL	Efficiency Level	Life-Cycle Cost Savings	
		% of Consumers that Experience Net Cost	Average Savings* 2013$
1	1	0%	$1
2	2	1%	$0
3	3	1%	$1

* The calculation includes households with zero LCC savings (no impact).

b. Consumer Subgroup Analysis[95]

In the consumer subgroup analysis, DOE estimated the impacts of the considered AFUE TSLs on low-income and senior-only households. The average LCC savings and simple payback periods for low-income and senior-only households are compared to the results for all consumers for the AFUE standards in Table V.12 and Table V.13. Because the Rest of Country efficiency levels at TSLs 1 and 2 are at the baseline, these tables only include results for the Northern region for these TSLs. Chapter 11 of the NOPR TSD presents detailed results of the consumer subgroup analysis, including results for standby mode and off mode standards.

Table V.12. Non-Weatherized Gas Furnace AFUE Standards: Impacts for Senior-Only and Low-Income Consumer Subgroups Compared to All Households

TSL	AFUE	Average Life-Cycle Cost Savings 2013$			Simple Payback Period years		
		Senior-Only	Low-Income	All Consumers	Senior-Only	Low-Income	All Consumers
1*	90%	$223	$148	$208	7.9	9.1	8.3
2*	95%	$405	$346	$374	6.7	7.6	7.2
3	92%	$326	$247	$305	6.8	8.3	7.2
4	95%	$427	$330	$388	6.9	8.3	7.4
5	98%	$542	$485	$441	7.5	8.5	8.3

*Only includes results for the North region.

Table V.13. Mobile Home Gas Furnace AFUE Standards: Impacts for Senior-Only and Low-Income Consumer Subgroups Compared to All Households

TSL	AFUE	Average Life-Cycle Cost Savings 2013$			Simple Payback Period years		
		Senior-Only	Low-Income	All Consumers	Senior-Only	Low-Income	All Consumers
1*	92%	$586	$746	$770	4.1	2.2	1.8

[95] As discussed in section IV.I, DOE did not perform a subgroup analysis for the residential furnace standby mode and off mode efficiency levels. The standby mode and off mode analysis relied on the test procedure to assess energy savings for the considered standby mode and off mode efficiency levels. Because the analysis used the same test procedure parameters for all sample households, there is no difference in energy savings between the consumer subgroups and the full sample.

2*	95%	$670	$882	$902	5.5	3.4	2.8
3	92%	$429	$677	$691	4.1	2.2	2.2
4	95%	$455	$763	$778	5.5	3.4	3.3
5	97%	$415	$768	$784	6.8	4.3	4.2

*Only includes results for the North region.

c. Rebuttable Presumption Payback Period

As discussed in section III.E.2, EPCA establishes a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. Accordingly, DOE calculated a rebuttable-presumption PBP for each TSL for NWGFs and MHGFs based on average usage profiles. As a result, DOE calculated a single rebuttable-presumption payback value, and not a distribution of PBPs, for each TSL. However, DOE routinely conducts an economic analysis that considers the full range of impacts to the consumer, manufacturer, Nation, and environment, as required by EPCA under 42 U.S.C. 6295(o)(2)(B)(i). The results of that analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level, thereby supporting or rebutting the results of any preliminary determination of economic justification. Table V.14 shows the rebuttable-presumption PBPs for the considered AFUE TSLs for NWGFs and MHGFs. Table V.15 shows the rebuttable-presumption PBPs for the considered TSLs for standby mode and off mode for NWGFs and MHGFs.

Table V.14. Rebuttable-Presumption Payback Periods (years) for NWGFs and MHGFs for Analysis of AFUE Standards

Product Class	Trial Standard Level				
	1*	2*	3	4	5
Non-Weatherized Gas Furnaces	4.2	3.5	3.9	3.9	4.8

Mobile Home Gas Furnaces	0.9	1.1	1.1	1.4	1.8

***** Results at TSLs 1 and 2 are for the North region. For the Rest of Country, the proposed standard levels at TSLs 1 and 2 are at the baseline, so no consumers are affected.

Table V.15. Rebuttable-Presumption Payback Periods (years) for NWGFs and MHGFs for Analysis of Standby Mode and Off Mode Standards

Product Class	**Trial Standard Level**		
	1	**2**	**3**
Non-Weatherized Gas Furnaces	1.5	11.1	8.6
Mobile Home Gas Furnaces	1.3	9.8	7.5

2. Economic Impacts on Manufacturers

DOE performed a manufacturer impact analysis (MIA) to estimate the impact of an amended energy conservation standard on manufacturers of residential gas-fired furnace products. The following section describes the expected impacts on manufacturers at each considered TSL. DOE first discusses the impacts of potential AFUE standards and then turns to the impacts of potential standby mode and off mode standards. Chapter 12 of the NOPR TSD explains the analysis in further detail.

a. Industry Cash-Flow Analysis Results

Cash-Flow Analysis Results for Residential Furnaces AFUE Standards

In this section, DOE provides GRIM results from the AFUE analysis, which examines changes in the industry that would result from a potential increase in the AFUE standard. DOE applied preservation of gross margin markup scenario as an upper bound to GRIM results (less severe) and the three-tiered markup scenario as the lower bound to GRIM results (more severe).

As discussed in sectionIV.J.2.b, DOE considered the preservation of gross margin percentage scenario by applying a uniform "gross margin percentage" markup across all efficiency levels. As production cost increases with efficiency, this scenario implies that the absolute dollar markup will increase. DOE assumed the nonproduction cost markup—which includes SG&A expenses, research and development expenses, interest, and profit to be a factor of 1.34 for non-weatherized gas furnaces and 1.27 for mobile home gas furnaces. These markups are consistent with the ones DOE assumed in the engineering analysis and in the base case of the GRIM. Manufacturers have indicated that it is optimistic to assume that as their production costs increase in response to an amended energy conservation standard, they would be able to maintain the same gross margin percentage markup. Therefore, DOE assumes that this scenario represents a high bound to industry profitability under an amended energy conservation standard.

To assess the more severe end of the range of potential impacts, DOE modeled the three-tier markup scenario, which reflects manufacturer concerns surrounding their inability to higher margins on premium efficiency products as the energy conservation standard increases. High-efficiency products that enjoy a premium markup in the base case see that premium erode in the standards case. Additional information can be found in section IV.J.2.b of this document and chapter 12 of the TSD.

As noted in the MIA methodology section (see IV.J.2), in addition to markup scenarios, the MPC, shipments, and conversion cost assumptions also affect GRIM results. The GRIM shows a change in industry value net present value that results from amended standards.

Each of the modeled scenarios in the AFUE standards analysis results in a unique set of annual free cash flows at each TSL. The INPV is the sum of the annual free cash flows from the 2014 to 2050, taking into account the time value of money. In the following discussion, the “change in INPV” refers to the difference in industry value between the base case and each standards case that results from the sum of the discounted cash flows from the base year 2014 through 2050. The change in INPV reflects the potential changes in industry valuation due to amended standards.

To provide perspective on the short-term impacts, DOE discusses the change in free cash flow between the base case and the standards case in the year before new standards would take effect. These figures provide an understanding of the magnitude of the required conversion costs at each TSL relative to the cash flow generated by the industry in the base case.

Table V.16 and Table V.17 depict the estimated financial impacts for residential furnace manufacturers (represented by changes in INPV, the short-term cash flow impacts, and the industry conversion costs that DOE expects at each TSL under each of the two markup scenarios discussed above.

Table V.16. Manufacturer Impact Analysis: AFUE Standards Results for Residential Gas-Fired Furnaces - Preservation of Gross Margin Percentage Markup Scenario

	Units	Base Case	Trial Standard Level*				
			1	2	3	4	5
INPV	$M	1,055.13	1,048.71	1,063.45	1,061.65	1,099.24	1,080.94
Change in INPV	$M	-	(6.42)	8.32	6.52	44.10	25.80
	%	-	(0.61)	0.79	0.62	4.18	2.45
2020 Free Cash Flow (FCF)	$M	22.55	10.32	0.88	0.41	(13.78)	(86.21)
Change in 2020 FCF	$M	-	(12.23)	(21.67)	(22.15)	(36.33)	(108.76)
	%	-	(54.22)	(96.09)	(98.19)	(161.08)	(482.22)
Product Conversion Costs	$M	-	15.77	23.00	16.47	23.00	64.36
Capital Conversion Costs	$M	-	16.95	33.24	38.53	65.81	199.94

*Parentheses indicate negative values

Table V.17. Manufacturer Impact Analysis: AFUE Standards Results for Residential Gas-Fired Furnaces - Three-Tier Markup Scenario

	Units	Base Case	Trial Standard Level*				
			1	2	3	4	5
INPV	$M	1,055.13	990.43	825.26	971.41	740.79	548.20
Change in INPV	$M	-	(64.71)	(229.87)	(83.72)	(314.34)	(506.94)
	%	-	(6.13)	(21.79)	(7.93)	(29.79)	(48.04)
2020 Free Cash Flow (FCF)	$M	22.55	10.32	0.88	0.41	(13.78)	(86.21)
Change in 2020 FCF	$M	-	(12.23)	(21.67)	(22.15)	(36.33)	(108.76)
	%	-	(54.22)	(96.09)	(98.19)	(161.08)	(482.22)
Product Conversion Costs	$M	-	15.77	23.00	16.47	23.00	64.36
Capital Conversion Costs	$M	-	16.95	33.24	38.53	65.81	199.94

*Parentheses indicate negative values

At TSL 1, DOE estimates the change in INPV to range from -$64.71 million to -6.42 million, or a change of -6.13 percent to -0.61 percent. At this level, industry free cash flow in 2020 (the year before the compliance date) is estimated to decrease to $10.32 million, or a change of -54.22 percent compared to the base-case value of $22.55 million.

TSL 1 proposes regional standards, requiring products the North to meet an efficiency level above the baseline while the Rest of Country remains at the current Federal minimum of 80% AFUE. NWGF products in the North would be required to meet a minimum efficiency of 90% AFUE while MHGF products in the North would be required to meet a minimum efficiency of 92% AFUE. Conversion costs are driven by the need for manufacturers to add a secondary condensing heat exchanger production capacity. Today, approximately 39% of NWGF shipments and 19 percent of MHGF shipments are sold at condensing levels. When the standard goes into effect, an additional 21 percent of NWGF shipments and 29 percent of MHGF will require secondary heat exchanges, requiring manufacturers to add capacity to their secondary heat exchanger production lines. Manufacturers will also incur product conversion costs driven by the development necessary to create compliant, cost competitive products. DOE estimates total conversion costs to be $32.72 million for the industry.

At TSL 2, DOE estimates the change in INPV to range from -$229.87 million to $8.32 million, or a change in INPV of -21.79 percent to 0.79 percent. At this level, free cash flow in 2020 is estimated to decrease to $0.88 million, or a decrease of 96.09 percent compared to the base-case value of $22.55million in the year 2020.

TSL 2 is a regional standard requiring the North to meet efficiency levels above the baseline while the Rest of Country remains at baseline. NWGFs and MHGFs in the North would be required to meet a minimum efficiency of 95% AFUE. Manufacturer feedback in interviews indicated that capital conversion costs ramp up significantly at 95% AFUE. DOE estimates total conversion costs to be $56.24 million for the industry.

Furthermore, most 95% AFUE products today are premium offerings that are sold at a higher markup than baseline products. Once 95% AFUE becomes the amended baseline standard in the North, manufacturers would need to investment engineering resources to create baseline, cost-optimized 95% AFUE models that are competitive at reduced markups. Additionally, manufacturers may find markups for products above 95% AFUE in the North are reduced, as there is less opportunity for differentiation based on efficiency between baseline products and premium products. This general reduction in markups in the North leads to reduced profitability for manufacturers and a potential drop in INPV.

At TSL 3, DOE estimates the change in INPV to range from -$83.72 million to $6.52 million, or a change in INPV of -7.93 percent to 0.62 percent. At this level, free cash flow is estimated to decrease to $0.41 million, or a change of -98.19 percent compared to the base-case value of $22.55 million in the year 2020.

TSL 3 represents a national standard at 92% AFUE for both NWGF and MHGF products. With a national condensing standard, an additional 5 percent of NWGF and an additional 81 percent of MHGF industry shipments would need condensing heat exchangers. That increase would require manufacturers to add significant secondary heat exchanger capacity to their operations. Models accounting for 65 percent of NWGF shipments and 81 percent of MHGF shipments would need to be redesigned. Industry conversion costs reach $55 million.

At 92% AFUE, the industry faces some compression of markups. However, on the whole, manufacturers are still able to maintain three tiers of markups with efficiency as a differentiator. As a result, even though TSL 3 conversion costs as similar to those at TSL 2, the INPV impacts are not as severe.

At TSL 4, DOE estimates the change in INPV to range from -$314.34 million to $44.1 million, or a change in INPV of -29.79 percent to 4.18 percent. At this level, free cash flow is estimated to decrease to -$13.78 million, or a change of -161.08 percent compared to the base-case value of $22.55 million in the year 2020.

TSL 4 represents a national standard at 95% AFUE for both NWGF and MHGF products. Manufacturers would need to add significant secondary heat exchanger capacity. Additionally, manufacturers would need to redesign a models accounting for 99 percent of NWGF shipments and 99 percent of MHGF shipments. Industry conversion costs reach $88.81 million. These conversion costs are a significant drain on industry cash flow and could results in manufacturers seeking outside capital to finance the conversion expenses.

At 95% AFUE, the industry faces significant compression of markups. As noted at TSL 2, most 95% AFUE products today are premium offerings that are sold at a higher markup than baseline products. Once 95% AFUE becomes the amended baseline standard, manufacturers would need to investment engineering resources to create baseline, cost-optimized 95% AFUE models that are competitive at reduced markups. Additionally, there is less opportunity for differentiation between baseline products and premium products, resulting in reduced markups for products that have premium efficiencies. This reduction in markups leads to reduced profitability for manufacturers and a potential drop in INPV.

At TSL 5, DOE estimates the change in INPV to range from -$506.94 million to $25.80 million, or a change in INPV of -48.04 percent to 2.45 percent. At this level, free cash flow is estimated to decrease to -$86.21 million, or a decrease of 482.22 percent compared to the base-case value of $22.55 million in the year 2020. TSL 5 represents the max-tech standard level.

Some manufacturers expressed great concern about the state of technology at max tech. They had concerns about the ability to deliver cost effectiveness of these products for their customers at such a high efficiency level. They also cited high conversion costs and large investment in R&D to produce all products at this level. Total conversion costs are expected to reach $264.30 million for the industry. Additionally at max-tech, there is no opportunity for product differentiation based on efficiency. DOE models all shipments as having a baseline product markup. This results in a large drop in profitability for manufacturers in the tiered markup scenario.

DOE seeks comments, information, and data on the capital conversion costs and product conversion costs estimated for each AFUE standard TSL.

Cash-Flow Analysis Results for Residential Furnaces Standby Mode and Off Mode Standards

Standby mode and off mode standards results are presented in Table V.18 and Table V.19. The impacts of standby mode and off mode features were analyzed for the same product classes as the amended AFUE standards, but at different efficiency levels, which correspond to a different set of technology options for reducing standby mode and off mode energy consumption. Therefore, the TSLs in the standby mode and off mode analysis do not correspond to the TSLs in the AFUE analysis.

DOE considered the impacts of standby mode and off mode features under two markup scenarios to represent the upper and lower bounds of industry impacts: (1) a preservation of gross margin percentage scenario; and (2) per-unit preservation of operating profit. As with the AFUE analysis, the preservation of gross margin percentage represents the upper bound of impacts (less severe), while the preservation of per-unit operating profit scenario represents the lower bound of impacts (more severe).

Table V.18. Manufacturer Impact Analysis: Standby Mode and Off Mode Standards Results for Residential Gas-Fired Furnace Standards - Preservation of Gross Margin Percentage Markup Scenario

	Units	Base Case	Trial Standard Level*		
			1	2	3
INPV	$M	1055.13	1054.61	1055.58	1055.99
Change in INPV	$M	-	(0.52)	(0.45)	(0.85)
	%	-	(0.05)	0.04	0.08
2020 Free Cash Flow (FCF)	$M	22.55	22.16	22.16	22.16
Change in 2020 FCF	$M	-	(0.39)	(0.39)	(0.39)
	%	-	(1.75)	(1.75)	(1.75)
Product Conversion Costs	$M	-	1.35	1.35	1.35
Capital Conversion Costs	$M	-	-	-	-

*****Parentheses indicate negative values.

Table V.19. Manufacturer Impact Analysis: Standby Mode and Off Mode Standards Results for Residential Gas-Fired Furnace Standards – Per-Unit Preservation of Operating Profit Scenario

	Units	Base Case	Trial Standard Level*		
			1	2	3
INPV	$M	1,055.13	1,053.41	1,046.10	1,042.97
Change in INPV	$M	-	(1.72)	(9.03)	(12.16)
	%	-	(0.16)	(0.86)	(1.15)
2020 Free Cash Flow (FCF)	$M	22.55	22.16	22.16	22.16
Change in 2020 FCF	$M	-	(0.39)	(0.39)	(0.39)
	%	-	(1.75)	(1.75)	(1.75)
Product Conversion Costs	$M	-	1.35	1.35	1.35
Capital Conversion Costs	$M	-	-	-	-

* Parentheses indicate negative values.

At TSL 1, DOE estimates impacts on INPV for residential gas-fired furnace manufacturers to decrease by less than one percent in both markup scenarios (preservation of gross margin and per-unit preservation of operating profit). At this potential standard level, industry free cash flow is estimated to decrease by less than two percent, compared to the base-case value of $22.55 million in 2020. DOE expects conversion costs for standby and off mode to be $1.35 million.

At TSL 2, DOE estimates impacts on INPV for residential gas-fired furnace manufacturers to decrease by less than one percent in both markup scenarios. At this potential standard level, industry free cash flow is estimated to decrease by less than two percent, compared to the base-case value of $22.55 million in 2020. DOE expects conversion costs for standby and off mode to be $1.35 million.

At TSL 3, DOE estimates impacts on INPV for residential gas-fired furnace manufacturers to range from a decrease of 1.15 percent to an increase of 0.08 percent, or a change in INPV of -$12.16 million to $0.85 million. At this potential standard level, industry free cash flow is estimated to decrease by less than two percent compared to the base-case value of $22.55 million in 2020. DOE expects conversion costs for standby mode and off mode to be $1.35 million.

DOE seeks comments, information, and data on the capital conversion costs and product conversion costs estimated for each standby mode and off mode TSL.

b. Direct Impacts on Employment

To quantitatively assess the potential impacts of amended energy conservation standards on direct employment in the residential furnaces industry, DOE used the GRIM to estimate the domestic labor expenditures and number of direct employees in the base case and at each standards case (TSL) from 2014 through 2050. DOE used statistical data from the U.S. Census Bureau's 2011 Annual Survey of Manufacturers,[96] the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic direct 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

[96] U.S. Census Bureau, Annual Survey of Manufacturers: General Statistics: Statistics for Industry Groups and Industries (2011) (Available at http://www.census.gov/manufacturing/asm/index.html).

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 production worker (production worker hours times the labor rate found in the U.S. Census Bureau's 2011 Annual Survey of Manufacturers). The production worker estimates in this section only cover workers up to the line-supervisor level who are directly involved in fabricating and assembling a product within an original equipment manufacturer (OEM) 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 amended energy conservation standards for NWGFs and MHGFs, as compared to the base case. Table V.20 shows the range of impacts of a potential amended energy conservation standard on U.S. production workers of residential gas-fired furnace products.

Table V.20. Potential Changes in the Total Number of Production Workers in the Residential Gas-Fired Furnace Industry in 2020

	Trial Standard Level					
	Base Case	1	2	3	4	5
Total Number of Domestic Production Workers in 2020 (without changes in production locations)	2,692	3,037	3,200	3,172	3,474	3,804
Potential Changes in Domestic Production Workers in 2020*	-	(2,692) to 75	(2,692) to 238	(2,692) to 210	(2,692) to 512	(2,692) to 842

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

In the absence of amended energy conservation standards, DOE estimates that the residential gas-fired furnace industry would employ 2,692 domestic production workers in 2020. The upper end of the range estimates the maximum increase in the number of production workers in the residential gas-fired furnace industry after implementation of an energy conservation standard at each TSL. It assumes manufacturers would continue to produce the same scope of covered products within the United States and would require some additional labor to produce more-efficient products. To establish a conservative lower bound, DOE assumes the entire industry shifts production to foreign countries. Some large manufacturers have already begun moving production to lower-cost countries, and an amended standard that necessitates large increases in labor content or that requires large expenditures to re-tool facilities could cause other manufacturers to re-evaluate production siting options.

DOE notes that its estimates of the impacts on direct employment are based on the analysis of amended AFUE energy efficiency standards only. Standby mode and off mode technology options considered in the engineering analysis would result in component swaps, which would not make the product significantly more complex and would not be difficult to implement. While some product development effort would be required, DOE does not expect the standby mode and off mode standard to meaningfully affect the amount of labor required in production. Consequently, DOE does not anticipate that the proposed standby mode and off mode standards will have a significant impact on direct employment.

These employment impact conclusions are independent of conclusions regarding indirect employment impacts in the broader United States economy, which are discussed in chapter 15 of the NOPR TSD.

c. Impacts on Manufacturing Capacity

According to residential gas-fired furnace manufacturers interviewed, production facilities as they are today may not be able to accommodate a large shift to condensing furnaces, if such shift were mandated by an energy conservation standard. However, manufacturers would be able to add capacity and adjust product designs between the announcement year of the standard and the compliance year of the standard. DOE interviewed manufacturers representing over 50 percent of industry sales. None of the interviewed manufacturers expressed concern over the industry's ability to ramp up production lines at TSL 1 to TSL 4 to meet consumer demand. At TSL 5, technical uncertainty was expressed by manufacturers that do not offer 98-percent AFUE products today, as they were unsure what production lines changes would be needed to meet a standard set at max-tech.

d. Impacts on Subgroups of Manufacturers

As discussed above, using average cost assumptions to develop an industry cash flow estimate is not adequate for assessing differential impacts among subgroups of manufacturers. Small manufacturers, niche players, or manufacturers exhibiting a cost structure that differs substantially from the industry average could be affected disproportionately. DOE used the results of the industry characterization to group manufacturers exhibiting similar characteristics. Specifically, DOE identified small business manufacturers as a subgroup for separate impact analyses.

For residential gas-fired furnace equipment, DOE identified and evaluated the impact of amended 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 identification, DOE identified five domestic manufacturers in the industry that qualify as a small business. For a discussion of the impacts on the small manufacturer subgroup, see the regulatory flexibility analysis in section VI.B of this NOPR 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 several recent or impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. Multiple regulations affecting the same manufacturer can strain profits and can 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.

For the cumulative regulatory burden analysis, DOE looks at other regulations that could affect NWGF and MHGF manufacturers that will take effect approximately three years before or after the 2021 compliance date of amended energy conservation standards for NWGF and MHGF. In interviews, manufacturers cited Federal regulations on equipment other than NWGF and MHGF that contribute to their cumulative regulatory burden. The compliance years and expected industry conversion costs of relevant amended energy conservation standards are indicated in Table V.21.

Table V.21 Compliance Dates and Expected Conversion Expenses of Federal Energy Conservation Standards Affecting NWGF and MHGF Manufacturers

Federal Energy Conservation Standards	Approximate Compliance Date	Estimated Total Industry Conversion Expense
Commercial Packaged Air Conditioners and Heat Pumps* 79 FR 58948 (September, 30, 2014)	2018	$226.4M (2013$)
Commercial Warm-Air Furnaces* 80 FR 6182 (February 4, 2015).	2018	$19.9M (2013$)
2014 Furnace Fans 79 FR 38130 (July 3, 2014)	2019	$40.6M (2013$)
Miscellaneous Residential Refrigeration*	2019	TBD
Single Packaged Vertical Units* 79 FR 78614 (December 30, 2014)	2019	$7.2M (2013$)
Commercial Water Heaters*	2019	TBD
Commercial Packaged Boilers*	2020	TBD
Residential Water Heaters*	2021	TBD
Clothes Dryers*	2022	TBD
Central Air Conditioners*	2022	TBD
Room Air Conditioners*	2022	TBD
Commercial Packaged Air Conditioning and Heating Equipment (Evaporatively and Water Cooled) *	2023	TBD

*The final rule for these energy conservation standards has not been published. The compliance date and analysis of conversion costs have not been finalized at this time. (If a value is provided for total industry conversion expense, this value represents an estimate from the NOPR.)

DOE notes that furnace fans standard creates a unique cumulative burden because today's proposed residential furnace standard and the furnace fans standard impact the same products (i.e., residential furnaces), affect the same group of manufacturers, and go into effect in a similar timeframe. A detailed summary of manufacturer impacts from the furnace fans final rule can be found in Table V.22. DOE explicitly notes the additional burdens of the furnace fan rule when weighing the benefits and costs of the trial standard levels in Section V.C.1 of today's Notice.

Table V.22 Summary of Manufacturer Financial Impacts from the Furnace Fans Final Rule

	Units	Furnace Fans Final Rule
INPV	$M	290.6 to 397.8
Change in INPV	$M	(59.0) to 48.2
	(%)	(16.9) to (13.8)
Product Conversion Costs	$M	25.5
Capital Conversion Costs	$M	15.1
Total Conversion Costs	$M	40.6

*Values in parentheses are negative values.

DOE requests comments on the identified regulations and their contribution to cumulative regulatory burden. Additionally, DOE requests feedback on product-specific regulations that take effect between 2018 and 2024 that were not listed, including identification of the specific regulations and data quantifying the associated burdens.

3. National Impact Analysis

This section presents DOE's estimates of the national energy savings and the NPV of consumer benefits that would result from each of the TSLs considered as potential amended furnace AFUE standards, as well as from each of the TSLs considered as potential standards for standby mode and off mode.

a. Significance of Energy Savings

For each TSL, DOE projected energy savings for NWGFs and MHGFs purchased in the 30-year period that begins in the year of anticipated compliance with amended standards (2021–2050). The savings are measured over the entire lifetime of product 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.23 presents the estimated primary energy savings for each considered TSL for AFUE standards, and Table V.24 presents the estimated FFC energy savings for each TSL for AFUE standards. The approach for estimating national energy savings is further described in section IV.H.

Table V.23 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Primary National Energy Savings for Potential AFUE Standards (Units Sold in 2021-2050)

Product Class	**Trial Standard Levels**				
	1	**2**	**3**	**4**	**5**
	quads				
Non-Weatherized Gas Furnaces	1.004	1.756	2.124	3.263	4.364
Mobile Home Gas Furnaces	0.062	0.066	0.127	0.131	0.142
Total	**1.066**	**1.821**	**2.251**	**3.394**	**4.507**

* Components may not sum due to rounding.

Table V.24 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Full-Fuel-Cycle National Energy Savings for Potential AFUE Standards (Units Sold in 2021-2050)

Product Class	**Trial Standard Levels**				
	1	**2**	**3**	**4**	**5**
	quads				
Non-Weatherized Gas Furnaces	1.222	2.054	2.638	3.963	5.322
Mobile Home Gas Furnaces	0.069	0.073	0.141	0.146	0.159
Total	**1.291**	**2.126**	**2.780**	**4.110**	**5.481**

* Components may not sum due to rounding.

For the proposed standards (TSL 3), the FFC savings of 2.780 quads is the net sum of the FFC natural gas savings (7.061 quads) and the increase in FFC energy use associated with higher electricity use due to switching to electric heating (4.281 quads).

As discussed in section IV.F.4, DOE conducted sensitivity analyses assuming higher and lower levels of product switching for NWGFs. Table V.25 compares the NES FFC results for potential AFUE standards under the default switching assumptions with the results in the sensitivity cases.

Table V.25 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Full-Fuel-Cycle National Energy Savings for Potential AFUE Standards (Units Sold in 2021-2050); Product Switching Sensitivity Analysis

Switching Case	**Trial Standard Levels**				
	1	**2**	**3**	**4**	**5**
	quads				
Default	1.291	2.126	2.780	4.110	5.481
High	1.147	1.914	2.129	3.272	4.541
Low	1.484	2.319	3.433	4.904	6.424

* Components may not sum due to rounding.

Table V.26 presents the estimated primary energy savings for each considered TSL for standby mode and off mode standards, and Table V.27 presents the estimated FFC energy savings for each TSL for standby mode and off mode standards.

Table V.26 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Primary National Energy Savings for Potential Standby Mode and Off Mode Power Standards (Units Sold in 2021-2050)

Product Class	**Trial Standard Levels**		
	1	**2**	**3**

	quads		
Non-Weatherized Gas Furnaces	0.147	0.176	0.264
Mobile Home Gas Furnaces	0.0002	0.0002	0.0003
Total*	**0.147**	**0.176**	**0.264**

* Components may not sum due to rounding.

Table V.27 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Full-Fuel-Cycle National Energy Savings for Potential Standby Mode and Off Mode Power Standards (Units Sold in 2021-2050)

Product Class	**Trial Standard Levels**		
	1	**2**	**3**
	quads		
Non-Weatherized Gas Furnaces	0.154	0.184	0.276
Mobile Home Gas Furnaces	0.0002	0.0002	0.0003
Total*	**0.154**	**0.185**	**0.277**

* Components may not sum due to rounding.

OMB Circular A-4[97] requires agencies to present analytical results, including separate schedules of the monetized benefits and costs that show the type and timing of benefits and costs. Circular A-4 also directs agencies to consider the variability of key elements underlying the estimates of benefits and costs. For this rulemaking, DOE undertook a sensitivity analysis using nine, rather than 30, years of product shipments. The choice of a nine-year period is a proxy for the timeline in EPCA for the review of certain energy conservation standards and potential revision of and compliance with such revised standards.[98] The review timeframe established in EPCA is generally not synchronized with the product lifetime, product manufacturing cycles, or other factors

[97] U.S. Office of Management and Budget, "Circular A-4: Regulatory Analysis" (Sept. 17, 2003) (Available at: http://www.whitehouse.gov/omb/circulars_a004_a-4/).
[98] Section 325(m) of EPCA requires DOE to review its standards at least once every 6 years, and requires, for certain products, a 3-year period after any new standard is promulgated before compliance is required, except that in no case may any new standards be required within 6 years of the compliance date of the previous standards. While adding a 6-year review to the 3-year compliance period adds up to 9 years, DOE notes that it may undertake reviews at any time within the 6 year period and that the 3-year compliance date may yield to the 6-year backstop. A 9-year analysis period may not be appropriate given the variability that occurs in the timing of standards reviews and the fact that for some consumer products, the compliance period is 5 years rather than 3 years.

specific to NWGFs and MHGFs. Thus, such results are presented for informational purposes only and are not indicative of any change in DOE's analytical methodology. The primary NES based on a nine-year analytical period are presented for the AFUE TSLs in Table V.28.[99] The impacts are counted over the lifetime of NWGFs and MHGFs purchased in 2021–2029. The percentage difference between the NES for 30 years of shipments and the NES for nine years of shipments is the same for FFC savings as for the primary NES.

Table V.28. Cumulative Primary National Energy Savings for Potential AFUE Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces; Nine Years of Shipments (Units Sold in 2021-2029)

Product Class	**Trial Standard Level**				
	1	2	3	4	5
	quads				
Non-Weatherized Gas Furnaces	0.330	0.570	0.601	0.950	1.307
Mobile Home Gas Furnaces	0.022	0.024	0.042	0.044	0.048
Total *	**0.352**	**0.594**	**0.643**	**0.994**	**1.355**

* Note: Components may not sum due to rounding.

b. Net Present Value of Consumer Costs and Benefits

Table V.29 shows the consumer NPV of the total costs and savings for consumers that would result from each AFUE TSL considered for NWGFs and MHGFs. In each case, the impacts cover the lifetime of products purchased in 2021–2050. In accordance

[99]DOE presents results based on a nine-year analytical period only for the AFUE TSLs; the percentage difference between nine-year and 30-year results for the standby mode and off mode TSLs is the same as for the AFUE TSLs.

with OMB's guidelines on regulatory analysis,[100] DOE calculated NPV using both a 7-percent and a 3-percent real discount rate.

Table V.29 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Net Present Value of Consumer Benefits for Potential AFUE Standards (Units Sold in 2021-2050)

Product Class	**Discount Rate**	**Trial Standard Level**				
		1	2	3	4	5
		billion 2013$				
Non-Weatherized Gas Furnaces	3%	8.1	13.5	15.1	20.4	24.1
Mobile Home Gas Furnaces		0.6	0.7	1.0	1.1	1.2
Total *		**8.6**	**14.1**	**16.1**	**21.5**	**25.3**
Non-Weatherized Gas Furnaces	7%	1.9	3.3	2.8	3.7	3.3
Mobile Home Gas Furnaces		0.2	0.2	0.3	0.3	0.3
Total *		**2.1**	**3.6**	**3.1**	**4.0**	**3.7**

* Note: Components may not sum due to rounding.

The NPV results based on the aforementioned nine-year analytical period are presented in Table V.30 for AFUE standards. The impacts are counted over the lifetime of products purchased in 2021–2029. As mentioned previously, such results are presented for informational purposes only and is not indicative of any change in DOE's analytical methodology or decision criteria.

Table V.30. Cumulative Net Present Value of Consumer Benefits for Potential AFUE Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces; Nine Years of Shipments (Units Sold in 2021-2029)

Product Class	**Discount Rate**	**Trial Standard Level**				
		1	2	3	4	5
		billion 2013$				
Non-Weatherized Gas Furnaces	3%	2.7	4.6	4.3	5.8	6.5
Mobile Home Gas Furnaces		0.2	0.3	0.4	0.4	0.4
Total *		**3.0**	**4.9**	**4.7**	**6.2**	**6.9**
Non-Weatherized Gas Furnaces	7%	0.8	1.5	0.9	1.2	0.7
Mobile Home Gas Furnaces		0.1	0.1	0.2	0.2	0.2

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

Total *		0.9	1.6	1.1	1.4	0.9

* Note: Components may not sum due to rounding.

The above results reflect the use of the default decreasing price trend (see section IV.F.1) to estimate the change in price for NWGFs and MHGFs over the analysis period. DOE also conducted a sensitivity analysis that considered one scenario with a constant price trend and one scenario with a slightly higher rate of price decline than the reference case. The results of these alternative cases are presented in appendix 10C of the NOPR TSD.

As discussed in section IV.F.4, DOE conducted sensitivity analyses assuming higher and lower levels of product switching for NWGFs. Table V.31 compares the NPV results (using 3 and 7-percent discount rate) for potential AFUE standards under the default switching assumptions with the results in the sensitivity cases.

Table V.31 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Net Present Value of Consumer Benefits for Potential AFUE Standards (Units Sold in 2021-2050); Product Switching Sensitivity Analysis

Product Class	**Discount Rate**	**Trial Standard Level**				
		1	2	3	4	5
		billion 2013$				
Default	3%	8.6	14.1	16.1	21.5	25.3
High		8.1	13.6	11.9	16.7	19.9
Low		9.2	14.8	19.9	25.8	30.4
Default	7%	2.1	3.6	3.1	4.0	3.7
High		1.9	3.4	1.6	2.3	1.8
Low		2.3	3.8	4.4	5.5	5.4

Table V.32 shows the consumer NPV results for each standby mode and off mode TSL considered for NWGFs and MHGFs. In each case, the impacts cover the lifetime of products purchased in 2021–2050. The NPV results based on the aforementioned nine-year analytical period are presented in Table V.33

Table V.32 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Net Present Value of Consumer Benefits for Potential Standby Mode and Off Mode Power Standards (Units Sold in 2021-2050)

Product Class	Discount Rate	Trial Standard Levels		
		1	**2**	**3**
		billion 2013$		
Non-Weatherized Gas Furnaces	3%	2.1	2.0	3.3
Mobile Home Gas Furnaces		0.002	0.002	0.003
Total *		**2.1**	**2.0**	**3.3**
Non-Weatherized Gas Furnaces	7%	0.7	0.6	1.0
Mobile Home Gas Furnaces		0.001	0.001	0.001
Total *		**0.7**	**0.6**	**1.0**

* Note: Components may not sum due to rounding.
Note: Parentheses indicate negative values.

Table V.33 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Cumulative Net Present Value of Consumer Benefits for Potential Standby Mode and Off Mode Power Standards; Nine Years of Shipments (Units Sold in 2021-2029)

Product Class	Discount Rate	Trial Standard Levels		
		1	**2**	**3**
		billion 2013$		
Non-Weatherized Gas Furnaces	3%	0.8	0.7	1.2
Mobile Home Gas Furnaces		0.001	0.001	0.001
Total *		**0.8**	**0.7**	**1.2**
Non-Weatherized Gas Furnaces	7%	0.4	0.3	0.5
Mobile Home Gas Furnaces		0.000	0.000	0.001
Total *		**0.4**	**0.3**	**0.5**

* Note: Components may not sum due to rounding.

c. Indirect Impacts on Employment

DOE expects that amended energy conservation standards for NWGFs and MHGFs would 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 (2021 to 2026), where these uncertainties are reduced.

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

4. Impact on Product Utility or Performance

DOE has tentatively concluded that the amended standards it is proposing in this NOPR would not lessen the utility or performance of NWGFs and MHGFs. DOE surveyed the market and found that high efficiency furnaces and baseline products serve the same function and, therefore, there is no resulting loss in product utility by using higher efficiency furnaces. Furthermore, manufacturers of these products currently offer furnaces that meet or exceed today's proposed standards. While higher efficiency standards may require different venting techniques and other installation considerations, these requirements do not affect the consumer's utility with respect to the quality of the heat provided by the furnace. While not a utility issue, DOE notes that certain considerations associated with higher efficiency furnaces, such as increased installation costs or product size were examined, as appropriate, in its analyses. (See, for example, section IV.F.2 for discussion of installation cost for high efficiency condensing furnaces.)

5. Impact of Any Lessening of Competition

DOE considered any lessening of competition that is likely to result from new or 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. To assist the Attorney General in making such determination, DOE has provided DOJ with copies of this NOPR 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

Enhanced energy efficiency, where economically justified, improves the Nation's energy security, strengthens the economy, and reduces the environmental impacts of energy production. Table V.34 provides DOE's estimate of cumulative reductions in air pollutant emissions resulting from the AFUE TSLs, and Table V.35 provides estimated cumulative emissions reductions for the TSLs considered for standby mode and off mode furnace efficiency. The tables include both power sector emissions and upstream emissions. The emissions were calculated using the multipliers discussed in section IV.K. The increase in emissions of SO_2, Hg, and N_2O is due to a fraction of NWGF consumers that are projected to switch from gas furnaces to electric heat pumps and electric furnaces under the potential standards. DOE reports annual emissions impacts for each TSL in chapter 13 of the NOPR TSD.

Table V.34. Cumulative Emissions Reduction Estimated for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Potential AFUE Standards

	Trial Standard Level				
	1	2	3	4	5
Site and Power Sector Emissions					
CO_2 (million metric tons)	51.0	91.3	105.5	163.2	215.5
SO_2 (thousand tons)	(76.3)	(72.3)	(200.5)	(242.0)	(339.0)
NO_X (thousand tons)	126.7	181.3	292.5	404.2	547.7
Hg (tons)	(0.238)	(0.226)	(0.624)	(0.754)	(1.056)
CH_4 (thousand tons)	(5.79)	(4.63)	(15.89)	(18.46)	(26.14)
N_2O (thousand tons)	(0.95)	(0.82)	(2.57)	(3.04)	(4.28)
Upstream Emissions					
CO_2 (million metric tons)	13.6	18.7	31.9	43.4	59.0
SO_2 (thousand tons)	(0.81)	(0.74)	(2.14)	(2.57)	(3.61)
NO_X (thousand tons)	222.6	303.0	523.4	708.7	965
Hg (tons)	(0.002)	(0.002)	(0.005)	(0.006)	(0.009)
CH_4 (thousand tons)	1,458	1,969	3,440	4,643	6,326
N_2O (thousand tons)	(0.011)	(0.001)	(0.037)	(0.036)	(0.054)
Total FFC Emissions					
CO_2 (million metric tons)	64.6	110.0	137.3	206.5	274.5
SO_2 (thousand tons)	(77.1)	(73.0)	(202.6)	(244.6)	(342.6)
NO_X (thousand tons)	349.3	484.3	815.9	1,113	1,513
Hg (tons)	(0.240)	(0.228)	(0.629)	(0.760)	(1.065)
CH_4 (thousand tons)	1,452	1,964	3,424	4,624	6,300
CH_4 (thousand tons CO_2eq)*	40,663	54,995	95,882	129,480	176,393
N_2O (thousand tons)	(0.96)	(0.82)	(2.61)	(3.07)	(4.34)
N_2O (thousand tons CO_2eq)*	(256)	(217)	(692)	(814)	(1,149)

* CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP).
Note: Parentheses indicate negative values.

Table V.35. Cumulative Emissions Reduction Estimated for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Potential Standby Mode and Off Mode Standards

	Trial Standard Level		
	1	2	3
Site and Power Sector Emissions			
CO_2 (million metric tons)	8.2	9.8	14.7
SO_2 (thousand tons)	7.1	8.6	12.9
NO_X (thousand tons)	6.5	7.8	11.8
Hg (tons)	0.022	0.026	0.040
CH_4 (thousand tons)	0.82	0.98	1.48
N_2O (thousand tons)	0.12	0.14	0.21
Upstream Emissions			
CO_2 (million metric tons)	0.5	0.6	0.9
SO_2 (thousand tons)	0.08	0.10	0.15
NO_X (thousand tons)	7.0	8.4	12.5
Hg (tons)	0.0002	0.0002	0.0003
CH_4 (thousand tons)	40.6	48.8	73.1
N_2O (thousand tons)	0.004	0.005	0.007
Total FFC Emissions			
CO_2 (million metric tons)	8.6	10.4	15.6
SO_2 (thousand tons)	7.2	8.7	13.0
NO_X (thousand tons)	13.5	16.2	24.3
Hg (tons)	0.022	0.027	0.040
CH_4 (thousand tons)	41.4	49.7	74.6
CH_4 (thousand tons CO_2eq)*	1,161	1,393	2,088
N_2O (thousand tons)	0.121	0.146	0.219
N_2O (thousand tons CO_2eq)*	32	39	58

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

As part of the analysis for this proposed rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the TSLs considered for NWGFs and MHGFs. As discussed in section IV.L, for CO_2, DOE used the most recent values for the SCC developed by an interagency process. The four sets of SCC values for CO_2 emissions reductions in 2015 resulting from that process (expressed in 2013$) are represented by $12.0/metric ton (the average value from a distribution that uses a 5-percent discount rate), $40.5/metric ton (the average value from a distribution that uses a 3-percent discount rate), $62.4/metric ton (the average value from a distribution that uses a 2.5-percent discount rate), and $119/metric ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). The values for later years are higher due to increasing damages (emissions-related costs) as the projected magnitude of climate change increases.

Table V.36 presents the global value of CO_2 emissions reductions at each TSL for AFUE standards. Table V.37 presents the global value of CO_2 emissions reductions at each TSL for standby mode and off mode standards. For each of the four cases, DOE calculated a present value of the stream of annual values using the same discount rate as was used in the studies upon which the dollar-per-ton values are based. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in chapter 14 of the NOPR TSD.

Table V.36. Estimates of Global Present Value of CO_2 Emissions Reduction for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Potential AFUE Standards

TSL	SCC Case*			
	5% discount rate, average	**3% discount rate, average**	**2.5% discount rate, average**	**3% discount rate, 95th percentile**
	million 2013$			
Site and Power Sector Emissions				
1	279.9	1,428	2,312	4,432
2	508.4	2,574	4,162	7,981
3	552.3	2,880	4,680	8,935
4	870.0	4,496	7,295	13,945
5	1,151	5,944	9,643	18,436
Upstream Emissions				
1	78.2	389.9	628.7	1,207.6
2	106.9	534.7	862.7	1,656
3	180.0	904.2	1,460	2,800
4	244.7	1,229	1,985	3,808
5	333.6	1,674	2,703	5,185

Total FFC Emissions				
1	358.1	1,818	2,941	5,640
2	615.4	3,109	5,024	9,637
3	732.3	3,784	6,140	11,735
4	1,115	5,726	9,280	17,752
5	1,484	7,618	12,346	23,621

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.0, $40.5, $62.4, and $119 per metric ton (2013$). The values are for CO_2 only (*i.e.*, not CO_{2eq} of other greenhouse gases).

Table V.37. Estimates of Global Present Value of CO_2 Emissions Reduction for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Potential Standby Mode and Off Mode Standards

TSL	SCC Case*			
	5% discount rate, average	3% discount rate, average	2.5% discount rate, average	3% discount rate, 95th percentile
	million 2013$			
Site and Power Sector Emissions				
1	46.1	231.4	373. 6	716.5
2	55.3	277.7	448.4	859.8
3	82.9	416.4	672.3	1,289
Upstream Emissions				
1	2.7	13.7	22.1	42.4
2	3.2	16.4	26.6	50.9
3	4.8	24.6	39.8	76.2
Total FFC Emissions				
1	48.8	245.1	395.8	758.9
2	58.5	294.1	474.9	910.6
3	87.8	441.0	712.1	1,365

* For each of the four cases, the corresponding SCC value for emissions in 2015 is $12.0, $40.5, $62.4, and $119 per metric ton (2013$). The values are for CO_2 only (*i.e.*, not CO_{2eq} of other greenhouse gases).

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

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from amended standards for the NWGFs and MHGFs that are the subject of this NOPR. The dollar-per-ton values that DOE used are discussed in section IV.L. Table V.38 presents the cumulative present values for NO_X emissions reductions for each AFUE TSL calculated using the average dollar-per-ton value and seven-percent and three-percent discount rates. Similarly, Table V.39 presents the cumulative present values for NO_X emissions reductions for each standby mode and off mode TSL.

Table V.38. Estimates of Present Value of NO_X Emissions Reduction for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Potential AFUE Standards

TSL	3% Discount Rate	7% Discount Rate
	million 2013$	
Site and Power Sector Emissions		
1	137.6	49.9
2	196.6	71.4
3	310.0	109.4
4	429.6	152.1

5	583.6	207.3
Upstream Emissions		
1	246.4	92.6
2	332.8	123.6
3	568.5	209.0
4	769.2	282.2
5	1050	386.4
Total FFC Emissions*		
1	384.0	142.5
2	529.5	195.0
3	878.6	318.4
4	1,199	434.4
5	1,634	593.7

* Components may not sum to total due to rounding.

Table V.39. Estimates of Present Value of NO_X Emissions Reduction for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Potential Standby Mode and Off Mode Standards

TSL	3% Discount Rate	7% Discount Rate
	million 2013$	
Site and Power Sector Emissions		
1	7.1	2.6
2	8.5	3.2
3	12.8	4.7
Upstream Emissions		
1	7.4	2.6
2	8.8	3.1
3	13.2	4.7
Total FFC Emissions*		
1	14.5	5.2
2	17.4	6.3
3	26.0	9.4

* Components may not sum to total due to rounding.

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.

8. Summary of National Economic Impacts

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this rulemaking. Table V.40 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each AFUE TSL for NWGFs and MHGFs considered in this rulemaking, at both a seven-percent and three-percent discount rate. Table V.41 presents the NPV values that result from adding the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each standby mode and off mode TSL for NWGFs and MHGFs considered in this rulemaking, at both a seven-percent and three-percent discount rate. The CO_2 values used in the columns of each table correspond to the four sets of SCC values discussed above.

Table V.40 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Net Present Value of Consumer Savings Combined with Present Value of Monetized Benefits from CO_2 and NO_X Emissions Reductions for Potential AFUE Standards

TSL	Consumer NPV at 3% Discount Rate added with:			
	SCC Case \$12.0/metric ton CO_2^* and Medium Value for NO_X	SCC Case \$40.5/metric ton CO_2^* and Medium Value for NO_X	SCC Case \$62.4/metric ton CO_2^* and Medium Value for NO_X	SCC Case \$119/metric ton CO_2^* and Medium Value for NO_X

	Billion 2013$			
1	9.4	10.8	12.0	14.7
2	15.3	17.8	19.7	24.3
3	17.7	20.8	23.1	28.7
4	23.8	28.4	32.0	40.4
5	28.4	34.5	39.2	50.5
TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Case $12.0/metric ton CO_2* and Medium Value for NO_X	SCC Case $40.5/metric ton CO_2* and Medium Value for NO_X	SCC Case $62.4/metric ton CO_2* and Medium Value for NO_X	SCC Case $119/metric ton CO_2* and Medium Value for NO_X
	Billion 2013$			
1	2.6	4.0	5.2	7.9
2	4.4	6.9	8.8	13.4
3	4.1	7.2	9.5	15.1
4	5.6	10.2	13.7	22.2
5	5.7	11.9	16.6	27.9

* These label values represent the global SCC in 2015, in 2013$. For NO_X emissions, each case uses the medium value, which corresponds to $2,684 per ton.

Table V.41 Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces: Net Present Value of Consumer Savings Combined with Present Value of Monetized Benefits from CO_2 and NO_X Emissions Reductions for Potential Standby Mode and Off Mode Standards

TSL	Consumer NPV at 3% Discount Rate added with:			
	SCC Case $12.0/metric ton CO_2* and Medium Value for NO_X	SCC Case $40.5/metric ton CO_2* and Medium Value for NO_X	SCC Case $62.4/metric ton CO_2* and Medium Value for NO_X	SCC Case $119/metric ton CO_2* and Medium Value for NO_X
	Billion 2013$			
1	2.19	2.38	2.53	2.90
2	2.09	2.32	2.51	2.94
3	3.38	3.74	4.01	4.66
TSL	Consumer NPV at 7% Discount Rate added with:			
	SCC Case $12.0/metric ton CO_2* and Medium Value for NO_X	SCC Case $40.5/metric ton CO_2* and Medium Value for NO_X	SCC Case $62.4/metric ton CO_2* and Medium Value for NO_X	SCC Case $119/metric ton CO_2* and Medium Value for NO_X
	Billion 2013$			
1	0.78	0.98	1.13	1.49
2	0.67	0.91	1.09	1.52
3	1.13	1.48	1.76	2.41

* These label values represent the global SCC in 2015, in 2013$. For NO_X emissions, each case uses the medium value, which corresponds to $2,684 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 different time frames for analysis. The national operating cost savings is measured for the lifetime of products shipped in 2021–2050. 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; these impacts continue well beyond 2100.

C. Proposed Standards

When considering 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)) As discussed previously, in determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens by, to the greatest extent practicable, considering the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard must also "result in significant conservation of energy." (42 U.S.C. 6295(o)(3)(B))

For this NOPR, DOE considered the impacts of amended standards for NWGFs and MHGFs 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. 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 (see section IV.I), and impacts on employment. DOE discusses the impacts on direct employment in NWGF and MHGF manufacturing in section IV.J, and discusses the indirect employment impacts in section IV.N.

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.[101]

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[102] 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 TSLs Considered for NWGFs and MHGFs AFUE Standards

Table V.42 and Table V.43 summarize the quantitative impacts estimated for each TSL for the NWGF and MHGF AFUE standards. The national impacts are measured over the lifetime of NWGFs and MHGFs purchased in the 30-year period that begins in the year of compliance with amended standards (2021-2050). The energy savings,

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

[102] 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).

emissions reductions, and value of emissions reductions refer to full-fuel-cycle results and include the impacts of projected fuel switching discussed in sections IV.F.4 and IV.H.3 and chapter 8 of the Technical Support Document. The efficiency levels contained in each TSL are described in section V.A.

Table V.42. Summary of Results for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces AFUE TSLs: National Impacts

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
FFC National Energy Savings					
quads	1.291	2.126	2.780	4.110	5.481
NPV of Consumer Benefits (2013$ billion)					
3% discount rate	8.6	14.1	16.1	21.5	25.3
7% discount rate	2.1	3.6	3.1	4.0	3.7
Cumulative Emissions Reduction (Total FFC Emissions)					
CO_2 (million metric tons)	64.6	110.0	137.3	206.5	274.5
SO_2 (thousand tons)	(77.1)	(73.0)	(202.6)	(244.6)	(342.6)
NO_X (thousand tons)	349.3	484.3	815.9	1,113	1,513
Hg (tons)	(0.240)	(0.228)	(0.629)	(0.760)	(1.065)
CH_4 (thousand tons)	1,452	1,964	3,424	4,624	6,300
CH_4 (thousand tons CO_2eq)*	40,663	54,995	95,882	129,480	176,393
N_2O (thousand tons)	(1.0)	(0.8)	(2.6)	(3.1)	(4.3)
N_2O (thousand tons CO_2eq)*	(256)	(217)	(692)	(814)	(1,149)
Value of Emissions Reduction (Total FFC Emissions)					
CO_2 (2013$ billion)**	0.358 to 5.640	0.615 to 9.637	0.732 to 11.75	1.115 to 17.75	1.484 to 23.62
NO_X – 3% discount rate (2013$ million)	384.0	529.5	878.6	1,199	1,634
NO_X – 7% discount rate (2013$ million)	142.5	195.0	318.4	434.4	593.7

* CO_2eq is the quantity of CO_2 that would have the same global warming potential (GWP).
** Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
Note: Parentheses indicate negative values.

Table V.43. Summary of Results for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces AFUE TSLs: Manufacturer and Consumer Impacts

Category	TSL 1**	TSL 2**	TSL 3	TSL 4	TSL 5
Manufacturer Impacts					
Industry NPV ($M) Base Case = 1055.13	990.43 to 1048.71	825.26 to 1063.45	971.41 to 1061.65	740.79 to 1099.24	548.20 to 1080.94
Change in Industry NPV (%)	(6.13)	(21.79)	(7.93)	(29.79)	(48.04)

	to (0.61)	to 0.79	to 0.62	to 4.18	to 2.45
Consumer Mean LCC Savings (2013$)					
Non-Weatherized Gas Furnaces	$208	$374	$305	$388	$441
Mobile Home Gas Furnaces	$770	$902	$691	$778	$784
Shipment-Weighted Average*	$220	$385	$313	$396	$449
Consumer Simple PBP (years)					
Non-Weatherized Gas Furnaces	8.3	7.2	7.2	7.4	8.3
Mobile Home Gas Furnaces	1.8	2.8	2.2	3.3	4.2
Shipment-Weighted Average*	8.1	7.1	7.0	7.3	8.2
Consumer LCC Impacts					
Non-Weatherized Gas Furnaces					
Consumers with Net Cost (%)	11%	14%	20%	24%	40%
Mobile Home Gas Furnaces					
Consumers with Net Cost (%)	4%	8%	7%	13%	25%

* Weighted by shares of each product class in total projected shipments in 2021. The results for TSLs 1 and 2 are weighted by shares of each product class in projected shipments to the North in 2021.
** Results at TSLs 1 and 2 refer to the Northern region. For the Rest of Country, the proposed standard levels at TSLs 1 and 2 are at the baseline, so no consumers are affected.
Note: Parentheses indicate negative values.

First, DOE considered TSL 5, which would save an estimated total of 5.48 quads of energy, an amount DOE considers significant. TSL 5 has an estimated NPV of consumer benefit of $3.7 billion using a 7-percent discount rate, and $25.3 billion using a 3-percent discount rate.

The cumulative emissions reductions at TSL 5 are 274 million metric tons of CO_2, 1,513 thousand tons of NO_X, and 6,300 thousand tons of CH_4. Projected emissions show an increase of 343 thousand tons of SO_2, 4.3 thousand tons of N_2O, and 1.065 tons of Hg. The increase is due to projected switching from gas furnaces to electric heat pumps and electric furnaces under the proposed standards. The estimated monetary value of the CO_2 emissions reductions at TSL 5 ranges from $1.48 billion to $23.62 billion.

At TSL 5, the average LCC savings are $441 for non-weatherized gas furnaces and $784 for mobile home gas furnaces. The simple PBP is 8.3 years for non-weatherized gas furnaces and 4.2 years for mobile home gas furnaces. The share of consumers experiencing a net LCC cost is 40 percent for non-weatherized gas furnaces and 25 percent for mobile home gas furnaces.

At TSL 5, the projected change in INPV ranges from a decrease of 506.94 million to an increase of $25.80 million. The upper bound is considered optimistic by industry because it assumes manufacturers could pass on all compliance costs as price increases to their customers. DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the larger decrease is reached, as DOE expects, TSL 5 could result in a net loss of up to 48.04 percent in INPV for manufacturers.

The Secretary tentatively concludes that, at TSL 5 for NWGFs and MHGFs AFUE standards, the benefits of energy savings, positive NPV of total consumer benefits at a 3-percent and 7-percent discount rates, average consumer LCC savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the very large reduction in industry value at TSL 5 and the high number of consumers experiencing a net LCC cost for NWGFs. Consequently, DOE has concluded that TSL 5 is not economically justified.

Next, DOE considered TSL 4, which would save an estimated total of 4.11 quads of energy, an amount DOE considers significant. TSL 4 has an estimated NPV of consumer benefit of $4.0 billion using a 7-percent discount rate, and $21.5 billion using a 3-percent discount rate.

The cumulative emissions reductions at TSL 4 are 207 million metric tons of CO_2, 1,113 thousand tons of NO_X, and 4,624 thousand tons of CH_4. Projected emissions show an increase of 245 thousand tons of SO_2, 3.1 thousand tons of N_2O, and 0.760 tons of Hg. The increase is due to projected switching from gas furnaces to electric heat pumps and electric furnaces under the proposed standards. The estimated monetary value of the CO_2 emissions reductions at TSL 4 ranges from $1.11 billion to $17.75 billion

At TSL 4, the average LCC savings are $388 for non-weatherized gas furnaces and $778 for mobile home gas furnaces. The simple PBP is 7.4 years for non-weatherized gas furnaces and 3.3 years for mobile home gas furnaces. The share of consumers experiencing a net LCC cost is 24 percent for non-weatherized gas furnaces and 13 percent for mobile home gas furnaces.

At TSL 4, the projected change in INPV ranges from a decrease of $314.34 million to an increase of $44.10 million. If the larger decrease is reached, TSL 4 could result in a net loss of 29.79 percent in INPV.

In considering this level, DOE notes that the agency recently published a final rule for energy conservation standards for furnace fans. 79 FR 38130 (July 3, 2014). Figure V.1 illustrates the compliance intervals of both the furnace fans final rule and the proposed rule for residential furnaces.

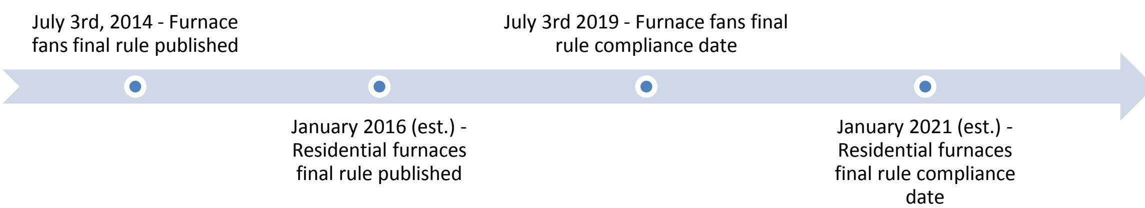

Figure V.1 Compliance timeline for furnace fans final rule and proposed residential furnaces rule

Furnace fans are a major component of residential furnaces. The final rule for furnace fans has a compliance date in 2019. This is relevant because manufacturers of furnaces also typically manufacture the furnace fans housed in those systems. Today's most common furnace blower motor technology is PSC motors. However, DOE believes that the furnace fan standard will likely require manufacturers to redesign residential furnaces to incorporate BPM motors and multi-staging for NWGF, and improved PSC motors for MHGF. Since these changes would also directly affect the furnace manufacturing industry, in addition to the new standards in this NOPR, DOE is aware that both rulemakings could present a cumulative burden impacting both product costs and upfront conversion costs. While cumulative burden issues are common in rulemakings (as manufacturers often produce more than one type of covered product), this situation is unique. First, both this energy conservation standards NOPR and the energy conservation standards furnace fan final rule will directly impact the design and manufacturing of the same product (i.e., residential furnaces). Second, the two rules impact an identical group of manufacturers. Third, these requirements are impacting the same product in a very short period of time. And finally the design changes resulting from this NOPR are additive to the design changes needed to meet the furnace fan standard. The combined requirements from this NOPR and from the furnace fans final rule will result in a larger burden in terms of both product cost and product conversion cost than would occur as a result of either of the individual rulemakings alone. Typically, manufacturers will attempt to recover these additional costs by passing them on to consumers. If these rules applied to different products the impact on consumer prices would be less and the impact on manufacturers could be spread across a larger revenue base. However, because these costs apply to the same product (i.e., furnaces), it may be more difficult for manufacturers to pass through all of the costs that they normally would to the consumer and the percentage reduction in industry value would be larger. Thus, manufacturers may feel this form of cumulative regulatory burden more acutely than that imposed on separate products in their manufacturing portfolio.

To reach TSL 4, DOE has tentatively concluded that manufacturers would need to increase the heat exchanger surface area (see section IV.C.1.b). In order to meet the adopted furnace fan standard, as discussed above, manufacturers would likely need to implement an improved blower motor and, for NWGF, add multi-staging. Although the furnace heat exchanger, blower components, and combustion system are all integrated in the residential furnace design, the changes expected from the two rules are largely additive, with little overlap. Thus, when analyzing the combined impact of the two rules, DOE expects that the full costs of each rule will be incurred, with limited opportunity for cost savings to be achieved through coordinating the expenditures of the two rules. DOE estimates that, on average, the MPC at TSL 4 would be $145 greater than the current baseline cost for NWGF. When added to the MPC increase projected from the furnace fan final rule of $68, the total resulting manufacturing cost increase would be $213 for NWGF. Likewise, when the estimated $154 MPC increase from this NOPR is combined with the $6 increase resulting from the furnace fans rulemaking, the total impact on the manufacturing cost of MHGF would be an increase of $160. In addition to the manufacturing costs being additive, the capital and product conversion costs are also largely additive, resulting in a greater impact on manufacturers than would be projected in the MIA results for either individual rulemaking. DOE projects that if TSL 4 was adopted as a result of this rulemaking, it would result in $65.8 million in capital conversion costs and $23.0 million in product conversion costs. These changes are in addition to a projected $15.1 million in capital expenditures and $25.5 million in product conversion costs from the furnace fan standard, for which compliance will be required in 2019. 79 FR 38130, 38188 (July 3, 2014). In sum, manufacturers would be expected to incur $80.9 million and $48.5 million in capital and product conversion costs, respectively, leading up to the 2019 furnace fans and the projected 2021 residential furnaces compliance dates.

DOE strongly considered TSL 4, and in a typical case, DOE's quantitative analysis would have likely led to proposed standards at those levels, given the potential for significant additional energy and carbon savings. However, as discussed above, the unique cumulative burden on manufacturers from this rule and the furnace fans rule is an important concern for DOE. In light of this situation, DOE seeks further information in order to balance the benefits and burdens of adopting TSL 4 in the final rule. For example, DOE seeks validation of its estimated capital conversion costs and product conversion costs. Conversely, DOE seeks information concerning whether its assumptions about cumulative regulatory burden are mistaken. That is, DOE solicits information regarding the potential for cost-reducing synergies in terms of improving the energy efficiency of furnaces and furnace fans at the same time. Based upon the information available at this time with respect to manufacturer impacts, including the cumulative effects of the furnace fan rulemaking, the Secretary tentatively concludes that, at TSL 4 for NWGF and MHGF AFUE standards, the benefits of energy savings, positive NPV of total consumer benefits at a 3-percent and 7-percent discount rates, positive average consumer LCC savings, emission reductions, and the estimated monetary value of the emissions reductions would be outweighed by the potential negative impacts on manufacturers.

Next, DOE considered TSL 3, which would save an estimated total of 2.78 quads of energy, an amount DOE considers significant. TSL 3 has an estimated NPV of consumer benefit of $3.1 billion using a 7-percent discount rate, and $16.1 billion using a 3-percent discount rate.

The cumulative emissions reductions at TSL 3 are 137 million metric tons of CO_2, 816 thousand tons of NO_X, and 3,424 thousand tons of CH_4. Projected emissions show an increase of 203 thousand tons of SO_2, 2.6 thousand tons of N_2O, and 0.629 tons of Hg. The increase is due to projected switching from gas furnaces to electric heat pumps and electric furnaces under the proposed standards. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $0.73 billion to $11.75 billion.

At TSL 3, the average LCC savings are $305 for non-weatherized gas furnaces and $691 for mobile home gas furnaces. The simple PBP is 7.2 years for non-weatherized gas furnaces and 2.2 years for mobile home gas furnaces. The share of consumers experiencing a net LCC cost is 20 percent for non-weatherized gas furnaces and 7 percent for mobile home gas furnaces.

At TSL 3, the projected change in INPV ranges from a decrease of $83.72 million to an increase of $6.52 million. If the larger decrease is reached, TSL 3 could result in a net loss of 7.93 percent in INPV. DOE notes that, as explained with TSL 4, cumulative burden from the furnaces and furnace fans rules is a significant concern. However, at

TSL 3, the projected manufacturer impacts are significantly less than at TSL 4, thereby mitigating some of these concerns.

DOE estimates that the MPC at TSL 3 would be, on average, $91 greater than the current baseline cost for NWGF. When added to the MPC increase projected from the furnace fans final rule of $68, the total resulting manufacturing cost increase would be $159 for NWGF. Likewise, for MGHF, when the estimated $98 MPC increase from this NOPR is combined with the $6 increase resulting from the furnace fans rulemaking, the total impact on the MGHF manufacturing cost would be an increase of $104. DOE projects that at TSL 3 manufacturers will incur $38.5 million in capital conversion costs and $16.5 million in product conversion costs. When considering the conversion costs of the furnace fans final rule ($15.1 million in capital expenditures and $25.5 million in product conversion costs from the furnace fan standard) and residential furnaces rule as additive, manufacturers would be expected to incur $53.6 million in capital conversion costs and $42 million product conversion costs in the years leading up to the 2019 furnace fans and the projected 2021 residential furnaces effective dates.

DOE notes that the extent of switching that would result from amended standards for NWGF AFUE (as represented in the range of estimates that DOE analyzed) would affect the benefits and costs of TSLs 3, 4, and 5. Thus, DOE requests comments on DOE's analysis of product switching.

After considering the analysis and weighing the benefits and the burdens, the Secretary has tentatively concluded that at TSL 3 for NWGF and MHGF AFUE standards and based upon DOE's understanding of currently available information, the benefits of energy savings, positive NPV of consumer benefit, positive impacts on consumers (as indicated by positive average LCC savings and favorable PBPs), emission reductions, and the estimated monetary value of the emissions reductions would outweigh negative impacts on some consumers and the potential reductions in INPV for manufacturers. Consequently, DOE is proposing energy conservation standards for NWGFs and MHGFs at TSL 3.

In today's proposed rule, DOE requests comments and data from interested parties that would assist DOE in determining whether TSL 4 for NWGF and MHGF AFUE standards would also lead to the benefits of energy savings, positive NPV of total consumer benefits at a 3-percent and 7-percent discount rates, positive average consumer LCC savings, emission reductions, and the estimated monetary value of the emissions reductions outweighing the reduction in industry value at TSL 4. If additional information points to such a conclusion, DOE will strongly consider adoption of TSL 4 in the final rule. Because DOE has not yet reached a final decision to set standards at TSL 3 or TSL 4, it seeks a more complete understanding of the benefits and burdens of moving forward at each of these levels, as well as any implementation problems that might be reasonably foreseen.

Based on the above considerations, DOE today proposes to adopt AFUE energy conservation standards for NWGFs and MHGFs at TSL 3, as presented in Table V.44.

Table V.44. Proposed Amended AFUE Energy Conservation Standards for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces

Product Class	AFUE %
Non-Weatherized Gas-Fired Furnaces	92
Mobile Home Gas-Fired Furnaces	92

2. Benefits and Burdens of TSLs Considered for NWGFs and MHGFs Standby Mode and Off Mode Standards

Table V.45 and Table V.46 present a summary of the quantitative impacts estimated for each TSL considered for NWGFs and MHGFs standby mode and off mode standards. The national impacts are measured over the lifetime of NWGFs and MHGFs purchased in the 30-year period that begins in the year of compliance with amended standards (2021-2050). The energy savings, emissions reductions, and value of emissions reductions refer to the full-fuel-cycle results. The efficiency levels contained in each TSL are described in section V.A.

Table V.45 Summary of Results for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Standby Mode and Off Mode TSLs: National Impacts

Category	TSL 1	TSL 2	TSL 3
FFC National Energy Savings			
quads	0.154	0.185	0.277
NPV of Consumer Benefits (2013$ billion)			
3% discount rate	2.1	2.0	3.3
7% discount rate	0.7	0.6	1.0
Cumulative Emissions Reduction (Total FFC Emissions)			
CO_2 (million metric tons)	8.6	10.4	15.6

SO_2 (thousand tons)	7.2	8.7	13.0
NO_X (thousand tons)	13.5	16.2	24.3
Hg (tons)	0.022	0.027	0.040
CH_4 (thousand tons)	41.45	49.74	74.58
CH_4 (thousand tons CO_2eq)*	1,161	1,393	2,088
N_2O (thousand tons)	0.12	0.15	0.22
N_2O (thousand tons CO_2eq)*	32.2	38.6	57.9
Value of Emissions Reduction (Total FFC Emissions)			
CO_2 (2013$ billion)**	0.05 to 0.76	0.06 to 0.91	0.09 to 1.37
NO_X – 3% discount rate (2013$ million)	14.5	17.4	26.0
NO_X – 7% discount rate (2013$ million)	5.2	6.3	9.4

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

Table V.46 Summary of Results for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Standby Mode and Off Mode TSLs: Manufacturer and Consumer Impacts

Category	TSL 1	TSL 2	TSL 3
Manufacturer Impacts			
Industry NPV ($M) Base case = 1055.13	1053.41to 1054.61	1046.10 to 1055.58	1042.97 to 1055.99
Change in Industry NPV (%)	(0.16) to (0.05)	(0.86) to 0.04	(1.15) to 0.08
Consumer Mean LCC Savings (2013$)			
Non-Weatherized Gas Furnaces	$12	$6	$13
Mobile Home Gas Furnaces	$1	$0	$1
Shipment-Weighted Average*	$12	$6	$13
Consumer Simple PBP (years)			
Non-Weatherized Gas Furnaces	1.3	9.7	7.5
Mobile Home Gas Furnaces	1.2	9.2	7.1
Shipment-Weighted Average*	1.3	9.6	7.4
Consumer LCC Impacts			
Non-Weatherized Gas Furnaces			
Consumers with Net Cost (%)	2%	15%	9%
Mobile Home Gas Furnaces			
Consumers with Net Cost (%)	0%	1%	1%

* Weighted by shares of each product class in total projected shipments in 2021.
Note: Parentheses indicate negative values.

First, DOE considered TSL 3, which would save an estimated total of 0.28 quads of energy, an amount DOE considers significant. TSL 3 has an estimated NPV of consumer benefit of $1.0 billion using a 7-percent discount rate, and $3.3 billion using a 3-percent discount rate.

The cumulative emissions reductions at TSL 3 are 15.6 million metric tons of CO_2, 24.3 thousand tons of NO_X, 13.0 thousand tons of SO_2, 0.040 tons of Hg, 0.22 thousand tons of N_2O, and 74.6 thousand tons of CH_4. The estimated monetary value of the CO_2 emissions reductions at TSL 3 ranges from $0.09 billion to $1.37 billion.

At TSL 3, the average LCC savings are $13 for non-weatherized gas furnaces and $1 for mobile home gas furnaces. The simple PBP is 7.5 years for non-weatherized gas furnaces and 7.1 years for mobile home gas furnaces. The share of consumers experiencing a net LCC cost is 9 percent for non-weatherized gas furnaces and 1 percent for mobile home gas furnaces.

At TSL 3, the projected change in INPV ranges from a decrease of $12.16 million to an increase of $0.08 million. If the larger decrease is reached, TSL 3 could result in a net loss of 1.15 percent in INPV.

The Secretary concludes that at TSL 3 for NWGF and MHGF standby mode and off mode standards, the benefits of energy savings, positive NPV of consumer benefits at both 7-percent and 3-percent discount rates, positive impacts on consumers (as indicated by positive average LCC savings, favorable PBPs, and a higher percentage of consumers who would experience LCC benefits as opposed to costs), emission reductions, and the estimated monetary value of the CO_2 emissions reductions would outweigh the economic burden on a small fraction of consumers and the small potential loss in manufacturer INPV. After considering the analysis and the benefits and burdens of TSL 3, the Secretary has concluded that this TSL offers the maximum improvement in energy efficiency that is technologically feasible and economically justified, and will result in the significant conservation of energy. Therefore, DOE proposes to adopt TSL 3 for NWGF and MHGF standby mode and off mode standards. The proposed energy conservation standards for standby mode and off mode, expressed as maximum power in watts, are shown in Table V.47.

Table V.47 Proposed Standby Mode and Off Mode Energy Conservation Standards for Non-Weatherized Gas Furnace and Mobile Home Gas Furnace

Product Class	$P_{W,SB}$ (watts)	$P_{W,OFF}$ (watts)
Non-Weatherized Gas Furnaces	8.5	8.5
Mobile Home Gas Furnaces	8.5	8.5

3. 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 2013$) of the benefits from operation of products that meet the proposed standards (consisting primarily of operating cost savings from using less energy, minus increases in product purchase costs, which is another way of representing consumer NPV), and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[103] The value of 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 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, while 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 NWGFs and MHGFs shipped in 2021-2050. The SCC values, on the other hand, reflect the present value of some future climate-related impacts resulting from the emission of one metric ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Estimates of annualized benefits and costs of the proposed AFUE standards for NWGFs and MHGFs are shown in Table V.48. The results under the primary estimate are as follows.

[103] To convert the time-series of costs and benefits into annualized values, DOE calculated a present value in 2014, the year used for discounting the NPV of total consumer costs and savings. For the benefits, DOE calculated a present value associated with each year's shipments in the year in which the shipments occur (*e.g.*, 2020 or 2030), and then discounted the present value from each year to 2014. The calculation uses discount rates of 3 and 7 percent for all costs and benefits except for the value of CO_2 reductions, for which DOE used case-specific discount rates, as shown in Table V.48. Using the present value, DOE then calculated the fixed annual payment over a 30-year period, starting in the compliance year, that yields the same present value.

Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, (for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015)), the estimated cost of the NWGFs and MHGFs AFUE standards proposed in this rule is $701 million per year in increased equipment costs, while the estimated benefits are $1,074 million per year in reduced equipment operating costs, $231 million per year in CO_2 reductions, and $39 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $642 million per year.

Using a 3-percent discount rate for all benefits and costs and the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs AFUE standards proposed in this rule is $709 million per year in increased equipment costs, while the estimated benefits are $1,690 million per year in reduced equipment operating costs, $231 million per year in CO_2 reductions, and $54 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $1,264 million per year.

Table V.48. Annualized Benefits and Costs of Proposed AFUE Standards (TSL 3) for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces*

	Discount Rate	Primary Estimate	Low Net Benefits Estimate	High Net Benefits Estimate
		million 2013$/year		
Benefits				
Consumer Operating Cost Savings	7%	1,074	903	1,174
	3%	1,690	1,383	1,887
CO_2 Reduction Monetized Value ($12.0/t case)**	5%	64	59	72
CO_2 Reduction Monetized Value ($40.5/t case)**	3%	231	211	260
CO_2 Reduction Monetized Value ($62.4/t case)**	2.5%	340	311	384
CO_2 Reduction Monetized Value ($119/t case)**	3%	715	654	805
NO_X Reduction Monetized Value (at $2,684/ton)**	7%	38.50	35.68	42.48
	3%	53.52	49.26	59.53
Total Benefits†	7% plus CO_2 range	1,177 to 1,828	998 to 1,593	1,288 to 2,022
	7%	1,343	1,150	1,476
	3% plus CO_2 range	1,807 to 2,458	1,491 to 2,087	2,018 to 2,751
	3%	1,974	1,643	2,206
Costs				
Consumer Incremental Equipment Costs	7%	701	750	683
	3%	709	766	689
Net Benefits/Costs				
Total†	7% plus CO_2 range	476 to 1,127	248 to 843	605 to 1,339
	7%	642	400	793
	3% plus CO_2 range	1,098 to 1,749	725 to 1,320	1,329 to 2,062
	3%	1,264	877	1,517

* This table presents the annualized costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the products purchased in 2021-2050. 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 from the AEO2014 Reference case, Low Economic Growth case and High Economic Growth case, respectively. In addition, incremental product costs reflect a modest decline rate for projected product price trends in the Primary Estimate, a constant rate in the Low Benefits Estimate, and a higher decline rate for projected price trends in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.1.
** The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The values in parentheses represent the SCC in 2015. The SCC time series 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-percent and 7-percent cases are derived using the series corresponding to average SCC with 3-percent discount rate ($40.5/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.

Estimates of annualized benefits and costs of today's proposed standards for NWGFs and MHGFs standby mode and off mode power are shown in Table V.49. The results under the primary estimate are as follows.

Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, (for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015)), the estimated cost of the NWGFs and MHGFs standby mode and off mode standards proposed in this rule is $40.4 million per year in increased equipment costs, while the estimated benefits are $165.4 million per year in reduced equipment operating costs, $26.9 million per year in CO_2 reductions, and $1.1 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $153.0 million per year.

Using a 3-percent discount rate for all benefits and costs and the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs standby mode and off mode standards proposed in this rule is $41.0 million per year in increased equipment costs, while the estimated benefits are $240.2 million per year in reduced equipment operating costs, $26.9 million per year in CO_2 reductions, and $1.6 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $227.6 million per year.

Table V.49 Annualized Benefits and Costs of Proposed Standby Mode and Off Mode Standards (TSL 3) for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces*

	Discount Rate	Primary Estimate	Low Net Benefits Estimate	High Net Benefits Estimate
		million 2013$/year		
Benefits				
Consumer Operating Cost Savings	7%	165.4	149.7	190.8
	3%	240.2	214.9	281.5
CO_2 Reduction Monetized Value ($12.0/t case)**	5%	7.65	6.94	8.60
CO_2 Reduction Monetized Value ($40.5/t case)**	3%	26.87	24.31	30.28
CO_2 Reduction Monetized Value ($62.4/t case)**	2.5%	39.46	35.68	44.50
CO_2 Reduction Monetized Value ($119/t case)**	3%	83.18	75.26	93.76
NO_X Reduction Monetized Value (at $2,684/ton)**	7%	1.14	1.04	1.27
	3%	1.59	1.44	1.78
Total Benefits†	7% plus CO_2 range	174 to 250	158 to 226	201 to 286
	7%	193.4	175.0	222.4
	3% plus CO_2 range	249 to 325	223 to 292	292 to 377
	3%	268.6	240.7	313.5
Costs				
Consumer Incremental Equipment Costs	7%	40.35	45.01	36.86
	3%	41.02	46.13	37.19
Net Benefits/Costs				
Total†	7% plus CO_2	134 to 209	113 to 181	164 to 249

	range			
	7%	153.0	130.0	185.5
	3% plus CO_2 range	208 to 284	177 to 246	255 to 340
	3%	227.6	194.6	276.3

* This table presents the annualized costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the equipment purchased in 2021-2050. 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 from the AEO2014 Reference case, Low Economic Growth case, and High Economic Growth case, respectively.
** The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The values in parentheses represent the SCC in 2015. The SCC time series incorporate an escalation factor. The value for NO_X is the average of the low and high values in DOE's analysis.
† Total benefits for both the 3-percent and 7-percent cases are derived using the series corresponding to average SCC with 3-percent discount rate ($40.5/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.

Estimates of the combined annualized benefits and costs of today's proposed standards for NWGFs and MHGFs AFUE and standby mode and off mode power are shown in Table V.50. The results under the primary estimate are as follows.

Using a 7-percent discount rate for benefits and costs other than CO_2 reduction, for which DOE used a 3-percent discount rate along with the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs AFUE and standby mode and off mode standards proposed in this rule is $741.2 million per year in increased equipment costs, while the estimated benefits are $1,240 million per year in reduced equipment operating costs, $257.4 million per year in CO_2 reductions, and $39.6 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $795.5 million per year.

Using a 3-percent discount rate for all benefits and costs and the average SCC series that uses a 3-percent discount rate ($40.5/t in 2015), the estimated cost of the NWGFs and MHGFs AFUE and standby mode and off mode standards proposed in this rule is $750.5 million per year in increased equipment costs, while the estimated benefits are $1,930 million per year in reduced equipment operating costs, $257.4 million per year in CO_2 reductions, and $55.1 million per year in reduced NO_X emissions. In this case, the net benefit would amount to $1,492 million per year.

Table V.50 Combined Annualized Benefits and Costs of Proposed AFUE and Standby Mode and Off Mode Standards (TSL 3) for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces*

	Discount Rate	Primary Estimate	Low Net Benefits Estimate	High Net Benefits Estimate
		million 2013$/year		
Benefits				
Consumer Operating Cost Savings	7%	1,240	1,053	1,365
	3%	1,930	1,598	2,168
CO_2 Reduction Monetized Value ($12.0/t case)**	5%	71.49	65.60	80.15
CO_2 Reduction Monetized Value ($40.5/t case)**	3%	257.4	235.2	290.0
CO_2 Reduction Monetized Value ($62.4/t case)**	2.5%	379.6	346.6	428.0
CO_2 Reduction Monetized Value ($119/t case)**	3%	798.1	729.2	898.9
NO_X Reduction Monetized Value (at $2,684/ton)**	7%	39.64	36.72	43.75
	3%	55.11	50.70	61.31
Total Benefits†	7% plus CO_2 range	1,351 to 2,077	1,155 to 1,819	1,489 to 2,308
	7%	1,537	1,325	1,699
	3% plus CO_2 range	2,057 to 2,783	1,715 to 2,378	2,310 to 3,128
	3%	2,243	1,884	2,519
Costs				
Consumer Incremental Equipment Costs	7%	741.2	795.0	719.9
	3%	750.5	812.4	726.3
Net Benefits/Costs				
Total†	7% plus CO_2	609.6 to	360.3 to	768.9 to

	range	1,336	1,024	1,588
	7%	795.5	529.8	978.7
	3% plus CO_2 range	1,306 to 2,033	0,902 to 1,566	1,583 to 2,402
	3%	1,492	1,072	1,793

* This table presents the annualized costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the equipment purchased in 2021-2050. 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 from the AEO 2014 Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect a modest decline rate for projected product price trends in the Primary Estimate, a constant rate in the Low Benefits Estimate, and a higher decline rate in the High Benefits Estimate. The methods used to derive projected price trends are explained in section IV.F.1.
** The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The values in parentheses represent the SCC in 2015. The SCC time series incorporate an escalation factor. The value for NO_X is the average of the low and high values in DOE's analysis.
† Total benefits for both the 3-percent and 7-percent cases are derived using the series corresponding to average SCC with 3-percent discount rate ($40.5/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.

Table V.51 compares the annualized benefits and costs of today's proposed standards for NWGF and MHGF AFUE under the default product switching estimate and under high and low switching estimates. The results under the primary, high, and low switching estimates are as follows. For the proposed standards for AFUE (TSL 3), the net benefits using a 7-percent discount rate amount to $396 million per year using high switching estimates, and $866 million per year using low switching estimates. These values compare to the primary net benefits of $642 million per year. The net benefits using a 3-percent discount rate amount to $942 million per year using high switching estimates, and $1,563 million per year using low switching estimates. These values compare to the primary net benefits of $1,264 million per year.

Table V.51 Annualized Benefits and Costs of Proposed AFUE Standards (TSL 3) for Non-Weatherized Gas Furnaces and Mobile Home Gas Furnaces Under Alternative Product Switching Estimates*

	Discount Rate	Primary Estimate	Low Switching Estimate	High Switching Estimate
		million 2013$/year		
Benefits				
Consumer Operating Cost Savings	7%	1,074	1,271	868
	3%	1,690	1,958	1,411
CO_2 Reduction Monetized Value ($12.0/t case)**	5%	64	83	44
CO_2 Reduction Monetized Value ($40.5/t case)**	3%	231	298	163
CO_2 Reduction Monetized Value ($62.4/t case)**	2.5%	340	439	241
CO_2 Reduction Monetized Value ($119/t case)**	3%	715	923	505
NO_X Reduction Monetized Value (at $2,684/ton)**	7%	39	40	37
	3%	54	55	52
Total Benefits†	7% plus CO_2 range	1,177 to 1,828	1,395 to 2,235	950 to 1,411
	7%	1,343	1,609	1,069
	3% plus CO_2 range	1,807 to 2,458	2,097 to 2,937	1,507 to 1,968
	3%	1,974	2,312	1,626
Costs				
Consumer Incremental Equipment Costs	7%	701	743	673
	3%	709	748	684
Net Benefits/Costs				
Total†	7% plus CO_2 range	476 to 1,127	651 to 1,491	277 to 738
	7%	642	866	396
	3% plus CO_2 range	1,098 to 1,749	1,349 to 2,189	823 to 1,284
	3%	1,264	1,563	942

* This table presents the annualized costs and benefits associated with NWGFs and MHGFs shipped in 2021-2050. These results include benefits to consumers which accrue after 2050 from the equipment purchased in 2021-2050. 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 Switching Estimate, and High Switching Estimates are explained in section IV.F.4.

** The interagency group selected four sets of SCC values for use in regulatory analyses. Three sets of values are based on the average SCC from the three integrated assessment models, at discount rates of 2.5, 3, and 5 percent. The fourth set, which represents the 95th-percentile SCC estimate across all three models at a 3-percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. The values in parentheses represent the SCC in 2015. The SCC time series incorporate an escalation factor. The value for NO_X is the average of the low and high values in DOE's analysis.
† Total benefits for both the 3-percent and 7-percent cases are derived using the series corresponding to average SCC with 3-percent discount rate ($40.5/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 these proposed standards address are as follows:

(1) Insufficient information and difficulty in analyzing relevant information leads some customers to miss opportunities to make cost-effective investments in energy efficiency.

(2) In some cases the benefits of more efficient equipment are not realized due to misaligned incentives between purchasers and users. An example of such a case is when the equipment purchase decision is made by a building contractor or building owner who does not pay the energy costs.

(3) There are external benefits resulting from improved energy efficiency of residential furnaces that are not captured by the users of such equipment. These benefits include externalities related to public health, environmental protection

and national security that are not reflected in energy prices, such as reduced emissions of air pollutants and greenhouse gases that impact human health and global warming.

In addition, DOE has determined that this regulatory action is a "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 this 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 this NOPR is consistent with these principles, including the requirement that, to the extent permitted by law, benefits justify costs and that net benefits are maximized.

B. Review Under the Regulatory Flexibility Act

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

For manufacturers of NWGFs and MHGFs, 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.[104] Manufacturing of NWGFs and MHGFs 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.

1. Description and Estimated Number of Small Entities Regulated

DOE reviewed the proposed energy conservation standards for NWGFs and MHGFs considered in this notice of proposed rulemaking under the provisions of the

[104] The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at http://www.sba.gov/category/navigation-structure/contracting/contracting-officials/small-business-size-standards.

Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. 68 FR 7990. To better assess the potential impacts of this rulemaking on small entities, DOE conducted a more focused inquiry of the 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 DOE's Compliance Certification Management System (CCMS[105]), industry trade association membership directories (including AHRI[106]), individual company websites, and market research tools (e.g., Hoovers reports[107]) to create a list of companies that manufacture or sell the NWGF and MHGF products covered by this rulemaking. DOE also asked industry representatives if they were aware of any other small manufacturers during manufacturer interviews. DOE reviewed publicly available data and contacted companies on its list, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered NWGF and MHGF products. 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. Out of 12 manufacturers DOE was able to identify, four manufacturers were classified as meeting the SBA's definition of a "small business" that manufactures products covered by this rulemaking. Three of those small manufacturers were domestic companies.

[105] DOE's Compliance Certification Management System, http://www.regulations.doe.gov/certification-data/ (last accessed Aug. 19, 2014).
[106] AHRI Directory, https://www.ahridirectory.org/ahridirectory/pages/home.aspx (last accessed Aug. 19, 2014).
[107] Hoovers | Company Information | Industry Information | Lists, http://www.hoovers.com/) (last accessed August 26, 2014).

Before issuing this NOPR, DOE attempted to contact all the small domestic business manufacturers of NWGFs and MHGFs it had identified. None of the small businesses consented to formal MIA interviews. DOE also attempted to obtain information about small business impacts while interviewing large manufacturers.

2. Description and Estimate of Compliance Requirements

Of the three small domestic manufacturers identified, one manufacturer was a NWGF manufacturer and two manufacturers were MHGF manufacturers. The small domestic NWGF manufacturer focuses on the residential furnace market and accounts for approximately 7 percent of the listings in the DOE Certification Compliance Database. This small manufacturer has condensing furnace product offerings, with 9 percent of its models meeting the proposed national standard level of 92% AFUE. In comparison, the NWGF industry as a whole has 46 percent of listings at or above 92% AFUE.

DOE made several key assumptions to estimate the conversion costs for small NWGF manufacturers. First, DOE assumed that conversion costs scaled with the number of model listings. Second, DOE assumed that small manufacturers accounted for 2 percent of NWGF industry revenues. Using these assumptions, DOE estimates the impacts on small manufacturer relative to large manufacturers:

	Total Conversion Cost as a Percentage of Revenue	Total Conversion Cost as a Percentage of EBIT	Capital Conversion Cost as a Percentage of Annual Capex	Product Conversion Cost as a Percentage of Annual R&D
Average Small Manufacturer	18%	304%	605%	148%

Average Large Manufacturer	3%	60%	99%	50%

These results suggest that small NWGF manufacturers could be at a disadvantage relative to the large NWGF manufacturers. In general, small manufacturers must make many of the same product redesign and cost optimization investments as their larger competitors. However, for the small manufacturer these upfront investments are spread over a smaller volume of shipments and smaller revenue base, making cost recovery more difficult.

The two small manufacturers producing MHGFs together account for approximately 32 percent of MHGF listings in the DOE Certification Compliance Database. These two manufacturers have zero listings at or above 92 percent AFUE, the proposed national standard level. In comparison, the MHGF industry as a whole has 58 percent of listings at or above 92 percent AFUE. These two small MHGF manufacturers would thus need to upgrade all product lines to remain in the industry. DOE estimates industry average conversion costs of approximately $0.9 million per company at this the proposed standard level. However, these estimates are driven by feedback from manufacturers who have condensing products today. Given that the two small manufacturers will need to develop a condensing product line from scratch, they may face substantially higher conversion costs for R&D and, perhaps, for tooling-up production of secondary heat exchangers. At the proposed AFUE standard level, the two small manufacturers may re-evaluate the cost-benefit of staying in the MHGF market.

DOE has tentatively concluded that the impacts of the standby mode and off mode requirements on small business are small relative to the AFUE standard impacts. Based on the engineering analysis, the cost of standby mode and off mode components are small to the overall cost of a residential furnace. DOE estimates that the standby mode and off mode requirements would add between $1 to $10 to the MPC of NWGF products (which ranges from $380 to $650) and to the MPC of MHGF products (which range from $323 to $568). The engineering analysis suggests that the design paths required to meet the standby mode and off mode requirements consist of relatively straight-forward component swaps. Additionally, the INPV and short-term cash flow impacts of the standby mode and off mode requirements are dwarfed by the impacts of the AFUE standard. In general, the impacts of the standby and off mode standard are significantly smaller than the impacts of the AFUE standard. For this reason, the IRFA focuses on the impacts of the AFUE standard.

DOE seeks comments, information, and data on the number of small businesses in the industry, the names of those small businesses, and their role in the market. Second, DOE requests data on the market share of small manufacturers in the NWGF and MHGF markets. Third, DOE request data on the estimate conversion costs for small manufacturers at all TSLs. Last, DOE requests comment on the potential impacts of the proposed AFUE standard and standby mode and off mode requirement on 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 in section V.B.2 analyzes impacts on small businesses that would result from DOE's proposed rule. In addition to the other TSLs being considered, the proposed rulemaking TSD includes a regulatory impact analysis (RIA) in chapter 17. For NWGFs and MHGFs, the RIA discusses the following policy alternatives: (1) no change in standard; (2) consumer rebates; (3) consumer tax credits; (4) manufacturer tax credits; (5) voluntary energy efficiency targets; and (6) bulk government purchases. While these alternatives may mitigate the economic impacts on small entities compared to the proposed standards, DOE has determined that the energy savings of these regulatory alternatives amount to 0.7 percent to 43.7 percent of the savings that would be expected to result from adoption of the proposed standard levels. Thus, DOE rejected these alternatives and is proposing the standards set forth in this rulemaking. See chapter 17 of the NOPR TSD for further detail on the policy alternatives DOE considered.

C. Review Under the Paperwork Reduction Act of 1995

Manufacturers of residential furnaces must certify to DOE that their products comply with any applicable energy conservation standards. In certifying compliance, manufacturers must test their products according to the DOE test procedures for residential furnaces, including any amendments adopted for those test procedures. DOE has established regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including residential furnaces. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement has been approved by OMB under OMB control number 1910-1400. Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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

D. Review Under the National Environmental Policy Act of 1969

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

Environmental Assessment or Environmental Impact Statement for this proposed rule. DOE's CX determination for this proposed rule is available at http://cxnepa.energy.gov/.

E. Review Under Executive Order 13132

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

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and

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

Although this proposed rule, which proposes amended energy conservation standards for residential furnaces, does not contain a Federal intergovernmental mandate, it may require expenditures of $100 million or more on 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 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 furnaces, 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), this proposed rule would establish amended energy conservation standards for residential furnaces 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 this proposed rule.

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

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

I. Review Under Executive Order 12630

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

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

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

K. Review Under Executive Order 13211

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

DOE has tentatively concluded that this regulatory action, which sets forth amended energy conservation standards for residential furnaces, 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: https://global.gotowebinar.com/pjoin/8897212172521229826/8403727164719562242 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 Office, Mailstop EE-5B, 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 webpage 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 postal mail. Comments and documents submitted via email, hand delivery, or postal 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. The efficiency levels analyzed for standby mode and off mode, and on the assumption that standby mode and off mode energy consumption (as defined by DOE) would be equal (see section IV.C.1.b).
2. The fraction of NWGFs and MHGFs that are used in commercial applications (see section IV.G.1).
3. The fraction of consumers that shut the furnace off during the non-heating season (see section IV.C.1.b).
4. Installation costs for condensing NWGFs and MHGFs. Specifically, the estimated fraction of houses that would see a large impact for installing a condensing furnace because of venting and/or condensate withdrawal issues (see section IV.F.2).

5. DOE’s current approach for determining NWGF and MHGF lifetime distribution (see section IV.F.3.d).

6. DOE’s current approach for calculating the fraction of NWGF consumers that would be expected to switch to other products in the standards cases (see section IV.F.4).

7. The estimated market share of condensing NWGFs and MHGFs in 2021 in the absence of amended energy conservation standards (see section IV.F).

8. The estimated market share of NWGFs and MHGFs that are used at each standby efficiency level in 2021 in the absence of amended energy conservation standards (see section IV.F).

9. The reasonableness of its assumption to apply a decreasing trend to the manufacturer selling price (in real dollars) of NWGFs and MHGFs, as well as any information that would support the use of alternative assumptions (see section IV.F.1).

10. Data that would allow for use of different price trend projections for condensing and non-condensing NWGFs and MHGFs (see section IV.F.1).

11. The methodology and data sources used for projecting the future shipments of NWGFs and MHGFs in the absence of amended energy conservation standards (see section IV.G.1).

12. The potential impacts on product shipments related to fuel and product switching (see section IV.G.2).

13. The reasonableness of the value that DOE used to characterize the rebound effect with higher-efficiency NWGFs and MHGFs (see section IV.E.1).

14. The approach for conducting the emissions analysis for NWGFs and MHGFs (see section IV.K).

15. DOE's approach for estimating monetary benefits associated with emissions reductions (see section IV.L).

16. Comments, information, and data on the capital conversion costs and product conversion costs estimated for each AFUE standard TSL (see section IV.J.2.a).

17. Comments, information, and data on the capital conversion costs and product conversion costs estimated for each standby mode and off mode TSL (see section IV.J.2.a).

18. Comments on the identified regulations and their contribution to cumulative regulatory burden. Additionally, DOE requests feedback on product-specific regulations that take effect between 2018 and 2024 that were not listed, including identification of the specific regulations and data quantifying the associated burdens (see section V.B.2.e and V.C.1).

19. Comments, information, and data on the number of small businesses in the industry, the names of those small businesses, and their role in the market

and the market share of small manufacturers in the NWGF and MHGF markets (see section VI.B.1 and VI.B.2).

20. Comment on the potential impacts of the proposed AFUE standard and standby mode and off mode requirement on small manufacturers. (see section VI.B.2)
21. Data, information, and feedback to enhance the estimate conversion costs for small manufacturers in the NWGF and MHGF to develop or adjust current product lines to meet the proposed standards (see section VI.B.2).
22. Comment on the potential impacts of the proposed AFUE standard and standby mode and off mode requirement on small manufacturers (see section VI.B.2).

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 in 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 February 10, 2015.

David T. Danielson
Assistant Secretary
Energy Efficiency and Renewable Energy

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

PART 430 - ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

2. Appendix N to subpart B of part 430 is amended by revising the note after the heading to read as follows:

Appendix N to Subpart B of Part 430— Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers

Note: The procedures and calculations that refer to standby mode and off mode energy consumption (*i.e.*, sections 8.6 and 10.11 of this appendix N) need not be performed to determine compliance with energy conservation standards for furnaces and boilers until required as specified below. However, any representation related to standby mode and off mode energy consumption of these products made after July 1, 2013 must be based upon results generated under this test procedure, consistent with the requirements of 42 U.S.C. 6293(c)(2). For non-weatherized oil-fired furnaces (including mobile home furnaces) and electric furnaces manufactured on and after May 1, 2013, compliance with the applicable provisions of this test procedure is required in order to determine compliance with energy conservation standards. For non-weatherized gas furnaces (including mobile home furnaces) manufactured on and after (*compliance date of final rule*), compliance with the applicable provisions of this test procedure is required in order to determine compliance with energy conservation standards. For boilers manufactured on and after (*compliance date of residential boilers final rule*), compliance with the applicable provisions of this test procedure is required in order to determine compliance with energy conservation standards.

*   *   *   *   *

3. Section 430.32 is amended by

a. Redesignating paragraph (e)(1)(iii) as paragraph (e)(1)(iv);

b. Adding a new paragraph (e)(1)(iii); and

c. Revising paragraph (e)(1)(iv).

The additions and revisions read as follows:

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

*   *   *   *   *

(e) *Furnaces and boilers.* (1) Furnaces.   *   *   *

(iii) The AFUE of non-weatherized gas-fired and mobile home gas furnaces shall not be less than the following starting on the compliance date indicated in the table below:

Product class	**AFUE (Percent)**[1]	**Compliance Date**
(A) Non-weatherized gas furnaces (not including mobile home furnaces)	92	*date 5 years after publication of final rule*

(B) Mobile home gas furnaces	92	*date 5 years after publication of final rule*

[1] Annual Fuel Utilization Efficiency, as determined in §430.23(n)(2) of this part.

(iv) Furnaces manufactured on and after the compliance date listed in the table below shall have an electrical standby mode power consumption ($P_{W,SB}$) and electrical off mode power consumption ($P_{W,OFF}$) not more than the following:

Product class	Maximum standby mode electrical power consumption, $P_{W,SB}$ (watts)	Maximum off mode electrical power consumption, $P_{W,OFF}$ (watts)	Compliance Date
(A) Non-weathered oil-fired furnaces (including mobile home furnaces)	11	11	May 1, 2013
(B) Electric furnaces	10	10	May 1, 2013
(C) Non-weatherized gas-fired furnaces (including mobile home furnaces)	8.5	8.5	*date 5 years after publication of final rule*

*   *   *   *   *