

# CHAPTER 1. INTRODUCTION

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## CHAPTER 1. INTRODUCTION

### 1.1 PURPOSE OF DOCUMENT

This technical support document (TSD) is a “stand-alone” report that provides technical analyses and results in support of the information presented in the final rule for residential furnaces and boilers energy conservation standards.

### 1.2 OVERVIEW OF APPLIANCE STANDARDS

Part B of Title III of the Energy Policy and Conservation Act (EPCA or the Act), Public Law 94–163—as amended by the National Energy Conservation Policy Act (NECPA), Public Law 95–619; the National Appliance Energy Conservation Act (NAECA) of 1987, Public Law 100–12; the National Appliance Energy Conservation Amendments of 1988 (NAECA 1988), Public Law 100–357; and the Energy Policy Act of 1992 (EPACT), Public Law 102–486—created the Energy Conservation Program for Consumer Products other than Automobiles. The consumer products subject to this Program (referred to hereafter as “covered products”) include residential furnaces and boilers. (42 U.S.C. 6295(f))

Before the Department of Energy (DOE) determines whether to adopt a proposed energy conservation standard, it must first solicit comments on the proposed standard. (42 U.S.C. 6295 (p)) Any new or amended standard must be designed so as to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295 (o)(2)(A)) If a proposed standard is not designed to achieve the maximum improvement in energy efficiency or the maximum reduction in energy use that is technologically feasible, the Secretary must state the reasons for this in the proposed rule. (42 U.S.C. 6295 (p)(2)) To determine whether economic justification exists, DOE must review comments on the proposal and determine that the benefits of the proposed standard exceed its burdens to the greatest extent practicable, weighing the following seven factors:

1. The economic impact of the standard on the manufacturers and on the consumers of the products subject to such standard;
2. The savings in operating costs throughout the estimated average life of the covered product in the type (or class) compared to any increase in the price of, or in the initial charges for maintenance expenses of, the covered products which 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.

### **1.3 HISTORY OF RESIDENTIAL FURNACE AND BOILER STANDARDS**

EPCA, as amended, requires DOE to consider amending the energy conservation standards for certain major appliances. The NAECA legislation of 1987 established efficiency standards for residential furnaces and boilers.<sup>a</sup> It set the standards in terms of the annual fuel utilization efficiency (AFUE) descriptor at a minimum value of 78 percent for most furnaces. For boilers, it set the minimum AFUE at 75 percent for gas steam boilers and 80 percent for other boilers. For mobile home furnaces, it set the minimum AFUE at 75 percent. The effective date for these standards was January 1, 1992.

For “small” furnaces (those having an input rate of less than 45,000 British thermal units per hour), EPCA required DOE to publish a final rule by January 1, 1989, and to set a minimum AFUE at a specific level not less than 71 percent and not more than 78 percent. (EPCA 325(f)(1)(B)(ii)) For these products, DOE published an advance notice of proposed rulemaking (ANOPR) (52 FR 46367, December 7, 1987), followed by a notice of proposed rulemaking (NOPR) (53 FR 48798, December 2, 1988), in which DOE proposed to establish an energy conservation standard of 78 percent AFUE for small gas furnaces. In a final rule (54 FR 47916, November 17, 1989), DOE set the minimum AFUE for these products at 78 percent, with an effective date of January 1, 1992.

For mobile home furnaces, the Act directed DOE to publish a final rule no later than January 1, 1992, to determine whether the standard should be amended. The Act required the effective date for amendments to be January 1, 1994. DOE started this activity and issued an ANOPR (55 FR 39624, September 28, 1990), followed by a NOPR. 59 FR 10464, March 4, 1994. DOE did not release a final rule for mobile home furnace standards. As part of this activity, DOE considered a new energy descriptor that accounts for both natural gas and electricity used by a furnace. DOE rejected this approach because of the difficulty of accounting for source energy associated with electricity use.

The Act also required DOE to publish a final rule to determine for all furnaces and boilers whether the standards should be amended. The Act required that DOE publish this final rule no later than January 1, 1994, and, if DOE determined that the standards should be amended, the Act required that those amendments be effective on January 1, 2002. EPCA,

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<sup>a</sup> EPCA Section 321 (23) 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/hr for forced-air and gravity central furnaces, and less than 300,000 Btu/hr for boilers. However, in the current furnace and boiler rulemaking DOE adopted the terminology used in the heating, ventilating, and air-conditioning (HVAC) industry, which considers furnaces and boilers as separate categories.

section 325(f)(3)(B), 42 U.S.C. 6295(f)(3)(B). DOE started this activity and published an ANOPR in which it presented the product classes for furnaces that it planned to analyze, and a detailed discussion of the analytical methodology and models that it expected to use in this rulemaking. 58 FR 47326, September 8, 1993. DOE invited comments and data on the accuracy and feasibility of the planned methodology and encouraged interested persons to recommend improvements or alternatives to DOE's approach.

The 1996 moratorium on appliance standards rulemakings temporarily prevented DOE from proceeding further with these rulemakings.<sup>a</sup> DOE responded to the moratorium by developing an improved process, known as the Process Rule, for developing energy conservation standards. *Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products*, 10 CFR Part 430, Subpart C, Appendix A. The Process Rule includes guidance on how DOE prioritizes its standards rulemakings. As a result, DOE pursued standards rulemakings for other products rather than continuing to pursue amendments to the standards for furnaces and boilers, and the existing minimum AFUEs for these products remained in place. For fiscal year 2001, however, DOE classified residential furnaces and boilers, including mobile home furnaces, as having a high priority for standards amendments, and it initiated the current rulemaking.

The current rulemaking has followed the requirements for developing efficiency standards, as described in Title 10 Energy, Code of Federal Regulations (CFR), Part 430, Subpart C, Appendix A, Section 4, *Process for Developing Efficiency Standards and Factors to be Considered*. Throughout the process, DOE reviewed important issues with expert groups and stakeholders.

### **1.3.1 Current Rulemaking**

In 2001, DOE published a Framework Document for Residential Furnaces and Boilers Standards Rulemaking and held a public meeting to discuss and seek comments on the procedural and analytical approaches in this rulemaking. In 2002, several events occurred in this rulemaking. DOE held a public meeting on issues related to venting installations; DOE received comments on its analysis of manufacturing costs; the Gas Appliance Manufacturers Association (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; and DOE posted its engineering analysis on its website and received stakeholder comments. These activities culminated in DOE's publication of an ANOPR on July 29, 2004, and a public meeting on September 29, 2004, at which DOE presented and received comments on the methodology and results of the ANOPR analyses. 69 FR 45419.

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<sup>a</sup> The Department of Interior and Related Agencies Appropriations Act for Fiscal Year 1996 (P.L. 104-134) included a moratorium on proposing or issuing final rules for appliance standards rulemakings in FY 1996.

On July 14, 2006, GAMA and ACEEE, on behalf of 28 residential boiler manufacturers and four energy efficiency organizations, submitted a joint stakeholder recommendation recommending new national standards for residential boilers that would consist of a performance requirement (minimum AFUE levels) and design requirements. The recommended performance levels were the maximum that the industry felt would safeguard against corrosion and ensure safe venting. For gas-fired boilers, both water and steam types, the stakeholder recommendation called for a ban on standing pilots. For gas-fired water boilers only, there were two design requirements. In addition to the ban on standing pilots, the stakeholder recommendation also required a “temperature reset” feature that automatically adjusts the boiler output according to the outdoor ambient air temperature. For oil-fired water boilers, the stakeholder recommendation contained the design requirement for the same “temperature reset” feature. In the NOPR, DOE determined that the recommended standards in the joint stakeholder recommendation are beyond the scope of its legal authority.

On October 6, 2006, DOE published a NOPR proposing residential furnace and boiler energy conservation standards. 71 FR 59203. In conjunction with the NOPR, DOE also published on its website the complete TSD for the proposed rule, which incorporated the final analyses DOE conducted and technical documentation of each analysis. The TSD included the engineering analysis spreadsheet, the life-cycle cost (LCC) spreadsheets, the national and regional impact analysis spreadsheets, and the manufacturer impact analysis (MIA) spreadsheet—all of which are accessible on the Internet from DOE's Furnace and Boiler Rulemaking page:

[http://www.eere.energy.gov/buildings/appliance\\_standards/residential/furnaces\\_boilers.html](http://www.eere.energy.gov/buildings/appliance_standards/residential/furnaces_boilers.html). From that page, follow the links to the final rule and then to the Analytical Tools.

The energy efficiency standards proposed for furnaces and boilers were as follows:

- 80-percent AFUE for non-weatherized gas furnaces
- 83-percent AFUE for weatherized gas furnaces
- 80-percent AFUE for mobile home gas furnaces
- 82-percent AFUE for oil-fired furnaces
- 84-percent AFUE for gas boilers
- 83-percent AFUE for oil-fired boilers.

The NOPR also included additional background information on the history of this rulemaking and on DOE's use in this rulemaking of the procedures, interpretations, and policies set forth in the Process Rule. 71 FR 59207-59208. DOE held a public meeting in Washington, DC on October 30, 2006, to hear oral comments on and solicit information relevant to the proposed rule.

Subsequent to the NOPR publication, DOE issued a Notice of Data Availability and Reopening of Comment Period on February 16, 2006, concerning DOE's assumptions regarding shipments in the base case and the installation cost for oil-fired furnaces. In addition, DOE met with GAMA and certain furnace manufacturers on December 14, 2006, to receive further

comments regarding cost and safety issues concerning weatherized gas furnaces at 83-percent AFUE.

According to the rulemaking timeline, DOE plans to issue a final rule in September 2007. The effective date for new standards for furnaces and boilers would be in September 2015.

## **1.4 STRUCTURE OF THE DOCUMENT**

This final rule TSD consists of 14 chapters, 25 appendices, an environmental assessment, and a regulatory impact analysis.

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| Chapter 1  | Introduction: provides an overview of the appliance standards program and how it applies to the residential furnaces and boilers rulemaking, and outlines the structure of the document.   |
| Chapter 2  | Analytical Framework: describes the furnace/boiler analytical process.   |
| Chapter 3  | Market and Technology Assessment: characterizes the relevant product markets and existing technologies.  |
| Chapter 4  | Screening Analysis: describes the technology options for efficiency improvement and evaluates them against specific criteria.  |
| Chapter 5  | Markups for Equipment Price Determination: describes how manufacturing costs are marked up to obtain retail prices.  |
| Chapter 6  | Engineering Analysis: describes the derivation of product costs, including manufacturing, installation, and maintenance costs. It describes the calculation of energy use according to the DOE test procedure.   |
| Chapter 7  | Energy Consumption of Furnaces and Boilers: describes the calculation of field energy use by furnaces and boilers for use in the LCC analysis.   |
| Chapter 8  | Life-Cycle Cost and Payback Period Analysis: describes the effects of potential candidate standards on individual purchasers and users of the appliances. This analysis compares the LCC of appliances with possible new standards against no change in standards. |
| Chapter 9  | Shipments: describes the methodology for forecasting shipments by product class, in the absence or presence of new regulations.  |
| Chapter 10 | National Impact Analysis: describes national forecasts of energy use and net present value in the absence or presence of new regulations.  |

- Chapter 11 Life-Cycle Cost Subgroup Analysis: describes the approach for estimating LCC impacts on any identifiable groups or customers who may be disproportionately affected by any proposed change in standard levels of residential furnace and boiler users.
- Chapter 12 Manufacturer Impact Analysis: describes the approach for estimating the financial impact of new efficiency standards on manufacturers.
- Chapter 13 Utility Impact Analysis: describes the approach for estimating the impact of proposed standard levels on the electric utility industry due to new efficiency standards.
- Chapter 14 Employment Impact Analysis: describes the approach for estimating the impact of new efficiency standards on national employment.
- Environmental Assessment: Describes the approach for estimating the changes in airborne emissions due to new efficiency standards.
- Regulatory Impact Analysis: Describes the approach for estimating the impact of non-regulatory alternatives to new efficiency standards.
- Appendix A: Detailed Data for Equipment Price Markups
- Appendix B: Technical Description of the Reverse-Engineering Cost Estimation Methodology
- Appendix C: Installation Cost Model
- Appendix D: Determination of Furnace and Boiler Energy Use in the Engineering Analysis
- Appendix E: Engineering Analysis Cost and Efficiency Tables
- Appendix F: Reduced Set of Furnace Models Database
- Appendix G: Decoding of Manufacturer Model Numbers
- Appendix H: Determination of Basic Furnace and Boiler Models
- Appendix I: Furnace Fan Curves
- Appendix J: Furnace Fan Power Curves
- Appendix K: Air-Moving Efficiency

- Appendix L: Determination of Furnace and Boiler Energy Use in the LCC Analysis
- Appendix M: Derivation of Heating Load Hours
- Appendix N: User Instructions for the Life-Cycle Cost Analysis Spreadsheet
- Appendix O: Glossary of Variables and Their Values From EIA's RECS 2001
- Appendix P: Distribution for Discount Rates
- Appendix Q: Life-Cycle Cost and Payback Period Results Using Alternative Energy Price Scenarios
- Appendix R: National Energy Savings and Net Present Value Using Alternative Energy Price Scenarios
- Appendix S: User Instructions for Shipments and national Energy Savings Spreadsheet Model
- Appendix T: Life-Cycle Cost and Payback Period Results Using Alternative Material Price Scenarios
- Appendix U: Interpolation of Utility and Environmental Results from NEMS-BT Output
- Appendix V: Assignment of Gas Furnace Efficiency in the Base Case
- Appendix W: Emissions Factors for Fuel Combustion from Natural Gas, LPG, and Oil-Fired Residential Furnace and Boilers
- Appendix X: Using Implementation Curves to Estimate Market Penetration of Non-Regulatory Policies
- Appendix Y: Government Regulatory Impact Model (GRIM)