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Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers; Proposed Rule

DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

10 CFR Part 430

[Docket Number EE–RM/STD–01–350]

RIN 1904–AA78

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

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

ACTION: Notice of proposed rulemaking and public meeting.

SUMMARY: The Energy Policy and Conservation Act (EPCA or the Act) prescribes energy conservation standards for various consumer products and commercial and industrial equipment, and requires the Department of Energy (DOE or the Department) to determine if amendments to increase the stringency of the standards are technologically feasible and economically justified, and if they would save a significant amount of energy. In this notice, the Department is proposing to amend the energy conservation standards for residential furnaces and boilers and is announcing a public meeting.

DATES: The Department will hold a public meeting on October 30, 2006, from 9 a.m. to 4 p.m., in Washington, DC. The Department must receive requests to speak at the public meeting before 4 p.m., October 16, 2006. The Department must receive a signed original and an electronic copy of statements to be given at the public meeting before 4 p.m., October 16, 2006.

The Department will accept comments, data, and information regarding the notice of proposed rulemaking (NOPR) before and after the public meeting, but no later than January 15, 2007. See section VII, ''Public Participation,'' of this notice for details.

ADDRESSES: You may submit comments, identified by docket number EE–RM/STD–01–350 and/or regulatory information number (RIN) 1904–AA78, by any of the following methods:

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

2. *E-mail: ResidentialFBNOPRComments@ee.doe.gov.* Include docket number EE–RM/STD–01–350 and/or RIN number 1904–AA78 in the subject line of the message.

3. *Mail:* Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, NOPR for Residential Furnaces and Boilers, Docket Number EE–RM/STD–01–350 and/or RIN number 1904–AA78, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Please submit one signed original paper copy.

4. *Hand Delivery/Courier:* Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Room 1J–018, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–2945. Please submit one signed original paper copy.

Instructions: All submissions received must include the agency name and Docket Number or RIN for this rulemaking. For detailed instructions on submitting comments and additional information on the rulemaking process, see section VII, ''Public Participation,'' of this notice for details.

Docket: For access to the docket to read background documents or comments received, visit the U.S. Department of Energy, Forrestal Building, Room 1J–018 (Resource Room of the Building Technologies Program), 1000 Independence Avenue, SW., Washington, DC 20585–0121, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Please call Ms. Brenda Edwards-Jones at the above telephone number for additional information regarding visiting the Resource Room. Please note: The Department's Freedom of Information Reading Room (formerly Room 1E–190 at the Forrestal Building) is no longer housing rulemaking materials.

FOR FURTHER INFORMATION CONTACT: Mohammed Khan, Project Manager, Energy Conservation Standards for Residential Furnaces and Boilers, U.S. Department of Energy, Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121, (202) 586–7892, e-mail: *Mohammed.Khan@ee.doe.gov.*

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I. Summary of the Proposed Rule

The Energy Policy and Conservation Act (EPCA or the Act), as amended, specifies that any new or amended energy conservation standard the Department of Energy (DOE or the Department) prescribes for consumer products shall be designed to ''achieve the maximum improvement in energy efficiency * * * which the Secretary determines is technologically feasible and economically justified.'' (42 U.S.C. 6295(o)(2)(A)) Furthermore, the new or amended standard must ''result in significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B)) In accordance with these and other statutory criteria discussed in this notice, the Department proposes to amend the residential furnace and boiler energy conservation standards and raise efficiency levels as shown in Table I.1. The proposed standards would apply to all covered furnaces and boilers offered for sale in the United States, effective on January 1, 2015.

TABLE I.1.—PROPOSED STANDARD LEVELS FOR FURNACES AND BOILERS

Product class	AFUE (%)
Non-weatherized gas furnaces	80
Weatherized gas furnaces	83
Mobile home gas furnaces	80
Oil-fired furnaces	82
Gas boilers	84
Oil-fired boilers	83

AFUE = annual fuel utilization efficiency.

The Department's analyses indicate that the proposed standards would save a significant amount of energy—an estimated 0.41 quadrillion British thermal units (Btu), or quads, of cumulative energy over 24 years (2015–2038). For comparison, approximately six quads are used annually for space heating in U.S. homes. The economic impacts on consumers—*i.e.,* the average life-cycle cost (LCC) savings—are positive.

The cumulative national net present value (NPV) of total consumer costs and savings of the proposed standard (DOE's trial standard level 2, or TSL2) from 2015 to 2038, in 2004$, ranges from $650 million (seven-percent discount rate) to $2.48 billion (three-percent discount rate). This is the estimated total value of future operating-cost-savings minus the estimated increased equipment costs, discounted to 2004. The Department estimated the furnace and boiler industry net present value (INPV) to be approximately $1.6 billion in 2004$. If the Department adopts the proposed standard, it expects manufacturers will lose 4.1 to 7 percent of the INPV, which is approximately $65–114 million. The NPV for consumers (at the seven-percent discount rate) exceeds industry losses due to energy efficiency standards by about seven times.

The proposed standard will lead to reductions in greenhouse gas emissions, resulting in cumulative (undiscounted) emission reductions of 19.6 million tons (Mt) of carbon dioxide (CO_2) from 2015 to 2038. Additionally, the standard would result in 13.0 thousand tons (kt) of nitrogen oxides (NO_X) emissions reductions or generate a similar amount of NO_X emissions allowance credits in areas where such emissions are subject to emissions caps. The standard would also generate 1.5 kt of sulfur dioxide (SO_2) emissions reductions from 2015 to 2038. Most of the energy saved is natural gas. In addition, the Department expects the energy savings from the proposed standards to eliminate the need for approximately 14 megawatts (MW) of generating capacity by 2030.

The above results reflect the Department's use of energy price projections from the U.S. Energy Information Administration (EIA)'s *Annual Energy Outlook 2005 (AEO2005).* In addition, the Department performed a sensitivity analysis to assess the impacts of the standard using the *Annual Energy Outlook 2006 (AEO2006)* energy price forecasts. In this sensitivity analysis, the proposed standards would save the same amount of energy (0.41 quads) over 2015–2038. The cumulative NPV of total consumer costs and savings of the proposed standard from 2015 to 2038, in 2004$, ranges from $820 million (seven-percent discount rate) to $3.02 billion (three-percent discount rate). The other results are approximately the same as in the analysis using *AEO2005*.

The Department has found the proposed standard represents the maximum improvement in energy efficiency that is technologically feasible and economically justified. The Department found the benefits to the Nation of the proposed standard (energy savings, consumer average LCC savings, national NPV increase, and emission reductions) outweigh the costs (loss of manufacturer NPV, and LCC increases for some consumers). The Department considered higher energy efficiency levels as trial standard levels; however, it found the burdens of the higher efficiency levels (loss of manufacturer NPV, LCC increases for some consumers, and safety concerns) outweigh the benefits (energy savings, LCC savings for some consumers, national NPV increase, and emission reductions). The Department concludes that the proposed standard is economically justified. Furthermore, DOE has found that the proposed standard is technologically feasible since products achieving these

efficiencies already are commercially available.

II. Introduction

A. Consumer Overview

The Department is proposing to raise the energy conservation standard levels for residential furnaces and boilers as shown above in Table II.1. The proposed efficiency standard would apply to all covered furnaces and boilers offered for sale in the United States, effective on January 1, 2015. Relative to the current standard levels, the proposed levels for residential furnaces and boilers represent an improvement in energy efficiency of one to five percent, depending on the product class.

TABLE II.1.—PROPOSED STANDARD LEVELS FOR FURNACES AND BOILERS

Product class	AFUE (%)
Non-weatherized gas furnaces	80
Weatherized gas furnaces	83
Mobile home gas furnaces	80
Oil-fired furnaces	82
Gas boilers	84
Oil-fired boilers	83

AFUE = annual fuel utilization efficiency.

B. Authority

Title III of EPCA sets forth a variety of provisions designed to improve energy efficiency. Part B of title III (42 U.S.C. 6291–6309) provides for the Energy Conservation Program for Consumer Products other than Automobiles. The program covers consumer products (referred to hereafter as ''covered products''), including residential furnaces and boilers. (42 U.S.C. 6292(a)(5))

Under the Act, the program consists essentially of these parts: Testing, labeling, and Federal energy conservation standards. The Federal Trade Commission (FTC) is responsible for labeling, and DOE implements the remainder of the program. Section 323 of the Act authorizes the Department, with assistance from the National Institute of Standards and Technology (NIST) and subject to certain criteria and conditions, to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. (42 U.S.C. 6293) The furnace and boiler test procedures appear at Title 10 of the Code of Federal Regulations (CFR) part 430, subpart B, Appendix N.

EPCA provides criteria for prescribing new or amended standards for covered products. As indicated above, any new or amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) EPCA precludes the Department from adopting any standard that would not result in significant conservation of energy. (42 U.S.C. 6295(o)(3)(B)) Moreover, the Department may not prescribe a standard: (1) For certain products, if no test procedure has been established for the product, or (2) if DOE determines by rule that the standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(B) The Act (42 U.S.C. 6295(o)(2)(B)(i)) also provides that, in deciding whether a standard is economically justified, DOE must, after receiving comments on the proposed standard, determine whether the benefits of the standard exceed its burdens by considering, to the greatest extent practicable, 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 imposition of the standard;

(3) The total projected amount of energy savings likely to result directly from the imposition of the standard;

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

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

(6) The need for national energy conservation; and

(7) Other factors the Secretary considers relevant.

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

In addition, section 325(o)(2)(B)(iii) of 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 efficiency 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 * * *.'' The rebuttable-presumption test is an alternative path to establishing economic justification. (42 U.S.C. 6295(o)(2)(B)(iii))

Section 325(q)(1) of EPCA is applicable to promulgating a standard for a type or class of covered product that has two or more subcategories. The Department must specify a different standard level than that which applies generally to such type or class of products ''for any group of covered products which have the same function or intended use, if * * * products within such group—(A) Consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) have a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard'' that applies or will apply to the other products. (42 U.S.C.6295(q)(l)) In determining whether a performance-related feature justifies such a different standard for a group of products, the Department must consider ''such factors as the utility to the consumer of such a feature'' and other factors DOE deems appropriate. 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)) The Department can, however, grant waivers of preemption for particular State laws or regulations, in accordance with the procedures and other provisions of section 327(d) of the Act. (42 U.S.C. 6297(d)) Specifically, States with a regulation that provides for an energy conservation standard for any type of covered product for which there is a Federal energy conservation standard may petition the Secretary for a DOE rule that allows the State regulation to become effective with respect to such covered product. The Department must prescribe a rule granting the petition if the State establishes by a preponderance

of the evidence that its regulation is needed to meet ''unusual and compelling State or local energy * * * interests.'' (42 U.S.C. 6297(d)(1)(B))

C. Background

1. Current Standards

EPCA established an energy conservation standard for residential furnaces and boilers.[1] It set the standard in terms of the annual fuel utilization efficiency (AFUE) descriptor at a minimum value of 78 percent for most furnaces. It set the minimum AFUE at 75 percent for gas steam boilers and 80 percent for other boilers. For mobile home furnaces, EPCA set the minimum AFUE at 75 percent. These standards became effective on January 1, 1992, with the exception of the standard for mobile home furnaces, for which the effective date was September 1, 1990. (42 U.S.C. 6295(f)(1)–(2))

2. History of Standards Rulemaking for Residential Furnaces and Boilers

For ''small'' gas furnaces (those having an input rate of less than 45,000 Btu per hour), the Department published a final rule on November 17, 1989, in which it set the minimum AFUE for these products at 78 percent, effective January 1, 1992. 54 FR 47916.

For mobile home furnaces, the Department issued an advance notice of proposed rulemaking (ANOPR) on September 28, 1990 (55 FR 39624), followed by a proposed rule on March 4, 1994. 59 FR 10464. The Interior and Related Agencies Appropriations for Fiscal Year 1996 (Pub. L. 104–34) included a moratorium on appliance standards rulemakings, preventing DOE from finalizing the standards on mobile home furnaces. The Department responded to the moratorium by developing an improved process, known as the Process Rule, for its energy conservation standards rulemakings (*Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products,* Title 10 CFR part 430, Subpart C, Appendix A). 61 FR 36974. The Process Rule provided guidance on how DOE prioritizes its standards rulemakings. As a result, the Department pursued standards rulemakings for other products rather than finalizing the proposed standard for mobile home furnaces. Therefore, the Department did not publish a final rule for amending mobile home furnace standards and the minimum energy conservation standard remained at 75 percent AFUE.

The Act also directed the Department to publish a final rule to determine whether the standards should be amended for all furnaces and boilers. (42 U.S.C. 6295(f)(3)(B)) On September 8, 1993, the Department published an ANOPR (hereafter referred to as the September 1993 ANOPR) in which it presented the product classes for furnaces that it planned to analyze, and a detailed discussion of the analytical methodology that it expected to use in this rulemaking. 58 FR 47326. The Department invited stakeholders to submit comments and data on the planned methodology. However, the 1996 moratorium on appliance standards rulemakings prevented DOE from proceeding further with the rulemaking process.[2]

In the fiscal year 2001 Priority Setting for the Appliance Rulemaking Process, DOE assigned a high level of priority to a rulemaking to consider amendments to the energy conservation standards for residential furnaces and boilers, including mobile home furnaces. On June 13, 2001, DOE published a *Framework Document for Residential Furnaces and Boilers Standards Rulemaking* (Framework Document). The Department held a public meeting on July 17, 2001, to discuss the procedural and analytical approaches in this rulemaking, and to seek stakeholder comments on the Framework Document.

The Department held another public meeting on May 8, 2002, to receive and discuss comments on issues related to venting installations. In June 2002, the Gas Appliance Manufacturers Association (GAMA) commented on DOE's analysis of manufacturing costs. In August 2002, GAMA convened a meeting with DOE and the American Council for an Energy-Efficient Economy (ACEEE) to discuss approaches for analyzing electricity use in furnaces. In September 2002, the Department posted its engineering analysis and received stakeholder comments. The Department published an ANOPR on July 29, 2004 (hereafter referred to as the 2004 ANOPR), and held a public meeting on September 29, 2004, to present the methodology and results of the ANOPR analyses. 69 FR 45419.

As set forth in the updated rulemaking timeline published in the Department's Semi-annual Regulatory Agenda on December 13, 2004, DOE expects to issue a final rule in 2007. 69 FR 72713. The effective date for any new standards for furnaces and boilers published in 2007 would be 2015, or eight years after publication as a final rule in the **Federal Register**. (42 U.S.C. 6295 (f)(3)(B))

3. Process Improvement

The Process Rule applies to the development of energy conservation standards for all consumer products, including those for residential furnaces and boilers. 61 FR 36974. In this notice, the Department describes the framework and methodologies by which it is developing the standard. The framework and methodologies reflect improvements made and steps taken in accordance with the Process Rule, including the use of improved economic models and analytical tools. The rulemaking process is dynamic, and as timely new data, models, or tools that enhance the development of standards become available, the Department will incorporate them into the rulemaking.

In response to the DOE's 2004 ANOPR, the American Gas Association (AGA) asserted that the spreadsheets used by the Department do not meet the requirements of the Process Rule, which specifies the use of transparent and robust analytical methods ''that are fully documented for the public and that produce results that can be explained and reproduced * * *.'' AGA suggested that DOE (1) explore simpler analytical methods for its analyses, or (2) provide stakeholders with more direct means of testing alternate assumptions and sensitivities. (AGA, No. 78 at p. 2)[3] Southern Company (Southern) commented that it would be helpful if DOE provided tools for the review of its analysis results that could be used more easily. (Southern, No. 71 at p. 3) After the 2004 ANOPR, DOE improved the design and user-friendliness of the analytical spreadsheets by creating process diagrams and by adding additional summary worksheets, help screens to assist the user, and input screens to allow the testing of alternate assumptions. The Department also expanded its documentation by adding

[1] EPCA states that a ''furnace'' includes forced-air and gravity central furnaces and low-pressure steam and hot water boilers, and that it must have a heat input rate of less than 225,000 Btu/h for forced-air and gravity central furnaces, and less than 300,000 Btu/h for boilers. (42 U.S.C. 6291(23)) However, in this notice, DOE has adopted the terminology used in the heating, ventilating, and air conditioning industry, which considers furnaces and boilers as separate categories.

[2] Pub. L. 104–34, the Department of the Interior and Related Agencies Appropriations Act for Fiscal Year 1996 which included a moratorium on proposing or issuing energy conservation appliance standard for FY 1996.

[3] A notation in the form ''AGA, No. 78 at p. 2'' identifies a written comment the Department has received and has included in the docket of this rulemaking. This particular notation refers to a comment (1) By the American Gas Association (AGA), (2) in the document number 78 in the docket of this rulemaking (maintained in the Resource Room of the Building Technologies Program), and (3) appear on page 2 of document number 78.

appendices that explain in detail the design and use of the spreadsheets.

GAMA commented that there should be more informal communication between DOE and the furnace industry during the course of the rulemaking. (GAMA, No. 67 at p. 8) In accordance with the Process Rule, DOE sought stakeholder review at several points in the rulemaking and organized public meetings, webcasts, and conference calls to discuss important issues. The Department recognizes the value of having informal, open communication with stakeholders, as stakeholder input can contribute significantly to the quality of the Department's analyses and improve the Department's decision making. However, the open nature of the process has introduced substantial delays in the Department's rulemaking schedules. Such delays have been an unintended consequence of the Process Rule. The Department therefore, recognizes the need for a balance in the allowance of stakeholder input and maintaining rulemaking schedules, and will better integrate stakeholder input and expert review within the scope of the structured notice-and-comment rulemaking process.

D. Negotiated Boiler Standards Agreement

On July 14, 2006, GAMA and ACEEE, on behalf of 28 residential boiler manufacturers and four energy efficiency organizations, submitted a negotiated agreement recommending new national standards for residential boilers that would consist of a performance requirement (minimum AFUE levels) and design requirements. The recommended performance levels are the maximum that the industry feels would safeguard against corrosion and ensure safe venting. Both GAMA and ACEEE believe that the design requirements would bring about additional, non-trivial energy savings.

For gas-fired boilers, both water and steam types, the agreement calls for a ban on standing pilots. For gas-fired water boilers only, there are two design requirements. In addition to the ban on standing pilots, the agreement also requires a ''temperature reset'' feature that automatically adjusts the boiler output according to the outdoor ambient air temperature. For oil-fired water boilers, the agreement contains the design requirement for the same ''temperature reset'' feature.

The Department sincerely appreciates the effort stakeholders have made to propose an agreement for the boiler portion of this rulemaking. However, the Department has determined that the recommended standards in the negotiated agreement are beyond the scope of its legal authority. The Energy Policy and Conservation Act (EPCA) authorizes the Secretary to amend energy conservation standards for specified products. (42 U.S.C. 6295) Section 321(6) of the EPCA defines the term ''energy conservation standard'' as

(A) A performance standard which prescribes a minimum level of energy efficiency or a maximum quantity of energy use, * * * or

(B) A design requirement for the products specified in paragraphs (6), (7), (8), (10), (15), (16), (17), and (19) of section 322(a) * * * [of this title.]

(42 U.S.C. 6291(6))

The language of EPCA authorizes the Department to establish a performance standard or a single design standard. EPCA's list of specified products for which a design standard can be established does not include residential furnaces and boilers. As such, a standard that establishes both a performance standard and a design requirement is beyond the scope of the Department's legal authority. In the case of gas-fired water boilers, the agreement recommends two design requirements which is contrary to EPCA's limit of one design requirement for the specified covered products.

The Department's staff met with representatives from GAMA and ACEEE on August 1, 2006, and August 7, 2006, respectively, to discuss the Department's legal position on the negotiated agreement. The Department regrets that this negotiated agreement does not meet the statutory criteria in EPCA and therefore cannot be accepted. The Department strongly encourages stakeholders to continue to work together to propose agreements to the Department in the future, understanding that the Department must comply with EPCA's statutory requirements.

III. General Discussion

A. General Issues

The Department received comments on several general issues related to the furnace and boiler rulemaking. Those issues are related to the impact of the standards on future natural gas prices, furnace electricity consumption, separate standards for equipment in new homes and replacements, and separate standards for different regions.

1. Impact of Furnace and Boiler Standards on Future Natural Gas Prices

The Natural Resources Defense Council (NRDC), American Chemistry Council (ACC), ACEEE, and Dow Chemical Company commented that more stringent furnace and boiler standards may result in lower natural gas prices in the future, and that DOE should account for the associated benefit for all gas consumers. (NRDC, No. 52 at p. 2; ACC, No. 62 at p. 3; ACEEE, No. 84 at p. 9; and Joint Comment by NRDC and Dow, No. 64 at p. 3) The impact of appliance standards on energy prices has not historically been a part of DOE's analysis. Estimating such impacts would require new analytical methods. The Department evaluated a recent study that includes consideration of the impacts of furnace and boiler standards on natural gas prices.[4] While this study finds that standards could result in a small decrease in natural gas prices, the Department's review of the study reveals that there is no conclusive evidence that furnace and boiler standards will affect overall natural gas prices. If the stakeholders' assertion is correct, then consumer gas prices will decrease, in turn decreasing the income of gas utilities—resulting in a transfer of benefits from the natural gas producers to the consumers. However, on a societal level, there is no clear evidence that there will be any impact on natural gas prices resulting from the furnace and boiler standards. Furthermore, DOE believes it is currently impossible, within the framework of a standards rulemaking, to estimate the possible impact of energy conservation standards on utility prices. Therefore, the Department did not consider these impacts in the current rulemaking.

2. Inclusion of Electricity Consumption in Furnace and Boiler Standards

The Department received a number of comments regarding the inclusion of furnace and boiler electricity consumption in amended standards for furnaces and boilers. The Department was recently given authority to regulate the electricity consumed by furnaces for the purposes of circulating air by the Energy Policy Act of 2005, Pub. L. 104–58 (EPACT 2005). EPACT 2005, section 135(c), amended section 325 of EPCA (42 U.S.C. 6295(f)(3)) to include the following: ''[T]he Secretary may consider and prescribe energy conservation standards or energy use standards for electricity used for purposes of circulating air through duct work.'' However, at the November 15, 2005, public meeting to discuss DOE's appliance-standards-program schedule-setting, the Department received comments from GAMA and the

[4] Wiser, R., M. Bolinger, M. St. Clair. Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency. LBNL. January 2005. (*http://eetd.lbl.gov/EA/EMP/reports/56756.pdf*).

Appliance Standards Awareness Project (ASAP) urging the Department to complete the AFUE standard rulemaking as soon as possible. Furthermore, GAMA and ASAP expressed their preference that DOE address furnace blower electricity consumption separately from the AFUE standard rulemaking. Since adding electricity consumption standards to this rulemaking would likely cause further substantial delay in the rulemaking process, the Department accepts the recommendations from GAMA and ASAP and has decided not to address furnace electricity consumption in this rulemaking. It will consider furnace electricity consumption separately to enable it complete the furnace and boiler AFUE rulemaking as expeditiously as possible.

3. Separate Standards for Equipment Installed in New Homes and as Replacements

ACEEE suggested that DOE consider separate standards for new construction and retrofits. (ACEEE, No. 53 at p. 5) EPCA directs the Department to establish performance standards that prescribe minimum levels of energy efficiency or maximum levels of energy use for covered products. The Act does not authorize DOE to set multiple levels of efficiency for a given covered product, depending on where the product is installed—either in terms of a given region of the country or in terms of home type, *i.e.,* new or existing. (42 U.S.C. 6291(6)(A)) The Department believes it does not have the authority to set separate standards for furnaces and boilers for new homes and for existing homes and, therefore, rejects the suggestion that it consider separate standards for new construction and retrofits.

4. Separate Standards for Different Regions

The Department received numerous comments regarding the setting of separate furnace and boiler standards for different regions of the country. Some of the commentators expressed reasons why separate standards would be beneficial or asked if DOE had the authority to set regional standards. (Ohio Consumers' Counsel (OCC), No. 70 at p. 5; Individuals, No. 73 at p. 1; Baltimore Gas and Electricity (BGE), No. 75 at p. 1; National Association of Regulatory Utility Commissioners (NARUC), No. 77 at p. 5; ACEEE, No. 59.8 at pp. 36 [5] and 165; Individual, No. 87 at p. 1; Northeast Energy Efficiency Partnerships (NEEP), No. 55 at pp. 2 and 3; NRDC, No. 59.8 at pp. 29 and 33, and No. 63 at p. 9; Oregon Department of Energy (ODOE), No. 61 at p. 2; National Consumer Law Center (NCLC), No. 66 at pp. 7 and 8; New Jersey Board of Public Utilities (NJBPU), No. 83 at p. 1; Izaak Walton League of America (IWL), No. 88 at p. 1; Southern, No. 71 at p. 21 and No. 59.8 at p. 219; Trane, No. 59.8 at p. 207; GAMA, No. 59.8 at pp. 206 and 217; York, No. 65 at p. 2; Edison Electric Institute (EEI), No. 69 at p. 2; Manufactured Housing Institute (MHI), No. 89 at p. 2; National Propane Gas Association (NPGA), No. 72 at p. 2; AGA, No. 59.8 at p. 40; Alliance to Save Energy (ASE), No. 80 at p. 2; North American Insulation Manufacturers Association (NAIMA), No. 60 at p. 1; and Lennox, No. 79 at p. 3)

As discussed in the 2004 ANOPR, the Department has determined that EPCA does not authorize DOE to set regional energy conservation standards; instead, the Department can only establish national standards. 69 FR 45419. None of the comments received in response to the 2004 ANOPR provided a basis for changing that determination.

However, the Department notes that EPCA allows states to seek from the Department a waiver of Federal preemption of state or local energy conservation standards. Section 327(d) of EPCA, ''Waiver of Federal Preemption,'' states that, ''Any State * * * with a State regulation which provides for any energy conservation standard * * * for any type * * * of covered product for which there is a Federal energy conservation standard * * * may file a petition with the Secretary requesting a rule that such State regulation become effective with respect to such covered product.'' (42 U.S.C. 6297(d)(1)(A)) Within a maximum of one year, DOE must act on any such petition. (42 U.S.C. 6297(d)(2))

The Department must prescribe a rule granting a waiver from Federal preemption if, subject to the condition specified in section 327(d), the State establishes by a preponderance of the evidence that its regulation is needed to meet ''unusual and compelling State or local energy * * * interests.'' (42 U.S.C. 6297(d)(1)(B)) The statute states that the phrase ''unusual and compelling State or local energy * * * interests'' means interests which:

> (i) Are substantially different in nature or magnitude than those prevailing in the United States generally; and (ii) are such that the costs, benefits, burdens, and reliability of energy * * * savings resulting from the State regulation make such regulation preferable or necessary when measured against the costs, benefits, burdens, and reliability of alternative approaches to energy * * * savings or production, including reliance on reasonably predictable market-induced improvements in efficiency of all products subject to the State regulation.
>
> The factors described in clause (ii) shall be evaluated within the context of the State's energy plan and forecast, and, with respect to a State regulation for which a petition has been submitted to the Secretary * * * [42 U.S.C. 6297(d)(1)(c)]

In evaluating the evidence that a State regulation is needed to meet unusual and compelling State energy interests, the Department will consider the factors described in 42 U.S.C. 6297(d)(1)(C)(i) and (ii). It appears to the Department that in the context of residential furnaces and boilers, where regional climatic effects can have significant impact on whether a specified energy conservation standard would be technologically feasible and economically justified in that region, such regional climatic effects will be important in DOE's assessment of whether there are ''unusual and compelling State or local energy interests'' for State energy conservation standards. States having higher-than-average, population-weighted heating degree days (HDDs) based on long-term National Oceanic and Atmospheric Administration data [6] would seem to have the best prospects for demonstrating ''unusual and compelling'' interests to support a waiver of preemption in the particular circumstances presented here.[7] (In conducting its analysis, the Department used average heating degree days within a State to divide States into groups for purposes of assessing standards.) States with significantly higher heating requirements have significantly higher furnace use. This may indicate that, for

[5] A notation in the form ''ACEEE, No. 59.8 at p. 36,'' identifies a comment in the transcript of the Public Meeting on Standards for Furnaces and Boilers held in Washington, DC, 9/29/2004, which is document number 59.8 in the docket of this rulemaking. This particular notation refers to a comment (1) by the American Council for an Energy-Efficient Economy (ACEEE), (2) in the document number 59.8 in the docket of this rulemaking (maintained in the Resource Room of the Building Technologies Program), and (3) appearing on page 36 of document number 59.8.

[6] *State, Regional, And National Monthly Heating Degree Days Weighted By Population (2000 Census), 1971—2000 (and previous normal periods).* Historical Climatography Series No. 5–1. National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration. Available at: *http://www5.ncdc.noaa.gov/climatenormals/hcs/HCS_51.pdf.*

[7] Nationwide, the U.S. averages 5528 HDDs. The following States average 6000 or more HDDs: Alaska, Colorado, Connecticut, Idaho, Illinois, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New York, North Dakota, South Dakota, Utah, Vermont, Wisconsin, and Wyoming.

those States, a State energy conservation standard which is higher than the Federal standard would be cost-effective and would provide significantly more energy savings than the Federal standard. If those States, particularly the ones most severely affected, adopted standards higher than DOE's proposed standards, and sought waivers, it could result in certain contiguous States with higher requirements, which would lessen the impact on manufacturers.

Another way to address the benefits and costs of proposed State regulations with higher energy conservation standards would be for a State in its application for a waiver of preemption to identify the saturation of homes with products that already meet those higher standards. For example, a State could provide evidence that a significant percentage of gas furnaces sold today in that State already meets, for example, a 90–percent–AFUE condensing standard.

A State applying to DOE for a preemption waiver also could identify any subsidies and/or incentives, such as tax rebates or purchase price rebates, that the State or other entities are offering. To the extent States demonstrate that these programs have not worked, they may be able to show that ''the costs, benefits, burdens, and reliability'' of energy savings from mandatory State energy conservation regulations make such regulations preferable to their voluntary programs.

EPCA section 327(d)(3) further provides that DOE may not grant a waiver if interested persons establish by a preponderance of the evidence that the State regulation would significantly burden manufacturing, marketing, distribution, sale, or servicing of the covered product on a national basis. (42 U.S.C. 6297(d)(3)) In determining whether the State regulation meets this criterion, the Department must consider the extent to which the State regulation addresses several factors.

The first factor is ''the extent to which the State regulation will increase manufacturing or distribution costs of manufacturers, distributors, and others * * *.'' (42 U.S.C. 6297(d)(3)(A)) In addressing this factor, a State seeking a waiver of federal preemption likely would want to address the extent to which manufacturers already produce and sell products that would meet the State's proposed standard. This description also could include information describing how efficiencies of shipments to that State already vary from current DOE efficiency levels.

The second factor is ''the extent to which the State regulation will disadvantage smaller manufacturers, distributors, or dealers or lessen competition in the sale of the covered product in the State * * *.'' (42 U.S.C. 6297(d)(3)(B)) Similar to the prior factor, in addressing this factor, a State seeking a waiver of federal preemption might wish to provide evidence with its petition that demonstrates that there are no, or just insignificant, differences between small and large manufacturers with respect to producing and selling furnaces in that State. A State also could offer other evidence as to why its regulation would not disadvantage these entities or lessen competition, based on the particular circumstances in that State. For example, a State could seek to demonstrate that the differences (or lack of differences) between small and large manufacturers, with respect to producing and selling furnaces in that State, indicate that the regulation would not disadvantage the smaller manufacturers.

The third factor is ''the extent to which the State regulation would cause a burden to manufacturers to redesign and produce the covered product type * * *, taking into consideration the extent to which the regulation would result in a reduction (i) in the current models, or in the projected availability of models, that could be shipped on the effective date of the regulation to the State and within the United States; or (ii) in the current or projected sales volume of the covered product type * * * in the State and the United States * * *.'' (42 U.S.C. 6297(d)(3)(c)) In addressing this factor, a State seeking a waiver of federal preemption might seek to demonstrate that high-efficiency heating equipment, such as condensing furnaces, already have achieved significant market shares in that State. In some relatively cold States with significant heating requirements, sales of condensing furnaces are reported to be on the order of 50 percent. A State also might wish to submit other information that addresses why it believes its regulation would not affect sales volumes or the number of models available (except for elimination of lower efficiency models).

The fourth factor is ''the extent to which the State regulation is likely to contribute significantly to a proliferation of State appliance efficiency requirements and the cumulative impact such requirements would have.'' (42 U.S.C. 6297(d)(3)(D)) In addressing this factor, a State seeking a waiver from DOE may wish to seek to demonstrate, for example, the extent to which it has chosen identical standard levels as other States that have developed proposed regulations or States that have regulations already in place.

An additional factor DOE must consider is the extent to which ''the State regulation is likely to result in the unavailability in the State of any covered product type * * * of performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as those generally available in the State * * *.'' (42 U.S.C. 6297(d)(4)) A State seeking preemption waiver may wish to explain in its petition or accompanying documents why it believes its regulation would not affect the characteristics and features (other than efficiency) of the furnaces that would be offered for sale in that State. It might seek to demonstrate, for example, that among products currently offered for sale in that or other States, high efficiency furnaces already have all of the characteristics and features available in less efficient furnaces sold in that State.

The Department recognizes that States have set, or are considering, standards for furnaces and that some may wish to seek a determination from DOE that their standards are needed to meet ''unusual and compelling State or local energy interests.'' The Department encourages States to coordinate among themselves the submission of any waiver petitions they may wish to file. The Department will consider an aggregate petition from multiple States as long as the petition individually addresses the statutory criteria for each of the States. The Department believes the approach taken in evaluating the regional impacts of standards in its analysis represents a reasonable approach for estimating the national impacts of having a Federal standard and one or more higher State energy conservation standards for furnaces and boilers. All petitions for waivers also must comply with requirements as described in 10 CFR Part 430.41(a)(1).

B. Test Procedures

Section 7(b) of the Process Rule provides that the Department will propose necessary modifications to the test procedures for a product before issuing the proposed rule concerning energy conservation standards for that product. For furnaces and boilers, the Department believes modifications are not currently necessary, so it has not proposed to modify the existing test procedure.

C. Technological Feasibility

1. General

The Department considers a design option to be technologically feasible if it is in use by the respective industry or

if research has progressed to the development of a working prototype. The Process Rule sets forth a definition of technological feasibility as follows: ''Technologies incorporated in commercial products or in working prototypes will be considered technologically feasible.'' 10 CFR part 430, Subpart C, Appendix A, section 4(a)(4)(i).

In each standards rulemaking, the Department conducts a screening analysis, which it bases on information gathered regarding existing technology options and prototype designs. In consultation with manufacturers, design engineers, and other stakeholders, the Department develops a list of design options for consideration in the rulemaking. Once the Department has determined that a particular design option is technologically feasible, it further evaluates each design option in light of the other three criteria in the Process Rule. 10 CFR part 430, Subpart C, Appendix A, section 4(a)(3) and (4). The three additional criteria are: (a) Practicability to manufacture, install, and service, (b) adverse impacts on product utility or availability, or (c) health or safety concerns that cannot be resolved. All design options that pass these screening criteria are candidates for further assessment.

As discussed in the 2004 ANOPR, the Department is not considering the following design options because they do not meet one or more of the screening criteria: self-generation of electric power, fuel-driven heat pumps, flue-gas recirculation, and smart valves. 69 FR 45387. In this notice, DOE has not changed the list of technology options that it screened out of the analysis. (See the Technical Support Document (TSD) accompanying this notice, Chapter 4.)

Lennox, Carrier, Trane, York, NPGA, Alagasco, and MHI commented that the maximum efficiency level considered for non-condensing, non-weatherized gas furnaces should be 80-percent AFUE. They contended that, at 81-percent AFUE, there would be a significant increase of risk to the consumer because of an increased potential for vent-system failure. These comments cited concerns regarding corrosion in vents from condensation, and noted that conditions under which consumers use the product are much more severe than lab conditions. (Lennox, Public Meeting Transcript, No. 59.8 at p. 27 and No. 79 at p. 1; Carrier, Public Meeting Transcript, No. 59.8 at p. 188 and No. 68 at p. 1; Trane, Public Meeting Transcript, No. 59.8 at p. 227; York, No. 65 at p. 7; NPGA, No. 72 at p. 3; Alagasco, No. 82 at p. 2; and MHI, No. 89 at p. 4) NAIMA, OCC, and NJBPU disagreed with limiting consideration to an 80-percent-AFUE level. (NAIMA, No. 60 at p. 1; OCC, No. 70 at p. 5; and NJBPU, No. 83 at p. 2) The Department has reviewed the manufacturer literature and found that products at 81-percent AFUE are available for sale. It believes the fact that such products are being offered for sale demonstrates that they are practicable to manufacture, install, and service and cannot be excluded from consideration in this rulemaking.

The Department recognizes that this AFUE level of 81 percent may pose health or safety concerns in certain conditions, but it believes that the concerns can likely be resolved with proper equipment and venting system design, as discussed in section IV.B.3. Therefore, DOE considered 81-percent AFUE in its analysis for non-weatherized gas furnaces, and took into account the stakeholders' concerns.

The 2004 ANOPR analysis included non-weatherized gas furnaces at 82 and 83-percent AFUE. However, because it is well understood that significant vent system corrosion problems, which can lead to potential safety issues, may exist at these efficiency levels for non-weatherized gas furnaces, the Department does not believe these products can be mass-produced and be reliable to install and service on the scale necessary to serve the relevant market by the effective date of the proposed standard. Therefore, DOE did not consider non-weatherized gas furnaces at 82 and 83-percent AFUE in the analysis for today's proposed rule.

The evaluated technologies all have been used (or are being used) in commercially available products or working prototypes. The designs all incorporate materials and components that are commercially available in today's furnace and boiler supply market. The Department believes all of the efficiency levels evaluated in this notice are technologically feasible.

2. Maximum Technologically Feasible Levels

In developing today's proposed rule, the Department followed the provisions of section 325(p)(2) of the Act, which states that, when the Department proposes to adopt, or to decline to adopt, an amended or new standard for each type (or class) of covered product, ''the Secretary shall determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible * * *.'' The Department determined the maximum technologically feasible (''max tech'') efficiency level in the engineering analysis using the most efficient design parameters that lead to the creation of the highest equipment efficiencies achievable. (See TSD Chapter 6.) Table III.1 lists the max tech levels that the Department determined for this rulemaking.

TABLE III.1.—MAX TECH LEVELS CONSIDERED IN FURNACE AND BOILER RULEMAKING

Product class	AFUE (%)
Non-weatherized gas furnaces	96
Weatherized gas furnaces	83
Mobile home gas furnaces	90
Oil-fired furnaces	85
Gas boilers	99
Oil-fired boilers	95

For all product classes, products with these efficiency levels already are being sold in small quantities. (There is one weatherized gas furnace listed in the GAMA directory at 82.8-percent AFUE.) No production models or prototypes of equipment at higher efficiency levels are currently available. For weatherized gas furnaces, the Department recognizes that the 83-percent-AFUE level may pose health or safety concerns in certain installations. DOE believes these concerns can be resolved with proper equipment and system design and proper installation.

D. Energy Savings

1. Determination of Savings

The Department used its national energy savings (NES) spreadsheet to estimate energy savings from amended standards for furnaces and boilers. (The NES Spreadsheet Model is described in section IV.D of this notice.) The Department forecasted energy savings over the period of analysis (beginning with 2015, the year that amended standards would go into effect, and ending in 2038) for each trial standard level, relative to the base case. It quantified the energy savings attributable to amended energy conservation standards as the difference in energy consumption between the standards case and the base case. The base case represents the forecast of energy consumption in the absence of amended energy conservation standards. The base case considers market demand for more-efficient products; for example, in the case of non-weatherized gas furnaces, the base case forecasts an increase in the market share of condensing furnaces by 2015.

The NES Spreadsheet Model calculates the electricity savings in ''site energy'' expressed in kilowatt-hours

(kWh). Site energy is the energy directly consumed on location by the furnace or boiler. The Department reports national energy savings in terms of the source energy savings, which is the savings of the energy that is used to generate and transmit the energy consumed at the site. (See TSD, Chapter 10.) The Department derived these conversion factors, which change with time, from the EIA's *AEO2005.*[8]

AGA commented that DOE should consider the ''rebound effect'' that may occur as a result of more intensive use of a more energy-efficient appliance, leading to higher energy consumption. (AGA, No. 54 at p. 3) ACEEE stated that the rebound effect has often been hypothesized, but actual field experience indicates that there is rarely a rebound effect resulting from use of more-efficient appliances. (ACEEE, No. 84 at p. 13)

The Department examined a summary of the literature regarding the rebound effect in relation to space heating equipment.[9] Based on five studies chosen for their robust methodology, the summary concluded that, for a 100 percent increase in fuel efficiency, values of ''take-back'' or rebound for space heating are between 10 and 30 percent of the energy consumption savings. The National Energy Modeling System (NEMS), which is used for developing EIA's *AEO*, incorporates a rebound effect for space heating. According to an EIA report,[10] the rebound effect for the residential module in NEMS results in a 0.15 percent increase in energy consumption for a 1 percent increase in efficiency. In keeping with EIA's approach, the Department chose to apply a rebound effect of 15 percent (for a 100 percent increase in efficiency) in its analysis of furnace and boiler standards. That is, DOE reduced the calculated energy savings and associated emissions reductions by 15 percent.

The take-back in energy consumption associated with the rebound effect provides consumers with increased value (*e.g.,* a warmer indoor environment, since the increased efficiency enables consumers to use their heating equipment more intensively). The impact on consumers is thus the sum of the change in the cost of owning the heating equipment (*i.e.,* life-cycle cost) and the increased value for the warmer indoor environment. However, the Department is unable to monetize this increase in consumer value in the LCC analysis. The Department believes that, if it were able to monetize the increased value to consumers added by the rebound effect, this value would be at least as great as the value of the foregone energy savings. For this analysis, the Department estimates that this value 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 LCC and NPV analyses, are the same.

2. Significance of Savings

Section 325 of the Act prohibits the Department from adopting a standard for a product if that standard would not result in ''significant'' energy savings. (42 U.S.C. 6295(o)(3)(B)) While the Act does not define the term ''significant,'' the U.S. Court of Appeals, in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended ''significant'' energy savings in this context to be savings that were not ''genuinely trivial.'' The energy savings for energy conservation standards at each of the trial standard levels considered in this rulemaking are nontrivial, and therefore the Department considers them ''significant'' within the meaning of section 325 of the Act.

E. Economic Justification

1. Specific Criteria

As noted earlier, EPCA provides seven factors to be evaluated in determining whether an energy conservation standard is economically justified. (42 U.S.C. 6295(o)(2)(B)) The following sections discuss how the Department has addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers. The Process Rule established procedures, interpretations, and policies to guide the Department in the consideration of new or revised appliance energy conservation standards. The provisions of the rule have direct bearing on the implementation of the manufacturer impact analysis (MIA). First, as provided in Section 10 of the Process Rule (Principles for the Analysis of Impacts on Manufacturers), the Department uses an annual-cash-flow approach in determining the quantitative impacts of a new or amended standard on manufacturers. This includes both a short-term assessment, based on the cost and capital requirements during the period between the announcement of a regulation and the time when the regulation becomes effective, and a long-term assessment. The impacts analyzed include INPV, cash flows by year, changes in revenue and income, and other measures of impact, as appropriate. Second, the Department analyzes and reports the impacts on different types of manufacturers, with particular attention to impacts on small manufacturers. Third, the Department considers the impact of standards on domestic manufacturer employment, manufacturing capacity, plant closures, and loss of capital investment. Finally, the Department takes into account cumulative impacts of different DOE regulations on manufacturers.

For consumers, measures of economic impact include the changes in LCC and payback period for each trial standard level. As the Act sets forth, the LCC is one of the seven factors to be considered in determining economic justification. (42 U.S.C. 6295(o)(2)(B)(i)(II)) It is discussed in detail in the section below.

ODOE commented that the simple payback period is not a useful metric, since it fails to take into account the rising costs of fuel. (ODOE, No. 61 at p. 10) The Department uses simple-payback-period results as one of the factors in evaluating the economic impacts of standards on consumers, but it relies more heavily on the impacts on LCC to take into account the changing cost of fuel.

b. Life-Cycle Costs. The LCC is the sum of the purchase price of equipment, including the installation, and the operating expense, including energy and maintenance expenditures, discounted over the lifetime of the equipment. Where possible in estimating the energy costs in the LCC calculation, DOE uses consumer marginal energy rates, which are the energy rates that correspond to incremental changes in energy use.

For each furnace and boiler product class, the Department calculated both LCC and LCC savings for various efficiency levels. The LCC analysis estimated the LCC for representative equipment in housing units that are representative of the segment of the U.S. housing stock that uses furnaces and boilers. To account for uncertainty and variability in specific inputs, such as equipment lifetime and discount rate, it used a distribution of values with probabilities attached to each value. For each housing unit, DOE sampled the values of these inputs from the probability distributions. As a result, the

[8] The Department conducted an energy price sensitivity analysis using EIA's *AEO2006.* Section IV.C.4 provides further explanation and details of the energy price sensitivity analysis.

[9] Greening, L.A., D.L. Greene, and C. Difiglio. Energy efficiency and consumption—the rebound effect—a survey. Energy Policy. 2000. 28: pp. 389–401.

[10] EIA, Price Responsiveness in the *AEO2003* NEMS Residential and Commercial Buildings Sector Models (p. 3).

analysis produced a range of LCCs. A distinct advantage of this approach is that DOE can identify the percentage of consumers achieving LCC savings or attaining certain payback values due to an increased energy conservation standard, in addition to the average LCC savings or average payback for that standard. The Department gives the LCC savings as a distribution, with a mean value and a range. The Department assumed in its analysis that the consumer purchases the furnace or boiler in 2015.

c. Energy Savings. While significant conservation of energy is a separate statutory requirement for imposing an energy conservation standard, the Act requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from the standard. (42 U.S.C. 6295(o)(2)(B)(i)(III)) The Department used the NES Spreadsheet results in its consideration of total projected savings.

d. Lessening of Utility or Performance of Products. In establishing classes of products, and in evaluating design options and the impact of potential standard levels, the Department aimed to develop standards for residential furnaces and boilers which would not lessen the utility or performance of the products under consideration in this rulemaking. (42 U.S.C. 6295(o)(2)(B)(i)(IV)) None of the considered trial standard levels would reduce the utility or performance of furnaces and boilers. The efficiency levels considered in this rulemaking do not involve changes in equipment design or unusual installation requirements that could reduce the utility or performance of furnaces and boilers.

e. Impact of Any Lessening of Competition. The Act directs the Department to consider any lessening of competition that is likely to result from standards. It 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, not later than 60 days after the publication of a proposed rule, together with an analysis of the nature and extent of such impact. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii)) The Department has transmitted a copy of today's proposed rule to the Attorney General and has requested that the Department of Justice (DOJ) provide its determination on this issue.

f. Need of the Nation To Conserve Energy. The non-monetary benefits of the proposed standard are likely to be reflected in improvements to the security and reliability of the Nation's energy system—namely, reductions in the overall demand for energy will result in reduced costs for maintaining reliability of the Nation's electricity system. The Department conducts a utility impact analysis to estimate how standards may impact the Nation's needed power generation capacity. This analysis captures the effects of efficiency improvements on furnace electricity consumption, as well as impacts associated with the market shift from natural gas heating to electric heating that DOE estimates will occur at higher gas-furnace efficiency levels. This market shift more than offsets the electricity savings from more efficient furnace designs, resulting in an increase in projected generating capacity for the higher trial standard levels.

The Department has determined that the energy conservation standards proposed today would result in reductions in greenhouse gas emissions. The Department quantified a range of primary energy conversion factors and estimated the emissions reductions associated with the generation displaced by the energy conservation standards. The Department reports the environmental effects of amended energy conservation standards at each trial standard level for this equipment in the TSD environmental assessment.

g. Other Factors. The Act allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors the Secretary deems to be relevant. (42 U.S.C. 6295 (o)(2) (B)(i)(VII)) Under this provision, the Department considered the potential for furnace and boiler standards to pose public health risks due to carbon monoxide release into the home as a result of venting system failure.

2. Rebuttable Presumption

As set forth in section 325(o)(2)(B)(iii) of EPCA, 42 U.S.C. 6295(o)(2)(B)(iii), there is a rebuttable presumption that an energy conservation standard is economically justified if the increased installed cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. However, although the Department examined the rebuttable-presumption criteria, it determined economic justification for the proposed standard levels through a more detailed analysis of the economic impacts of increased efficiency as described above, pursuant to section 325(o)(2)(B)(i) of EPCA. (42 U.S.C. 6295(o)(2)(B)(i)) The rebuttable presumption payback calculation is discussed in section IV.B.5 of this notice.

IV. Methodology and Discussion of Comments

The Department used spreadsheet models to meet certain objectives of the Process Rule for this rulemaking. It used the Engineering Spreadsheet to develop the relationship between cost and efficiency for furnaces and boilers and to calculate the simple payback for the purposes of satisfying the rebuttable payback requirements. The LCC Spreadsheet calculates the consumer benefits and payback periods for amended energy conservation standards. The National Impact Analysis Spreadsheet provides shipments forecasts and then calculates NES and NPV impacts of potential amended energy conservation standards. The Department also assessed manufacturer impacts, largely through the use of the Government Regulatory Impact Model (GRIM).

Additionally, DOE estimated the impacts of residential furnace and boiler energy conservation standards on utilities and the environment. The Department used a version of EIA's NEMS for the utility and environmental analyses. The NEMS model simulates the energy economy of the U.S. and has been developed over several years by the EIA primarily for the purpose of preparing the *AEO*. The NEMS produces forecasts for the U.S. that are available in the public domain. The version of NEMS used for appliance standards analysis is called NEMS–BT, and is primarily based on the *AEO2005* version with minor modifications.[11] The NEMS offers a sophisticated picture of the effect of standards, since it accounts for the interactions between the various energy supply and demand sectors and the economy as a whole.

The Department invites comments on the validity of the analytical methods used in this rulemaking and the appropriateness of the interpretation and use of the results of the analysis.

A. Product Classes

For this rulemaking, the Department initially considered the product classes

[11] The EIA approves the use of the name NEMS to describe only an *AEO* version of the model without any modification to code or data. Because the present analysis entails some minor code modifications and runs the model under various policy scenarios that deviate from *AEO* assumptions, the name NEMS–BT refers to the model as used here. For more information on NEMS, refer to The National Energy Modeling System: An Overview. DOE/EIA–0581 (98), February, 1998. BT is DOE's Building Technologies Program. NEMS–BT was formerly called NEMS–BRS.

discussed in the 1993 ANOPR. In 1987, the Act set the initial Federal energy conservation standard, which covered furnaces, boilers, mobile home furnaces, and ''small'' furnaces. In the 1993 ANOPR, the Department expanded the product classes to differentiate fuel type, heat transfer medium (*i.e.*, hot water or steam for boilers), and outdoor and indoor installation suitability (*i.e.*, weatherized or non-weatherized). Table IV.1 lists the product classes DOE initially considered in this rulemaking.

TABLE IV.1.—PRODUCT CLASSES CONSIDERED IN FURNACE AND BOILER RULEMAKING

Product	Characteristics
Gas furnaces	Non-weatherized and weatherized.
Oil-fired furnaces	Non-weatherized and weatherized.
Mobile home furnaces	Gas and oil-fired.
Electric resistance furnaces	Electric.
Hot water boilers	Gas and oil-fired.
Steam boilers	Gas and oil-fired.

Based on the market assessment and stakeholder comments, the Department grouped the product classes into three categories for the analysis for today's proposed rule. The first category consists of the most widely used product class, non-weatherized gas furnaces.

The second category consists of those classes that have fewer shipments, but typically more than 100,000 per year: Weatherized gas furnaces, mobile home gas furnaces, non-weatherized oil-fired furnaces, hot-water gas boilers, and hot-water oil-fired boilers. The Department's analysis of these product classes was similar to its analysis of non-weatherized gas furnaces.

The third category includes product classes for which DOE did not perform analyses and is not proposing an amendment to the current standards for these products. This category includes steam gas boilers and steam oil-fired boilers, which have annual shipments below 40,000 units and show a declining trend of shipments. This category also includes weatherized oil-fired furnaces, mobile home oil-fired furnaces, and electric furnaces. Weatherized oil-fired furnaces and mobile home oil-fired furnaces have very low shipments and are represented by only a few models in the GAMA directory; promulgating a higher standard for these products would result in *de minimis* energy savings. Additionally, all of the GAMA-listed models for weatherized oil-fired furnaces and mobile home oil-fired furnaces exceed the current 78-percent-AFUE standard. Therefore, for these classes, DOE is not proposing an update of the existing standard. The Department did not consider electric furnaces since their efficiency approaches 100-percent AFUE and improvements to them would also have *de minimis* energy-savings potential. Therefore, for electric furnaces, DOE is not proposing a standard.

B. Engineering Analysis

The purpose of the engineering analysis is to characterize the relationship between efficiency and cost of furnaces and boilers. The Department used this efficiency/cost relationship as input to the payback period, LCC, and NES analyses.

The engineering analysis develops data that can be used to establish the consumer price of more-efficient equipment. These data include manufacturing costs, markups, installation costs, and maintenance costs.

To generate the manufacturing costs, the Department identified three basic methodologies: (1) The design-option approach, which provides the incremental costs of adding design options to a baseline model that will improve efficiency; (2) the efficiency-level approach, which provides the incremental costs of moving to higher energy-efficiency levels, without regard to the particular design option(s) used to achieve such increases; and (3) the cost-assessment (or reverse-engineering) approach, which provides ''bottom-up'' manufacturing cost assessments for achieving various levels of increased efficiency, based on detailed data on costs for parts and material, labor, shipping/packaging, and investment for models that operate at particular efficiency levels.

The Department began the manufacturing cost analysis by exploring how manufacturers would likely design products to perform at the various efficiency levels considered and to thoroughly understand the relationships between different equipment configurations and efficiency. The Department initially considered several design options that could meet each considered efficiency level. It selected the design option(s) it believed manufacturers would most likely implement to achieve a given considered energy efficiency level. To estimate the manufacturing costs of these design options, the Department relied primarily on the cost-assessment (or reverse-engineering) approach, but also used the design-option approach.

To compare the total additional consumer cost of improved equipment efficiency, the Department defined a baseline design for each product class. The baseline model establishes the starting point for analyzing technologies that provide energy-efficiency improvement. Based on its market assessment and input provided by GAMA, the Department defined a baseline model as an appliance with an efficiency at the minimum level prescribed by EPCA (*i.e.*, 78-percent AFUE for non-weatherized gas furnaces), and having commonly available features and technologies.

The Department next determined markups, installation cost, and maintenance cost to complete the engineering analysis. It estimated markups using publicly available corporate and industry data and, for mobile home furnaces, data from MHI. To estimate installation costs, DOE created an Installation Model to assess venting costs, and verified it against known existing data. It estimated maintenance costs using publicly available industry data.

Table IV.2 summarizes the approach and data DOE used to derive the inputs to the engineering analysis for the 2004 ANOPR analysis, and the changes made in the analysis for today's proposed rule. Discussion of the changes follows in the sections below.

TABLE IV.2.—APPROACH AND DATA USED TO DERIVE THE INPUTS TO THE ENGINEERING ANALYSIS

Input	2004 ANOPR analysis	Proposed rule analysis
Equipment Cost	For the most widely used efficiency levels, used a cost model of manufacturing costs created by tear-down analysis; for the remaining levels, used design-opinion analysis. Incorporated industry feedback from GAMA and individual manufacturers to generate manufacturing-cost-versus-efficiency curves.	Added cost of drip pan for condensing units. Some units omit a combustion air pipe. Updated underlying metal and cost data to 2004 via Consumer Price Index. Did not consider design options at 82-percent and 83-percent AFUE for non-weatherized gas furnaces due to potential safety hazards. Updated manufacturing-cost-versus-efficiency curves.
Markups	Derived markups from an analysis of corporate financial data. Multiplied manufacturing costs by manufacturer, distributor, contractor, and builder markups, and sales tax, as appropriate, to get equipment price.	No change.
Installation Cost	Used a distribution of weighted-average installation costs from the Installation Model. Installation configuration are weight-averaged by frequency of occurrence in the field, and vary by installation size. The Installation Model is based on a commonly used cost-estimation method and is comparable to available, known data.	Same method; new assumption that all 81-percent AFUE gas furnaces use double wall vents.
Maintenance Costs	Used Gas Research Institute data for gas furnaces and boilers, water heater rulemaking survey results for oil-fired equipment, and data from the 1993 rulemaking for mobile home furnaces.	Same sources, but accounted for higher maintenance frequency for modulating design option, and used same costs for condensing and non-condensing equipment.
Annual Energy Use*	Calculated energy use using the DOE test procedure.**	No change.
Energy Prices*	*AEO2003* forecast prices for year 2012	*AEO2005* forecast prices for effective date of 2015.

* Inputs required to calculate rebuttable-presumption payback period. For more details on the rebuttable-presumption payback period, refer to section IV.B.5.

** The Department uses field-representative energy use values in the LCC and payback period analysis. Refer to section IV.C.3. for more details.

The Department received comments concerning the efficiency levels it should consider in the engineering analysis.

GAMA and Rheem expressed concern about producing an entire family of gas furnaces at 81-percent AFUE and suggested that, for some, and not all, furnace models within a given family, it is possible to design and produce units that can safely perform at the 81-percent level. They indicated that developing a complete family of furnaces, spanning the full range of capacities, in which all units could safely operate at 81-percent AFUE, would be difficult due to confining design and manufacturing procedures. (GAMA, Public Meeting Transcript, No. 59.8 at p. 177; Rheem, Public Meeting Transcript, No. 59.8 at p. 179) In response to these comments, DOE conducted an analysis evaluating approaches necessary to manufacture a full line of product that can perform at 81-percent AFUE and the additional costs involved for producing such a family of furnaces.

To perform this analysis, the Department identified an approach to manufacturing an entire furnace family at 81-percent AFUE without posing unacceptable safety and reliability risks. The Department identified two potential cases for producing an entire family of 81-percent AFUE non-weatherized gas furnaces, and the additional per-unit cost associated with each case. The Department based the estimates for both cases on manufacturer-provided data, which an independent consultant reviewed. The first case, estimate case 1, includes SKU cost (Stock Keeping Unit and customization development cost), parts cost increases, and vent connector cost; case 2, in addition to the above costs, assumes that a heat exchanger redesign cost would be needed. The estimated additional per-unit cost for producing a family of furnaces that can achieve reliable, safe operation at 81-percent AFUE is $47.20 for case 1 (the default case) and $88.70 for case 2.

York asserted that DOE cannot set the proposed standard for mobile home furnaces above 80-percent AFUE, since section 325(o)(4) of EPCA, 42 U.S.C. 6295(o)(4), provides that DOE may not prescribe an amended standard if ''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.'' York also stated that there are no non-condensing mobile home furnaces currently available on the market that exceed 80-percent AFUE. Additionally, York stated that their interpretation of this EPCA provision also applies to 90-percent AFUE units for mobile home furnaces. (York, No. 65 at p. 7)

After considering the comments from York, DOE concluded that section 325(o)(4) of EPCA, 42 U.S.C. 6295(o)(4), does not require it to set a new or amended energy conservation standard either at an efficiency level currently available in the U.S., or at an efficiency level that would ensure all products meeting the standard would have all of the attributes of currently available products. The ''performance characteristics'' and ''features'' referred to in section 325(o)(4) of EPCA, 42 U.S.C. 6295(o)(4), do not include efficiency or energy-use levels. Rather, these terms refer to other types of product characteristics of concern to consumers, such as features affecting temperature control or user comfort. To

interpret section 325(o)(4) of EPCA, 42 U.S.C. 6295(o)(4), otherwise would bar DOE from ever prescribing higher minimum standard levels, because any such higher levels necessarily result in new energy-efficiency-improving technologies incorporated into the product and the unavailability of products including less efficient technologies. This interpretation would be inconsistent with EPCA's other provisions and its purpose of improving product efficiencies. Thus, the lack of currently available, non-condensing, mobile home furnaces above 80-percent AFUE does not mean that section 325(o)(4) of EPCA, 42 U.S.C. 6295(o)(4), bars DOE from adopting a level higher than that as a minimum standard for this product class. Thus, DOE believes that section 325(o)(4) of EPCA, 42 U.S.C. 6295(o)(4), does not preclude DOE from considering efficiencies for mobile home furnaces above a given level, such as 80-percent AFUE. As discussed in section III.C.2 above, DOE identified 90-percent AFUE as the maximum technologically feasible level for mobile home furnaces. The Department analyzed efficiency levels that include 80-percent and 90-percent AFUE for mobile home furnaces and the results are presented in section V.C.

1. Manufacturing Costs

The Department adjusted its engineering cost model based on cost data received from several individual manufacturers, and used the model to create new cost-efficiency curves for the industry. The Department then used these cost-efficiency curves as manufacturing cost inputs for the MIA. Details of the MIA are in Chapter 12 of the TSD.

Lennox, York, and GAMA commented that the cost of materials in the 2004 ANOPR TSD was outdated. (Lennox, Public Meeting Transcript, No. 59.8 at p. 66; York, No. 65 at p. 3; and GAMA, No. 67 at p. 6) For the 2004 ANOPR engineering analysis, reviewed by manufacturers, the Department used a five-year average of material prices from years 2000 through 2004. In response to various comments, the Department reviewed material-cost data from the first quarter of 2005 and found prices higher than those in the reference scenario that it used in the 2004 ANOPR analysis. Based on the more recent data, DOE updated the five-year average prices used in the analysis for this notice and conducted a material price sensitivity analysis with two additional material-price scenarios. The reference case uses a revised five-year average of material prices from years 2000 through 2004. The new prices of copper, aluminum, steel, and stainless steel reflect prices from the Bureau of Labor Statistics (BLS) Producer Price Indices (PPIs) spanning 2000–2004. The Department used the PPIs for copper rolling, drawing, and extruding, and for steel mill products, and adjusted them to 2004$ using the gross-domestic-product implicit-price deflator.

The Department created two scenarios for the material-price sensitivity analysis: a low-bound and a high-bound. It calculated the low-bound scenario by finding the lowest price per pound of M6 core steel between 2000 and 2004. The lowest price of M6 core steel on a per-pound basis occurred in 2002. Then, DOE applied a 15-percent reduction to each of the raw material costs in that same year. It used these prices to determine their effect on the cost-efficiency relationship. Likewise, DOE calculated the high-bound scenario using the average price for each of the raw materials from the first quarter of 2005, when prices of raw materials were uncharacteristically high. The Department evaluated the results of the material price sensitivity analysis, using all three material-cost scenarios, in the engineering analysis and then used them as inputs for the LCC analysis. The results for the material-price-sensitivity analysis are presented in Appendix Z of the TSD.

GAMA stated that DOE's cost estimate for modulating furnaces is about 30 percent too low because of faulty assumptions regarding the cost of upgrading the controls. (GAMA, No. 67 at p. 2) The Department reviewed its cost estimate for modulating furnaces. Based on market data, it determined that the cost of the components for the evaluated design (two-stage modulation) is slightly higher than the cost used in the ANOPR analysis. Consequently, the Department implemented this small change in price for the NOPR analysis.

Carrier stated that improving efficiency with modulation assumes maintaining constant excess air when switching from high fire to low fire. Carrier further stated that a brushless, direct-current (DC) draft inducer motor is required to maintain constant excess air, so DOE should include the cost of brushless, DC draft inducers in its analysis. (Carrier, Public Meeting Transcript, No. 59.8 at p. 181) To some extent, DOE did this in the analysis for the 2004 ANOPR. Current modulating furnaces have a two-stage motor for the draft inducer, and DOE included the cost of this motor in analyzing the cost of achieving that level of efficiency. The Department has revised its analysis for the proposed rule to account for the cost of the two-stage modulation design option components, including the cost of the draft inducer as advocated by Carrier, for all products that achieve higher efficiencies using modulation.

2. Markups

Using the cost data, DOE developed estimates of the consumer price of furnaces and boilers. To estimate prices, DOE determined typical markups at each stage of the distribution chain, from the manufacturer to the consumer. In addition to estimating average markups, the Department characterized the markups with probability distributions through a statistical analysis of U.S. Census data and used these distributions in the LCC analysis. (See TSD, Chapter 5.)

The Department estimated the manufacturer markup based on analysis of corporate financial records. It included the following expenses in the determination of the manufacturer markup: research and development (R&D), net profit, general and administrative costs, warranty expenses, taxes, and sales and marketing costs. It excluded shipping expenses (out-bound) because these expenses were included in the manufacturing cost. The Department determined R&D expenses by assuming that engineering budgets would be reallocated from value engineering and new-feature development to product development and redesign.

The Department based the wholesale and contractor markups on firm balance sheet data. It estimated builder markup (applied to new construction installations only) from U.S. Census data for the residential and commercial building construction industry and from heating, ventilating, and air-conditioning (HVAC) industry data. The Department used recent State and local sales tax data to estimate sales taxes (applied to replacement installations only).

For mobile home furnaces, the distribution chain is shorter than the distribution chains for other product classes. The heating equipment manufacturer sells to the manufactured housing maker, who installs the furnace at the factory. In this case, the Department estimated markups using information from MHI.

The overall markups are lower for new construction installations than for replacement installations. For wholesalers and contractors, the markup on incremental costs (*i.e.*, the costs over and above the costs for a baseline model) is lower than the markup on the baseline model cost. The reason is that only wholesalers' and contractors' profits and other operating costs

typically scale with the price they pay for the products they sell. Trane questioned the assumption that incremental markups should be lower than baseline markups. (Trane, Public Meeting Transcript, No. 59.8 at p. 147) AGA said that wholesalers, contractors, and builders will base markups not on incremental costs of the technology, but on the economic value of the product in the supply chain. (AGA, No. 78 at p. 4) The Department evaluated the markup chain and found that the markup on incremental costs is lower than the baseline markup for wholesalers and contractors, so the Department did not change its application of markups. (See TSD, Chapter 5.)

3. Installation Costs

The Department defines the installation cost as the expense to the consumer for professional installation of a furnace or a boiler. The installation cost is not part of the equipment's retail price. The cost of installation covers all labor and material costs associated with the installation of a new unit or the replacement of an existing one, excluding the cost of the unit itself. For furnaces and boilers, the installation cost is typically the largest single component of the total cost to the consumer and is greater than the equipment price.

The predominant part of the installation cost is the venting system. The American National Standards Institute (ANSI) standard Z21.47–1993 defines four furnace and boiler categories (I–IV) with respect to the venting system. The categories are defined based on the operating pressure and temperature of the combustion gases inside the vent. Most non-condensing equipment falls into Category I (high temperature, negative pressure). Most condensing equipment falls into Category IV (low temperature, positive pressure), but some non-condensing boilers are in Category III (high temperature, positive pressure). Category III venting requires stainless steel material (AL29–4C) and sealed joints.

The Department devoted considerable effort to identifying appropriate cost figures to use in its analysis. In the process, DOE found that there is no complete, up-to-date data source for installation costs for the product classes under consideration. Therefore, DOE developed its own Installation Model to determine installation costs for non-weatherized gas furnaces. The Department used RS Means, a well-known construction-cost-estimation method, to develop labor costs, and obtained quotes from national distributors to develop material costs. The Installation Model weight-averages the detailed costs for a large variety of typical installations in the field, including both new construction and retrofit installations; single and multifamily housing; plastic, metal, and masonry chimney vents; single- and double-wall vent connectors; and common venting with other appliances. Chimney relining practices and orphaned water heaters are explicitly modeled. The Department modified certain assumptions to apply the Installation Model to oil-fired furnaces and gas- and oil-fired boilers.

In their comments, Carrier, Lennox, Alagasco, and York addressed space constraints and other issues related to the cost of installing furnaces and boilers. Carrier stated that, in southern and western markets, many furnaces are installed in attics, and if the furnace is more than 21 inches wide, it will not fit into the attic through the attic access. (Carrier, Public Meeting Transcript, No. 59.8 at p. 51) Lennox asked that the installation analysis account for non-conventional installations of very large units. (Lennox, Public Meeting Transcript, No. 59.8 at p. 75) Lennox commented that, with regard to oil-fired furnaces, because of the larger heat exchangers, the physical size of the furnace cabinet can cause space constraint problems. (Lennox, No. 79 at p. 2) Alagasco stated that DOE's installation model underestimates costs associated with the installation of gas furnaces, especially for replacement markets. (Alagasco, No. 82 at pp. 1–2) Finally, York stated that, due to the large size of residences in some areas of the country, more than one furnace system may be installed in a dwelling, and installing or changing multiple systems has a different cost impact than changing or installing a single system. (York, Public Meeting Transcript, No. 59.8 at p. 74) The Department's Installation Model includes a wide variety of installation situations, as mentioned above, and accounts for most situations where space constraints may be an issue.

a. Non-Weatherized Gas Furnaces. In the 2004 ANOPR, DOE estimated that eight percent of all installations of non-weatherized gas furnaces at 81-percent AFUE will require Category III venting. It based this estimate on the fact that if the steady-state efficiency of a non-condensing furnace exceeds 83 percent, it must be vented with a Category III venting system to prevent condensation problems. The Department arrived at the eight-percent value by considering the difference between the steady-state efficiency and the AFUE for actual models, based on the model information listed in the GAMA directory. Carrier and Lennox commented that the Department did not appropriately account for the fraction of 81-percent-AFUE furnaces that would require Category III venting and recommended that the eight-percent number be raised considerably. (Lennox, Public Meeting Transcript, No. 59.8 at p. 89 and No. 79 at p. 2; and Carrier, Public Meeting Transcript, No. 59.8 at p. 89) GAMA and Carrier stated that DOE's approach underestimates the fraction of Category III models because there is at least 0.5-percent difference between the steady-state efficiency as measured by the DOE test procedure and as measured in the ANSI Z21.47 categorization test. (The ANSI Z21.47 test is applied by manufacturers to identify venting categories to develop information for the manufacturers' installation manuals.) (GAMA, Public Meeting Transcript, No. 59.8 at p. 85 and No. 67 at p. 5; and Carrier, Public Meeting Transcript, No. 59.8 at p. 93 and No. 68 at p. 1)

In the analysis for this proposed rule, DOE did not directly estimate the fraction of Category III models by considering the difference between the steady-state efficiency and the AFUE for actual models. For this analysis, DOE investigated existing models and manufacturers' installation manuals. It determined that non-weatherized gas furnaces at 80- and 81-percent AFUE, when applied in vertical venting installations, fall into Category I. When 81-percent-AFUE furnaces replace 80-percent-AFUE furnaces, a significant fraction of installations requires an update from a single-wall to a Type-B, double-wall vent connector. In the case of replacement installations, the Department added the cost of a Type-B, double-wall vent connector to 40-percent of the installations. When applied in horizontal venting installations, furnaces at 80 and 81-percent AFUE are either in Category III or are in Category I using a power venter. The cost for these two venting methods is similar. Since horizontal installations account for a negligible fraction of all non-condensing furnace installations (estimated at less than 0.1-percent), DOE did not include this type of installation in its analysis.

Carrier, NPGA, and Lennox commented that lack of knowledge on the part of installers regarding proper installation practices for 81-percent-AFUE furnaces could result in incorrect installation and unsafe conditions for the consumer. (Carrier, Public Meeting Transcript, No. 59.8 at p. 83; NPGA, No. 72 at p. 4; and Lennox, No. 79 at p. 2) York and Alagasco stated that there are

issues regarding long-term safety, reliability, and performance of the Category III venting materials or systems available on the market today, and this is a major concern if thousands of installations across the country will require such systems. (York, No. 65 at p. 3; Alagasco, No. 82 at p. 2) Carrier, Rheem, and York commented that they do not offer Category III appliances, and stated that Category III venting is not used for 81-percent-AFUE models. (Carrier, Public Meeting Transcript, No. 59.8 at p. 115; Rheem, Public Meeting Transcript, No. 59.8 at p. 117; and York, No. 65 at p. 3) The Department recognizes the stakeholders' concerns. As discussed above, however, analysis for this proposed rule indicated that Category III venting would be required for a negligible fraction of installations of 81-percent-AFUE gas furnaces. Furthermore, based on the existing use of Category III venting, particularly for high-efficiency boilers, the Department believes that the relevant stainless steel materials (AL29–4C) would perform with an acceptable degree of safety and reliability for Category III furnaces.

The ODOE commented that the assumed overall cost for condensing furnace installation is too high, as it fails to account for the expected growth in the share of condensing furnaces that are for the replacement market, and the relatively small installation cost for replacing a condensing furnace. (ODOE, No. 61 at pp. 7–8) NRDC noted that installation costs will decline when replacement of 90-percent-AFUE furnaces becomes widespread. (NRDC, No. 528 at p. 4) The Department adjusted its estimate of installation costs for condensing furnaces to account for a higher share of replacements in total installations of condensing furnaces in 2015. With regard to the cost for replacing a condensing furnace, the Department did not find any new data to justify a change to the cost used in the 2004 ANOPR analysis.

AGA stated that installation costs for condensing furnaces are incompletely represented in the 2004 ANOPR, since installation codes require that condensing appliances be provided with an auxiliary drain pan to prevent damage to building components in the event of a blockage in the condensate drain piping system, and an estimated 40-percent of all condensing furnace installations need drain pans. (AGA, No. 78 at p. 5) The Department adjusted its Installation Model to account for the use of drain pans in 40 percent of condensing furnace installations.

In addition, the Department recognizes that some consumers may experience additional costs that exceed those used in the Department's analysis to address necessary structural changes for installing a condensing furnace, primarily for the vent systems associated with non-weatherized gas furnaces and for mobile home gas furnaces at or above 90-percent-AFUE. The Department understands that, for some dwellings, it may be necessary to make ''structural'' changes, such as the removal or penetration of an interior wall, exterior wall, or roof, to accommodate new vent systems (and combustion air intakes). While the Department has no data to quantify the number of consumers that may be affected in this manner and the cost magnitude, it believes the possible cost impacts may be significant enough to warrant consideration in evaluating the adoption of a standard level that would require condensing technology. The Department invites comments on the number of consumers that may be affected by structural changes for installing a condensing furnace and the cost magnitude of any structural changes.

b. Other Product Classes. For weatherized gas furnaces, the Department estimated the installation cost for the baseline model using data from Section 400 of the 2002 *RS Means Mechanical Cost Data.* The assumption that installation costs remain mostly constant as efficiency increases seems reasonable for single-package systems. The increases in size and weight for more-efficient systems are small relative to the large size and weight of the baseline model unit.

For mobile home gas furnaces in new homes, installation costs are part of the equipment cost because mobile home gas furnaces are assembled in the factory rather than in the field. The Department included these factory assembly costs in the manufacturer markup. With respect to mobile home gas furnaces for replacement, the Department did not find any new data to estimate an installation cost, so it used the same approach as for new-home furnaces.

York, GAMA, and MHI commented on venting issues related to mobile home furnaces. GAMA and York suggested that DOE did not sufficiently explore vent corrosion issues related to mobile home furnaces and weatherized furnaces in the 2004 ANOPR analysis. (GAMA, Public Meeting Transcript, No. 59.8 at p. 228; and York, No. 65 at p. 5) York, GAMA, and MHI noted that approved venting materials for Category III venting are not available for mobile home furnace installations. (York, No. 65 at p. 5; GAMA, No. 67 at p. 6; and MHI, No. 89 at p. 3) York also stated that condensation and resulting corrosion must be considered for weatherized furnaces, along with the cost impact of materials having more corrosion-resistant properties. (York, No. 65 at p. 8) GAMA agreed with DOE that it is appropriate not to include venting costs for weatherized products, but stated that there is a need to capture the increased likelihood of heat exchanger and flue corrosion resulting in premature failure. (GAMA, No. 67 at p. 6) In conducting its analysis for this notice, DOE reviewed the issue of vent corrosion for mobile home furnace installations and included a cost to account for proper venting system installation. For weatherized furnaces, the Department reviewed corrosion issues and found that current models having an AFUE of up to 82 percent do not have special requirements to address corrosion issues. Therefore, the Department did not change its cost estimates for this product class for this proposed rule.

For gas hot water boilers, the 2004 ANOPR analysis used a uniform assumption that 20-percent of installations would require Category III venting at 80–84-percent-AFUE levels. GAMA, ACEEE, and AGA commented that the analysis should include a gradually increasing share of Category III venting as the AFUE rises. (GAMA, Public Meeting Transcript, No. 59.8 at p. 111; ACEEE, Public Meeting Transcript, No. 59.8 at p. 113; and AGA, No. 78 at p. 5) GAMA asked that DOE's analysis use GAMA's data showing the fraction of gas hot water boiler models vented with Category III by efficiency level. (GAMA, Public Meeting Transcript, No. 59.8 at p. 107) AGA stated that manufacturers' installation instructions for a number of gas hot water boilers in the range of 83–84-percent AFUE do require Category III venting, and recommended that DOE consider these requirements. (AGA, No. 78 at p. 5)

In the analysis for today's proposed rule, DOE used data provided by GAMA on the fraction of installations at each efficiency level that would require Category III venting. The Department also conducted a sensitivity analysis using similar assumptions as in the 2004 ANOPR. This analysis reflected current construction practices, which use Category III venting for horizontal venting installations at all efficiency levels.

GAMA and ACEEE commented that DOE should further investigate installation practices for oil-fired equipment at various efficiency levels. (GAMA, Public Meeting Transcript, No. 59.8 at pp. 112 and No. 67 at p. 4; and ACEEE, No. 53 at p. 6) ACEEE stated

that DOE's analysis for oil systems does not fully account for the fact that exhaust from oil systems is generally at a higher temperature and has lower moisture content than exhaust from gas systems. (ACEEE, No. 84 at p. 11) Carrier urged DOE to perform vent condensation analyses on higher-efficiency oil furnace designs. (Carrier, No. 68 at p. 4)

The 2004 ANOPR analytical approach for oil-fired furnaces assumed that all installations of 83-percent-AFUE, or lower efficiency, equipment would be vented using Type L vents, and all installations of 84-percent-AFUE, or higher efficiency, equipment would be vented using 316-grade stainless steel vent systems. For this notice, the Department consulted Brookhaven National Laboratory and other experts, and also reviewed the National Fire Protection Association (NFPA) standards NFPA–31 *Standard for the Installation of Oil-Burning Equipment* and NFPA–11 *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.* The analysis for today's proposed rule has taken into consideration the NFPA–31 standard, which provides that Type L vents can be used safely with products of up to 88 percent, steady-state efficiency (or 87-percent AFUE), depending on the vent configurations and equipment size. The Department used a gradual increase in the number of 316-grade stainless steel vent installations from zero percent at 80–82-percent AFUE to 100-percent at 86-percent AFUE. The mid-point of the range is 50 percent at 84-percent AFUE. This assumption accounts for the NFPA–31 recommendations at the upper end of the range. The Department used a similar approach for oil-fired boilers, but shifted the above AFUE values upward by one AFUE efficiency point, in accordance with the NFPA–31 standard. The approach DOE used in this proposed rule accounts for the fact that exhaust from oil systems is generally at a higher temperature and has lower moisture content than exhaust from gas systems. It also addresses vent condensation on higher-efficiency, oil-fired furnace designs.

4. Maintenance Costs

Maintenance costs are the costs of regular maintenance of a furnace or boiler when it fails, including all associated labor and material costs. For non-weatherized and weatherized gas furnaces and gas boilers, in the 2004 ANOPR analysis, DOE used data on the cost and frequency of maintenance that were provided in the Gas Research Institute (GRI)-94/0175 topical report *Assessment of Technology for Improving the Efficiency of Residential Gas Furnaces and Boilers.* The Department used this information to estimate required minimum maintenance frequencies of once every five years for all equipment without modulation, and once every four years for all equipment with modulation, to account for the greater complexity of the modulation feature. For oil-fired furnaces and oil-fired boilers, DOE applied the results of a survey performed for its previous water heater rulemaking. For mobile home furnaces, DOE used data from the *Technical Support Document: Energy Efficiency Standards for Consumer Products, DOE/EE–0009,* published in November 1993. (See TSD, Chapter 6.)

The ODOE and York stated that the GRI data DOE used are outdated. (ODOE, No. 61 at p. 9; and York, No. 65 at p. 6) GAMA stated that maintenance costs should at least scale with the cost of the product, if not meet some other more rigorous assumption. (GAMA, Public Meeting Transcript, No. 59.8 at p. 165) ODOE commented that, unless DOE can provide data that support its contention that the maintenance costs vary proportionally to the efficiency of the furnace, using the same maintenance costs would be appropriate for all furnaces. (ODOE, No. 61 at p. 9) In its review of these comments, DOE confirmed that maintenance frequency, and therefore cost, does not necessarily vary with AFUE. Rather, the greater complexity of the modulation feature causes furnaces with this feature to require more frequent maintenance and thus incur higher maintenance costs.

The ODOE disagreed with how the 2004 ANOPR analysis represented maintenance costs for condensing equipment in terms of maintenance contracts. (ODOE, No. 61 at p. 9) In the 2004 ANOPR, DOE used a value for condensing equipment from the GRI report that represented the cost of a service contract that includes a specified set of routine repairs. In the analysis for this notice, the Department compared maintenance instructions for non-condensing and condensing gas furnaces from manufacturers' manuals, researched *RS Means* literature for maintenance differences between non-condensing and condensing gas furnaces, and collected opinions from several furnace installation and maintenance experts. It found, as asserted by ODOE, that annual maintenance contracts are not commonly applicable to condensing gas furnaces, and it did not find evidence of differences in maintenance requirements between condensing and non-condensing designs. Thus, in accordance with ODOE's comment, the Department used the same maintenance cost data for condensing and non-condensing furnaces, and it applied the same considerations to gas boilers.

5. Rebuttable-Presumption Payback Period

Section 325(o)(2)(B)(iii) of the Act 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))

The Department defines the rebuttable-presumption payback period as the length of time it takes the consumer to recover the higher installed cost of more-energy-efficient equipment through lowering operating costs. Numerically, the rebuttable-presumption payback period is the ratio of the increase in total installed cost (including the purchase price and installation cost) to the decrease in operating expenses (including maintenance). Energy expenses are the primary component of operating expenses. The Department determines the changes in total installed cost and operating expenses relative to the baseline for each product class (*i.e.,* the current standard level). Energy-expense savings are the first year's energy savings multiplied by the average energy prices forecast for the year in which a new standard is expected to take effect—in this case, the year 2015. The Department used energy price forecasts from the *AEO2005* to estimate the energy price in the year 2015.[12] To calculate energy-expense savings at each efficiency level, the Department uses the DOE test procedure for calculating annual energy consumption. (See TSD, Chapter 6.)

C. Life-Cycle Cost and Payback Period Analysis

In response to the requirements of section 325(o)(2)(B)(i) of the Act, the Department conducted an LCC and payback period analysis to evaluate the economic impacts of possible new furnace and boiler energy conservation standards on individual consumers. This section of this notice describes the

[12] Although the Department conducted an energy price sensitivity analysis using *EIA's AEO2006,* it did not perform a sensitivity analysis to determine the effect of *AEO2006* energy prices on the rebuttable-presumption payback period.

LCC and payback period analysis. The Department conducted the analysis using a spreadsheet model developed in Microsoft (MS) Excel for Windows 2000 or XP. (See TSD, Chapter 8.)

The LCC is the total consumer expense over the life of the furnace or boiler, including purchase and installation expense and operating costs (energy expenditures and maintenance costs). To compute LCCs, the Department discounted future operating costs to the time of purchase and summed them over the lifetime of the furnace or boiler. The payback period is the change in purchase expense due to an increased efficiency standard, divided by the change in annual operating cost that results from the standard. Otherwise stated, the payback period is the number of years it would take for the consumer to recover the increased costs of a higher-efficiency product through energy savings.

The Department measures the change in LCC and the change in payback period associated with a given efficiency level relative to a base case forecast of equipment efficiency. The base case forecast reflects the market in the absence of amended mandatory energy conservation standards. It depicts the current status of the market, including the existing demand for products that exceed the current energy conservation standards.

The Department calculated the LCC and payback periods for a nationally representative set of housing units. It selected the representative sample of households from EIA's Residential Energy Consumption Survey (RECS). Whereas the 2004 ANOPR used the 1997 RECS, the analysis for today's proposed rule used the 2001 survey (RECS 2001), which are the most recent data available. For each sampled household, DOE determined the energy consumption and energy price for either a furnace or a boiler. Thus, by using a representative sample of households, the analysis allowed for the capture of the wide variability in energy consumption and energy prices associated with furnace and boiler use. The Department determined the LCCs and payback periods for each sampled household using the furnace or boiler energy consumption and energy price unique to each household, as well as other input variables. As discussed below, DOE characterized the other input variables with probability distributions. The Department calculated the LCC associated with the baseline furnace or boiler in each household. To calculate the LCC savings and payback period associated with more-efficient equipment (*i.e.,* equipment meeting higher efficiency standards), DOE substituted the baseline unit with a more efficient design.

Inputs for determining the total installed cost include equipment prices—which account for manufacturer costs, manufacturer markups, distributor and wholesaler markups, builder or contractor markups, and sales taxes—and installation costs. Inputs for determining operating expenses include annual household energy consumption, marginal natural gas and electricity prices, natural gas and electricity price projections, maintenance costs, equipment lifetime, discount rates, and the year standards take effect.

To account for uncertainty and variability in certain inputs, the Department created distributions of values with probabilities attached to each value. Of the listed installed cost inputs, DOE characterized the manufacturer, dealer, distributor, and builder markups, as well as the sales tax and installation price, with distributions. Of the operating cost inputs, it characterized the discount rate and the equipment lifetime with distributions. For each housing unit, DOE sampled and randomly selected the values of these inputs from the distributions, according to their probability. With regard to energy consumption and energy price, as noted earlier, DOE determined unique values for each sampled household. Although DOE did not characterize energy consumption and energy price with probability distributions, it captured the variability of these inputs by using a representative set of households in the LCC and payback period analysis. The LCC and Payback Period Model uses a Monte Carlo simulation to incorporate uncertainty and variability into the analysis when combined with Crystal Ball (a commercially available software program). The Monte Carlo simulations sampled input values randomly from the probability distributions. The model calculated the LCC and payback period for each design option for 10,000 housing units per simulation run.

AGA commented that it appeared DOE was using Monte Carlo analysis for variables that are independent and for which DOE did not account for the correlation. (AGA, No. 54 at p. 3) For those variables that it characterized with probability distributions, DOE had no evidence to suggest that any of the variables—for example, discount rates and equipment lifetime—were correlated with each other. Thus, DOE assigned the discount rate associated with any given household based on its probability of occurrence, without consideration of the assumed lifetime for the furnace or boiler in that household. In the case of energy consumption and energy price, because DOE determined unique values for each sampled household rather than assigning them using probability distributions, it in effect correlated energy consumption and energy price for each household.

AGA also said that probability distributions for a number of variables used in the uncertainty analysis appear to be unjustified by data. (AGA, No. 54 at p. 2) In constructing probability distributions for the variables, the Department used the most recent data from multiple sources (See TSD, Chapters 7 and 8). The Department reviewed the data used to develop the probability distributions for all of the variables. The Department believes that the distributions are supported by the available data.

GAMA commented that the LCC analysis should include financing costs, since many consumers use some form of credit to purchase a furnace or boiler. (GAMA, Public Meeting Transcript, No. 59.8 at p. 153) The Department implicitly accounts for financing costs in its application of discount rates. As discussed in section IV.C.7, the discount rate for equipment purchased as part of a new home is based on mortgage rates, and the discount rate for replacement equipment considers interest rates for a number of loan and credit types. Using these rates, the discounted sum of annual payments on a loan or credit amount would be equal to the total installed cost if it were paid in full at the time of purchase. Therefore, the Department believes it is not necessary to separately account for financing costs.

Table IV.3 summarizes the approach and data DOE used to derive the inputs to the LCC and payback period calculations for the 2004 ANOPR, and the changes it made for today's proposed rule. Discussion of the inputs and the changes follows in the sections below.

TABLE IV.3.—SUMMARY OF INPUTS AND KEY ASSUMPTIONS USED IN THE LCC AND PAYBACK PERIOD ANALYSES

Inputs	2004 ANOPR description	Changes for proposed rule
Affecting Installed Costs		
Equipment Price	Derived by multiplying manufacturer cost by manufacturer, distributor, contractor, and builder markups and sales tax, as appropriate.	No change.
Installation Cost	Used a distribution of weighted-average installation costs from the Installation Model. Weight-averaged installation configuration by frequency of occurrence in the field.	No change.
Affecting Operating Costs		
Maintenance Costs	Used GRI data for gas furnaces and boilers, water heater rulemaking survey results for oil-fired equipment, and data from the 1993 rulemaking for mobile home furnaces.	Same sources, supplemented with new information that indicates higher maintenance frequency for modulating equipment, and identical maintenance costs for condensing and non-condensing equipment (See TSD, Chapter 5).
Annual Heating Load	Calculated heating and cooling loads using 1997 RECS data. Assumed the furnace input capacity versus airflow capacity based on the vintage of the equipment and characteristics of each house.	Calculated heating loads using 2001 RECS data (cooling loads not considered). Incorporated adjustment to account for change in new home size and shell performance between 2001 and 2015 (See TSD, Chapter 7).
Annual Energy Use	Used 26 virtual models that captured the range of common furnace sizes. Energy calculations used annual heating load for each housing unit.	Same method, using RECS 2001 data.
Energy Prices *	Calculated 1998 average and marginal energy prices for each sample house. Used *AEO2003* forecasts to estimate future average and marginal energy prices.	Calculated 2001 average and marginal energy prices for each sample house. Used *AEO2005* forecasts to estimate future average and marginal energy prices.
Affecting Present Value of Annual Operating Cost Savings		
Lifetime	Used 2001.58(9) Appliance Magazine survey results.	Same, except for boilers, for which DOE developed new estimates based on a literature review (See TSD, Chapter 8).
Discount Rate	Applied data from 1998 Survey of Consumer Finances and other sources to estimate a discount rate for each house. (See ANOPR TSD, Chapter 8).	Same sources; used more recent data (See TSD, Chapter 8).

* The Department used the *AEO2006* forecasts to estimate future average and marginal energy prices for the energy price sensitivity analysis. Section IV.C.4. provides further explanation of the rationale and methodology for the energy price sensitivity analysis.

1. Equipment Prices

As described in section IV.B.1 above, the Department determined manufacturing costs reflecting different efficiency levels using a reverse-engineering cost analysis for one size of equipment representative of each product class. To derive the manufacturing costs for other sizes of furnaces and boilers, DOE scaled the costs from the sizes used in the engineering analysis.

To develop a range of equipment sizes for non-weatherized gas furnaces that represent the majority of combinations of input capacity and nominal maximum airflow, the Department developed generic models to represent 26 different combinations of those two variables. The Department derived the models from baseline models with the most commonly occurring input capacities and corresponding maximum nominal airflow rates. To develop the manufacturing cost for each model, DOE took the cost from the engineering analysis for a model with a typical capacity, scaled the cost for other input capacities, and adjusted costs for furnaces with different-size blowers.

For the analysis of weatherized gas furnaces, DOE used the same generic models as in the analysis of non-weatherized gas furnaces. For the analysis of mobile home furnaces, the Department used a subset of those models. For the analysis of oil-fired furnaces and gas- and oil-fired boilers, the Department used a number of different sizes derived from the distribution of models in the GAMA March 2005 directory. For all of these product classes, DOE scaled the cost for each input size from the cost identified for a typical model for the specific product class in the engineering analysis.

The Department applied markups to the manufacturer cost of each virtual model to arrive at the equipment price paid by the purchaser. It determined markups on each stage of the distribution chain from the manufacturer to the consumer. (See TSD, Chapter 5.) In addition to estimating average markups, the Department characterized the markups with probability distributions through a statistical analysis of U.S. Census data. The markups assigned to units in the new construction subsample include a builder markup. The markups assigned to units in the replacement equipment subsample include sales taxes. The Department determined that the markup

for wholesalers and contractors on incremental costs for higher efficiency equipment is lower than the markup on the cost of a baseline model. Thus, for calculating the equipment cost of baseline equipment, the Department used the distribution of baseline markups. For the incremental cost of equipment at efficiency levels above the baseline, the Department applied incremental markups.

2. Installation Costs

The LCC and payback period analysis drew on the engineering analysis for installation costs at various efficiency levels. The Department assigned each household an installation cost from a distribution of weight-averaged values. For non-weatherized gas furnaces, oil-fired furnaces, and gas- and oil-fired boilers, DOE calculated the distribution using its Installation Model. For weatherized gas furnaces, DOE used calculations based on the RS Means approach to determine a mean value and assigned a triangular distribution of ±15-percent around the mean. For mobile home furnaces, it included the installation cost in the manufacturer markup.

3. Household Annual Energy Consumption

The Department calculated furnace fuel and electricity use by considering how furnaces operate in the sample housing units. (See TSD, Chapter 7.) While the AFUE measure does not consider electricity use, it is necessary to include it in the LCC analysis because both fuel and electricity consumption change with AFUE and these changes together determine the overall energy savings. The Department recognizes that the heat from a furnace blower contributes to heating the conditioned space. It included this effect in its LCC analysis to capture all operating expenses and completely evaluate the impact of new furnace standards on consumers.

The LCC and payback period analysis calculated furnace and boiler energy consumption under field conditions for a representative sample of housing units. These conditions included the climate conditions during the heating season and the size of the house, which influence the number of hours the equipment operates.

The calculation of furnace or boiler energy consumption required an estimate of the annual heating load for each housing unit (the amount of heat needed to keep it comfortable over an entire year). Determining the annual heating load for a housing unit required making assumptions about its size and construction, thermal efficiency, and geographical location. In the 2004 ANOPR analysis, DOE used data associated with the sample houses from the 1997 RECS. North Star Energy Group (NSEG) and Lennox commented that DOE's estimation of heating loads should account for improvement in thermal shells and changes in home size that are likely by the effective date of new standards. (NSEG, Public Meeting Transcript, No. 59.8 at p. 195; Lennox, Public Meeting Transcript, No. 59.8 at p. 166) In the analysis for today's proposed rule, the Department adjusted heating loads calculated for new construction housing units using data from *AEO2005* that projected changes in the thermal efficiency and the floor area of new houses. While thermal efficiency is projected to improve somewhat, the impact on heating load is roughly balanced by an expected increase in floor area. The Department applied these adjustment factors to the calculated heating loads for those RECS houses designated as representative of new houses.

Determination of the energy consumption of the equipment installed in each sampled housing unit also required estimating the input capacity and efficiency of the existing furnace. The Department then calculated how much energy furnaces with various improved designs would need to meet the heating load of the sampled housing unit.

The Department received several comments suggesting that it re-examine its 2004 ANOPR calculation of the energy consumption impacts of two-stage modulation. (GAMA, Public Meeting Transcript, No. 59.8 at p. 177; Individual, Public Meeting Transcript, No. 59.8 at p. 183; Lennox, Public Meeting Transcript, No. 59.8 at p. 152; York, No. 65 at p. 3; Carrier, No. 68 at p. 68; AGA, No. 78 at p. 4; and Alagasco, No. 82 at p. 2) For today's proposed rule, DOE took into account these comments and revised the energy consumption calculation. It used the 2004 public review draft of the proposed update of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) SPC 103 test procedure, ''Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers,'' which accounts for the effects of two-stage modulation. The results now show that this design option does not provide efficiency benefits unless an electronically commutated blower motor is used.

ACEEE and ODOE commented that DOE's electricity consumption results in the 2004 ANOPR LCC analysis appear to be inconsistent with the data on average annual auxiliary electricity consumption (E_{ae}) as reported in the GAMA directory of models. (ACEEE, No. 53 at p. 3; and ODOE, No. 61 at p. 4) For this proposed rule, DOE revised its approach for calculating electricity consumption for the LCC analysis. It based the revised calculations on data on the most current manufacturer product literature. (See TSD, Chapter 7) The resulting electricity consumption values are consistent with the data in the GAMA directory.

4. Energy Prices

The Department used average energy prices to calculate the energy costs of the base-case equipment and marginal energy prices for the cost of saved energy associated with higher-efficiency equipment. Marginal energy prices reflect a change in a consumer's bill associated with a change in energy consumed, and thus such prices capture the value of the increment of energy saved as a result of standards. Consumer gas bills typically have multiple rates—a base rate for the first block of gas used and different rates for further increments. Increased efficiency will impact the gas use at the rate applied to the last incremental consumption. For oil-fired furnaces and boilers, as well as gas furnaces using liquefied petroleum gas (LPG), the Department used average fuel prices for both base-case and higher-efficiency equipment, since consumers typically purchase fuel oil and LPG in bulk amounts, and the energy saved is based on the price paid for the bulk amount.

For each household sampled from the RECS database, DOE identified the average gas and electricity prices either from that household's data, if available, or from another household in the same Census division for which both prices were available. The Department estimated marginal energy prices from the RECS monthly billing data. The estimated marginal prices are very close to average prices. The Department invites comments on the methodology and data it used to determine marginal energy prices.

As in past rulemakings, the Department used price forecasts by the EIA to estimate the future trend in energy prices. It multiplied the average or marginal prices by the forecasted annual price changes in the Reference Case forecast in *AEO2005*.

EIA published its *Annual Energy Outlook* for 2006, *AEO2006*, after DOE had completed much of the analysis for this proposed rule. While the energy price forecast in *AEO2006* did not change substantially for electricity after

2015, the effective date of this rulemaking, the natural gas price forecasts were significantly different when compared to the energy price forecast in *AEO2005*. The natural gas price forecasts in the *AEO2005* are consistently lower by an average of $1.40 after 2015 than the natural gas price forecasts in the *AEO2006*. The oil price forecasts in the *AEO2005* are consistently lower by an average of $4.60 after 2015 than the oil price forecasts in the *AEO2006* by an average of $4.60 after 2015. On average, the *AEO2006* forecasts show approximately a 20-percent increase in energy prices over those in *AEO2005*. Since most of the energy used by furnaces is natural gas (and oil), this change could impact the analysis results. To account and assess the possible impact of these increases in projected energy prices, the Department conducted an energy price sensitivity analysis using the *AEO2006* scenario. The energy price sensitivity analysis uses recently published energy prices, housing starts, and site-to-source conversion factors based on the *AEO2006*. It examines the impact of these changes on the LCC and Payback Period, Consumer Subgroup, and National Impact analyses. The results of each analysis are shown in sections V.B.1.a., V.B.1.b., V.B.3.a., and V.B.3.b., respectively. For the *AEO2006* energy price sensitivity analysis, the Department determined that the consumers' purchasing decisions in the base case (*i.e.*, in the case where no change in standards is assumed to occur) would be similar to those as in the energy price trajectory using *AEO2005*. The Department welcomes comment on the determination of the forecast of the gas furnace shipments as a function of the energy prices. Furthermore, the Department intends to use the most recent energy price forecasts from the EIA in its revised analyses for the final rule.

5. Maintenance Costs

For the LCC analysis, DOE used the maintenance cost data derived in the engineering analysis. Based on a sensitivity analysis in a 1994 GRI report and on engineering judgment, the Department assumed a triangular distribution for maintenance costs to capture the variability of these costs among homes, with a minimum at 80 percent of the average cost and a maximum at 120 percent of the average cost. The Department is not aware of any recent data that provide a distribution of maintenance costs.

6. Equipment Lifetime

The Department defines the equipment lifetime as the age at which a furnace or boiler is retired from service. Because none of the available data on equipment lifetime show a clear relationship between efficiency and lifetime, DOE assumed that equipment lifetime is independent of efficiency. The Department used a triangular probability distribution from the range for each product class to assign a lifetime to individual furnaces and boilers in the sample housing units.

In the 2004 ANOPR, DOE used an average lifetime of 20 years for gas furnaces, 15 years for oil-fired furnaces and boilers, and 17 years for gas boilers. ACEEE commented that DOE's equipment lifetime estimates appeared to be somewhat short, and were a significant change from values used in the last DOE rulemaking on these products. ACEEE recommended that DOE look for field data on actual average equipment lifetime. (ACEEE, No. 84 at p. 11) The Department conducted a literature review to obtain estimates of boiler lifetime. Based on the information found, it increased the lifetimes used for gas- and oil-fired boilers to 25 years.

7. Discount Rates

The Department derived the discount rates for the LCC analysis from estimates of the finance cost to purchase a furnace or boiler. New-housing equipment is purchased as part of the home, which is almost always financed with a mortgage loan. Therefore, the Department estimated discount rates for new-housing equipment using the effective mortgage rate for home buyers, not simply the nominal rate. For the consumer life-cycle-cost calculation, the effective rate corresponds to the interest rate after deduction of mortgage interest for income tax purposes. Such adjustment is not appropriate for the NPV calculations. As described in section IV.D.7., for the NPV calculations the Department used discount rates of both seven percent and three percent, in accordance with the Office of Management and Budget (OMB)'s guidelines contained in *Circular A–4, Regulatory Analysis,* September 17, 2003. (OMB Circular A–4, § E (September 17, 2003)).

Households use a variety of methods, the prevalence of which may change over time, to finance a replacement furnace or boiler. The shares of different financing vehicles in total replacement equipment purchases are unknown, so the Department identified all possible customary sources of acquiring funds for purchase of replacement furnaces, including household assets that might be sold to raise funds. The Department then estimated the shares of the various debt and equity classes in the average U.S. household equity and debt portfolios using data from the 1998 and 2001 Federal Reserve Board's *Survey of Consumer Finances* (SCF) (See TSD, Chapter 8.) The Department estimated a distribution of interest or return rates associated with each type of equity and debt from the SCF and other sources, and then developed a distribution of weighted-average finance costs for replacement equipment.

NRDC commented that DOE's approach for deriving discount rates in the 2004 ANOPR analysis had shortcomings that resulted in the use of rates that were too high. (NRDC, No. 63 at p. 12) The Department acknowledges there are diverse views on selecting discount rates for household purchase of appliances, but the approach DOE used for furnaces and boilers is consistent with the method it used for its rulemaking for residential air-conditioning equipment. For this notice, DOE incorporated more recent data on consumer finances, mortgage rates, other debt interest rates, and rates of return on equity classes. The resulting discount rates are lower than those used in the 2004 ANOPR analysis for new-home furnace and boiler purchases (See TSD, Chapter 8.)

GAMA commented that using a different discount rate for each household is questionable. (GAMA, No. 67 at p. 7) The Department disagrees. Since the finance cost for purchasing a furnace or boiler varies among households depending on their financial situation, the Department found that using different discount rates was appropriate.

8. Effective Date of the New Standards

Generally all covered products to which a new or amended energy conservation standard applies must comply with the standard if they are manufactured or imported on or after a specified date. (42 U.S.C. 6291(10), 6295 (b)–(k)) Section 325(f)(3)(B) of EPCA directs that DOE is to publish a final rule for furnaces and boilers by January 1, 1994, and that any amendment shall apply to products manufactured on or after January 1, 2002. The Department has applied this eight-year implementation period to determine the effective date of any standard prescribed by this rulemaking. Since DOE expects to issue a final rule in 2007, the effective date for this rulemaking will be 8 years from the date of publication of the final rule, that is, in 2015. Thus, the

Department calculated the LCC and payback period for all consumers as if each one purchased a new residential furnace or boiler in 2015.

9. Inputs to Payback Period Analysis

The payback period is the length of time it takes the consumer to recover the higher installed cost of more-energy-efficient equipment through lower operating costs. Numerically, the payback period is the ratio of the increase in total installed cost (including the purchase price and installation cost) to the decrease in operating expenses (including maintenance). Thus, similar to the LCC, the payback period is based on the total installed cost and the operating expenses. However, unlike for the LCC, DOE considers only the first year's operating expenses in the calculation of the payback period. Because DOE considers only the first year's operating expenses, the payback period does not take into account changes in operating expense over time or the time value of money; that is, electricity price trends and discount rates are not required inputs. Energy expenses are the primary component of operating expenditures. The Department determines the energy-expense savings for the payback period as the first year's energy savings multiplied by the energy prices for the year in which a new standard is expected to take effect, in this case the year 2015.

The energy consumption DOE used to calculate the payback period for the LCC analysis reflects current field conditions for a representative sample of housing units. This approach to determining energy consumption and savings is in contrast to the rebuttable-payback-period calculations in the engineering analysis, which use the DOE test procedure's method for calculating annual energy consumption. The change in the annual energy consumption (otherwise called the energy savings) between the base-case furnace or boiler and a more efficient unit, as calculated in the LCC analysis, is smaller than the change in the energy consumption calculated from the DOE test procedure. Because smaller energy savings result in smaller decreases in operating expenses, the payback periods calculated for the LCC analysis are longer than the rebuttable-payback periods.

10. Base-Case Equipment

The base-case forecasts equipment that consumers are expected to purchase in the absence of new standards. In the 2004 ANOPR analysis, DOE developed the base-case forecast for each product class using the available data on shipments of furnaces and boilers by efficiency levels. For non-weatherized gas furnaces, the Department forecasted the base-case share of condensing furnaces based on the average growth rate for the period 1991–2000. The projected condensing furnace market share increased from 24 percent in the late 1990s to 27 percent in 2015. The Gas Technology Institute (GTI), ACEEE, NSEG, AGA, GAMA, York, and Lennox commented that DOE should account for recent market trends that are leading to greater sales of condensing gas furnaces. (GTI, No. 74 at p. 2; ACEEE, No. 84 at p. 13; NSEG, Public Meeting Transcript, No. 59.8 at p. 23; AGA, No. 59.8 at p. 42; GAMA, Public Meeting Transcript, No. 59.8 at p. 158; York, No. 65 at p. 2; and Lennox, 79 at p. 3) The Department agrees that use of the most recent data is important. In its analysis for this notice, the Department revised its assignment of gas furnaces to sampled housing units in the base case to reflect the recent trend toward a higher market share for condensing furnaces, as shown in shipments data through 2003 provided by GAMA. There is a strong correlation between condensing furnace market share and the natural gas price for the 1990–2003 period. The Department based the projected market share of condensing furnaces in 2015 on an evaluation of this correlation, projected natural gas prices from *AEO2005,* and market factors that could sustain the condensing furnace market share even with a lower gas price. The projected condensing furnace market share for 2015 is 35 percent. Therefore, for the LCC analysis base case, the Department assigned condensing furnaces to 35 percent of the sampled housing units with non-weatherized gas furnaces.[13]

GAMA commented that the 2004 ANOPR analysis does not draw a correlation between an individual household's characteristics and the furnace it would have bought under the base case. (GAMA, Public Meeting Transcript, No. 59.8 at p. 158) The Department's analysis does correlate the type of furnace assigned as base-case equipment with certain household characteristics. Specifically, in assigning condensing furnaces as base-case equipment, the Department used a ranking of the RECS sample housing units by heating degree days to assign condensing furnaces to households in colder climates.

[13] The Department assumed the same disbursement of condensing furnaces, 35 percent, within the sampled housing units for non-weatherized gas furnaces in the energy price sensitivity analysis, which it based on *AEO2006.*

For other product classes, the Department assigned base-case equipment to the sampled housing units from a distribution of AFUEs that is representative of current shipments for each product class. The assignment of equipment efficiency took climate into account.

D. National Impact Analysis—National Energy Savings and Net Present Value Analysis

1. Shipments, National Energy Savings, and Net Present Value

The Department calculated the NES and the NPV of total customer costs and savings expected to result from new standards at specific efficiency levels, defined as a difference between a base-case forecast (without new standards) and the standards case (with new standards). The NES refers to cumulative energy savings from 2015 through 2038. The Department calculated net monetary savings in each year relative to the base-case as the difference between total operating-cost savings and increases in total installed cost. Cumulative savings are the sum of the annual NPV over the specified time period. The Department accounted for operating-cost savings until all the equipment installed through 2038 is retired.

An important element in the estimate of the future impact of a standard is product shipments. The shipments portion of the NES Spreadsheet uses historical data as a basis for projecting furnace and boiler shipments. Furnace and boiler shipments comprise units used to replace retired units of the same type or of another fuel type, as well as units installed in new homes. (See TSD, Chapter 9.)

In the 2004 ANOPR analysis, the Department estimated retirements based solely on past shipments and the assumed equipment lifetimes. For gas furnaces (all three product classes together), the resulting total shipments in the 1993–2001 period were less than those reported by GAMA. (GAMA, No. 24) For today's proposed rule, the Department added two additional components of gas furnace shipments in this period, early retirement and fuel switching, which brought the shipments estimated by the model into closer agreement with the GAMA data. (GAMA, No. 94)

The first added component of gas furnace shipments is the early retirement of non-condensing furnaces and their replacement with more-efficient condensing furnaces. Evidence for this trend can be seen in the GAMA data, which show a large increase in

condensing furnace shipments in this period in response to rising natural gas prices. The second added component is conversion from non-central gas heating to central heating with a gas furnace. There is evidence for this conversion in the RECS data, which show a large increase between 1993 and 2001 in homes with central gas heating that were built before 1990, as well as in the trade literature. The shipments from these additional components are most likely to be non-weatherized gas furnaces, because they account for about 90 percent of all gas furnace shipments. The Department assumed that shipments from these additional components follow a normal distribution, rising gradually from 1993, reaching a maximum value, and then decreasing again. It assumed that shipments from these additional components gradually taper off due to a decline in the number of homes for which conversion from non-central gas heating or early retirement of non-condensing furnaces is possible or economically attractive. The Department corrected replacements in subsequent years to avoid double-counting due to furnaces being removed from the stock before the end of their lifetime. The Department also estimated the annual number of replacements based on past shipments, projected shipments to new housing construction over the next decade, and equipment retirement rates.

York stated that the 2004 ANOPR analysis neglected the market for replacement of furnaces in mobile homes. (York, No. 65 at p. 5) In the NES calculations for the proposed rule, the Department included estimated shipments for replacement of furnaces in mobile homes.

To estimate future conversions to natural gas, DOE used data from utility surveys conducted by the AGA that report the numbers of households that converted to natural gas space heating. ACC commented that DOE should consider expected relative prices of natural gas and electricity in estimating future conversions. (ACC, No. 62 at p. 3) The Department estimated the annual conversions to natural gas as a constant percentage of projected replacements using data from the 1985–1995 period. The trend in relative energy prices in this period is similar to the trend of projected energy prices.

EEI commented that DOE should address the impact of DOE's new energy conservation standard for heat pumps on heating system conversions after January 2006. (EEI, No. 69 at p. 2) The Department believes few existing houses with a heat pump that is due to be replaced would be likely to convert to a combination of a gas furnace and central air conditioner, even if the price of a new heat pump is several hundred dollars more after the new central air conditioner/heat pump standard goes into effect. Houses with a heat pump typically lack venting systems, and/or access to a source of natural gas, which are necessary to convert to gas heating. Therefore, the Department did not include conversions from heat pumps to natural gas equipment in its analysis.

The Department also estimated the number of annual shipments of each product class going to new housing units as a function of the market share estimated for each product class. For non-weatherized and mobile home gas furnaces, the Department estimated market-shift effects from changes in relative fuel prices and from equipment price increases expected from higher efficiency standards. In forecasting gas furnace market shares, the Department assumed an impact of higher installed costs due to standards would be a decrease in market share held by gas furnaces in new construction, in favor of electric heating. The Department accounted for these market shift effects in the calculation of NES and NPV by considering the differential in energy consumption, utility bills and equipment cost between households with gas heating and those with electric heating. The Department based its estimates on the current market share of heat pumps and electric furnaces in households with electric space heating, as provided by RECS 2001. For non-weatherized gas furnaces, DOE assumed that heat pumps account for 54 percent of the additional electric heating equipment purchased due to market shift, and electric resistance furnaces account for 46 percent. It based these values on equipment shares in homes built in 1999–2003. For mobile home gas furnaces, the assumed shares of additional electric heating equipment purchased due to market shift are 41 percent for heat pumps and 59 percent for electric resistance furnaces. In determining market shift effects, the Department assumed the above shares of heat pumps and electric resistance furnaces remained constant over the analysis period. The Department invites comments on its assumption of constant heat pump and electric resistance furnace market shares in order to calculate the market shift effects on NES and NPV.

NPGA, Laclede, and NSEG recommended that DOE analyze the potential for a market shift from gas furnaces to electric heating equipment resulting from new gas furnace standards. (NPGA, No. 72 at p. 4; Laclede, No. 76 at p. 3; and NSEG, Public Meeting Transcript, No. 59.8 at p. 24) Similarly, EEI commented that DOE should consider how the increased energy-efficiency standards for heat pumps in 2006 will shift market shares in new construction from electric to gas space-heating systems. (EEI, No. 69 at p. 2) In the analysis for this notice, the Department used the same approach to evaluate market shifts as in the 2004 ANOPR analysis, but it used more recent data on heating equipment prices. (*See* TSD, Chapter 9.) The Department also included the impact of projected higher heat pump prices after 2006. (*See* TSD, Chapter 9.) Projected market share shifts are reflected in the MIA.

Southern and Carrier commented that standards for gas furnaces could induce switching to combination space- and water-heating appliances. (Southern, Public Meeting Transcript, No. 59.8 at p. 200; and Carrier, Public Meeting Transcript, No. 59.8 at p. 198) The Department believes that the historical market data necessary for estimating the potential for consumers to switch to combination space- and water-heating appliances do not exist. Therefore, DOE was not able to include this potential market effect in the shipments projection.

The Department estimated the future market shares of oil-fired furnaces and gas- and oil-fired boilers in total new housing completions based on their average shares in homes built in the 1999–2003 period. For new homes that use oil-fired equipment, gas is generally not available, so the Department considered the market shares to be independent of changes in equipment price due to the implementation of standards. Gas boilers in new homes are associated with specific types of heating systems, such as hydronic radiators or radiant floors, so substitution of alternative equipment is unlikely. Therefore, the Department assumed that the market share would not be affected by changes in equipment price due to standards.

Table IV.4 summarizes the approach and data DOE used to derive the inputs to the shipments analysis for today's proposed rule, and the changes made in the analysis for this proposed rule. (*See* TSD, Chapter 9.)

TABLE IV.4.—APPROACH AND DATA USED TO DERIVE THE INPUTS TO THE SHIPMENTS ANALYSIS

Input	2004 ANOPR description	Changes for proposed rule
Shipments*	Calculated total shipments for replacements based on past shipments and retirement function, and for new homes based on projection of new housing from *AEO2003.* The projected market shares in new homes were a function of relative heating equipment prices. Based conversions-upon-replacement on historic survey data.	Same approach as ANOPR, with updated shipments data from GAMA. Included shipments for mobile home furnace replacement. Projection of new housing updated to *AEO2005.* Market share projection used re-estimated parameters. Model used two additional shipment categories to calibrate with GAMA data.
Replacements in kind	Replacement of worn-out heating equipment with unit of same equipment type (i.e., furnace versus boiler) and same fuel (natural gas or oil). Applies a replacement probability distribution based on equipment lifetime.	No change.
Conversions	Replacement of worn-out heating equipment with equipment utilizing a different fuel. Based on utility surveys conducted by AGA that report the numbers of households that converted from oil or electricity to natural gas space heating. Source: AGA House Heating Survey 1985–1995.	No change.
Installations in new housing	Installation of heating equipment into new single-family, multi-family or mobile homes according to construction rates and equipment type market shares. Used housing completions according to DOE forecast and modeled market shares according to energy and equipment price trends.	No change.
Gas furnace early replacement	Not applied	Early replacement of non-condensing furnaces with more efficient condensing furnaces. Model calibrated to GAMA data, which show a large increase in condensing furnace shipments in response to rising natural gas prices.
Conversion from non-central gas heating to central heating with a gas furnace.	Not applied	Conversion from non-central gas heating to central heating with a gas furnace. Model used RECS data, which show a large increase between 1993 and 2001 in homes with central gas heating that were built before 1990.

*For the energy price sensitivity analysis, the Department based its new housing projections on forecasts from the *AEO2006.* Section V.B.3.a presents the results of the energy price sensitivity analysis.

To make the analysis more accessible and transparent to stakeholders, the Department used an MS Excel spreadsheet model to calculate the NES and NPV. MS Excel is the most widely used spreadsheet calculation tool in the U.S. and there is general familiarity with its basic features. Thus, the Department's use of MS Excel for the spreadsheet models provides stakeholders access to the models within a familiar context. In addition, the TSD and other documentation that DOE provides during the rulemaking explain the models and how to use them, and stakeholders can review DOE's analyses by changing various input quantities within the spreadsheet. Unlike the LCC analysis, the NES Spreadsheet does not use distributions for inputs. The Department examined the sensitivity of monetary savings by applying different scenarios of energy prices and societal discount rates. (See TSD, Chapter 10.)

In addition to analyzing national impacts, the Department analyzed the NES and NPV for the Southern and Northern regions. The Department defined the Southern region as including those States that have an average of less than 5,000 heating degree-days. The Department defined the Northern region as including those States that have an average of more than 5,000 heating degree-days.[14] See section III.A.4 for a list of States that fall under the Northern or Southern regions.

Table IV.5 summarizes the approach and data DOE used to derive the inputs to the NES and NPV analyses for the 2004 ANOPR, and the changes made in the analyses of the proposed rule. (See TSD, Chapter 10.)

[14] The following States average 5000 or more HDDs: Alaska, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming.

TABLE IV.5.—APPROACH AND DATA USED TO DERIVE THE INPUTS TO THE NATIONAL ENERGY SAVINGS AND NET PRESENT VALUE ANALYSES

Input	2004 ANOPR description	Changes for proposed rule
Shipments	Annual Shipments form shipments model	See Table IV.4.
Date Products Must Meet Standard	2012	2015.
Annual UEC (Unit Energy Consumption)	Annual weighted-average values were a function of efficiency level. Base case UEC for non-weatherized gas furnaces accounted for projected share of condensing furnaces.	No change. Projected share of condensing furnaces reflected recent shipments data.
Installed Cost per Unit	Annual weighted-average values were a function of efficiency level (established from the LCC analysis).	No change.
Maintenance Cost per Unit	Annual weighted-average values were a function of efficiency level (established from the LCC analysis).	No change.
Energy Prices *	*AEO2003* forecasts to 2025 and extrapolation beyond 2025.	*AEO2005* forecasts to 2025 and extrapolation beyond 2025.
Energy Site-to-Source Conversion	Generated by DOE/EIA's National Energy Modeling System (includes electric generation, transmission, and distribution losses).	No change.
Discount Rate	7-percent and 3-percent real	No change.
Present Year	Future expenses discounted to year 2001	Future expenses discounted to year 2004.

* For the energy price sensitivity analysis, the Department used *AEO2006* forecasts to derive its energy prices up to 2025 and extrapolated beyond 2025. The rationale and methodology for the energy price sensitivity analysis is further explained in Section V.B.3.a.

2. Annual Unit Energy Consumption

The annual unit energy consumption (UEC) values for the base-case forecast and each higher efficiency level come from the LCC analysis. Each UEC includes a value for gas (or oil) consumption. The base-case forecast reflects the expected pattern of equipment purchases in the absence of any new standards. Since there is little evidence of change in recent years in the average AFUE for each product class, DOE used the average values from recent GAMA shipments data for each year of the base-case forecast. In particular, for non-weatherized gas furnaces, DOE took into account the considerable rise in the market share of condensing furnaces in 2001–2003 shown in data provided by GAMA. This increase (to 31 percent) corresponds to the sharp rise in the average residential gas price in this period. Given that the price forecast in the *AEO2005* shows a residential gas price in future years that is considerably lower than in 2003, one might expect the condensing furnace market share to be lower in the future than in 2003. However, other factors could potentially sustain the condensing furnace market share even with a lower gas price (such as the greater acceptance of condensing furnaces among homebuilders). Therefore, the Department projected that the share remains at slightly above the 2003 level (35 percent) throughout the considered period.[15] The Department also evaluated alternative scenarios of the future condensing furnace market share. Appendix R of the TSD describes these scenarios and presents the NES and NPV results for non-weatherized gas furnaces using the alternative scenarios. The Department invites comments on its assumption of constant condensing furnace market share in its default scenario for calculating annual unit energy consumption.

3. Site-to-Source Conversion Factors

Primary energy consumption includes energy used and lost in the production and transmission of the energy consumed at the site. The Department derived annual site-to-source conversion factors using the NEMS *AEO2005* Reference Case and estimated energy savings and system load impacts as a result of possible standards for each year.[16] The factors the Department used are marginal values, which represent the response of the system to an incremental decrease in consumption associated with energy conservation standards. Natural gas losses include pipeline leakage, pumping energy, and transportation fuel.

4. Installed Equipment Costs

Average installed equipment costs for the base-case forecast and each efficiency level came from the LCC analysis. Total equipment costs for each efficiency level equal the average cost multiplied by shipments in each year. The Department assumed no change in real equipment costs at each level after 2015. In cases where a market shift away from gas furnaces is projected, DOE accounted for the equipment costs of the electric heating equipment purchased instead.

5. Maintenance Costs

The Department took average annualized maintenance costs for the base-case forecast and each efficiency level from the LCC analysis. It considers the annualized maintenance cost to be an operating cost that is applied for each year that the equipment remains in the stock. The Department assumed no change in real maintenance costs after 2015.

6. Energy Prices

The NPV calculation used energy prices to value energy savings for natural gas and electricity. It used average energy prices for fuel oil and LPG, since consumers typically purchase fuel oil and LPG in bulk amounts, and the energy saved is based on the price paid for the bulk amount. The Department used 2001 energy prices for the RECS housing sample in the LCC analysis. To project prices out to 2025, DOE used energy price projections from *AEO2005*. In the energy price sensitivity analysis, DOE calculated the NES and NPV using the recently-published energy price projections from *AEO2006*. For the years after 2025, DOE applied the

[15] The Department assumed the same disbursement of condensing furnaces, 35 percent, within the sampled housing units for non-weatherized gas furnaces in the energy price sensitivity analysis. In other words, the Department did not update this percentage based on *AEO2006* for the energy price sensitivity analysis.

[16] For the energy price sensitivity analysis, the Department derived the annual site-to-source conversion factors using the NEMS *AEO2006* Reference Case.

average annual growth rate in 2010–2025 for gas and heating oil prices and the average annual growth rate in 2015–2025 for electricity prices in both cases.

The Northwest Power and Conservation Council (NPCC) asked if NEMS (used for the *AEO2005* projections) has a feedback loop between gas consumption and the forecast of future prices for natural gas. (NPCC, Public Meeting Transcript, No. 59.8 at p. 245) NEMS does incorporate such feedback.

Southern, ACEEE, and ODOE commented that DOE should conduct a sensitivity analysis using a greater range of fuel prices, and independent forecasts, such as forecasts prepared by Energy and Environmental Analysis, Inc. (Southern, No. 71 at p. 3; ACEEE, Public Meeting Transcript, No. 59.8 at p. 163; and ODOE, No. 61 at p. 10) The Department used for today's analysis price forecasts from the *AEO2005*, including the High and Low Economic Growth Cases. For the energy price sensitivity analysis, the Department used the price forecasts from *AEO2006, including the High and Low Economic Growth Cases.* The range of prices in these forecasts, especially for natural gas, is quite wide and encompasses the scenarios in the AGA's ''Natural Gas Outlook to 2020'' (February 2005), which were prepared by the Energy and Environmental Analysis, Inc. Therefore, the Department concludes that its analysis encompasses a reasonable range of future energy prices.

GTI commented that the analysis should consider reallocation of gas utility distribution costs in the case where furnace standards result in lower natural gas demand. (GTI, No. 51 at p. 2) Historically, DOE has used the same energy price forecasts for standards cases as for the base case. Lower natural gas demand due to furnace standards could lead to higher fixed-cost charges for natural gas consumers, but such charges are subject to State regulation and the Department is not aware of a reliable method for estimating the magnitude of the impact on average retail prices. Since developing a reliable method for evaluating such costs is outside the scope of the rulemaking, DOE has not included this factor in its analysis.

7. Discount Rates

To discount future impacts, the Department used discount rates of both seven percent and three percent, in accordance with the Office of Management and Budget (OMB)'s guidelines contained in *Circular A–4, Regulatory Analysis,* September 17, 2003. (OMB Circular A–4, § E (September 17, 2003)). For the purpose of this analysis, the Department used 2005 as the reference year for discounting because it concluded the analysis in this year.

E. Consumer Subgroup Analysis

In analyzing the potential consumer impact of new or amended standards, the Department evaluated the impact on identifiable groups of consumers (*i.e.*, subgroups) that may be disproportionately affected by a national standard level. The Department analyzed the potential effect of standards on households with low income levels and households occupied by seniors, two consumer subgroups of interest. The Department defined seniors as those households having a head of household over age 65, and defined low income as those households at or below 100 percent of the poverty level. (See TSD, Chapter 11.)

The Department also analyzed the potential effect of standards on Southern and Northern households. For this analysis, the Department defined Southern households as those households located in States that have an average of less than 5,000 heating degree-days. The Department defined Northern households as those households located in States that have an average of more than 5,000 heating degree-days. See section III.A.4 for a list of States that fall under the Northern or Southern regions.

EEI commented that DOE should examine the same subgroups that it analyzed for the residential air conditioner and heat pump rulemaking. (EEI, No. 69 at p. 5) The Department analyzed households with low income levels and households occupied by seniors in the furnace and boiler analysis, as it did in the residential air conditioner and heat pump rulemaking. NSEG suggested that DOE use discount rates specific to each subgroup. (NSEG, No. 51 at p. 6) The Department's analysis uses a distribution of discount rates that accounts for all consumer subgroups.

F. Manufacturer Impact Analysis

1. General Description

In determining whether a standard for a covered product is economically justified, the Secretary of Energy is required to consider ''the economic impact of the standard on the manufacturers and on the consumers of the products subject to such standard.'' (42 U.S.C. 6295(o)(2)(B)(i)(I)) The statute also calls for an assessment of the impact of any lessening of competition as determined by the Attorney General. (42 U.S.C. 6295(o)(2)(B)(i)(V)) The Department conducted the MIA to estimate the financial impact of efficiency standards on the residential furnace and boiler industry and to assess the impact of such standards on employment and manufacturing capacity.

The MIA has both quantitative and qualitative components. The quantitative part of the MIA primarily relies on the GRIM, an industry-cash-flow model adapted for this rulemaking. The key GRIM inputs relate to industry cost structure, shipments, and pricing strategies. The GRIM's key output is the INPV. The model estimates the financial impact of higher efficiency standards by comparing changes in INPV between the baseline and the various trial standard levels. The qualitative part of the MIA addresses factors such as product characteristics, characteristics of particular firms, and market and product trends, and includes an assessment of the impacts of standards on subgroups of manufacturers. (See TSD, Chapter 12.)

On July 17, 2001, the Department prepared a Framework Document entitled *Framework Document for Residential Furnaces and Boilers Energy Conservation Standards Rulemaking.*[17] This document outlined the procedural and analytical approaches to be used in the MIA. Later in the rulemaking, the 2004 ANOPR further discussed the three-step process involved in determining the impact of new residential furnace and boiler standards on manufacturers. 69 FR 45451. This process is detailed below. In response to the 2004 ANOPR documentation and public meeting, the Department received specific comments on the MIA, which are addressed in this section.

As outlined, the Department conducted the MIA in three phases. Phase 1, Industry Profile, consisted of preparing an industry characterization, including data on market share, sales volumes and trends, pricing, employment, and financial structure. Phase 2, Industry Cash Flow, focused on the industry as a whole. In this phase, DOE used the GRIM to prepare an industry-cash-flow analysis. Using publicly available information developed in Phase 1, the Department adapted the GRIM's generic structure to perform an analysis of residential furnace and boiler energy conservation

[17] U.S. Department of Energy, *Framework Document for Residential Furnaces and Boilers Energy Conservation Standards Rulemaking,* July 17, 2001. This document is available at *http://www.eere.energy.gov/buildings/applicance_standards/residential/furnace_boiler_framework_mtg.html.*

standards. In Phase 3, Subgroup Impact Analysis, DOE conducted interviews with manufacturers representing over 80 percent of domestic furnace and boiler sales. This group included large and small manufacturers of furnaces and boilers, providing a representative cross-section of the industry. During these interviews, the Department discussed engineering, manufacturing, procurement, and financial topics specific to each company and also obtained each manufacturer's view of the industry as a whole. The interviews provided valuable information that the Department used to evaluate the impacts of a standard on manufacturers' cash flows, manufacturing capacities, and employment levels.

2. Industry Profile

In Phase 1 of the MIA, the Department prepared a profile of the residential furnace and boiler industry that built on the market and technology assessments originally prepared for the 2004 ANOPR analysis and subsequently updated for today's proposed rule. Before initiating the detailed impact studies, DOE collected information on the present and past structure and market characteristics of residential furnace and boiler manufacturing. The information DOE collected at that time included market share, product shipments, markups, and cost structure for various manufacturers. The industry profile includes further detail on product characteristics, estimated manufacturer market shares, the financial situation of manufacturers, trends in the number of firms, the market, and product characteristics of the residential furnace and boiler industry.

The industry profile included a topdown cost analysis of residential furnace and boiler manufacturers that DOE used to derive cost and preliminary financial inputs for the GRIM (e.g., revenues; material; labor; overhead; depreciation; selling, general, and administrative expenses; and R&D expenses). The Department also used public sources of information to expand its initial characterization of the industry, including 10–K reports from the Securities and Exchange Commission, Moody's company data reports, Standard & Poor's stock reports, Value Line industry composites, corporate annual reports, the U.S. Census Bureau's Economic Census, Dun & Bradstreet reports, and industry analysis from Ibbotson Associates and Dow Jones Financial Services.

3. Industry Cash Flow Analysis

Phase 2 of the MIA focused on the financial impacts of new standards on the industry as a whole. Energy conservation standards can affect furnace and boiler manufacturers in three distinct ways, including: (1) Increased investment; (2) higher production costs per unit; and (3) altered revenue by virtue of higher per-unit prices and changes in sales volumes. The analytical tool DOE uses for calculating the financial impacts of standards on manufacturers is the GRIM. To quantify these impacts in Phase 2 of the MIA, the Department performed a cash flow analysis of the residential furnace and boiler industry using the GRIM.

4. Subgroup Impact Analysis

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 largely differs from the industry average could be more negatively affected. The Department used the results of the industry characterization to group manufacturers exhibiting similar characteristics. In the Framework Document and at the 2004 ANOPR public meeting, the Department invited stakeholders to comment on the manufacturing subgroups that should be analyzed for the MIA. The Department had established six subgroups corresponding to each of the product classes in the 2004 ANOPR. It did not receive comments at the public meeting or in response to either the Framework Document or the 2004 ANOPR. Consequently, the Department decided to use the six subgroups that correspond to each of the product classes in the MIA, based on the market assessment.

Based on this decision, the Department prepared two different interview guides—one for furnace manufacturers and one for boiler manufacturers. The Department used these interview guides to tailor the GRIM to incorporate unique financial characteristics from both industries. Within each of these industries, the Department contacted companies from its database of manufacturers, which provided a representation of each subgroup. It interviewed small and large companies, subsidiaries and independent firms, and public and private corporations. The Department also made an effort to interview companies that had previously participated in the Department's rulemaking process for residential furnaces and boilers. The purpose of the meetings was to enhance the Department's understanding of how manufacturer impacts vary with the trial standard levels. During the course of the MIA, the Department held nine interviews with furnace manufacturers and five interviews with boiler manufacturers, together representing over 80 percent of domestic furnace and boiler sales. Finally, DOE developed a GRIM for each of the six subgroups.

The Department also evaluated the impact of the energy conservation standards on small businesses. Small businesses, as defined by the Small Business Administration (SBA) for the furnace and boiler manufacturing industry, are manufacturing enterprises with 750 or fewer employees. The Department created a version of the interview guide tailored for small furnace and boiler manufacturers, and contacted 11 small businesses to determine if they were interested in discussing differential impacts standards would have on their companies. (See TSD, Chapter 12.)

5. Government Regulatory Impact Model Analysis

A higher energy conservation standard can affect a manufacturer's cash flow in three distinct ways, resulting in: (1) Increased investment; (2) higher production costs per unit; and (3) altered revenue by virtue of higher per-unit prices and changes in sales volumes. As mentioned, the Department uses the GRIM to quantify changes in cash flow that result in a higher or lower industry value. The GRIM analysis uses a standard, annual-cash-flow analysis that incorporates manufacturer prices, manufacturing costs, shipments, and industry financial information as inputs and models changes in costs, distribution of shipments, investments, and associated margins that would result from new regulatory conditions (in this case, standard levels). The GRIM spreadsheet uses a number of inputs to arrive at a series of annual cash flows, beginning with the base year of the analysis, 2004, and continuing to 2038. The Department calculated INPVs by summing the stream of annual discounted cash flows during this period.

The Department used the GRIM to calculate cash flows using standard accounting principles and to compare changes in INPV between a baseline and different trial standard levels for energy conservation standards (the standards case). Essentially, the difference in INPV between the baseline and the standards case represents the financial impact of the new standard on manufacturers. The Department collected this information from a number of sources, including publicly available data and interviews

with several manufacturers. (See TSD, Chapter 12.)

GAMA asked if the MIA included consideration of cumulative regulatory burden. (GAMA, Public Meeting Transcript, No. 59.8 at p. 241) The Department considered the impacts of cumulative regulations in the MIA. Section V.B.2.d of this notice and Chapter 12 of the TSD summarize these impacts.

6. Manufacturer Interviews

As part of the MIA, DOE discussed potential impacts of standards with manufacturers responsible for a majority of residential furnace and boiler sales. The manufacturers interviewed comprise 82 percent of the gas furnace market, close to 100 percent of the mobile home furnace market, 61 percent of the oil-fired furnace market, and 79 percent of the boiler market. These interviews were in addition to those the Department conducted during the 2004 ANOPR as part of the engineering analysis. The interviews provided valuable information that DOE used to evaluate the impacts of new standards on manufacturers' cash flows, manufacturing capacities, and employment levels.

a. *Issues.* Venting was the most common concern discussed by manufacturers, both at the 2004 ANOPR public meeting and during the manufacturer interviews. Proper venting is necessary because of the safety and reliability issues associated with corrosion that is caused from condensation within the venting systems at certain efficiency levels. Due to this concern, many manufacturers commented that residential furnaces and boilers cannot be properly or safely vented at certain AFUE levels. Instead, some manufacturers stated that they would choose not to manufacturer an entire line of products at those efficiency levels for which the safety concerns exceed the benefits. To address these concerns, the Department requested additional information from manufacturers. For example, for non-weatherized gas furnaces, the Department requested information from manufacturers on the costs for designing, manufacturing, and selling an entire furnace family at an 81-percent-AFUE efficiency level. The Department used manufacturer responses to update product costs in the engineering analysis and investment figures in the MIA. However, this still does not fully address manufacturer concerns with venting because some manufacturers stated they are not willing to bear the increased risk at any cost. (See TSD, Chapter 12.)

Manufacturers of furnaces and boilers stated that the development, manufacture, sale, and use of the products at near-condensing levels would increase the risk of warranty and product liability claims, and that such claims could be substantial and have a significant adverse effect on their future profitability. During the interviews, manufacturers indicated that their warranty costs could double or even triple. Considering that earnings before interest and taxes are typically about seven percent for manufactures of furnaces and boilers, this level of increase in warranted costs could reduce profits by twenty percent or more. Although DOE attempted to quantify the financial impacts resulting from warranty cost increases, it did not consider these costs in its assessment of INPV due to insufficient information relating to changes in equipment failure rates and their associated costs. The Department seeks comment and information which would help to monetize these impacts. (See TSD, Chapter 12.)

Another concern expressed by the manufacturers during the interviews centered on the shipments forecasted by the NES model. The NES model forecasts the total number of products sold and the efficiency distribution of these products for the base case and all trial standard levels. During the course of the interviews, DOE asked manufacturers to comment on the NES forecasts. For many product classes, manufacturers generally agreed with the projected impacts of standards on total shipments and the distribution mix of efficiencies. However, most manufacturers stated that DOE overestimated the shipment levels predicted at higher efficiency levels (trial standard levels 4 and 5). In some cases, they maintained that consumers would stop buying furnaces and boilers and would choose heat pumps and/or combination systems instead. The manufacturers expressed a common view that new construction markets and southern States are most susceptible to product switching. They also noted that higher efficiency standards will affect replacement market sales, where consumers may be more inclined to repair their existing system than to purchase a new system with a costly installation. Finally, manufacturers commented on the predicted distribution of products by efficiency level for the year 2015. In several instances, they provided revised estimates, which the Department used to revise the shipment forecasts in the GRIM. The next section provides further details on the manufacturers' shipments forecast and the NES shipments forecast.

b. *GRIM Scenarios and Key Inputs.*

1. *Shipments Forecast.* The GRIM estimates manufacturer revenues based on total-unit-shipment forecasts and the distribution of these values by AFUE levels. Changes in the efficiency mix by standard level are a key driver of manufacturer finances. For this analysis, the GRIM used both NES and manufacturers' shipments forecasts for each product from 2004 to 2038. Total shipments forecasted by the NES for all trial standard levels in 2015 are shown in Table IV.6 and are further detailed in this section of this proposed rule.

TABLE IV.6.—TOTAL NES-FORECASTED SHIPMENTS IN 2015

[Millions]

Product class	Base case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Non-weatherized gas furnaces	2.77	2.77	2.77	2.76	2.74	2.67
Weatherized gas furnaces	0.424					
Mobile home gas furnaces	0.196	0.195	0.195	0.192	0.182	0.182
Oil-fired furnaces	0.0879					
Gas boilers	0.279					
Oil-fired boilers	0.12					

As described above, manufacturers stated during interviews that the NES understated the decline in shipments at increased efficiency levels. In particular, some manufacturers commented that at trial standard level 4 and above, for non-

weatherized gas furnaces, they expect consumers to switch to heat pumps or repair their existing equipment due to the increased cost of condensing non-weatherized gas furnaces. Manufacturers also suggested that there will be a market shift away from non-weatherized gas furnaces at 90-percent AFUE and above in the southern climates, where heat pumps are more feasible. One manufacturer expects on the order of a 50-percent drop in shipments at trial standard level 5 and a 25-percent drop in shipments at trial standard level 4 for non-weatherized gas furnaces. Manufacturers also expressed their concern that, at trial standard levels 1, 2, and 3, equipment switching alone would cause shipment drops that did not seem to be characterized by the NES.

For weatherized gas furnaces, some manufacturers stated that there would be a decline in shipments for all efficiency levels above the current standard, with more significant declines at 83-percent AFUE. One manufacturer commented that consumers would be more likely to purchase heat pumps because of their reliability, and because of the increased risk of condensation with 83-percent-AFUE furnaces. However, some manufacturers acknowledged that consumers usually buy weatherized gas furnaces with an air-conditioning unit, and the air-conditioning unit is the key driver in consumers' decision.

Manufacturers expressed similar concerns for mobile home furnaces as they did for non-weatherized gas furnaces at and above 90-percent AFUE. They commented that consumers will switch to heat pumps or combination systems rather than make an increased investment in more-efficient mobile home furnaces. For oil-fired furnaces, manufacturers suggested that the industry for this equipment will begin to shrink at trial standard levels 4 and 5. In addition, they foresee a drop in shipments at higher efficiency levels because consumers will either change to alternative heating sources like heat pumps or use propane. Finally, manufacturers of boilers expressed concern that the NES analysis did not forecast any decline in shipments at any of the trial standard levels. They stated that, because of increased first cost, consumers are more likely to choose radiant or electric furnaces than more-efficient boiler systems. One manufacturer recognized that there had already been consolidation within the boiler industry and predicted that increased efficiency standards would cause further consolidation within the boiler industry. Furthermore, other manufacturers stated that they believe that the industry would continue to move toward consolidation even in the absence of increased energy efficiency standards.

The Department took into consideration all of the manufacturers' concerns with the NES shipments forecast and derived an alternative shipments forecast (referred to as ''manufacturers forecast'') for each product class, based on information received during the manufacturer interviews. Table IV.7 shows the alternative shipments forecast for all trial standard levels in 2015 by product class.

TABLE IV.7.—TOTAL MANUFACTURERS' FORECASTED SHIPMENTS IN 2015

[Millions]

Product class	NAECA	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Non-weatherized gas furnaces	2.77	2.77	2.77	2.76	2.33	1.49
Weatherized gas furnaces	0.424					
Mobile home gas furnaces	0.196	0.195	0.195	0.192	0.182	0.182
Oil-fired furnaces	0.0879	0.088	0.088	0.088	0.086	0.082
Gas boilers	0.279	0.279	0.251	0.251	0.251	0.223
Oil-fired boilers	0.12	0.12	0.12	0.12	0.12	0.096

The manufacturers' shipments forecast shows increased declines over the declines forecasted by the NES model for most product classes at increased efficiency levels. Trial standard level 5 shows a more significant decline for all product classes except weatherized gas furnaces. For non-weatherized gas furnaces, the difference between the decline forecasted by the manufacturers' shipments and the decline forecasted by the NES shipments for trial standard levels 4 and 5 is approximately -14 percent and -44 percent, respectively. For weatherized gas furnaces, the Department used the NES shipments forecast because the prices of the products did not largely vary across trial standard levels and, thus, the Department would not expect a decline in the total shipments. Finally, based on its analysis of the furnace and boiler industry, DOE assumed that shipments at lower efficiencies were most likely to be rolled up into higher efficiency levels in response to increases in the efficiency standard. In other words, at an increased minimum standard level, the shipments at efficiencies below the new minimum standard level will be added to the shipments at the new minimum standard level. The Department took both the NES shipments forecast and the manufacturers' shipments forecast into consideration when assessing impacts on the industry.

2. *Markups.* During the interviews, manufacturers commented on the differentiation between basic and premium products. Manufacturers generally stated that they differentiate between basic and premium products and include both in their mix of product offerings. To accomplish this differentiation, manufacturers usually offer higher efficiency levels and more features for premium products, which increases their profitability for these types of products. To estimate the manufacturer price of the equipment sold, DOE applied different markups to the production costs estimated in the engineering analysis.

For the MIA analysis, DOE considered up to four distinct markup scenarios to bound the range of expected product prices following standards. For each product class, the Department used the markup scenarios that best characterize the markup conditions described by manufacturers, and that reflect the type of market responses manufacturers expect as a result of standards. Table IV.8 summarizes the markup scenario DOE used for each product class and the markup applied for the flat markup scenario. (See TSD, Chapter 12.)

TABLE IV.8.—SUMMARY OF MARKUP SCENARIO BY PRODUCT CLASS

Product class	Flat markup (Markup applied)	Two-tier markup	Three-tier markup	Constant price markup
Non-weatherized gas furnaces	1.4	x		
Weatherized gas furnaces	1.4			x
Mobile home gas furnaces*	1.29			
Oil-fired furnaces	1.4			x
Gas boilers	1.44		x	
Oil-fired boilers	1.44		x	

* For mobile home gas furnaces, the Department used flat markup scenario only.

For the flat markup scenario, the Department applied a uniform ''flat markup'' across all products, which it calculated from industry data. A flat markup assumes no differentiation in gross-margin percentage across product efficiency levels. The Department based the two-tier markup on the assumption that manufacturers differentiate between baseline and premium products—giving a baseline product one markup and a premium product another, higher markup. The Department used the three-tier markup assumption for boilers, based on the information the manufacturers provided during the interviews regarding the change in profitability for different efficiency levels. Finally, since some manufacturers commented that they will not be able to recover any of the incremental product cost resulting from new standards for some product classes, the Department used a constant price markup and modeled this situation by assuming manufacturers' baseline prices remain unchanged even if the baseline efficiency level is increased.

3. *Product and Capital Conversion Costs.* Energy conservation standards typically cause manufacturers to incur one-time conversion costs to bring their production facilities and product designs into compliance with the new regulation. For the purpose of the MIA, DOE classified these one-time conversion costs into two major groups. Product conversion expenses are one-time investments in research, development, testing, and marketing, focused on making product designs comply with the new efficiency standard. Conversion-capital expenditures are one-time investments in property, plant, and equipment to adapt or change existing production facilities so that new product designs can be fabricated and assembled.

The Department assessed the R&D expenditures manufacturers would be required to invest at each trial standard level. It obtained financial information through manufacturer interviews and compiled the results in an aggregated form to mask any proprietary or confidential information from any one manufacturer. For each product class and trial standard level, DOE considered a number of manufacturer responses. The Department estimated the total product conversion expenditures by gathering the responses received during the manufacturer interviews, then weighed these data by market share for each industry and, finally, extrapolated each manufacturer's R&D expenditures for each product.

The Department also evaluated the level of conversion-capital expenditures needed to comply with new energy conservation standards. It prepared preliminary estimates of the capital investments required using the manufacturing cost model. The Department then used the manufacturer interviews to gather additional data on the level of capital investment required at the various efficiency levels. Manufacturers explained how different trial standard levels impacted their ability to use existing plants, warehouses, tooling, and equipment. From the interviews, the Department was able to estimate what portion of existing manufacturing assets needed to be replaced and/or reconfigured, and what additional manufacturing assets were required to manufacture the higher efficiency equipment. In most cases, higher standards required the replacement of a larger proportion of existing assets.

G. Employment Impact Analysis

The Process Rule includes employment impacts among the factors that DOE considers in selecting a proposed standard. Employment impacts include direct and indirect impacts. Direct employment impacts are any changes in the number of employees for furnace and boiler manufacturers. Indirect impacts are those changes of employment in the larger economy that occur due to the shift in expenditures and capital investment that is caused by the purchase and operation of more-efficient furnace and boiler equipment. The MIA addresses direct employment impacts; this section describes indirect impacts.

Indirect employment impacts from furnace and boiler standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, as a consequence of: (1) Reduced spending by end users on energy (electricity, gas—including LPG—and oil); (2) reduced spending on new energy supply by the utility industry; (3) increased spending on the purchase price of new furnaces and boilers; and (4) the effects of those three factors throughout the economy. The Department expects the net monetary savings from standards to be redirected to other forms of economic activity. The Department also expects these shifts in spending and economic activity to affect the demand for labor in the short term.

In developing this proposed rule, the Department estimated indirect national employment impacts using an input/output model of the U.S. economy, called IMBUILD (impact of building energy efficiency programs). The Department's Office of Building Technology, State, and Community Programs (now the Building Technologies Program) developed the model. IMBUILD is a personal-computer-based, economic-analysis model that characterizes the interconnections among 35 sectors of the economy as national input/output structural matrices, using data from the U.S. Bureau of Labor Statistics (BLS). The IMBUILD model estimates changes in employment, industry output, and wage income in the overall economy of the United States resulting from changes in expenditures in the various sectors of the economy. The Department estimated changes in expenditures using the NES Spreadsheet. Using IMBUILD, it then estimated the net national, indirect-employment impacts of potential furnace and boiler efficiency standards on employment by sector.

While both the IMBUILD input/output model and the direct use of BLS employment data suggest the proposed furnace and boiler standards could increase the net demand for labor in the economy, the gains would most likely be very small relative to total national employment. The Department therefore concludes only that the proposed furnace and boiler standards are likely to produce employment benefits that are sufficient to offset fully any adverse impacts on employment in the furnace and boiler or energy industries. (See TSD, Chapter 14.)

The Department did not receive stakeholder comments on these indirect employment impact methods, which it proposed in the 2004 ANOPR for use in the today's analysis.

H. Utility Impact Analysis

The utility impact analysis estimates the change in the forecasted power generation capacity for the Nation. This analysis separately determines the changes to supply and demand as a result of natural gas, fuel oil, LPG or electricity residential consumption savings due to the standard. The Department calculated this change using the NEMS–BT computer model. The NEMS–BT models certain policy scenarios such as the effect of reduced energy consumption per trial standard level by fuel type. The analysis output provides a forecast for the needed generation capacities at each trial standard level. The estimated net benefit of the standard is the difference between the forecasted generation capacities by NEMS–BT and the *AEO2005* Reference Case.

The Department obtained the energy savings inputs associated with electricity and natural gas consumption savings from the NES analysis. These inputs reflect the effects of efficiency improvement on furnace energy consumption, both fuel (natural gas, fuel oil, and LPG) and electricity. The inputs also reflect the impacts associated with the market shift from natural gas heating to electric heating projected to occur at trial standard levels that have an increased installed cost for gas furnaces. At trial standard levels 4 and 5, the electricity consumption due to the market shift more than offsets the electricity savings through more-efficient furnace designs. This effect results in an overall increase in projected generating capacity. The results represent the corresponding changes to utility sector supply and demand as a result of natural gas, fuel oil, LPG, or electricity residential consumption savings (or in some cases increases). Chapter 13 of the TSD presents results of the utility impact analysis.

AGA stated that the impact of market shifts from natural gas heating to electric heating on natural gas utilities should be developed in the utility impact analysis. (AGA, Public Meeting Transcript, No. 59.8 at p. 41) Historically, the Department's approach for the utility impact analysis has only evaluated the impact of market shifts associated with standards on energy consumption, which is related to utility sales. The evaluation of other types of utility impacts that result from declines in the sales of natural gas or other forms of energy is not part of the analysis methodology; thus, DOE did not perform this type of evaluation in the utility impact analysis for the furnace and boiler standards rulemaking.

EEI commented that DOE should evaluate the direct impact of new standards on the peak loads of the natural gas grid and oil supply chain in the United States, in addition to any analysis on the indirect impacts on the electric system. (EEI, No. 69 at p. 5) The utility impact analysis used NEMS to account for electricity peak load impacts. It did not consider peak load impacts on the natural gas grid and oil supply chain because these systems have sufficient storage to avoid peak demand impacts.

I. Environmental Analysis

Under 42 U.S.C. 6295(o)(2)(B)(i)(VI), the Department determined the environmental impacts of the proposed standard. The Department estimated direct emissions impacts at the household level as well as impacts on power plant emissions. While the Department is not proposing to regulate furnace and boiler electricity use, the electricity use of these appliances affects power plant emissions.

The Department calculated the reduction in power plant emissions of CO_2 and NO_X using the NEMS–BT computer model. The NEMS–BT is similar to the *AEO2005* NEMS, except that furnace and boiler energy usage is reduced by the amount of energy (by fuel type) saved due to the trial standard levels. The Department obtained the input of energy savings from the NES Spreadsheet. For the environmental analysis, the output is the forecasted physical emissions. The net impact of the standard is the difference between emissions estimated by NEMS–BT and the *AEO2005* Reference Case. NEMS–BT tracks CO_2 emissions using a detailed module that provides robust results because of its broad coverage of all sectors and inclusion of interactive effects. The Department also generated alternative price forecasts for use by NEMS–BT, corresponding to the High and Low Economic Growth sensitivity cases found in *AEO2005,* and used them as alternative scenarios. The Department presents these forecasts in the environmental assessment in the TSD.

The Department does not report an estimated reduction in power plant emissions of SO_2 because any such reduction resulting from an efficiency standard would not affect the overall level of SO_2 emissions in the U.S. The Clean Air Act Amendments of 1990 set an SO_2 emissions cap on all power generation. The attainment of this target is flexible among generators and is enforced through the use of emissions allowances and tradable permits. Accurate simulation of SO_2 trading implies that the effect of efficiency standards on physical emissions will be near zero because emissions will always be at or near the allowed ceiling. Thus, there may not be an actual reduction in SO_2 emissions from electricity savings as long as emission ceilings are binding. However, although there may not be an environmental benefit from reduced SO_2 emissions from electricity savings, there still may be an economic benefit. Electricity savings can decrease the need to purchase or produce SO_2 emissions allowance credits, which decreases the costs of complying with regulatory caps on emissions. The Department reports household SO_2 emissions savings, because the SO_2 emissions caps do not apply to household emissions.

Power sector NO_X emissions impacts will be affected by the Clean Air Interstate Rule (CAIR), which the U.S. Environmental Protection Agency (EPA) issued on March 10, 2005. CAIR will permanently cap emissions of NO_X in 28 eastern states and the District of Columbia. 70 FR 25162 (May 12, 2005). As with SO_2 emissions, a cap on NO_X emissions means that equipment efficiency standards may result in no physical effects on these emissions. When NO_X emissions are subject to emissions caps, the Department's emissions reduction estimate corresponds to incremental changes in emissions allowance credits in cap-and-trade emissions markets rather than physical emissions reductions. Therefore, while the emissions cap may not result in physical emissions reduction from the proposed standards, it does produce an environmental-related economic benefit in the form of emissions allowance credits.

In addition to electricity, the operation of furnaces and boilers requires use of fossil fuels, and results in household emissions of CO_2, NO_X,

and SO_2 at the sites where appliances are used. NEMS–BT provides no means for estimating such household emissions. Therefore, DOE calculated separate estimates of the effect of the proposed standard on household emissions of CO_2, NO_X, and SO_2, based on emissions factors derived from the literature.

The Department invites comments on the environmental assessment that is published with the TSD.

V. Analytical Results

A. Trial Standard Levels

The Department analyzed the benefits and burdens of the five trial standard levels considered in today's proposed rule. Table V.1 presents the five trial standard levels and the corresponding product class efficiencies.

TABLE V.1.—TRIAL STANDARD LEVELS FOR FURNACES AND BOILERS

Product classes	Trial standard levels (AFUE, %)				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Non-weatherized gas furnaces	80	80	81	90	96
Weatherized gas furnaces	80	83	83	83	83
Mobile home gas furnaces	80	80	81	90	90
Oil-fired furnaces	80	82	82	84	85
Gas boilers	82	84	84	84	99
Oil-fired boilers	83	83	83	84	95

Trial standard level 1 represents the most common product efficiencies of the current market, based on the NES shipments forecast. (See TSD, Chapter 9.) For example, for non-weatherized, gas-fired furnaces, trial standard level 1 is 80-percent AFUE. The Department also examined the 2005 GAMA directory and compared the number of models listed in the directory to the NES shipments forecast. For non-weatherized gas furnaces, 80-percent AFUE also represents the highest number of models listed in the 2005 GAMA directory. Furthermore, trial standard level 1, 80-percent AFUE, for non-weatherized gas furnaces represents a two-percent increase in AFUE compared to the current base-case standard level for these products.

Trial standard level 2 is the set of efficiencies for all product classes that yields the maximum NPV as calculated in the NES analysis, assuming a seven-percent discount rate and only considering non-condensing technologies.[18] (See TSD, Chapter 10.) For example, for weatherized gas furnaces, 83-percent AFUE represents the efficiency level that corresponds to the maximum NPV calculated in the NES. Trial standard level 2, 83-percent AFUE, also corresponds to the maximum technologically feasible level for weatherized gas furnaces.

Trial standard level 3 consists of the efficiency ratings that correspond to the maximum NPV as defined by the selection criteria for trial standard level 2, except that the efficiency levels for non-weatherized gas furnaces and mobile home furnaces are adjusted to 81-percent AFUE. The Department recognizes there is a potential for increased safety risk to consumers at 81-percent AFUE for non-weatherized gas furnaces and mobile home furnaces because of a higher potential for vent system and heat exchanger corrosion failure. In its 2004 ANOPR analysis, the Department found that as many as eight percent of the installations could pose increased risk of vent and heat exchanger failure. 69 FR 45419. The Department believes the increased safety risk can likely be resolved through the use of venting materials that are impervious to the corrosive effects of condensate and improved heat exchanger designs. It included the cost of implementing such techniques in its analysis for trial standard level 3. In addition, DOE recognizes that, in some instances, consumers could instead elect to install a more efficient, condensing gas-fired furnace. The Department's analysis did not capture that possibility.

Trial standard level 4 consists of efficiency ratings that correspond to the maximum efficiency level that has positive NPV calculated by the NES, assuming a three-percent discount rate. For example, oil-fired boilers at trial standard level 4, or 84-percent AFUE, represent the maximum efficiency level for which there would still be positive savings between the standards case and the base case. At efficiency levels above trial standard level 4, there are negative consumer impacts as shown by the negative NPVs.

Trial standard level 5 is the maximum technologically feasible level. It represents condensing technologies for all classes, except weatherized gas-fired furnaces and oil-fired boilers.

B. Economic Justification and Energy Savings

1. Economic Impacts on Consumers

a. *Life-Cycle Cost and Payback Period.* To evaluate the net economic impact of the standards on consumers, the Department conducted an LCC and payback period analysis for each of the trial standard levels. Higher-efficiency furnaces and boilers would affect consumers in two ways: Annual operating expense would decrease and purchase price and payback period would increase. The payback period is an economic benefit-cost measure that uses benefits and costs without discounting. Section IV.C discusses the inputs used for calculating the LCC and payback period.

For each trial standard level and for all product classes, the LCC analysis estimates the fraction of households for which the LCC will either decrease (net benefit), or increase (net cost), or exhibit no change (no impact) relative to the base case equipment forecast. No impacts occur when the equipment efficiencies of the base case forecast already equal or exceed the considered trial standard level efficiency.

Tables V.2 through V.7 show the mean LCC savings and the percent of households with a net cost, no impact, and a net benefit (*i.e.*, positive savings) at each trial standard level for each of the product classes, using the *AEO2005* energy prices forecast. (Values in parentheses in the columns for LCC savings represent an increase in LCC.) The tables also show the mean payback period at each trial standard level.

[18] The Department established the efficiency levels in each TSL based on the analysis using *AEO2005* energy price forecasts.

The annual energy consumption calculated from the test procedure is greater than the annual energy consumption used in the LCC analysis. Therefore, the mean payback periods calculated for the LCC analysis are longer than the rebuttable payback periods, which use the test procedure energy consumption results.

TABLE V.2.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR NON-WEATHERIZED GAS FURNACES

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	9,985	.....	.....	.....	.....	.....
1	80	9,834	2	0	98	2	1.5
2	80	9,834	2	0	98	2	1.5
3	81	9,826	2	32	36	32	26
4	90	9,753	5	39	35	25	23
5	96	10,521	(731)	88	4	8	88

TABLE V.3.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR WEATHERIZED GAS FURNACES

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefits	years
		2004$	2004$	%	%	%	
Baseline Unit	78	8,256	.....	.....	.....	.....	.....
1	80	8,179	2	0	98	2	1.6
2	83	8,085	73	6	0	94	4.6
3	83	8,085	73	6	0	94	4.6
4	83	8,085	73	6	0	94	4.6
5	83	8,085	73	6	0	94	4.6

TABLE V.4.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR MOBILE HOME GAS FURNACES

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	75	7,930	.....	.....	.....	.....	.....
1	80	7,600	51	1	85	14	5
2	80	7,600	51	1	85	14	5
3	81	7,635	18	71	5	24	31
4	90	7,524	124	42	5	53	25
5	90	7,524	124	42	5	53	25

TABLE V.5.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR OIL-FIRED FURNACES

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	11,593	.....	.....	.....	.....	.....
1	80	11,418	7	0	96	4	0.3
2	82	11,257	113	0	30	70	0.8
3	82	11,257	113	0	30	70	0.8
4	84	11,425	(23)	54	15	31	18
5	85	11,518	(109)	67	7	25	22

TABLE V.6.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR GAS BOILERS

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	80	15,847	.....	.....	.....	.....	.....
1	82	15,416	158	11	44	46	12
2	84	15,334	232	18	15	67	12
3	84	15,344	232	18	15	67	12
4	84	15,344	232	18	15	67	12
5	99	16,412	(795)	77	3	20	40

TABLE V.7.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR OIL-FIRED BOILERS

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	80	16,896	.....	.....	.....	.....	.....
1	83	16,506	40	0	84	16	1.2
2	83	16,506	40	0	84	16	1.2
3	83	16,506	40	0	84	16	1.2
4	84	16,606	1	24	61	15	27
5	95	17,775	(1070)	90	0	10	36

Similarly, Tables V.8 through V.13 show LCC results for the energy price sensitivity analysis. They list the mean LCC savings and the percent of households with a net cost, no impact, and a net benefit (*i.e.,* positive savings) at each trial standard level for each of the product classes, based on energy price forecast from *AEO2006.* (Values in parentheses in the columns for LCC savings represent an increase in LCC.) The tables also show the mean payback period at each trial standard level.

TABLE V.8.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR NON-WEATHERIZED GAS FURNACES IN THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	11,214	.....	.....	.....	.....	.....
1	80	11,038	2	0	98	2	1.6
2	80	11,038	2	0	98	2	1.6
3	81	11,018	8	30	36	34	22
4	90	10,850	63	35	35	29	20
5	96	11,564	(626)	85	4	12	75

TABLE V.9.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR WEATHERIZED GAS FURNACES IN THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	8,898	.....	.....	.....	.....	.....
1	80	8,809	2	0	98	2	1.4
2	83	8,698	86	5	0	95	4.0

TABLE V.9.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR WEATHERIZED GAS FURNACES IN THE ENERGY PRICE SENSITIVITY ANALYSIS—Continued

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
3	83	8,698	86	5	0	95	4.0
4	83	8,698	86	5	0	95	4.0
5	83	8,698	86	5	0	95	4.0

TABLE V.10.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR MOBILE HOME GAS FURNACES IN THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	75	9,399	.....	.....	.....	.....	.....
1	80	8,940	$71	1	85	14	3.6
2	80	8,940	71	1	85	14	3.6
3	81	8,964	49	64	5	31	28
4	90	8,764	240	32	5	63	21
5	90	8,764	240	32	5	63	21

TABLE V.11.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR OIL-FIRED FURNACES IN THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	14,946	.....	.....	.....	.....	.....
1	80	14,690	10	0	96	4	0.2
2	82	14,453	167	0	30	70	0.6
3	82	14,453	167	0	30	70	0.6
4	84	14,548	90	39	15	46	13
5	85	14,606	37	52	7	41	15

TABLE V.12.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR GAS BOILERS IN THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	80	17,772	.....	.....	.....	.....	.....
1	82	17,193	196	9	44	47	10
2	84	17,074	299	15	15	70	10
3	84	17,074	299	15	15	70	10
4	84	17,074	299	15	15	70	10
5	99	17,922	(508)	70	3	27	35

TABLE V.13.— SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR OIL-FIRED BOILERS IN THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	80	22,527	.....	.....	.....	.....	.....
1	83	21,937	61	0	84	16	0.8
2	83	21,937	61	0	84	16	0.8
3	83	21,937	61	0	84	16	0.8
4	84	21,973	47	17	61	22	19
5	95	22,542	(471)	72	0	28	26

b. *Consumer Subgroup Analysis.* Using the LCC Spreadsheet Model, the Department determined the impact of the standards for non-weatherized gas furnaces on the following consumer subgroups: Low-income households, senior-only households, and Southern and Northern households. The results for low-income and senior-only households indicate that the LCC impacts on these subgroups and the payback periods are similar to the LCC impacts and payback periods on the full sample of residential consumers. Thus, the proposed furnace and boiler standards would have an impact on low-income households and senior-only households that would be similar to their impact on the general population of residential consumers. (See TSD, Chapter 11.)

The Department also determined the impact of the standards for non-weatherized gas furnaces on Southern and Northern households. Tables V.14 and V.15 show the mean LCC savings and the percent of households with a net cost, no impact, and a net benefit (*i.e.*, positive savings) at each trial standard level for non-weatherized gas furnaces, using the *AEO2005* energy prices forecast. (Values in parentheses in the columns for LCC savings represent an increase in LCC.) The tables also show the mean payback period at each trial standard level.

TABLE V.14.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR NON-WEATHERIZED GAS FURNACES IN THE NORTHERN REGION

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	11,383	.....	.....	.....	.....	.....
1	80	11,202	2	0	99	1	0.6
2	80	11,202	2	0	99	1	0.6
3	81	11,179	10	23	48	30	17
4	90	10,990	79	24	48	28	15
5	96	11,695	(582)	85	6	9	65

TABLE V.15.—SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR NON-WEATHERIZED GAS FURNACES IN THE SOUTHERN REGION

[AEO2005 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78%	8,359	.....	.....	.....	.....	.....
1	80	8,242	1	0	98	2	2.1
2	80	8,242	1	0	98	2	2.1
3	81	8,250	(9)	44	20	35	32
4	90	8,305	(79)	57	19	23	29
5	96	9,140	(894)	91	1	7	110

Similarly, Tables V.16 and V.17 show the LCC subgroup results by region for the energy price sensitivity analysis. The tables indicate the impact of the standards for non-weatherized gas furnaces on Southern and Northern

households, based on the *AEO2006* energy price forecast, in terms of the mean LCC savings and the percent of households with a net cost, no impact, and a net benefit (*i.e.*, positive savings) at each trial standard level. (Values in parentheses in the columns for LCC savings represent an increase in LCC.) The tables also show the mean payback period at each trial standard level.

TABLE V.16.— SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR NON-WEATHERIZED GAS FURNACES IN THE NORTHERN REGION EVALUATED AS PART OF THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	12,835	.....	.....	.....	.....	.....
1	80	12,625	2	0	99	1	0.5
2	80	12,625	2	0	99	1	0.5
3	81	12,588	17	21	48	32	15
4	90	12,286	138	20	48	32	13
5	96	12,926	(471)	81	6	13	55

TABLE V.17.— SUMMARY OF LCC AND PAYBACK PERIOD RESULTS FOR NON-WEATHERIZED GAS FURNACES IN THE SOUTHERN REGION EVALUATED AS PART OF THE ENERGY PRICE SENSITIVITY ANALYSIS

[AEO2006 energy price forecast]

Trial standard level	Efficiency level (AFUE) (%)	LCC					Payback period
		LCC	LCC savings	Net cost	No impact	Net benefit	years
		2004$	2004$	%	%	%	
Baseline Unit	78	9,274	.....	.....	.....	.....	.....
1	80	9,139	1	0	98	2	1.9
2	80	9,139	1	0	98	2	1.9
3	81	9,137	(2)	42	20	38	28
4	90	9,122	(20)	53	19	27	25
5	96	9,916	(796)	89	1	10	95

c. *Rebuttable-Presumption Payback.* As set forth in section 325(o)(2)(B)(iii) of EPCA, 42 U.S.C. 6295(o)(2)(B)(iii), there is a rebuttable presumption that an energy conservation standard is economically justified if the increased installed cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. However, while the Department examined the rebuttable-presumption criteria, it determined economic justification for the proposed standard levels through a weighting of the benefits and burdens of increased efficiency in accordance with section 325(o)(2)(B)(i) of EPCA. (42 U.S.C. 6295(o)(2)(B)(i))

The Department calculated a rebuttable-presumption payback period for each trial standard level to determine if DOE could presume that a standard at that level is economically justified. Table V.18 shows the rebuttable-presumption payback periods. Rather than using distributions for input values, DOE used discrete values and, as required by EPCA, based the calculation on the DOE furnace and boiler test procedure assumptions. As a result, the Department calculated a single rebuttable-presumption payback value, and not a distribution of payback periods, for each standard level.

TABLE V.18.—REBUTTABLE-PRESUMPTION PAYBACK PERIOD USING DOE TEST PROCEDURE

Product class	Payback period (years)				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Non-weatherized Gas Furnaces	0.9	0.9	na	na	na
Weatherized Gas Furnaces	0.8	na	na	na	na
Mobile Home Gas Furnaces	2.5	2.5	na	na	na
Oil-fired Furnaces	0.1	0.2	0.2	na	na
Gas Boilers	na	na	na	na	na
Oil-fired Boilers	0.4	0.4	0.4	na	na

2. Economic Impacts on Manufacturers

The Department performed an MIA to estimate the impact of higher efficiency standards on furnace and boiler manufacturers. (See TSD, Chapter 12.)

a. *Industry Cash Flow Analysis Results.* The Department used the INPV in the MIA to compare the financial impacts of different trial standard levels on furnace and boiler manufacturers. The INPV is the sum of all net cash flows discounted at the industry's cost of capital, or discount rate. Because the INPV applies only to the furnace and boiler manufacturing industry, the INPV is different from the NPV that the Department used to assess the cumulative benefit or cost of standards to consumers on a national basis. The GRIM estimated cash flows between 2004 and 2038 and found them to be consistent with the forecast period used in the national impact analysis.

The Department compared the INPV of the base case (no new efficiency standard) to that of each trial standard level. The difference in INPV is an estimate of the economic impacts that implementing that particular standard would have on the entire industry. To evaluate the range of cash flow impacts on the industry, the Department constructed up to four different GRIM scenarios for each product class that used different assumptions for markups and shipments, as described above.

i. Non-Weatherized Gas Furnaces. For non-weatherized gas furnaces, the Department considered four cash flow scenarios:

The flat markup and two-tier markup scenarios are each combined with NES shipment forecasts and manufacturers' shipment forecasts. To assess the lower end of the range of potential impacts, the Department used the flat markup and NES shipments scenario, which represents an optimistic situation where shipments are not greatly affected by even a large increase in cost to the consumer. In addition, this scenario assumes that manufacturers do not differentiate their baseline products from their premium products, either in the base case or the standards case—thus, the scenario assumes a constant markup across all efficiencies. The Department did not reduce this profit margin to offset some of the price burden passed on to the consumer in the standards case. Consequently, some of the manufacturer impacts on INPV are positive.

To assess the higher end of the range of potential impacts, the Department used the manufacturers' shipments forecast and modeled a two-tiered markup structure. The two-tier scenario assumes that the proportion of premium-margin sales will be reduced by the ''roll-up'' of lower efficiency products to the new standard level. The manufacturers' shipments forecast assumes an increased drop in shipments for trial standard levels 4 and 5 due to equipment switching and an increase in repairs of current systems. As can be observed from the cash flow results, both the shipment scenario and the markup scenario have a significant impact on the results. Table V.19 shows the manufacturer impacts for each of the four scenarios.

TABLE V.19. CHANGES IN INDUSTRY NET PRESENT VALUE, NON-WEATHERIZED GAS FURNACES

TSL	NES shipments					
	Flat markup			Two-tier markup		
	INPV $MM	Change in INPV from base		INPV $MM	Change in INPV from base	
		$MM	% change		$MM	% change
Base case	1,044	.....	.....	1,010	.....	.....
1	1,044	0	0	1,010	0	0
2	1,044	0	0	1,010	0	0
3	974	(69)	−7	938	(72)	−7
4	1,056	13	1	801	(209)	−21
5	1,258	214	21	824	(186)	−18

TSL	Manufacturers' shipments					
	Flat markup			Two-tier markup		
	INPV $MM	Change in INPV from base		INPV $MM	Change in INPV from base	
		$MM	% change		$MM	% change
Base case	1,068	.....	.....	1,073	.....	.....
1	1,068	0	0	1,073	0	0
2	1,068	0	0	1,073	0	0
3	998	(71)	−7	1,000	(73)	−7
4	980	(88)	−8	777	(295)	−28
5	807	(261)	−24	575	(498)	−46

At trial standard levels 1 and 2 (80-percent AFUE), the impact on INPV and cash flow would be slight, since the bulk of the product being sold is already at the 80-percent AFUE level; thus, industry revenues and costs are not significantly negatively impacted. Furthermore, little investment is required to meet the standard.

At trial standard level 3 (81-percent AFUE), concern over safety and reliability associated with corrosion due to condensation is the dominant issue for manufacturers of non-weatherized gas furnaces. Based on information submitted by industry, to mitigate theses concerns a standard at trial standard level 3 would require a

complete redesign of furnace heat exchangers, entailing $60 million in product conversion expenses and a $121-million investment in new tooling and equipment. Furthermore, manufacturers maintain that this capital outlay does not fully address their safety, reliability, and equipment longevity concerns. Finally, manufacturers stated that, at trial standard level 3, they must address additional liability impacts that are not illustrated by the quantitative results presented here. The impact on INPV at trial standard level 3 is −7 percent and cash flow in the year leading to the effective date would be reduced to approximately zero from a base case value of $67 million.

Trial standard level 4 requires the production of 90-percent-AFUE condensing, non-weatherized gas furnaces. If manufacturers lose the ability to market and sell premium products, such as high AFUE condensing products, then DOE expects the impact on INPV to be larger. Another key uncertainty in future profitability is the market response to the higher price and corresponding energy savings of the condensing product. Manufacturers predict a much greater drop in unit sales than the NES analysis forecasted. The INPV impacts range from +1-percent to −28 percent. The required product and capital conversion costs are significant and estimated to be $82 million and $174.3 million, respectively, because of the need for a secondary heat exchanger. At this level, the industry cash flow becomes slightly negative, −$1 million, compared to the base case value of $67 million in the year leading up to the standards.

At trial standard level 5 (96-percent-AFUE), the impact on INPV would range between +21 percent and −46 percent, depending on markup and shipment assumptions. The industry would experience an increase in value if it were able to fully pass through to consumers the incremental production costs and associated markups, and the shipments were reduced according to the forecasts in the NES shipments model. However, there is a risk of very large negative impacts if shipments were reduced according to manufacturers' expectations and in the very likely situation that manufacturers were no longer able to offer premium products at higher margins. During the interviews, manufacturers expressed disbelief at the possibility of manufacturing an entire product line at 96-percent AFUE, since there is only one model currently being manufactured at this efficiency level. Most manufacturers did not provide DOE with projected product conversion costs or capital conversion costs at this level, since they could not conceive of what designs might reach this efficiency level. The Department estimated the required product and capital conversion costs, based on limited input, to be $144 million and $705 million, respectively for TSL 5. The impact on annual cash flow from product conversion and capital expenditures prior to the standard would be severe. The peak negative cash flow would be approximately four times the magnitude of the base-case positive cash flow.

ii. Weatherized Gas Furnaces. For weatherized gas furnaces, the Department considered two cash flow scenarios, which include the flat-markup and the constant-price scenario—both using NES shipments forecasts. The flat-markup and NES-shipments scenario represents a situation where shipments are not greatly affected, even by a large increase in cost to the consumer. In the second scenario, the constant-price aspect assumes that manufacturers of weatherized gas furnaces will not be able to recover the incremental product costs resulting from increased standards. The Department used these two markup scenarios because manufacturers currently do not differentiate between baseline and premium products, since condensing technologies are not used in weatherized gas furnaces and therefore are not a differentiating feature that requires a premium markup. Consequently, the Department did not consider a two-tier markup scenario. Table V.20 shows the weatherized gas furnace industry impacts using the two scenarios.

TABLE V.20.—CHANGES IN INDUSTRY NET PRESENT VALUE, WEATHERIZED GAS FURNACES

TSL	NES shipments					
	Flat markup			Constant price markup		
	INPV $MM	Change in INPV from base		INPV $MM	Change in INPV from base	
		$MM	% change		$MM	% change
Base case	246	.....	.....	246	.....	.....
1	220	(27)	−11	215	(31)	−13
2	199	(47)	−19	167	(79)	−32
3	199	(47)	−19	167	(79)	−32
4	199	(47)	−19	167	(79)	−32
5	199	(47)	−19	167	(79)	−32

The impact on INPV for weatherized gas furnaces at trial standard level 1 (81-percent AFUE) ranges between −11 percent and −13 percent. Even with the flat-markup assumption and accepting the NES-shipments forecast unaltered, the industry value drops because of the large conversion costs relative to industry revenues. To achieve 81-percent AFUE, manufacturers estimate product conversion costs of $49 million and capital conversion expenses of $28 million. Negative cash flows peak at approximately $5 million from a base-case value of $17 million in 2014.

At 83-percent AFUE, trial standard levels 2–5, DOE forecasts that the INPV will drop between 19 percent and 32 percent. At 83-percent AFUE, investment in corrosion-resistant materials must be made. The Department estimates the required product-conversion and capital-conversion costs at $70 million and $61 million, respectively. Manufacturers stated that this is primarily due to the need for stainless steel heat exchangers. Net cash flow would drop to approximately −$25 million, a drop of $40 million from the base case.

iii. Mobile Home Gas Furnaces. For mobile home furnaces, the Department considered two cash flow scenarios: the

flat-markup and NES-shipments scenario, and the flat-markup and manufacturers' shipments scenario. The flat-markup and NES-shipments scenario represents a situation where shipments are not greatly affected by a large increase in cost to the consumer. The Department used the flat-markup because it does not believe there is a large variation in gross margin across all available efficiency levels. To represent the higher range of potential impacts, the Department used the flat-markup and manufacturers' shipments scenario. The manufacturers' shipments forecast shows a decline in mobile home furnace shipments at trial standard levels 4 and 5. Manufacturers stated that consumers are more likely to choose heat pumps, combination systems, electric furnaces, or electric strip heaters, instead of buying the more efficient, more costly mobile home furnaces at trial standard levels 4 and 5. Table V.21 shows the manufacturer impacts for mobile home gas furnaces.

TABLE V.21.—CHANGES IN INDUSTRY NET PRESENT VALUE, MOBILE HOME GAS FURNACES

TSL	Flat markup					
	NES shipments			Manufacturers' shipments		
	INPV $MM	Change in INPV from base		INPV $MM	Change in INPV from base	
		$MM	% change		$MM	% change
Base case	21	.....	.....	21	.....	.....
1	21	0	0	21	0	0
2	21	0	0	21	0	0
3	18	(3)	−14	18	(3)	−14
4	12	(9)	−42	11	(10)	−49
5	12	(9)	−42	11	(10)	−49

At 80-percent AFUE, trial standard levels 1 and 2, the INPV and cash flow impacts are negligible, and little investment is required to meet the standard.

At trial standard level 3, DOE estimates that the INPV will drop by 14 percent. It estimates product-conversion and capital-conversion costs at $1.7 million and $6 million, respectively. Net cash flow drops precipitously from +$1 million to slightly negative values in the year 2014.

At 90-percent AFUE, trial standard levels 4 and 5, product-conversion costs of $6.7 million and capital expenditures of $12 million contribute to lowering INPV by 42–49 percent. Net cash flow becomes negative by a factor of more than seven times the base-case value.

iv. Oil-Fired Furnaces. For oil-fired furnaces, the Department considered two cash flow scenarios: The flat-markup and NES-shipments scenario, and the constant-price and NES-shipments scenario. The flat-markup and NES-shipments scenario represents a situation where shipments are not greatly affected by increased cost to the consumer. For the second scenario, the Department also used the NES-shipments forecast and applied a constant-margin assumption. While the Department realizes that there will be a drop in shipments at trial standard levels 4 and 5 due to equipment switching, the Department used the NES-shipments forecast because the difference between the NES shipments and the manufacturers' shipments was small and some manufacturers stated that they expected a small drop in shipments at higher proposed standard levels. Furthermore, the Department does not expect a change in shipments when applying a constant-price assumption, because there will be no change in the product costs as a result of new efficiency standards. Table V.22 displays the impacts on INPV for the oil-fired furnace industry for both scenarios.

TABLE V.22.—CHANGES IN INDUSTRY NET PRESENT VALUE, OIL-FIRED FURNACES

TSL	NES shipments					
	Flat markup			Constant price markup		
	INPV $MM	Change in INPV from base		INPV $MM	Change in INPV from base	
		$MM	% change		$MM	% change
Base case	36	.....	.....	36	.....	.....
1	34	(2)	−5	34	(2)	−5
2	33	(3)	−8	31	(4)	−12
3	33	(3)	−8	31	(4)	−12
4	29	(7)	−19	26	(10)	−27
5	28	(8)	−21	23	(12)	−35

At trial standard level 1 (80-percent AFUE), DOE estimates the INPV impacts to be −5 percent for oil-fired furnaces. Cash flow is cut approximately in half, from approximately $2 million to $1 million in 2014. The Department estimates product-conversion costs to be $3 million and capital requirements to total $1 million.

At 82-percent AFUE, trial standard levels 2 and 3, DOE estimates the INPV

impacts to range from −8 percent to −12 percent for oil-fired furnaces. Cash flow would be slightly positive in 2014, a drop of $2 million from the base case. The Department estimates product-conversion costs to be $4.5 million and capital requirements to total $3.6 million. At 82-percent AFUE, one manufacturer indicated the firm would not invest the necessary capital, since it could not justify the investment.

At trial standard level 4 (84-percent AFUE), the INPV impacts range from −19 percent to −27 percent, and at trial standard level 5 (85-percent AFUE) the impacts range from −21 percent to −35 percent. Achieving these efficiency levels would require new heat exchanger designs, which raises the product conversion costs to $8.5 million at both trial standard level 4 and trial standard level 5. Total capital requirements rise to $7 million at trial standard level 4 and $8 million at trial standard level 5. Net cash flow is reduced by nearly 200 percent to −$3.4 million at TSL 4.

Other considerations from the standpoint of manufacturers of oil-fired furnaces include the possibility of implementing a de-rating strategy at trial standard levels 1, 2, and 3 to reduce capital costs. A de-rating strategy aims to achieve higher efficiency levels by using a larger capacity furnace compensated with a downsized burner. This would reduce the span of the product line through elimination of some higher capacity models. In addition, for oil-fired furnaces at 82-percent AFUE, some manufacturers expressed concerns about increased maintenance costs due to sulfur in the fuel and exhaust gas. This sulfur can form a residue that potentially would increase maintenance costs as efficiency rises.

v. Gas Boilers. For gas boilers, the Department considered two cash flow scenarios: the flat markup and the three-tier markup, both using manufacturer-supplied shipment estimates. The Department did not use NES shipments in the GRIM, since they did not demonstrate any price responses by shipments—even at very high efficiency levels. Manufacturers stated that shipments would decrease with increases in efficiency, particularly at the higher levels where consumers would repair existing systems rather than replace them.

The Department therefore defines the two scenarios by the assumed markup strategy—a flat markup or a three-tiered markup. The Department learned from manufacturers that the pricing of boilers is determined on the basis of three product tiers. During the MIA interview, manufacturers provided information on the range of typical AFUE levels for each of the three tiers and the change in profitability associated with each level for gas boilers. Table V.23 displays the manufacturer impacts on the gas boiler industry for both scenarios.

TABLE V.23.—CHANGES IN INDUSTRY NET PRESENT VALUE, GAS BOILERS

TSL	Manufacturers' shipments					
	Flat markup			Three-tier markup		
	INPV $MM	Change in INPV from base		INPV $MM	Change in INPV from base	
		$MM	% change		$MM	% change
Base case	167	.....	.....	167	.....	.....
1	166	(1)	−1	163	(4)	−3
2	155	(12)	−7	148	(20)	−12
3	155	(12)	−7	148	(20)	−12
4	155	(12)	−7	148	(20)	−12
5	140	(27)	−16	83	(84)	−50

At trial standard level 1 (82-percent AFUE), the impact on INPV ranges from −0.9 percent to −3 percent for gas boilers. The Department estimates the product-conversion costs and capital-conversion costs at $7.5 and $9.5 million, respectively. Net cash flow is reduced from $10 million to $9 million in 2014.

At 84-percent AFUE, trial standard levels 2, 3, and 4, the impact on INPV for gas boilers ranges from −7 percent to −12 percent. The Department estimates product-conversion costs to be $8.7 million and capital requirements to total $12.5 million. Cash flow is reduced from $10 million to $8 million in 2014. Several manufacturers stated that, at this efficiency level, there is a high risk of safety and reliability issues. There is also a great likelihood that standing-pilot versions of these products would be eliminated.

At trial standard level 5 (99-percent AFUE), the impact on INPV for gas boilers ranges between −16 percent and −50 percent. During the interviews, manufacturers stated that this level is simply not achievable with current technologies and is beyond the maximum technologically feasible level. Instead, some manufacturers recommended that the max tech level would more reasonably be 96-percent or 97-percent AFUE. In addition, some manufacturers would not provide product-conversion cost or capital-conversion costs at this level, since they could not conceive what designs might reach this efficiency level. Consequently, with limited responses from manufacturers, DOE estimated the required product and capital conversion costs to be $20 million and $150 million, respectively. The net cash flow is reduced to nearly −$45 million.

vi. Oil-Fired Boilers. For oil-fired boilers, the Department considered two cash flow scenarios: The flat markup and the three-tiered markup, both using manufacturer-supplied shipment estimates. The Department considered only manufacturer-supplied shipment estimates for the same reasons given for gas boilers. Manufacturers stated that shipments would decrease for oil-fired boilers at higher efficiency levels, because the market would move toward radiant or electric furnaces and consumers would repair rather than replace their existing boilers.

Thus, similarly to the markups defined for gas boilers, DOE defines the two scenarios by the assumed markup strategy—a flat markup or a three-tiered markup. The Department learned from manufacturers that the pricing of boilers is determined on the basis of three product tiers. During the MIA interviews, manufacturers provided

information on the range of typical AFUE levels for each of the three tiers and the change in profitability associated with each level for oil-fired boilers. Table V.24 shows the changes in INPV as compared to the base case for each trial standard level for oil-fired boiler manufacturers.

TABLE V.24.—CHANGES IN INDUSTRY NET PRESENT VALUE, OIL-FIRED BOILERS

TSL	Manufacturers' shipments					
	Flat markup			Three-tier markup		
	INPV $MM	Change in INPV from base		INPV $MM	Change in INPV base	
		$MM	% change		$MM	% change
Base case	84	.....	.....	84	.....	.....
1	82	(3)	−3	73	(11)	−13
2	82	(3)	−3	73	(11)	−13
3	82	(3)	−3	73	(11)	−13
4	82	(2)	−2.5	72	(12)	−14
5	69	(16)	−19	46	(38)	−45

At 83-percent AFUE, trial standard levels 1, 2, and 3, the impact on INPV ranges from −3 percent to −13 percent for oil-fired boilers. At trial standard level 4 (84-percent AFUE), the impact on INPV ranges from between −2.5 percent to −14 percent. The Department estimates product-conversion costs and capital-conversion costs to be $4 million and $3.2 million, respectively, for trial standard levels 1, 2, and 3. For trial standard level 4, DOE estimates product-conversion costs and capital-conversion costs to be $4.1 million and $3.4 million, respectively. At these levels, manufacturers would likely use a de-rating strategy to reduce capital costs. This would reduce the span of the product line through elimination of some higher capacity models. Cash flow is reduced from $5 million to $4 million in 2014 for trial standard levels 1 through 4.

At trial standard level 5 (95-percent AFUE), the impact on INPV ranges from −19 percent to −45 percent. Net cash flow would be reduced to approximately −$22 million. The Department estimates product-conversion and capital-conversion costs to be $10.3 and $70.4 million, respectively. At this level, manufacturers expect complete loss of sales to competing products.

b. Impacts on Manufacturing Capacity. To the extent that more stringent energy conservation standards increase the size of the heat exchanger, they could reduce plant throughput, particularly for those plants that are constrained in their heat exchanger fabrication area. The standards thus could necessitate that manufacturers add floor space to their existing plants and warehouses. In addition, assembly and fabrication times could increase for the larger equipment. In an attempt to recoup capacity, manufacturers might need to invest in productivity, or equipment, or consider outsourcing some heat exchanger production.

It is not clear that all new capacity would be added in the United States. During the MIA interviews, several manufacturers stated that there has been a trend in the industry to move production facilities to overseas locations where labor markets offer cost savings. Some of these companies commented that new standards could speed up this trend.

For condensing gas boilers, in particular, the European market is as large as the non-weatherized gas furnace market in the United States, with attendant high-volume pricing and large company suppliers. If standards were to require condensing technology, it is likely that manufacturers would out-source heat exchangers to European countries.

c. Impacts on Subgroups of Manufacturers. 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 largely from the industry average could be affected differently. The Department used the results of the industry characterization to group manufacturers exhibiting similar characteristics.

The Department evaluated the impact of new energy conservation standards on small businesses, as defined by the SBA for the furnace and boiler manufacturing industry as manufacturing enterprises with 750 or fewer employees. The Department created a more tailored version of the interview guide for small furnace and boiler manufacturers, and contacted small businesses to determine if they were interested in discussing differential impacts that standards would have on their companies. The Department received feedback from five manufacturers, which suggested that impacts on them would not differ from impacts on larger companies within the industry. (See TSD, Chapter 12.)

During the manufacturer interviews, the Department also identified several types of residential furnaces and boilers that are used in particular or unusual applications, have features that differ from those of the vast majority of products available on the marketplace, and have some unique utility. The Department refers to these as ''niche products.'' In the TSD, DOE presents niche product classes that the Department identified and further considered. During the manufacturer interviews, several manufacturers claimed that certain niche products would not be viable if required to meet higher efficiency standards. All of these products serve relatively small niche markets and, as such, the efficiency standards established for these products will have little effect on national energy savings. Some of the niche products have very similar characteristics to the product class they belong to, and will not be disproportionately affected or threatened by new standards. (See TSD, Chapter 12.)

d. Cumulative Regulatory Burden. One aspect of the assessment of manufacturer burden is the cumulative impact of multiple DOE standards and the regulatory actions of other Federal agencies and States that affect the manufacture of a covered product. The Department believes that a standard level is not economically justified if it contributes to an unacceptable

cumulative regulatory burden. While any one regulation may not impose a significant burden on manufacturers, the combined effects of several 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.

Companies that produce a wider range of regulated products may be faced with more capital and product development expenditures than their competitors. This can prompt those companies to exit the market or reduce their product offerings, potentially reducing competition. Smaller companies can be especially affected, since they have lower sales volumes over which to amortize the costs of meeting new regulations.

The most significant regulatory actions affecting the furnace and boiler industries are compliance with more stringent Federal energy conservation standards for residential and commercial air conditioners, and the EPA-mandated phase out of hydrofluorocarbon (HFC) and hydrochlorofluorocarbon (HCFC) refrigerants. Manufacturers of residential furnaces and boilers also manufacturer approximately 82 percent of the residential central air conditioners and heat pumps and many of these manufacturers also manufacture commercial unitary air conditioners and heat pumps. The effective date for the residential AC rulemaking was January 23, 2006. Manufacturers were working to redesign all of the product lines and have allocated most of their capital resources for redesigning and retooling of their production lines to meet the new minimum efficiency standard. The effective date for the new commercial unitary air conditioner and heat pump standards is January 1, 2010, as specified in EPACT 2005. Manufacturers are now re-designing their product offerings and will need to retool to meet those standards. In addition, the EPA-mandated refrigerant phase out comes into effect on January 1, 2010, and is expected to have the biggest cumulative impact on residential furnace and boiler manufacturers. Chapter 12 of the TSD quantifies the anticipated level of investments needed to meet each of these regulatory burdens.

3. National Impact Analysis

a. Significance of Energy Savings. To estimate the energy savings through 2038 due to amended energy conservation standards, the Department compared the energy consumption of furnaces and boilers under the base case to energy consumption of furnaces and boilers under the five trial standard levels. As discussed in section III.D.1, the results account for a rebound effect of 15 percent (*i.e.*, 15 percent of the total savings from higher equipment efficiency are ''taken back'' by consumers to provide more heating service). Table V.25 shows the forecasted national energy savings at each of the trial standard levels calculated using the *AEO2005* energy price forecast. The table also shows the magnitude of the energy savings if the savings are discounted at rates of seven and three percent. Each trial standard level considered in this rulemaking would result in significant energy savings, and the amount of savings increases with higher efficiency standards. (See TSD, Chapter 10.)

TABLE V.25.—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR RESIDENTIAL FURNACES AND BOILERS (ENERGY SAVINGS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2005 energy price forecast]

Trial standard level	National energy savings (quads)		
	Primary	3% discounted	7% discounted
1	0.18	0.09	0.03
2	0.41	0.19	0.08
3	0.69	0.33	0.13
4	3.19	1.52	0.61
5	6.22	2.95	1.18

For the energy price sensitivity analysis, the Department also estimated the energy savings through 2038 due to amended energy conservation standards based on the *AEO2006* energy price forecasts. Table V.26 shows the results for the national energy savings in the energy price sensitivity analysis, which are slightly different for trial standard levels 3, 4, and 5.

TABLE V.26.—SUMMARY OF CUMULATIVE NATIONAL ENERGY SAVINGS FOR RESIDENTIAL FURNACES AND BOILERS (ENERGY SAVINGS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2006 energy price forecast]

Trial standard level	National energy savings (quads)		
	Primary	3% discounted	7% discounted
1	0.18	0.09	0.03
2	0.41	0.2	0.08
3	0.7	0.33	0.13
4	3.2	1.52	0.61
5	6.31	3	1.2

In addition to examining cumulative energy savings as a nation for residential furnaces and boilers, the Department looked at the cumulative energy savings by region. The Department defined the same two regions for the regional energy savings analysis as it used in the Consumer Subgroup analysis. Table V.27 shows the forecasted energy savings at each of the trial standard levels for the Northern and Southern regions based on the *AEO2005.* In addition, the Department also examined the cumulative energy savings by region in the energy price sensitivity analysis. Table V.28 shows the forecasted energy savings at each of the trial standard levels for the Northern and Southern regions based on the *AEO2006.*

TABLE V.27.—SUMMARY OF CUMULATIVE ENERGY SAVINGS BY REGION FOR RESIDENTIAL NON-WEATHERIZED GAS FURNACES (ENERGY SAVINGS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2005 energy price forecast]

Trial standard level	Primary energy savings (quads)	
	Northern region	Southern region
1	0.01	0.004
2	0.01	0.004
3	0.2	0.12
4	1.72	1.04
5	3.16	1.71

TABLE V.28.—SUMMARY OF CUMULATIVE ENERGY SAVINGS BY REGION FOR RESIDENTIAL NON-WEATHERIZED GAS FURNACES IN THE ENERGY PRICE SENSITIVITY ANALYSIS (ENERGY SAVINGS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2006 energy price forecast]

Trial standard level	Primary energy savings (quads)	
	Northern region	Southern region
1	0.01	0.004
2	0.01	0.004
3	0.19	0.13
4	1.64	1.12
5	3	1.78

b. Net Present Value. The NPV analysis is a measure of the cumulative benefit or cost of standards to the Nation. In accordance with OMB's guidelines on regulatory analysis (OMB Circular A–4, section E, September 17, 2003), DOE calculated NPV using both a seven-percent and a three-percent real discount rate. The seven-percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy, and reflects the returns to real estate and small business capital as well as corporate capital. The Department used this discount rate to approximate the opportunity cost of capital in the private sector, since recent OMB analysis has found the average rate of return to capital to be near this rate. In addition, DOE used the three-percent rate to capture the potential effects of standards on private consumption (*e.g.*, through higher prices for equipment and the purchase of reduced amounts of energy). This rate represents the rate at which ''society'' discounts future consumption flows to their present value. This rate can be approximated by the real rate of return on long-term government debt (*i.e.*, yield on Treasury notes minus annual rate of change in the Consumer Price Index), which has averaged about three-percent on a pre-tax basis for the last 30 years.

Table V.29 shows the forecasted NPV at each of the trial standard levels, based on the *AEO2005* energy price forecasts. Use of a three-percent discount rate increases the present value of future equipment-purchase costs and operating-cost savings. However, because annual operating-cost savings in later years grow at a faster rate than annual equipment-purchase costs, use of a three-percent discount rate increases the NPV at most trial standard levels. (See TSD, Chapter 10.) Similarly, the Department also calculated the forecasted NPV in the energy price sensitivity analysis based on the *AEO2006*. Table V.30 exhibits the forecasted NPV at each trial standard level, based on the *AEO2006* energy price forecasts.

TABLE V.29.—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR RESIDENTIAL FURNACES AND BOILERS (IMPACTS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2005 energy price forecast]

Trial standard level	NPV (billion 2004$)	
	7% discount rate	3% discount rate
1	0.33	1.24
2	0.65	2.48
3	0.53	3.00
4	0.06	8.37
5	−17.53	−22.42

TABLE V.30.—SUMMARY OF CUMULATIVE NET PRESENT VALUE FOR RESIDENTIAL FURNACES AND BOILERS IN THE ENERGY PRICE SENSITIVITY ANALYSIS (IMPACTS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2006 energy price forecast]

Trial standard level	NPV (billion 2004$)	
	7% discount rate	3% discount rate
1	0.43	1.53
2	0.82	3.02
3	0.90	4.12
4	1.83	13.64
5	−13.49	−10.34

In addition to national net present value, the Department examined the regional effects of standards on the net present value. Table V.31 shows the forecasted NPV at each of the trial standard levels for the Northern and Southern regions based on the *AEO2005* energy price forecasts. In addition, the Department examined the NPV by region in the energy price sensitivity analysis. Table V.32 shows the NPV at each of the trial standard levels for the Northern and Southern regions based on the *AEO2006* energy price forecasts.

TABLE V.31.—SUMMARY OF CUMULATIVE NET PRESENT VALUE BY REGION FOR RESIDENTIAL NON-WEATHERIZED GAS FURNACES (IMPACTS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2005 energy price forecast]

Trial standard level	NPV (billion 2004$)			
	Northern region		Southern region	
	7% discount rate	3% discount rate	7% discount rate	3% discount rate
1	0.02	0.07	0.01	0.03
2	0.02	0.07	0.01	0.03
3	0.11	0.72	−0.1	0.11
4	0.79	5.99	−0.82	1.10
5	−6.85	−7.77	−8.29	−13.90

TABLE V.32.—SUMMARY OF CUMULATIVE NET PRESENT VALUE BY REGION FOR RESIDENTIAL NON-WEATHERIZED GAS FURNACES IN THE ENERGY PRICE SENSITIVITY ANALYSIS (IMPACTS FOR UNITS SOLD FROM 2015 TO 2038)

[AEO2006 energy price forecast]

Trial standard level	NPV (billion 2004$)			
	Northern region		Southern region	
	7% discount rate	3% discount rate	7% discount rate	3% discount rate
1	0.02	0.07	0.01	0.04
2	0.02	0.07	0.01	0.04
3	0.18	0.92	−0.01	0.38
4	1.41	7.70	−0.08	3.51
5	−5.07	−3.00	−7.74	−11.8

c. *Impacts on Employment.* In accordance with the Process Rule, section 4(d)(7)(vi), the Department estimated the employment impacts of the proposed standard on the economy in general. 61 FR 36983. As discussed above, the Department expects energy conservation standards for residential furnaces and boilers to reduce energy bills for consumers, and the resulting net savings to be redirected to other forms of economic activity. The Department also realizes that these shifts in spending and economic activity could affect the demand for labor. To estimate these effects, the Department used an input/output model of the U.S. economy using BLS data (as described in section IV.G). (See TSD, Chapter 14.)

This input/output model suggests the proposed furnace and boiler standards are likely to slightly increase the net demand for labor in the economy. Neither the BLS data nor the input/output model used by DOE includes the quality or wage level of the jobs. As shown in Table V.33, the Department estimates that net indirect employment impacts from a proposed furnace and boiler energy-efficiency standard are positive.

TABLE V.33.—NET NATIONAL CHANGE IN INDIRECT EMPLOYMENT, THOUSANDS OF JOBS IN 2038

Trial standard level (thousands of jobs)				
TSL1	TSL2	TSL3	TSL4	TSL5
1.3	2.9	9.7	18	20.1

4. Impact on Utility or Performance of Products

As presented in section III.E.1.d, of this notice, DOE concluded that none of the efficiency levels considered in this notice reduce the utility or performance of residential furnaces and boilers. Furthermore, furnace and boiler manufacturers currently offer products that meet or exceed the proposed standards. (42 U.S.C. 6295(o)(2)(B)(i)(IV))

5. Impact of Any Lessening of Competition

The Department considers any lessening of competition that is likely to result from 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 to the Secretary together with an analysis of the nature and extent of such impact. (See 42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii))

To assist the Attorney General in making such a determination, the Department has provided the Department of Justice (DOJ) with copies of this notice and the TSD for review. The Department will consider DOJ's comments on the proposed rule in preparing the final rule.

6. Need of the Nation To Conserve Energy

Enhanced energy efficiency also produces environmental benefits. The expected energy savings from higher furnace and boiler standards will reduce the emissions of air pollutants and greenhouse gases associated with energy production and household use of fossil fuels. Table V.34 shows cumulative CO_2, SO_2, and NO_X emissions reductions over the analysis period. As discussed in section III.D.1, the results account for a rebound effect of 15 percent. The cumulative CO_2, NO_X, and SO_2 emissions reductions range up to 341.0 Mt, 203.4 kt, and 69.0 t, respectively. The Department reports annual CO_2, SO_2, and NO_X emissions reductions for each trial standard level in the environmental assessment, a separate report in the TSD.

As discussed in section IV.I, DOE reports SO_2 emissions reductions at the household level instead of reporting these emissions from power plants. The reported NO_X emissions reductions do include the impacts of each trial standard level at power plants. If NO_X emissions are subject to emissions caps in the evaluation period, the Department assumes that the reported emissions reductions correspond to the production of emissions allowance credits.

TABLE V.34.—SUMMARY OF EMISSIONS REDUCTIONS FOR RESIDENTIAL FURNACES AND BOILERS

[Cumulative reductions for units sold from 2015 to 2038]

Emissions	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
CO_2 (Mt)	9	19.6	37	171.1	341
NO_X (kt)	6	13	24.5	113	203.4
SO_2 (kt)	0.7	1.5	2.7	12.7	69

The Department also presents its results for discounted emissions of CO_2, NO_X, and SO_2. The Department used the same discount rates that it used in calculating the NPV (seven percent and three percent real) to calculate discounted cumulative emission reductions. Table V.35 shows the discounted cumulative emissions impacts for residential furnaces and boilers. The Department intends the seven-percent and three-percent real discount rate values to capture the present value of costs and benefits associated with projects facing an average degree of risk. Other discount rates may be more applicable to discount costs and benefits associated with projects facing different risks and uncertainties. The Department seeks input from interested parties on the appropriateness of using other discount rates in addition to seven percent and three percent real to discount future emissions reductions.

TABLE V.35.—SUMMARY OF DISCOUNTED EMISSIONS REDUCTIONS FOR RESIDENTIAL FURNACES AND BOILERS

[Cumulative reductions for units sold from 2015 to 2038]

Emissions	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
7% Discount Rate:					
CO_2 (Mt)	1.7	3.6	6.9	31.8	63.2
NO_X (kt)	1	2.2	4.1	18.9	33.5
SO_2 (kt)	0.1	0.3	0.5	2.4	12.5
3% Discount Rate:					
CO_2 (Mt)	4.1	8.9	16.9	78.1	155.3
NO_X (kt)	2.6	5.6	10.6	49	87.2
SO_2 (kt)	0.3	0.7	1.3	5.8	31.2

7. Other Factors

The Secretary of Energy, in determining whether a standard is economically justified, may consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) The Department recognizes the importance of incorporating safe venting systems with the use of residential furnace and boilers. Consequently, safety was one of the factors DOE identified for consideration in weighing the benefits and burdens of the trial standards.

C. Proposed Standard

The Act, at 42 U.S.C. 6295(o)(2)(A), specifies that any new or amended energy conservation standard 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. In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard also must ''result in significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B))

The Department considers the impacts of standards beginning with the maximum technologically feasible level, *i.e.*, trial standard level 5, to determine whether that level was economically justified. The Department then considers less efficient levels until it reaches the level which is technologically feasible and economically justified and saves a significant amount of energy.

To aid the reader as the Department discusses the benefits and/or burdens of each trial standard level, Table V.36 presents a summary of quantitative analysis results for each trial standard level based on the assumptions and methodology discussed above. These include manufacturing cost estimates, equipment lifetimes, and energy prices based on the reference case from the *AEO2005* energy price forecast. Additional quantitative results, including regional impacts and the results of the energy price sensitivity analysis, including the life-cycle-cost, national energy savings, and regional analyses based on the *AEO2006* energy price forecast, are provided in sections

V.B.1.a., V.B.1.b., V.B.3.a., and V.B.3.b., above.

In addition to the quantitative results, the Department also considers other burdens and benefits that affect economic justification. This includes the potential impacts on safety, reliability and consumers' utility (*i.e.*, the ability to replace a furnace or boiler with a new, more efficient product, without having to make any significant modifications to the existing dwelling).

TABLE V.36.—SUMMARY OF RESULTS BASED UPON THE AEO2005 ENERGY PRICE FORECAST*

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Primary energy saved (quads)	0.18	0.41	0.69	3.19	6.22
7% Discount rate	0.03	0.08	0.13	0.61	1.18
3% Discount rate	0.09	0.19	0.33	1.52	2.95
Generation capacity change (GW)**	0	0	0	0.1	4
NPV (2004$billion):					
7% Discount rate	0.33	0.65	0.53	0.06	−17.5
3% Discount rate	1.24	2.48	3	8.37	−22.4
Industry impacts:					
Industry NPV (2004$million)	(33) to (48)	(65) to (114)	(137) to (190)	(64) to (425)	107 to (720)
Industry NPV (% Change)	(2%) to (3%)	(4%) to (7%)	(9%) to (12%)	(4%) to (26%)	7% to (44%)
Cumulative emissions impacts***:					
CO_2 (Mt)	9	19.6	37	171	341
NO_X (kt)	6	13	24.5	113	203
SO_2 (kt)	0.7	1.5	2.7	12.7	69
Mean life-cycle cost savings (2004$):					
Non-Weatherized Gas Furnaces	2	2	2	5	−731
Weatherized Gas Furnaces	2	73	73	73	73
Oil-Fired Furnaces	7	113	113	−23	−109
Gas Boilers	158	232	232	232	−795
Oil-Fired Boilers	40	40	40	1	−1070
Mobile Home Gas Furnaces	51	51	18	124	124
Mean Payback Period (years):					
Non-Weatherized Gas Furnaces	1.5	1.5	26	23	88
Weatherized Gas Furnaces	1.6	4.6	4.6	4.6	4.6
Oil-Fired Furnaces	0.3	0.8	0.8	18	22
Gas Boilers	12	12	12	12	40
Oil-Fired Boilers	1.2	1.2	1.2	27	36
Mobile Home Gas Furnaces	5	5	31	25	25

* Parentheses indicate negative (−) values.
** Reductions in installed generation capacity by the year 2030 based on *AEO2005* Reference Case.
*** CO_2 emissions impacts include physical reductions at power plants and households. NO_X emissions impacts include physical reductions at power plants and households as well as production of emissions allowance credits where NO_X emissions are subject to emissions caps. SO_2 emissions impacts include physical reductions at households only.

First, the Department considered trial standard level 5, the maximum technologically feasible level, for each product class. Trial standard level 5 will likely save 6.22 quads of energy through 2038, an amount the Department considers significant. Discounted at 7 percent, the energy savings through 2038 would be 1.18 quads. For the Nation as a whole, trial standard level 5 would result in a net cost of $17.5 billion in NPV. The emissions impacts are 341 Mt of CO_2,[19] 203 kt of NO_X,[20] and 69.0 kt of SO_2.[21] Total generating capacity in 2030 increases by 4.0 gigawatts (GW) under trial standard level 5, due to projected switching from gas furnaces to electric heating equipment.

At trial standard level 5, the average consumer would experience a significant increase in life-cycle costs for most product classes. Purchasers of non-weatherized gas furnaces would lose on average $731 over the life of the product in present value terms and purchasers of gas-fired boilers would lose on average $795 in present value terms.[22] The Department found at trial standard level 5 that 91 percent of households in the South have a life-cycle net cost. The Department's life-cycle cost analysis shows that over 80 percent of all non-weatherized gas furnace consumers in the southern region (approximately 16 million households) would experience net increases in their life-cycle costs of more than $500 and a small (four-percent), but significant percentage of these households might experience net increases in life-cycle costs of over $1700. Furthermore, the life-cycle cost analysis indicates that on average, the mean LCC savings would be negative for 88 percent of households in the Nation with non-weatherized gas furnaces at TSL 5. Reinforcing the primary LCC result, the Department estimates that the mean payback period of all product classes except for weatherized gas furnaces would be substantially longer than the mean lifetime of these furnaces.

The change in industry value (INPV) ranges from an increase of $107 million to a decrease of $720 million. The magnitude of the impacts is largely determined by the cashflow results for the non-weatherized gas furnaces. For this product class, the impacts are driven primarily by the assumptions regarding future product shipments and the ability to offer differentiated products that command a premium mark-up. The Department recognizes the significant difference between the

[19] For all of the TSLs, CO_2 emissions impacts include physical reductions at power plants and households.

[20] For all of the TSLs, NO_X emissions impacts include physical reductions at power plants and households as well as production of emissions allowance credits where NO_X emissions are subject to emissions caps.

[21] For all of the TSLs, SO_2 emissions impacts include physical reductions at households only.

[22] Non-weatherized gas furnaces are the most prominent class of residential furnaces and boilers accounting for approximately 72 percent of the total industry sales and approximately 81 percent of residential furnace sales. Gas-fired boilers are the most prominent class of residential boilers accounting for 6 percent of the total industry sales and 61 percent of residential boiler sales.

shipments forecasted by the NES and those anticipated by manufacturers. The Department is concerned with an increase in total installed cost of $1519 for non-weatherized gas furnaces, or 82 percent. With an increase of that size, there is a significant risk of consumers switching to other heating systems, including heat pumps and electric resistance heating. The Department also recognizes that the ability to maintain a full product line is more difficult at higher standard levels. Therefore, the Department places more weight on the two-tiered markup scenario for non-weatherized gas furnaces at trial standard level 5. In particular, if the high range of impacts is reached as DOE expects, trial standard level 5 could result in a net loss of $498 million to the non-weatherized gas furnace industry.

After carefully considering the analysis, comments on the ANOPR, and the benefits versus burdens, the Secretary concludes that at trial standard level 5 the benefits of energy savings and emissions impacts would be outweighed by the potential multi-billion dollar negative net economic cost to the Nation, the economic burden on consumers, and the large capital-conversion costs that could result in the large reduction in INPV for manufacturers. Consequently, the Secretary has concluded that trial standard level 5, the maximum technologically feasible level, is not economically justified.

Next, the Department considered trial standard level 4, which specifies a 90-percent AFUE for non-weatherized gas furnaces and 85-percent AFUE for gas-fired boilers. Primary energy savings would likely be 3.19 quads of energy through 2038, which the Department considers significant. Discounted at 7 percent, the energy savings through 2038 would be 0.61 quad. For the Nation as a whole, trial standard level 4 would result in a net savings of $0.06 billion in NPV. The emissions impacts are 171 Mt of CO_2, 113 kt of NO_X, and 12.7 kt of SO_2. Total generating capacity in 2030 under trial standard level 4 would increase by 0.1 GW. This would be due to the projected switching from gas furnaces to electric heating equipment.

At trial standard level 4, consumers would experience an increase in life-cycle costs for oil-fired furnaces and a decrease in life-cycle costs for the other five product classes. Purchasers of non-weatherized gas furnaces would save, on average, $5 over the life of the product in present value terms, and purchasers of gas-fired boilers would save, on average, $232 over the life of the boiler in present value terms. The Department found that 39 percent of households with non-weatherized gas furnaces would experience a net cost, and 25 percent of households with non-weatherized gas furnaces would experience a net gain.

The Department also examined the regional impacts to consumers of non-weatherized gas furnaces in Northern and Southern climates separately. Because TSL 4 requires the use of condensing technology for non-weatherized gas furnaces, a majority of the affected consumers in the South would experience a significant increase in total installed cost. Sixty-three percent of consumers in the South with non-weatherized gas furnaces would experience an increase in total installed cost greater than $500, while a small, but significant (approximately 2 percent) of these consumers would experience an increase in total installed cost of more than $900. In the Southern region, where the operating cost savings of condensing technology are less important, these substantial increases in total installed costs lead to increased life-cycle costs. The Department found that the majority, 57 percent, of households in the South with a non-weatherized gas furnace would experience a life-cycle net cost, while 23 percent would experience a net gain. At trial standard level 4, the average net LCC increase to the Southern consumer with a non-weatherized gas furnace is $79, while the average net decrease to the Northern consumer with a non-weatherized gas furnace is $79. Almost half of the consumers in the northern region with a non-weatherized gas furnace would not be affected by the standard because the equipment the household currently uses already meets or exceeds the trial standard level 4 efficiency level (*i.e.*, 90-percent AFUE). However, 81 percent of Southern consumers with a non-weatherized gas furnace would be impacted by the standard. Seventy percent of those Southern consumers with non-weatherized gas furnace impacted by the standard would experience an increase in life-cycle cost. The Department's life-cycle cost analysis shows that ten percent of all non-weatherized gas furnace consumers in the southern region (approximately 2 million households) would experience net increases in their life-cycle costs of more than $500 and a small (seven percent), but significant percentage of these households would experience net increases in life-cycle costs of over $700. Reinforcing this primary LCC result, the Department estimates that the mean payback period of non-weatherized gas furnaces in the Southern climate would be substantially longer than the mean lifetime of these furnaces.

The Department also considers the impact of proposed standard level TSL 4 on industry. The change in industry value ranges from a loss of $64 million to a loss of $425 million, which could potentially cause up to a 26 percent drop in total industry value. The magnitude of impacts is still largely determined by the cashflow results for the non-weatherized gas furnaces. For this product class, the impacts continue to be driven primarily by the assumptions regarding future product shipments and the ability to offer differentiated products. Although the impacts will not be as severe as expected for TSL 5 for the non-weatherized gas furnace industry, the magnitude of the impacts would still be determined primarily by the assumptions regarding future product shipments and the ability to offer differentiated products that command a premium markup. Although the range of possible impacts is not as large as TSL 5, the Department still recognizes the significant differences between the shipments forecast by the NES analysis and those anticipated by manufacturers. Furthermore, the Department believes that with an increase in total installed cost of $571 for non-weatherized gas furnaces, or 31 percent, for example, there is a significant risk of consumers switching to other heating systems, including heat pumps and electric resistance heating. Additionally, some product classes would require large, product-conversion costs because the products would require new heat-exchanger designs to meet the efficiency requirements established in trial standard level 4. Even though the ability for manufacturers to differentiate products is greater at TSL 4 than at TSL 5, it will still be harder for manufacturers to differentiate products because all of the products offered in TSL 4 for non-weatherized gas furnaces use condensing technology. In particular, if the high range of impacts is reached as DOE expects, trial standard level 4 could result in a net loss of $295 million to the non-weatherized gas furnace industry.

After carefully considering the results of the analysis, comments on the ANOPR, and the benefits versus burdens, the Secretary concludes that at trial standard level 4, the benefits of energy savings and emissions impacts would still be outweighed by the economic burden on consumers as indicated by large increase in total installed cost, the high percentage of,

and disproportionate negative life-cycle cost impacts to Southern households, and the large capital conversion costs that could result in the large reduction in INPV for manufacturers. Consequently, the Secretary has concluded that trial standard level 4 is not economically justified.[23]

Next, the Department considered trial standard level 3. Trial standard level 3 will likely save 0.69 quad of energy through 2038, an amount the Department considers significant. Discounted at 7 percent, the energy savings through 2038 would be 0.13 quads. For the Nation as a whole, trial standard level 3 would result in a net benefit in NPV of $0.53 billion. The emissions impacts are 37.0 Mt of CO_2, 24.5 kt of NO_X, and 2.7 kt of SO_2. Total generating capacity in 2030 under trial standard level 3 is unchanged compared to the base case.

At trial standard level 3, purchasers of non-weatherized gas furnaces would save, on average, $2 over the life of the product and purchasers of gas-fired boilers would save, on average, $232. At trial standard level 3, the Department found that 44 percent of households in the South with a non-weatherized gas furnace would experience a net life-cycle cost. Nationwide, the Department estimates that 32 percent of households with non-weatherized gas furnaces would experience a net cost. Of these affected households, the increase in net cost is a result of the increased unit installation costs, which account for equipment redesign to adequately address the safety of these products at 81-percent AFUE for non-weatherized gas furnaces and mobile home furnaces. Reinforcing the primary LCC result, the Department estimates that the mean payback period for two of the product classes to be substantially longer than the mean lifetime of these products.

Additionally, trial standard level 3 includes a standard for non-weatherized gas furnaces and for mobile home gas furnaces at 81-percent AFUE. The Department is concerned that at this level, there may be an increased risk of safety concerns with this equipment due to venting issues. Some manufacturers believe that the margin of safety is diminished in many instances at 81-percent AFUE, and some manufacturers commented that they would not be willing to accept the risk and/or cost involved in producing a full line or family of products at 81-percent AFUE. This potential safety concern is a factor that the Secretary considers relevant. Based on the Department's evaluation of all the information considered during the rulemaking, the Department believes that a standard at 81-percent AFUE could pose a potential for safety problems for some consumers as discussed in section IV.B.3.

The change in INPV ranges between a loss of $190 million and a loss of $137 million. Furthermore, some manufacturers stated they would likely use a de-rating strategy to reduce the increased capital costs associated with trial standard level 3. Consequently, the variety of products offered by the manufacturers would be reduced by eliminating some of the higher-capacity models to reduce the negative impacts. Consumers would experience an increase in total installed cost of $77 for non-weatherized gas furnaces, or 4 percent, as provided in Chapter 8 of the TSD. Consequently, based on the information provided by manufacturers, there could be a risk of consumers switching to other heating systems, including heat pumps and electric resistance heating, as further detailed in the shipments forecast discussion in section IV.F.6. For the furnace industry alone, the industry value would decrease from 9.1 percent to 11.6 percent.

After carefully considering the analysis, comments on the ANOPR, and the benefits versus burdens, the Secretary concludes that, at trial standard level 3, the benefits of energy savings and emissions impacts would be outweighed by the burdens of negative economic impacts to some consumers and to the manufacturers, and in particular, the potential for safety problems for some consumers. Consequently, the Secretary has concluded that trial standard level 3 is not economically justified.

Next, DOE considered trial standard level 2. Primary energy savings at this level would likely be 0.41 quad of energy through 2038, which the Department considers significant. Discounted at 7 percent, the energy savings through 2038 would be 0.08 quad. For the Nation as a whole, trial standard level 2 would result in a net savings of $0.65 billion in NPV. The emissions impacts are 19.6 Mt of CO_2, 13.0 kt of NO_X, and 1.5 kt of SO_2. Total generating capacity in 2030 under trial standard level 2 is unchanged compared to the base case.

At trial standard level 2, purchasers of non-weatherized gas furnaces would save, on average, $2 over the life of the product and purchasers of gas-fired boilers would save, on average, $232. The Department's analysis indicates that no households with non-weatherized gas furnaces would experience a net life-cycle cost at TSL 2, including Southern households. The mean payback periods are less than the average equipment lifetime for all product classes at trial standard level 2. For example, the mean payback period for non-weatherized gas furnaces at trial standard level 2 is 1.5 years.

The change in industry value ranges from a loss of INPV of $114 to a loss of $65 million. Trial standard level 2 could cause up to a 6-percent loss in INPV for the furnace industry and up to a 12-percent loss in INPV for the boiler industry. Furthermore, the Department believes manufacturers of non-weatherized gas furnaces would still be able to differentiate their premium products and retain profitability margins.

Trial standard level 2 includes a standard for non-weatherized gas furnaces and for mobile home gas furnaces at 80-percent AFUE. Based on its evaluation of all the information considered during the rulemaking, the Department believes that a standard at 80-percent AFUE would not result in safety problems for consumers. However, trial standard level 2 also includes a standard for weatherized gas furnaces at 83-percent AFUE. The Department is concerned with the safety and cost of ensuring the safety of weatherized gas furnaces at this level, due to possible condensation in the heat exchanger, and is seeking comment on this issue.

After carefully considering the analysis, comments on the ANOPR, and the benefits and burdens, the Secretary concludes that this standard saves a significant amount of energy and is technologically feasible and economically justified. Therefore, the Department today proposes to adopt the energy conservation standards for residential furnaces and boilers at trial standard level 2.

[23] The Department further examined its decision to reject TSL 4 in the energy price sensitivity analysis using *AEO2006*. A discussion of the results for the energy price sensitivity analysis and the rationale for rejection based on these results are presented at the end of this section.

TABLE V.37.—SUMMARY OF RESULTS BASED ON THE AEO2006 ENERGY PRICE FORECAST *

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Primary energy saved (quads)	0.18	0.41	0.7	3.2	6.31
7% Discount rate	0.03	0.08	0.13	0.61	1.2
3% Discount rate	0.09	0.2	0.33	1.52	3
NPV (2004$billion):					
7% Discount rate	0.43	0.82	0.9	1.83	−13.5
3% Discount rate	1.53	3.02	4.12	13.6	−10.3
Mean life-cycle cost savings (2004$):					
Non-Weatherized Gas Furnaces	2	2	8	63	−626
Weatherized Gas Furnaces	2	86	86	86	86
Oil-Fired Furnaces	10	167	167	90	37
Gas Boilers	196	299	299	299	−508
Oil-Fired Boilers	61	61	61	47	−471
Mobile Home Gas Furnaces	71	71	49	240	240
Mean Payback Period (years):					
Non-Weatherized Gas Furnaces	1.6	1.6	22	20	75
Weatherized Gas Furnaces	1.4	4	4	4	4
Oil-Fired Furnaces	0.2	0.6	0.6	13	15
Gas Boilers	10	10	10	10	35
Oil-Fired Boilers	0.8	0.8	0.8	19	26
Mobile Home Gas Furnaces	3.6	3.6	28	21	21

* Parentheses indicate negative (−) values.
** Reductions in installed generation capacity by the year 2030 based on *AEO2005* Reference Case.

In addition to the Department's NOPR analyses based on the *AEO2005* energy price forecast, the Department analyzed the impact of the *AEO2006* energy price forecasts on the LCC and PBP analysis and the national impact analysis. Table V.37 presents a summary of the results using *AEO2006*. As explained in section IV.C.4., *AEO2006* provides a significantly higher price forecast for natural gas and fuel oil over the analysis period. The Department took into consideration the effect that these increased energy prices would have on the analysis at each trial standard level through an energy price sensitivity analysis and presented the results in sections V.B.1.a., V.B.1.b., V.B.3.a., and V.B.3.b. In particular, the Department was interested in seeing whether the results from the energy price sensitivity analysis would change the Department's proposed standard level (TSL 2) as presented above. The Department believes that the results from the energy price sensitivity analysis warrant the most discussion in its rejection of TSL 4. Based on the *AEO2006* energy price forecast, the consumer economics at TSL 5 are still unattractive, especially for non-weatherized gas furnaces and gas boilers (the prominent product classes). At TSL 3, although the consumer economics are attractive based on the energy price sensitivity analysis using the *AEO2006* energy price forecast, the Department is unwilling to impose the associated safety risk on consumers as explained above.

At TSL 4, the Department found that the nation as a whole would experience a net savings of $1.83 billion in NPV using the energy price sensitivity analysis (compared to $0.06 billion in NPV based on *AEO2005*). This is a significant increase in national savings as a result of increased energy prices. In addition, the consumer, on average, would save $58 more in life-cycle savings as compared to the *AEO2005* analysis. Purchasers of non-weatherized gas furnaces would save, on average, $63 over the life of the product and purchasers of gas-fired boilers would save, on average, $299 over the life of the boiler. However, the Department found that 35 percent of households with non-weatherized gas furnaces across the nation would still experience a net cost.

The Department also examined the regional impacts to consumers of non-weatherized gas furnaces in the Northern and Southern climate zones separately for the energy price sensitivity analysis using the *AEO2006* energy price forecast. Just as the *AEO2005* regional analysis showed, the Department found differential impacts between Northern and Southern consumers using non-weatherized gas furnaces in the energy price sensitivity analysis. While only 20 percent of households with non-weatherized gas furnaces in the Northern region would be negatively impacted by TSL 4, a majority of households in the Southern region with non-weatherized gas furnaces (53 percent) would be negatively impacted by a condensing standard. The consumer in the South with a non-weatherized gas furnace, on average, would experience an increase in LCC of $20, while the Northern consumer with a non-weatherized gas furnace, on average, would experience a decrease in LCC of $138. Almost half of the consumers in the North with a non-weatherized gas furnace (48 percent) would not be affected by the standard because the equipment that the household currently uses already meets or exceeds the trial standard level 4 efficiency level (*i.e.*, 90-percent AFUE), just as the *AEO2005* analysis showed. In contrast, 81 percent of Southern consumers with a non-weatherized gas furnace would be impacted by the standard. Of those 81 percent impacted consumers with a non-weatherized gas furnace in the Southern region, 65 percent would experience an increase in LCC and 33 percent would experience a decrease in LCC. This is only a five percentage point decrease in the number of adversely impacted Southern consumers as compared to the *AEO2005* analysis results. Most consumers in the South with a non-weatherized gas furnace would experience an increase in total installed cost of at least $500, as the *AEO2005* and *AEO2006* analysis results showed. Even though DOE forecasts the price of energy to increase significantly in the energy price sensitivity analysis using *AEO2006*, many consumers in the South will still experience an increase in life-cycle-cost. Consequently, the Department's life-cycle cost analysis shows that 8 percent of all non-weatherized gas furnace consumers in the southern climate zone (approximately 1.6 million consumers) would experience net increases in their life-cycle costs of more than $500 and

7 percent of these consumers (approximately 100,000 households) would experience a significant net increase in life-cycle-costs over $700. Reinforcing its primary LCC result and the *AEO2005* analysis, the Department estimates, using the *AEO2006* energy price forecast, that the mean payback period of non-weatherized gas furnaces in the Southern climate would still exceed the mean lifetime of these furnaces.

While the Secretary recognizes the increased economic benefits to the nation as a result of TSL 4 under the increased energy price forecast, *AEO2006*, as captured by the energy price sensitivity analysis, the Secretary still concludes that the benefits of a federal standard at TSL 4 would still be outweighed by the economic burden that would be placed upon consumers in the South. Consequently, the Secretary has concluded that the energy price sensitivity analysis which addresses the effects of the *AEO2006* energy price forecast does not change the Department's rejection of TSL 4, and its choice of TSL 2 as the proposed standard level.

VI. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Department has determined today's regulatory action is an ''economically significant'' action'' under section 3(f)(1) of Executive Order 12866, ''Regulatory Planning and Review.'' 58 FR 51735 (October 4, 1993). Accordingly, today's action required a regulatory impact analysis (RIA) and, under the Executive Order, was subject to review by the Office of Information and Regulatory Affairs (OIRA) in the OMB. The Department presented to OIRA for review the draft proposed rule and other documents prepared for this rulemaking, including the RIA, and has included these documents in the rulemaking record. They are available for public review in the Resource Room of DOE's Building Technologies Program, Room 1J–018, 1000 Independence Avenue, SW., Washington, DC, (202) 586–9127, between 9 a.m and 4 p.m., Monday through Friday, except Federal holidays.

The RIA is contained in the TSD prepared for the rulemaking. The RIA consists of: (1) A statement of the problem addressed by this regulation, and the mandate for government action; (2) a description and analysis of the feasible policy alternatives to this regulation; (3) a quantitative comparison of the impacts of the alternatives; and (4) the national economic impacts of the proposed standard.

The RIA calculates the effects of feasible policy alternatives to residential furnace and boiler standards, and provides a quantitative comparison of the impacts of the alternatives. The Department evaluated each alternative in terms of its ability to achieve significant energy savings at reasonable costs, and compared it to the effectiveness of the proposed rule. The Department analyzed these alternatives using a series of regulatory scenarios as input to the NES/Shipments Model for furnaces and boilers, which it modified to allow inputs for these measures.

The Department identified the following major policy alternatives for achieving increased furnace and boiler energy efficiency:

- No new regulatory action;
- Consumer rebates;
- Consumer tax credits;
- Manufacturer tax credits;
- Voluntary energy-efficiency targets;
- Bulk government purchases;
- Early replacement incentives; and
- Regional performance standards (climates ≥5000 heating degree days and climates ≥6000 heating degree days).

The Department evaluated each alternative in terms of its ability to achieve significant energy savings at reasonable costs, and compared it to the effectiveness of the proposed rule.

TABLE VI.1.—NON-REGULATORY ALTERNATIVES TO STANDARDS

Policy alternatives	Energy savings* (quads)	Net present value** (billion $)	
		7% discount rate	3% discount rate
No new regulatory action	0	0	0
Consumer Rebates	0.078	0.086	0.37
Consumer Tax Credits	0.047	0.052	0.22
Manufacturer Tax Credits	0.023	0.026	0.11
Voluntary Energy-Efficiency Targets	0.046	0.074	0.3
Early Replacement Incentives	0.025	0.059	0.16
Bulk Government Purchases	0.005	0.006	0.026
Regional Performance Standards for NWGF***:			
Cold States (≥5000 HDD) (TSL 4)	1.72	0.79	5.99
Warm States (<5000 HDD) (TSL 2)	0.004	0.01	0.03
Regional Performance Standards for NWGF***:			
Cold States (≥6000 HDD) (TSL 4)	0.2	0.04	0.59
Warm States (<6000 HDD) (TSL 2)	0.01	0.02	0.07

* Energy savings are in source quads.

** Net present value is the value in the present of a time series of costs and savings. The Department determined the net present value from 2015 to 2038 in billions of 2004 dollars.

*** For non-weatherized gas furnaces (NWGF) only with national performance standard set at TSL 2, the energy savings is 0.01 quads. The net present value is $0.03 billion with a 7-percent discount rate and $0.10 billion with a 3-percent discount rate. The Department analyzed two scenarios, the first with cold states having 5000 heating degree days (HDD) or more and the second with 6000 HDD or more.

The net present value amounts shown in Table VI.1 refer to the NPV for residential consumers. The costs to the government of each policy (such as rebates or tax credits) are not included in the costs for the NPV since, on balance, consumers are both paying for (through taxes) and receiving the benefits of the payments. The following paragraphs discuss each of the policy alternatives listed in Table VI.1. (See TSD, RIA.)

No new regulatory action. The case in which no regulatory action is taken with regard to furnaces and boilers constitutes the ''base case'' (or ''No Action'') scenario. In this case, between the years 2015 and 2038, furnaces and boilers are expected to use 101 quads of primary energy. Since this is the base case, energy savings and NPV are zero by definition.

Rebates. If consumers were offered a rebate that covered a portion of the incremental price difference between products meeting baseline efficiency levels and those meeting the energy efficiency levels in trial standard level 2, the Department estimates that the percentage of consumers purchasing the more-efficient products would increase by 2 percent to 34 percent, depending on the product class. The Department assumed the impact of this policy would be to permanently transform the market so that the shipment-weighted efficiency gain seen in the first year of the program would be maintained throughout the forecast period. At the estimated participation rates, the rebates would provide 0.078 quads of national energy savings and an NPV of $0.086 billion (at a seven-percent discount rate). Although DOE estimates that rebates will provide national benefits, they are much smaller than the benefits resulting from national performance standards. Thus, the Department rejected rebates as a policy alternative to national performance standards.

Consumer Tax Credits. If consumers were offered a tax credit equivalent to the amount mentioned above for rebates, the Department's research suggests that the number of consumers buying a furnace or boiler that would take advantage of the tax credit would be approximately 60 percent of the number that would take advantage of rebates. Thus, as a result of the tax credit, the percentage of consumers purchasing the more-efficient products would increase by 1 percent to 20 percent, depending on the product class. The Department assumed the impact of this policy would be to permanently transform the market so that the shipment-weighted efficiency gain seen in the first year of the program would be maintained throughout the forecast period. The Department estimated that tax credits would yield a fraction of the benefits that rebates would provide. The Department rejected rebates, as a policy alternative to national performance standards, because the benefits that rebates provide are much smaller than those resulting from performance standards. Thus, because consumer tax credits provide even smaller benefits than rebates, the Department also rejected consumer tax credits as a policy alternative to national performance standards.

The Energy Policy Act of 2005 includes tax credits for very high efficiency furnaces and boilers with AFUE of 95 percent or higher. Although the Department recognizes this requirement, this RIA focuses only on non-regulatory approaches to promoting the proposed standard, which is well below 95-percent AFUE. Thus, the Department's action to promote 95-percent-AFUE products does not affect this RIA.

Manufacturer Tax Credits. The Department believes even smaller benefits would result from availability of a manufacturer tax credit program that would effectively result in a lower price to the consumer by an amount that covers part of the incremental price difference between products meeting baseline efficiency levels and those meeting trial standard level 2. Because these tax credits would go to manufacturers instead of consumers, the Department believes that fewer consumers would be aware of this program relative to a consumer tax credit program. The Department assumes that 50 percent of the consumers who would take advantage of consumer tax credits would buy more-efficient products offered through a manufacturer tax credit program. Thus, as a result of the manufacturer tax credit, the percentage of consumers purchasing the more-efficient products would increase by 0.6 percent to 10 percent (*i.e.,* 50 percent of the impact of consumer tax credits), depending on the product class.

The Department assumed the impact of this policy would be to permanently transform the market so that the shipment-weighted efficiency gain seen in the first year of the program will be maintained throughout the forecast period. The Department estimated that manufacturer tax credits would yield a fraction of the benefits that consumer tax credits would provide. The Department rejected consumer tax credits as a policy alternative to national performance standards because the benefits that consumer tax credits provide are much smaller than those resulting from performance standards. Thus, because manufacturer tax credits provide even smaller benefits than consumer tax credits, the Department also rejected manufacturer tax credits as a policy alternative to national performance standards.

Voluntary Energy-Efficiency Targets. The Federal government's Energy Star program currently has voluntary energy-efficiency targets for non-weatherized gas furnaces and gas boilers. Equipment purchases that result from the Energy Star program, and hence the impact of that program, already are reflected in the Department's ''base case'' scenario. The Department evaluated the potential impacts of increased marketing efforts within the Energy Star program that would encourage purchase of products meeting the trial standard level 2 efficiency levels. The Department modeled the voluntary efficiency program based on this scenario and assumed that the resulting shipment-weighted efficiency gain would be maintained throughout the forecast period. The Department estimated that the enhanced effectiveness of voluntary energy-efficiency targets would provide 0.046 quads of national energy savings and an NPV of $0.074 billion (at a seven-percent discount rate). Although this would provide national benefits, they are much smaller than the benefits resulting from national performance standards. Thus, the Department rejected use of voluntary energy-efficiency targets as a policy alternative to national performance standards.

GAMA commented that, when DOE considers voluntary programs, it should survey the types of the programs used in various States, and extrapolate those results to other States and regions that do not avail themselves of voluntary programs or whose programs are less successful. (GAMA, No. 67 at p. 8) The Department considered State voluntary programs in the RIA.

Early Replacement Incentives. This policy alternative envisions a program to replace old, inefficient furnaces and boilers with models meeting the efficiency levels in trial standard level 2. The Department modeled this policy by projecting an increase in the number of such replacements equal to 20 percent of the number of replacements for failed equipment. It assumed the program would last as long as it takes to completely replace all of the eligible existing stock in the year that the program begins (2015). The Department estimated that such an early replacement program would provide 0.025 quads of national energy savings and an NPV of $0.059 billion (at a seven-percent discount rate). Although DOE estimates that this early replacement program will provide national benefits, they are much smaller than the benefits resulting from national performance standards. Thus, the Department rejected early replacement incentives as a policy alternative to national performance standards.

Bulk Government Purchases. Under this policy alternative, the government sector would be encouraged to purchase

increased amounts of equipment that meet the efficiency levels in trial standard level 2. Federal, State, and local government agencies could administer such a program. At the Federal level, this would be an enhancement to the existing Federal Energy Management Program (FEMP). The Department modeled this program by assuming an increase in installation of equipment meeting the efficiency levels of trial standard level 2 among those households for whom government agencies purchase or influence the purchase of furnaces and boilers. The Department estimated that bulk government purchases would provide 0.005 quads of national energy savings and an NPV of $0.006 billion (at a seven-percent discount rate), benefits which are much smaller than those estimated for national performance standards. The Department rejected bulk government purchases as a policy alternative to national performance standards.

Regional Performance Standards. The Department considered two alternatives based on heating degree days. These alternatives contemplate efficiency standards for non-weatherized gas furnaces only, depending on the region of the country. The Department modeled the policy of regional performance standards by aggregating States into two broad geographic regions based on climate (*i.e.,* based on heating degree days). In the first alternative, DOE defines the cold climate as having 5,000 or more heating degree days and would include the cold-climate States, including the New England, Middle Atlantic, East North Central, West North Central, Mountain (northern part only including Colorado, Idaho, Montana, Utah, Wyoming), and Pacific Census divisions (northern part only including Alaska, Oregon and Washington), and West Virginia; and warm-climate States would include the South Atlantic (with the exception of West Virginia), East South Central, Mountain (southern part only including Arizona, Nevada and New Mexico), West South Central, and Pacific (southern part only including California and Hawaii) Census divisions. For the second alternative, greater than 6000 heating degree days, the cold-climate States do not align closely with the Census divisions and include the states of Alaska, Colorado, Connecticut, Idaho, Illinois, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New York, North Dakota, South Dakota, Utah, Vermont, Wisconsin, Wyoming; the warm-climate States would include the rest of U.S. States.

The Department selected the efficiency level for this alternative based on maximizing consumer NPV. The standard that yields the maximum consumer NPV at a seven-percent discount rate for the cold-climates (*i.e.,* ≥5,000 heating degree days and ≥6,000 heating degree days) is trial standard level 4, with trial standard level 2 for the warm climates. Both alternatives yield greater energy savings and national NPVs than the standards proposed today. However, as discussed above, the Department lacks authority to adopt regional standards, so it must reject these alternatives. (42 U.S.C. 6291(6)(A))

However, DOE does have authority to grant State petitions for an exemption from Federal preemption of higher State standards, if the State filing the petition demonstrates that its higher standards are needed to meet State or local energy interests that (1) are substantially different from those in the U.S. generally and (2) are such that the costs, benefits, burdens, and energy savings resulting from the State's standards, considered in light of the State's energy plan, would outweigh the costs, benefits, burdens, and energy savings of alternative approaches. (42 U.S.C. 6297(d)) In addition, the Department must reject the petition if ''interested persons'' establish that the State regulation would ''significantly burden manufacturing, marketing, distribution, sale or servicing'' of the covered equipment on a national basis. (42 U.S.C. 6297(d)) Each of the regional standards alternatives evaluated, DOE believes, is representative of the energy and national NPV impacts that would occur if States in the cold-climate regions were to make a case that unusual and compelling State or local energy interests exist and DOE were to grant State petitions for exemption from Federal standards. In the first case—cold climate greater or equal to 5,000 heating degree days—the regional standards would save 1.72 quads of energy for non-weatherized gas furnaces only, which compares to 0.01 quads forecasted to be saved by today's proposed rule. In the second case—cold climate greater or equal to 6,000 heating degree days—DOE found that the regional standards would save 0.20 quads of energy.

National Performance Standards (TSL 2). The Department proposes to adopt the efficiency levels listed in section V.C. As indicated in the paragraphs above, with the exception of regional performance standards which the Department has determined it cannot promulgate, none of the alternatives DOE examined would save as much energy as the proposed standards. Also, several of the alternatives would require new enabling legislation, such as consumer or manufacturer tax credits, since authority to carry out those alternatives does not presently exist.

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 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. The Department has made its procedures and policies available on the Office of General Counsel's Web site: *http://www.gc.doe.gov.*

The Department reviewed today's proposed rule under the provisions of the Regulatory Flexibility Act and the procedures and policies published on February 19, 2003. 68 FR 7990. A regulatory flexibility analysis examines the impact of the rule on small entities and considers alternative ways of reducing negative impacts.

The Department used the small business size standards published on January 31, 1996, as amended, by the Small Business Administration to determine whether any small entities would be required to comply with the rule. 61 FR 3286 and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description. Residential furnace manufacturing is classified under NAICS 333415 and residential boiler manufacturing is classified under NAICS 333414. To be categorized as a small business, a manufacturer of residential furnaces and/or boilers and its affiliates may employ a maximum of 750 employees. The residential furnace and boiler industry is characterized by many different domestic manufacturers. However, consolidation within the industry has reduced the number of parent companies that manufacture similar equipment under different affiliates and labels.

The Department surveyed GAMA's *Consumers' Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment* (2005) and created a list of every manufacturer that had certified product ratings in the directory. The Department also asked stakeholders and GAMA representatives within the residential furnace and boiler industry if they were aware of any other small manufacturers. The Department then looked at publicly available data and contacted manufacturers, where needed, to determine if they meet the SBA's definition of a small manufacturing facility and have their manufacturing facilities located within the U.S. Based on this analysis, the Department estimates that there are 11 small manufacturers of residential furnaces and boilers. The Department then contacted all 11 small manufacturers. It subsequently conducted two on-site interviews and three phone interviews with small manufacturers to determine if there are differential impacts on these companies that may result from the standard.

The Department found that, in general, small manufacturers have the same concerns as large manufacturers regarding energy conservation standards. In addition, the Department found no significant differences in the R&D emphasis or marketing strategies between small business manufacturers and large manufacturers. Therefore, for the classes comprised primarily of small businesses, the Department believes the GRIM analysis, which models each product class separately, is representative of the small businesses affected by standards.

On the basis of the foregoing, DOE certifies that this proposed rule, if promulgated, will have no significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. The Department will transmit the certification and supporting statement of factual basis to the Chief Counsel for Advocacy of the Small Business Administration for review under 5 U.S.C. 605(b).

C. Review Under the Paperwork Reduction Act

This rulemaking will impose no new information or record keeping requirements. Accordingly, Office of Management and Budget clearance is not required under the Paperwork Reduction Act. (44 U.S.C. 3501 *et seq.*)

D. Review Under the National Environmental Policy Act

The Department is preparing an environmental assessment of the impacts of the proposed rule and DOE anticipates completing a Finding of No Significant Impact (FONSI) before publishing the final rule on residential furnaces and boilers, pursuant to the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*), the regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), and the Department's regulations for compliance with the National Environmental Policy Act (10 CFR part 1021).

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 4, 1999), imposes certain requirements on 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. The Department has examined today's proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition the Department for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) 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'' (61 FR 4729, February 7, 1996) 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; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. 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. The Department 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 (Pub. L. 104–4) (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. 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 small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under

UMRA. 62 FR 12820. (Also available at *http://www.gc.doe.gov.*)

Today's proposed rule will not likely result in a final rule that could impose expenditures of $100 million or more in a given year in the furnace and boiler manufacturing industry before or after the effective date of the proposed standard. The proposed rule also does not contain a Federal intergovernmental mandate. Thus, DOE is not required by UMRA to prepare a written statement assessing the costs, benefits and other effects of the proposed rule on the national economy.

Although not required by UMRA, DOE has estimated the costs, benefits, and other effects of the proposed standards on manufacturers, consumers, and the nation, and it has considered regulatory alternatives (see section VI.A.). As required by section 325(o) of EPCA (42 U.S.C. 6295(o)), today's proposed energy conservation standards for residential furnaces and boilers would achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. DOE may not select a regulatory alternative that does not meet this statutory standard.

H. Review Under the Treasury and General Government Appropriations Act of 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

The Department has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 53 FR 8859 (March 18, 1988), that this regulation would not result in any takings which might require compensation under the Fifth Amendment to the United States Constitution.

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

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. The OMB's guidelines were published at 67 FR 8452 (February 22, 2002), and DOE's guidelines were published at 67 FR 62446 (October 7, 2002). The Department has reviewed this notice 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 the Office of Information and Regulatory Affairs (OIRA), Office of Management and Budget, a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgated 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.

Today's regulatory action would not have a significant adverse effect on the supply, distribution, or use of energy and, therefore, is not a significant energy action. Accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, the Office of Management and Budget (OMB), in consultation with the Office of Science and Technology (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). (70 FR 2664, January 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.

The Department's Office of Energy Efficiency and Renewable Energy, Building Technologies Program, held formal in-progress peer reviews covering the analyses (*e.g.*, screening/engineering analysis, life-cycle cost analysis, manufacturing impact analysis, and utility impact analysis) used in conducting the energy efficiency standards development process on June 28–29, 2005. The in-progress review is a rigorous, formal and documented evaluation process using objective criteria and qualified and independent reviewers to make a judgment of the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The Building Technologies Program staff is preparing a peer review report which, upon completion, will be disseminated on the Office of Energy Efficiency and Renewable Energy's Web site and included in the administrative record for this rulemaking.

M. Review Under Executive Order 12898

The Department considers environmental justice under Executive Order 12898, ''Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,'' 59 FR 7629 (February 16, 1994). The Executive Order requires Federal agencies to assess whether a proposed Federal action causes any disproportionately high and adverse human health or environmental effects on low-income or minority populations. The Department evaluated the socioeconomic effects of standards on low-income households.

VII. Public Participation

A. Attendance at Public Meeting

The time and date of the public meeting are listed in the **DATES** section at the beginning of this notice of proposed rulemaking. The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room E–245, 1000 Independence Avenue, SW., Washington, DC 20585–0121. To attend the public meeting, please notify Ms. Brenda Edwards-Jones at (202) 586–2945. Foreign nationals visiting DOE Headquarters are subject to advance security screening procedures, requiring a 30-day advance notice. Any foreign national wishing to participate in the meeting should advise DOE of this fact as soon as possible by contacting Ms. Brenda Edwards-Jones to initiate the necessary procedures.

B. Procedure for Submitting Requests To Speak

Any person who has an interest in this notice, or who is a representative of a group or class of persons that has an interest in these issues, may request an opportunity to make an oral presentation. Such persons may hand-deliver requests to speak, along with a compact disc (CD) in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format to the address shown in the **ADDRESSES** section at the beginning of this notice of proposed rulemaking between the hours of 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Requests may also be sent by mail or e-mail to: *Brenda.Edwards-Jones@ee.doe.gov.*

Persons requesting to speak should briefly describe the nature of their interest in this rulemaking and provide a telephone number for contact. The Department requests persons selected to be heard to submit an advance copy of their statements at least two weeks before the public meeting. At its discretion, DOE may permit any person who cannot supply an advance copy of their statement to participate, if that person has made advance alternative arrangements with the Building Technologies Program. The request to give an oral presentation should ask for such alternative arrangements.

C. Conduct of Public Meeting

The Department 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 5 U.S.C. 553 and section 336 of EPCA, 42 U.S.C. 6306. A court reporter will be present to record the proceedings and prepare a transcript. The Department reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. 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. The Department will present summaries of comments received before the public meeting, allow time for presentations by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a prepared general statement (within time limits determined by DOE), before the discussion of specific topics. The Department will permit 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. Department representatives also may 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.

The Department will make the entire record of this proposed rulemaking, including the transcript from the public meeting, available for inspection at the U.S. Department of Energy, Forrestal Building, Room 1J–018 (Resource Room of the Building Technologies Program), 1000 Independence Avenue, SW., Washington, DC, (202) 586–9127, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

The Department will accept comments, data, and information regarding the proposed rule before or after the public meeting, but no later than the date provided at the beginning of this notice of proposed rulemaking. Please submit comments, data, and information electronically. Send them to the following e-mail address: *ResidentialFBNOPR Comments@ee.doe.gov.* Submit electronic comments in WordPerfect, Microsoft Word, PDF, or text (ASCII) file format and avoid the use of special characters or any form of encryption. Comments in electronic format should be identified by the docket number EE–RM/STD–01–350 and/or RIN number 1904–AA78, and wherever possible carry the electronic signature of the author. Absent an electronic signature, comments submitted electronically must be followed and authenticated by submitting the signed original paper document. No telefacsimiles (faxes) will be accepted.

According 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 two copies: One copy of the document including all the information believed to be confidential, and one copy of the document with the information believed to be confidential deleted. The Department of Energy will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to the Department 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.

E. Issues on Which DOE Seeks Comment

The Department is particularly interested in receiving comments and views of interested parties concerning:

(1) The number of consumers that may be affected by structural changes for installing a condensing furnace and the cost magnitude of any structural changes;

(2) The assumption of constant heat pump and electric resistance furnace market shares over the analysis period in order to calculate the possible market shift effects of non-weatherized gas furnace energy conservation standards on NES and NPV;

(3) The assumption of constant condensing furnace market share over the analysis period in the base case forecast in order to calculate the annual unit energy consumption of non-weatherized gas furnaces;

(4) The feasibility and safety of weatherized gas furnaces at trial standard level 2 (83-percent AFUE), due to possible condensation in the heat exchanger; and

(5) Information that would allow the Department to monetize changes in warranty costs resulting from the installation of products at near-condensing levels.

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this proposed rule.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

Issued in Washington, DC, on September 25, 2006.

Alexander A. Karsner,

Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, Part 430 of Title 10, Code of Federal Regulations, is proposed to be amended as set forth below.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

2. Section 430.32(e) of subpart C is amended by adding new paragraphs (e)(1) and (2) and revising the table to read as follows:

§ 430.32 Energy conservation standards and effective dates.

* * * * *

(e) * * *

(1) The annual fuel utilization efficiency of furnaces and boilers shall not be less than the following for products manufactured on or after the indicated dates.

(2) The annual fuel utilization efficiency of furnaces and boilers, except mobile home oil-fired furnaces, weatherized oil-fired furnaces, and gas steam boilers, and oil-fired steam boilers, shall not be less than the following for products manufactured on or after the indicated dates. Standards for mobile home oil-fired furnaces, weatherized oil-fired furnaces, gas steam boilers, and oil-fired steam boilers, remain as in paragraph (e)(1) of this section.

Product class	AFUE[1] (percent)	Effective date
1. Non-weatherized gas furnaces	80	XX/XX/2015
2. Weatherized gas furnaces	83	XX/XX/2015
3. Mobile home gas furnaces	80	XX/XX/2015
4. Oil-fired furnaces	82	XX/XX/2015
5. Gas hot-water boilers	84	XX/XX/2015
6. Oil-fired hot-water boilers	83	XX/XX/2015

[1] Annual Fuel Utilization Efficiency, as determined in section 430.22(n)(2) of this part.

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