Rulemaking Framework for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Program

September 27, 2006

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1 History of the Appliances and Commercial Equipment Standards Program 2
1.2 Overview of the Rulemaking Process 4
1.2.1 Rulemaking Process and Stakeholder Participation 4
1.2.2 Advance Notice of Proposed Rulemaking 5
1.2.3 Notice of Proposed Rulemaking 6
1.2.4 Final Rule 7
1.2.5 Rulemaking Schedule 7
1.3 Overview of Heating Products 7
1.3.1 Residential Water Heaters 7
1.3.2 Direct Heating Equipment 10
1.3.3 Pool Heaters 12
2. ANALYSES FOR RULEMAKING 12
3. MARKET AND TECHNOLOGY ASSESSMENT 15
3.1 Market Assessment 15
3.2 Product Classes 16
3.3 Technology Assessment 17
3.4 Baseline Models 19
4. SCREENING ANALYSIS 24
5. ENGINEERING ANALYSIS 25
5.1 Engineering Analysis Overview 25
5.2 Proposed Approach for Determining the Cost-Efficiency Relationship 26
5.3 Manufacturer Prices 30
5.4 Proprietary Designs 32
5.5 Outside Regulatory Changes Affecting the Engineering Analysis 32
6. ENERGY USE 33
7. MARKUPS FOR EQUIPMENT PRICE DETERMINATION 34
8. LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS 35
8.1 Energy Prices 36
8.2 Discount Rates 36
8.3 Maintenance, Repair, and Installation Costs 37
8.4 Product Lifetimes 38
9. SHIPMENTS ANALYSIS 38
9.1 Base Case Forecast 38
9.2 Accounting Methodology 39
9.3 Standards Impact on Product Shipments 39
10. NATIONAL IMPACT ANALYSIS 40
10.1 Inputs to Forecasts 40
10.2 Calculation of Energy Savings 40
10.3 Net Present Value 41
11. LIFE-CYCLE COST SUBGROUP ANALYSIS 42
12. MANUFACTURER IMPACT ANALYSIS 42
12.1 Sources of Information for the Manufacturer Impact Analysis 43

12.2 Industry Cash Flow Analysis 43
12.3 Manufacturer Subgroup Analysis 44
12.4 Competitive Impacts Assessment 44
12.5 Cumulative Regulatory Burden 44
13. UTILITY IMPACT ANALYSIS 45
14. EMPLOYMENT IMPACT ANALYSIS 45
15. ENVIRONMENTAL ASSESSMENT 46
16. REGULATORY IMPACT ANALYSIS 47

LIST OF TABLES AND FIGURES

Table 1. Product Classes for Residential Water Heaters* 16
Table 2. Product Classes for Direct Heating Equipment* 17
Table 3. Existing Federal Minimum Energy Conservation Standards for Residential Water Heaters* 21
Table 4. Representative Input Ratings for Direct Heating Baseline Models 22
Table 5. Existing Federal Minimum Energy Conservation Standards for Direct Heating Equipment* 23
Table 6. Efficiency Levels for 50-gallon Electric, Storage-Type Water Heaters 27
Table 7. Efficiency Levels for 40-gallon Gas-fired, Storage-Type Water Heaters 27
Table 8. Efficiency Levels for 30-gallon Oil-fired, Storage-Type Water Heaters 28
Table 9. Efficiency Levels for Gas-Fired, Instantaneous Water Heaters..... 28
Table 10. Efficiency Levels for Fan Wall Furnace 28
Table 11. Efficiency Levels for Gravity Wall Furnace..... 29
Table 12. Efficiency Levels for Floor Furnace 29
Table 13. Efficiency Levels for Room Heaters..... 29
Table 14. Efficiency Levels for 250,000 Btu/hour Gas-fired Pool Heaters..... 29
Table 15. Preliminary Manufacturer Markups*..... 31
Table 16. Preliminary Cost Structures (Percent)* 31

LIST OF ACRONYMS

AEO	Annual Energy Outlook
AFUE	annual fuel utilization efficiency
ANOPR	advance notice of proposed rulemaking
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
BT	Building Technologies Program
C	Celsius
CEE	Consortium for Energy Efficiency
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CO_2	carbon dioxide
DOE	U.S. Department of Energy
DOJ	U.S. Department of Justice
EERE	Office of Energy Efficiency and Renewable Energy
EF	energy factor
EIA	Energy Information Administration
EPACT	Energy Policy Act of 2005
EPCA	Energy Policy and Conservation Act
F	Fahrenheit
FR	Federal Register
FTC	Federal Trade Commission
GAMA	Gas Appliance Manufacturers Association
GRI	Gas Research Institute
GRIM	Government Regulatory Impact Model
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
ImSET	Impact of Sector Energy Technologies
LBNL	Lawrence Berkeley National Laboratory
LCC	life-cycle cost
MIA	manufacturer impact analysis
MJ	megajoules
NAECA	National Appliance Energy Conservation Act of 1987
NECPA	National Energy Conservation Policy Act of 1978
NEMS	National Energy Modeling System
NES	national energy savings
NIA	national impact analysis
NOPR	notice of proposed rulemaking
NO_x	oxides of nitrogen
NPV	net present value
OIRA	Office of Information and Regulatory Affairs
PBP	payback period
PNNL	Pacific Northwest National Laboratory
quad	quadrillion British thermal units
R&D	research and development
RECS	Residential Energy Consumption Survey

RIA	regulatory impact analysis
SEC	Securities and Exchange Commission
SG&A	selling, general and administrative expenses
SO_2	sulfur dioxide
TSL	trial standard level
TSD	technical support document
U.S.	United States

Rulemaking Framework for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters

1. INTRODUCTION

The purpose of this document is to describe the procedural and analytical approaches the U.S. Department of Energy (DOE) anticipates using to evaluate energy conservation standards for residential water heaters, direct heating equipment, and pool heaters. Residential water heaters include gas-fired, storage-type water heaters, electric, storage-type water heaters, oil-fired, storage-type water heaters, tabletop water heaters, gas-fired, instantaneous water heaters, and electric, instantaneous water heaters. For this rulemaking, direct heating equipment only refers to vented home heating equipment, including room heaters, gravity wall furnaces, fan wall furnaces, and floor furnaces.

The DOE Appliances and Commercial Equipment Standards Program, of the Office of Energy Efficiency and Renewable Energy (EERE's) Building Technologies Program (BT), develops and promulgates test procedures and energy conservation standards for consumer appliances and commercial equipment. A DOE report submitted to Congress on January 31, 2006,[1] identifies the rulemakings DOE has scheduled for completion by June 2011, and explains many of the techniques DOE will use to meet this schedule. Also, DOE will continue to apply the procedures set forth in the Process Rule,[2] to the extent they do not inhibit completion of the rule by the scheduled dates.

The process for developing standards involves analysis, public notice, and consultation with interested parties. Such parties, collectively referred to as stakeholders, include manufacturers, consumers, energy conservation and environmental advocates, State and Federal agencies, and any other groups or individuals with an interest in the standards and test procedures.

This document is intended to inform stakeholders of the process of the standards rulemaking for residential water heaters, direct heating equipment, and pool heaters and to encourage and facilitate stakeholder input during the rulemaking. This document represents a starting point for developing standards and is not a definitive statement with respect to any issue to be determined in the rulemaking.

The rulemaking Framework Document is composed of 16 sections related to the rulemaking. Section 1 provides an overview of the rulemaking process and of heating products. Sections 2 through 16 discuss analyses DOE intends to conduct to fulfill the statutory requirements and guidance for this standards rulemaking. Although DOE is bundling the above three product types into a single rulemaking, it will conduct separate analyses for each product class to

---

[1] On January 31, 2006, pursuant to section 141 of the Energy Policy Act of 2005 and to the Conference Report (109-275) to the Fiscal Year 2006 Energy and Water Development Appropriations Act, DOE submitted to Congress its report entitled *Energy Conservation Standards Activities*. The report is available as a PDF file on the DOE webpage at: http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

[2] *Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products* (the "Process Rule"), 61 FR 36974 (July 15, 1006), Appendix A to Subpart C of Title 10, Code of Federal Regulations, Part 430 (10 CFR Part 430).

determine whether amended energy conservation standards are technologically feasible and economically justified. In other words, for each of the three products examined in this rulemaking, DOE will perform a set of separate analyses, including an engineering analysis, a life-cycle cost (LCC) and payback period (PBP) analysis, a national impact analysis (NIA), and a manufacturer impact analysis (MIA).

DOE will maintain information regarding this rulemaking on the DOE website at: http://www.eere.energy.gov/buildings/appliance_standards/.

While DOE invites stakeholder comment on all aspects of the material presented in this document, several specific issues on which DOE seeks comment are identified in comment boxes like this one. These comment boxes are used to highlight issues and to ask specific questions on the approaches DOE is proposing to follow in the analyses required for the standards rulemaking. DOE has numbered such requests for stakeholder feedback according to the section in which they appear.

1.1 History of the Appliances and Commercial Equipment Standards Program

The Energy Policy and Conservation Act (EPCA) of 1975 (42 U.S.C. 6291–6309) established an energy conservation program for major household appliances. The National Energy Conservation Policy Act of 1978 (NECPA) amended EPCA to add Part C of Title III (42 U.S.C. 6311–6317), which established an energy conservation program for certain industrial equipment. The amendments to EPCA in the National Appliance Energy Conservation Act of 1987 (NAECA) established energy conservation standards for residential water heaters, direct heating equipment, and pool heaters, as well as requirements for determining whether these standards should be amended. (42 U.S.C. 6291–6309)

In 2005, DOE published draft data sheets containing energy savings potentials from certain residential products and commercial equipment as part of the 2006 schedule-setting process.[3] The data sheets include energy savings calculations for direct heating equipment and pool heaters. DOE completed the energy savings calculations for residential water heaters in previous years. The following provides a summary of the rulemaking activities and includes the energy savings estimates for each of the three product types.

NAECA established energy conservation standards for residential water heaters, direct heating equipment[4], and pool heaters and required that DOE conduct two cycles of rulemakings to

[3] FY2006 Draft Rulemaking Activities Data Sheets, October 2005. This document can be downloaded from the DOE website at: http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

[4] Initially, EPCA included vented and unvented home heating equipment in DOE's appliance standards program. However, EPCA did not specifically use the term direct heating equipment. NAECA prescribed energy conservation standards for direct heating equipment instead of vented and unvented home heating equipment, but NAECA did not include a definition of the products covered under the direct heating equipment category. Since DOE has established test procedures to measure the energy efficiency of vented home heating equipment and the test procedures for unvented home heating equipment do not have an energy efficiency measure, DOE has determined that direct heating equipment only refers to vented home heating equipment for the purpose of this rulemaking.

determine if more stringent standards are economically justified and technologically feasible for these products. (42 U.S.C. 6295 (e)(1) and (4)) Specifically, NAECA directed the Secretary to publish a final rule determining whether the standards for residential water heaters, direct heating equipment, and pool heaters should be amended by January 1, 1992, and January 1, 2000. (42 U.S.C. 6295 (e)(4)) On February 7, 2989 and October 17, 1990, DOE issued a final rule codifying the standards prescribed by NAECA, and thereby established the first set of energy conservation standards for residential water heaters, direct water heating equipment, and pool heaters. 54 FR 6077 and 55 FR 42163.

Pursuant to 42 U.S.C. § 6295(e)(4)(A), on January 17, 2001 (the January 2001 final rule), DOE published in the *Federal Register* a final rule, effective on January 20, 2004, amending the energy conservation standards for residential water heaters. 66 FR 4474. DOE estimated that the standard in the January 2001 final rule had the potential to save 4.6 quadrillion (quads) British thermal units (Btus) of energy over 26 years for residential water heaters. 66 FR 4475. The current test procedure for residential water heaters was initially established by a final rule published on October 17, 1990 (the October 1990 final rule), codified at Appendix E to Subpart B of 10 CFR Part 430. 55 FR 42163. DOE amended the residential water heater test procedure on May 11, 1998, (the May 1998 final rule) by adding the following provisions: (1) a revision to the method used in determining the first hour rating of storage-type water heaters, (2) an additional rating for electric and gas-fired instantaneous water heaters, and (3) a revision to the definition of a heat pump water heater. 63 FR 25996. On July 20, 1998, DOE published in the *Federal Register* a correction to the May 1998 final rule, which added residential water heater testing schematics. 63 FR 38737. Along with the amended energy conservation standards published in the January 2001 final rule, DOE also amended the test procedure by adding a definition for tabletop water heaters and reaffirming the test methods specified in Appendix E to Subpart B of 10 CFR Part 430. 66 FR 4476.

DOE initially analyzed energy conservation standards for direct heating equipment as part of an eight-product standards rulemaking. When DOE analyzed direct heating equipment in these earlier proceedings, DOE only considered products categorized as vented home heating equipment. DOE issued a notice of proposed rulemaking (NOPR) on March 4, 1994, proposing to amend the energy conservation standards for direct heating equipment as well as other consumer products. 59 FR 10464. The Department of Interior and Related Agencies Appropriations Act for Fiscal Year 1996 (P.L. 104-134) provided for a moratorium on proposing or issuing final rules for appliance standards rulemakings for the remainder of Fiscal Year 1996, thereby preventing DOE from finalizing the 1994 proposed standards and leaving the existing NAECA efficiency levels in place. DOE prescribed a vented home heating equipment test procedure in a notice published in the *Federal Register* on May 2, 1978. 43 FR 20182. Thereafter, on May 12, 1997, DOE published a final test procedure rule, (the May 1997 final rule), that amended the test procedures for direct heating equipment, and in particular, vented home heating equipment. 62 FR 26140. The May 1997 final rule included modified calculation procedures for the weighted-average steady-state efficiency and annual fuel utilization efficiency (AFUE) levels for certain manually controlled heaters and also added a procedure for calculating the annual energy consumption of fossil fuel and auxiliary electrical energy for this type of equipment. Finally, DOE's schedule-setting activities for fiscal year 2005 included an updated

analysis of amended standards for all product classes of direct heating equipment, projecting an estimated energy savings potential of 0.1–0.2 quads.[5]

As with direct heating equipment, DOE initially analyzed standards for pool heaters as part of the eight-product standards rulemaking of 1994, 59 FR 10464, but (as noted above) never finalized the proposed standards. On May 12, 1997, DOE published in the *Federal Register* a final rule that amended the test procedure for pool heaters. 62 FR 26140. The May 1997 final rule updated the referenced American National Standards Institute (ANSI) standard for pool heaters from ANSI Standard Z21.56-1986, Gas-Fired Pool Heaters, to ANSI Standard Z21.56-1994, added a procedure for calculating the annual energy consumption of fossil fuel auxiliary electrical energy for pool heaters, and added a seasonal efficiency descriptor. 62 FR 26141. DOE has not amended the energy conservation standards for pool heaters since NAECA established them in 1987. DOE's schedule-setting activities for fiscal year 2005 included an updated analysis of amended standards for pool heaters, projecting an estimated energy savings potential of 0.3–0.6 quads.[6]

1.2 Overview of the Rulemaking Process

1.2.1 Rulemaking Process and Stakeholder Participation

Under EPCA, when DOE is analyzing new or amended standards, it must consider, to the greatest extent practicable: (1) the economic impact of the standard on the manufacturers and consumers of the affected products; (2) the savings in operating costs throughout the estimated average life of the product compared to any increases in the initial cost, or maintenance expense; (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 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. (42 U.S.C.§6295(o)(2)(B)(i)) Other statutory requirements are set forth in 42 U.S.C. 6295(o)(1)-(2)(A), (2)(B)(ii)-(iii), and (3)-(4).

DOE considers stakeholder participation to be a very important part of the process for setting energy conservation standards. DOE actively encourages the participation and interaction of all stakeholders during the comment period of each rulemaking stage. Beginning with the Framework Document and during subsequent comment periods, interactions among stakeholders provide a balanced discussion of critical information required to conduct the standards rulemaking.

In conducting the energy conservation standards rulemakings, DOE involves stakeholders through formal public notification (*i.e.*, Federal Register notices). For this residential water heating, direct heating equipment, and pool heating energy conservation standards rulemaking, DOE will employ the procedures set forth in the Process Rule, to the extent they are appropriate for the development of energy conservation standards for these products.

[5] Id.
[6] Id.

The standards rulemaking process involves three formal, major public notices, which are published in the Federal Register. The first of the rulemaking notices is an advance notice of proposed rulemaking (ANOPR, see section 1.2.2). The ANOPR is designed to publicly vet the models and tools used in the rulemaking and to facilitate public participation before the proposed rule stage. The second notice is a notice of proposed rulemaking (NOPR, see section 1.2.3), which presents a discussion of comments received in response to the ANOPR; analysis of the impacts of standards on consumers, manufacturers and the nation; DOE's weighting of the impacts; and the proposed standards. The third notice is the final rule (see section 1.2.4), which presents a discussion of comments received in response to the NOPR; the revised analysis of the impacts of standards; DOE's weighting of the impacts; the standards adopted by DOE; and the effective dates of the standards.

1.2.2 Advance Notice of Proposed Rulemaking

As part of its initial rulemaking activities, DOE typically identifies the product design options or efficiency levels that it will analyze in detail and those it should eliminate from further consideration. This process includes a market and technology assessment (see section 3) and a screening analysis (see section 4). These activities include consultations with stakeholders and independent technical experts who can assist with identifying the key issues and design options or efficiency levels to be considered by DOE in the rulemaking.

At the start of the ANOPR analysis, DOE considers efficiency levels or design options for each product class. DOE uses these efficiency levels to collect manufacturer cost data, historical shipment data, shipment-weighted average efficiency data, and preliminary manufacturer impact data (e.g., conversion-capital expenditures, marketing costs, and research and development (R&D) costs). During the ANOPR stage, DOE presents consumer LCC impact and PBP results (see section 8), national energy savings (NES) and consumer net present value (NPV) results (see section 10) for a range of efficiency or energy use levels; and will also present a preliminary MIA (see section 12).

DOE's selection of efficiency or energy use levels to analyze is based on the costs and benefits of efficiency levels or design options. In addition to the efficiency corresponding to the maximum technologically feasible ("max tech") design and the efficiency corresponding to the minimum life-cycle-cost point, DOE generally selects levels or design options for consideration that span the full range of technologically achievable efficiencies.

The range of levels analyzed typically includes:

- The highest energy efficiency level or lowest energy consumption level that is technologically feasible (the "max-tech" level);
- The level with the lowest LCC; and
- Levels that incorporate noteworthy technologies or fill large gaps between efficiency levels of other levels considered.

The efficiency or energy use levels analyzed serve to demonstrate the models' and tools' functions and outputs. During the ANOPR, models and tools are tested for the different product

classes at each efficiency or energy use level analyzed. In addition, preliminary ANOPR results may facilitate negotiations among interested parties.

DOE will make the results of the analyses available on its website for review and will consider comments after publication of the ANOPR. When DOE publishes the ANOPR, it also will make available a technical support document (TSD) containing the details of all the analyses performed to date.

After the publication of the ANOPR, there is a 75-day public comment period and one public meeting. At this point, DOE encourages stakeholders to develop joint recommendations for standard levels.

1.2.3 Notice of Proposed Rulemaking

After the ANOPR, DOE will conduct further economic impact analyses. These analyses may include refinements of previous analyses, and will include a consumer LCC sub-group analysis (see section 11), a complete MIA (see section 12), a utility impact analysis (see section 13), an employment impact analysis (see section 14), an environmental assessment (see section 15), and a regulatory impact analysis (RIA) (see section 16).

DOE will make the results of all the analyses available on its website for review and will consider comments after the publication of the NOPR. This review and comment process may result in revisions to the analyses. The analytical process ends with the selection of proposed standard levels that will be presented in the NOPR. DOE selects the proposed standard levels from the trial standard levels (TSLs) analyzed. The NOPR, published in the *Federal Register*, will document the evaluation and selection of any proposed standards.

For each product class, DOE will identify the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible. If DOE proposes a level that is below the maximum technologically feasible level, it will sequentially explain its reasons for eliminating higher levels, beginning with the highest level considered. DOE will present the analysis results in the NOPR and the analysis details in an accompanying TSD.

DOE considers many factors in selecting proposed standards. These factors or criteria are established by statute and capture the many benefits, costs, and impacts of the standards. Additionally, DOE encourages stakeholders to develop joint recommendations for standard levels. DOE will carefully consider such recommendations in its decision process.

When DOE publishes the NOPR, it will provide the Department of Justice (DOJ) with a copy of the NOPR and TSD and will solicit feedback on the impact of the proposed standard levels on competition. DOJ will review the proposed standard levels in light of any lessening of competition that is likely to result from the imposition of standards. In preparing the final rule, DOE will consider DOJ's determination on the impacts of the proposed standard on competition. The publication of the NOPR will be followed by a 75-day public comment period that includes one public meeting.

1.2.4 Final Rule

Revisions to the analyses may result from the public comments on the NOPR. On the basis of the public comments, DOE will review the engineering and economic impact analyses and proposed standards and make modifications as necessary.

After the publication of the NOPR, DOE will conduct a thorough review of all analyses performed, and of the TSLs. Final revisions to the analyses and trial standard levels will be made as appropriate.

Before the final rule is issued, DOE will consider DOJ comments on the NOPR relating to the impacts of the proposed standard levels on competition to determine whether changes to these standard levels are needed.

The standards rulemaking will conclude with the publication of the final rule. DOE will select the final standard levels based on the complete record. The final rule will promulgate the final standard levels and their effective date and explain the basis for their selection. The final rule will be accompanied by a final TSD.

1.2.5 Rulemaking Schedule

The Energy Conservation Standards Activities report submitted to Congress in January 2006 summarizes the rulemaking timetable for residential water heaters, direct heating equipment, and pool heaters.[7] In part, the report states that the DOE will initiate a rulemaking pertaining to water heaters, direct heating equipment, and pool heaters by approximately the fourth quarter of 2006 and issue a final rule by March, 2010.

1.3 Overview of Heating Products

The heating products covered under this rulemaking include:

1. Residential water heaters
2. Direct heating equipment
3. Pool heaters

These three types of products are discussed in sections 1.3.1, 1.3.2, and 1.3.3, respectively.

1.3.1 Residential Water Heaters

EPCA defines "water heater" as "a product which utilizes oil, gas, or electricity to heat potable water for use outside the heater upon demand, including –

> (A) storage type units which heat and store water at a thermostatically controlled temperature, including gas storage water heaters with an input of 75,000 [British thermal

[7] Pursuant to section 141 of the Energy Policy Act of 2005 and to the Conference Report (109-275) to the Fiscal Year 2006 Energy and Water Development Appropriations Act, January 31, 2006, DOE issued a report entitled, *Energy Conservation Standards Activities*. The report is available as a PDF file on the DOE webpage at: http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

units] Btu per hour or less, oil storage water heaters with an input of 105,000 Btu per hour or less, and electric storage water heaters with an input of 12 kilowatts or less;

(B) instantaneous type units which heat water but contain no more than one gallon of water per 4,000 Btu per hour of input, including gas instantaneous water heaters with an input of 200,000 Btu per hour or less, oil instantaneous water heaters with an input of 210,000 Btu per hour or less, and electric instantaneous water heaters with an input of 12 kilowatts or less; and

(C) heat pump type units, with a maximum current rating of 24 amperes at a voltage no greater than 250 volts, which are products designed to transfer thermal energy from one temperature level to a higher temperature level for the purpose of heating water, including all ancillary equipment such as fans, storage tanks, pumps, or controls necessary for the device to perform its function."

(42 U.S.C. 6291(27)) DOE has incorporated this definition into its regulations in section 430.2 of 10 CFR Part 430. Appendix E to Subpart B of 10 CFR Part 430 contains refinements of the definitions of storage-type, instantaneous, and tabletop residential water heaters, as follows:

1. "Gas Storage-type Water Heater means a water heater that uses gas as the energy source, is designed to heat and store water at a thermostatically controlled temperature of less than 180°F (82°C), has a nominal input of 75,000 Btu (79 megajoules (MJ)) per hour or less, and has a rated storage capacity of not less than 20 gallons (76 liters) nor more than 100 gallons (380 liters)." (Appendix E, section 1.12.2)

2. "Oil Storage-type Water Heater means a water heater that uses oil as the energy source, is designed to heat and store water at a thermostatically controlled temperature of less than 180°F (82°C), has a nominal energy input of 105,000 Btu/h (110 MJ/h) or less, and has a manufacturer's rated storage capacity of 50 gallons (190 liters) or less." (Appendix E, section 1.12.4)

3. "Electric Storage-type Water Heater means a water heater that uses electricity as the energy source, is designed to heat and store water at a thermostatically controlled temperature of less than 180°F (82°C), has a nominal input of 12 kilowatts (40,956 Btu/h) or less, and has a rated storage capacity of not less than 20 gallons (76 liters) nor more than 120 gallons (450 liters)." (Appendix E, section 1.12.1)

4. "Tabletop water heater means a water heater in a rectangular box enclosure designed to slide into a kitchen countertop space with typical dimensions of 36 inches high, 25 inches deep and 24 inches wide." (Appendix E, section 1.16)

5. "Gas Instantaneous Water Heater means a water heater that uses gas as the energy source, initiates heating based on sensing water flow, is designed to deliver water at a controlled temperature of less than 180°F (82°C), has an input greater than 50,000 Btu/h (53 MJ/h) but less than 200,000 Btu/h (210 MJ/h), and has a manufacturer's specified

storage capacity of less than 2 gallons (7.6 liters). The unit may use a fixed or variable burner input." (Appendix E, section 1.7.2)

Although section 1.12.3 of Appendix E in 10 CFR Part 430 also contains a separate definition for "heat pump water heaters," DOE intends to treat heat pump water heaters as a design option for electric storage-type water heaters, as was done in the January 2001 final rule. 66 FR 4476. In addition, DOE will not consider solar water heaters in this rulemaking because DOE lacks the authority to prescribe energy conservation standards for these products. Section 321(3) of EPCA defines the term energy as meaning electricity, or fossil fuels. (42 U.S.C 6291(3)) Therefore, appliances that utilize the sun's energy instead of fossil fuels or electricity are not covered by EPCA. Lastly, section 135(C)(3) of the Energy Policy Act of 2005 (EPACT 2005) amends section 325(o) of EPCA to add subsection (5), which gives DOE the authority to set two separate energy conservation standards for a product that performs two different functions (*i.e.*, space conditioning and water heating). DOE does not intend to set standards for combination space conditioning and water heating systems in the advance notice of public rulemaking (ANOPR) stage of the rulemaking because there is no DOE test procedure for these products.[8]

Due to their small size, tabletop water heaters provide utility to the consumer, but this design feature affects the energy efficiency potential of the product. In 2001, DOE established a separate product class for tabletop water heaters (which are primarily electric) due to the strict size limitations for these products. Even though DOE created a separate product class for tabletop water heaters, DOE did not amend the energy factor from the levels prescribed by NAECA for electric storage-type water heaters because tabletop water heaters cannot be manufactured any larger. In order to increase the efficiency of the systems, manufacturers could increase the insulation thickness, which would increase the size of the system. DOE recognizes that these systems are located underneath tabletops in very specialized applications and that manufacturers already maximize the size of the water heater in order to meet the current minimum energy factors promulgated by the January 2001 final rule. Considering these strict size limitations for these products, DOE is not aware of any feasible technological advancement which would change its conclusion from 2001. Therefore, DOE is proposing to exclude tabletop water heaters from consideration in this rulemaking.

DOE recognizes that electric, instantaneous water heaters with an input of less than 12 kilowatts are subject to the energy conservation standards in section 430.32(d) of 10 CFR Part 430. However, DOE is proposing to exclude electric instantaneous water heaters from consideration in this rulemaking because there is no significant energy savings potential from these products.[9] The energy efficiency metric for water heaters is a combination of standby losses and recovery efficiency. All electric water heaters, including instantaneous water heaters, have minor losses in

[8] The National Institute of Standards and Technology (NIST) is developing a DOE test procedure for combined water heating and space heating equipment based on the ASHRAE Standard 124-1991, "Methods of Testing for Rating Combination Space-Heating and Water-Heating Appliances." DOE's process for adopting this test procedure has not yet been completed.

[9] DOE does not intend to propose a separate definition for "electric instantaneous water heaters" for incorporation into Appendix E in Subpart B of 10 CFR Part 430. DOE believes that manufacturers do not need such a definition to determine whether their products are covered by the statute, nor to test their products using the test procedure set forth in that subpart.

recovery efficiency, and electric instantaneous water heaters have negligible standby losses due to their small storage size. In addition, many of the electric instantaneous water heaters currently on the market are well above the existing minimum energy conservation standard and utilize the available technologies to reduce the standby losses of the product.

Item 1-1 *DOE seeks comment on the coverage and scope of residential water heaters for this rulemaking as defined by the above statutory definitions.*

1.3.2 Direct Heating Equipment

EPCA initially gave DOE the authority to prescribe standards for vented and unvented home heating equipment. However, NAECA did not include these descriptions for home heating equipment and, instead, prescribed energy conservation standards for direct heating equipment, as shown in section 430.32(i) of 10 CFR Part 430. In addition, NAECA did not include a definition of direct heating equipment that would specify the products that would be covered by the standards. The energy conservation standards set by NAECA for direct heating equipment are consistent with the energy efficiency metric described in the vented home heating equipment test procedure. Since DOE's established test procedure for unvented home heating equipment does not include a method for determining energy efficiency, DOE assumed these direct heating equipment standards are applicable only to vented home heating equipment. The section detailing the energy conservation standards prescribed by NAECA, at section 430.32 of 10 CFR Part 430, includes 16 product classes of gas-fired wall, floor, or room heaters. Therefore, DOE assumes that this rulemaking applies only to vented home heating equipment and that the term *direct heating equipment* only refers to *vented home heating equipment*.

In its 1992 rulemaking, DOE said that all types of direct heating equipment have two items in common: (1) heat is conveyed without ducts (directly) from the point of generation to the heated space and (2) flue products (products of combustion) are vented outside. The decision to exclude unvented home heating equipment from this rulemaking is further supported by the fact that unvented heating equipment does not require venting to the outside.

As described under section 430.2 of 10 CFR Part 430, the definitions of vented wall furnace, vented floor furnace, and vented room heater are as follows:

1. "Vented wall furnace means a self-contained vented heater complete with grilles or the equivalent, designed for incorporation in, or permanent attachment to, a wall of a residence and furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing."

2. "Vented floor furnace means a self-contained vented heater suspended from the floor of the space being heated, taking air for combustion from outside this space. The vented floor furnace supplies heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing."

3. "Vented room heater means a self-contained, free standing, nonrecessed, vented heater for furnishing warmed air to the space in which it is installed. The vented

room heater supplies heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing."

Vented hearth products, sold either as fireplaces, fireplace inserts, gas stoves, or log sets, can be used to provide residential space heating. When used to furnish heat to a living space, vented hearth products provide the same function and utility as vented heaters. The definition for vented home heating equipment (or vented heater) (section 430.2 of 10 CFR Part 430) states that this equipment is designed to furnish warmed air to the living space of the residence, directly from the device, without duct connections and includes vented wall furnaces, vented floor furnaces, and vented room heaters. Vented hearth products, which include fireplaces, fireplace inserts, gas-stoves, and log sets, also furnish warmed air to the living space of a residence, directly from the device, without duct connections. Therefore, DOE believes the product classes that are covered by the vented heater definition include vented hearth products.

DOE believes the energy conservation standards provided in section 430.32(i) of 10 CFR Part 430, entitled, "Direct Heating Equipment,"[10] would be applicable to vented hearth products if the appliance has energy-saving features such as a blower, a thermostat, or if the appliance's primary function is space heating. DOE recognizes that manufacturers of these types of hearth products currently test their products using DOE's test procedure for vented home heating equipment (vented heaters) and certify compliance with the standards provided in section 430.32(i) of 10 CFR Part 430. DOE believes these standards are appropriate, and in particular, DOE believes that the energy conservation standards for gas wall fans or gravity furnace types should apply to recessed vented hearth products and the energy conservation standards for gas room heaters should apply to nonrecessed vented hearth products.

Unvented heating products, such as unvented fireplaces, would be tested using the unvented test procedure in Appendix G to Subpart B of 10 CFR Part 430, which does not specify a method for determining energy efficiency or consumption. Therefore, unvented hearth products cannot be considered in the direct heating equipment category and would be excluded from this rulemaking.

Item 1-2 *DOE seeks comment on the coverage and scope of direct heating equipment for this rulemaking, as defined by the above definitions.*

Item 1-3 *DOE seeks comment on DOE's assumption that the terms "direct heating equipment" and "vented home heating equipment" are synonymous for the purposes of this rulemaking. In particular, DOE seeks comment on excluding unvented home heating equipment from this rulemaking for direct heating equipment.*

Item 1-4 *DOE seeks comment on the recognition of vented hearth products as part of the direct heating equipment rulemaking.*

[10] It is noted the CFR does not provide a definition for direct heating equipment in section 430.2, but this term appears in the CFR table 430.32(i) which provides the efficiency standards for vented heaters.

Item 1-5 *DOE seeks comment whether the energy conservation standards would be applicable to vented hearth products only if the appliance has energy-saving features such as a thermostat, or the space heating is its primary function.*

Item 1-6 *DOE seeks comment whether the energy conservation standards for gas wall fan or gravity furnace types should apply to recessed vented hearth products and the energy conservation standards for gas room heaters should apply to nonrecessed vented hearth products.*

1.3.3 Pool Heaters

The EPCA defines "pool heater" as "an appliance designed for heating nonpotable water contained at atmospheric pressure, including heating water in swimming pools, spas, hot tubs and similar applications." (42 U.S.C. 6291(25)) DOE incorporated this definition into its regulations under section 430.2 at 10 CFR Part 430.

DOE only intends to assess the technological feasibility and economic justification for amending energy conservation for gas-fired pool heaters. DOE recognizes that a majority of consumers with pool heaters utilize this technology and could benefit from amended energy conservation standards. In addition, the test method incorporated by reference into Appendix P to Subpart B of 10 CFR Part 430 only specifies the method of test for gas-fired pool heaters. More specifically, DOE will not consider solar pool heaters in its review and possible amendment of the energy conservation standards for pool heaters. According to section 321(3) of EPCA, energy is defined as electricity and fossil fuels. (42 U.S.C 6291(3)) Therefore DOE does not have authority to prescribe energy conservation standards for solar pool heaters. Recognizing this technology can reduce energy consumption for pool heating applications, DOE encourages the use of these systems.

DOE proposes to exclude from consideration in this rulemaking pool heaters that have an input capacity greater than 1,000,000 Btu per hour. Pool heater manufacturers market pool heaters with input capacity greater than 1,000,000 Btu per hour as light industrial or commercial products. EPCA intended for DOE only to consider amending the energy conservation standards for those pool heaters for residential use. Accordingly, DOE proposes only to consider those pool heaters with an input capacity of 1,000,000 Btu per hour or less in this rulemaking.

2. ANALYSES FOR RULEMAKING

Ultimately, DOE intends to select energy conservation standards that achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. Economic justification includes consideration of the economic impacts on domestic manufacturers and consumers, national benefits, including environmental impacts, issues of consumer utility, and impacts from any lessening of competition. The purpose of the analyses conducted in support of the standards rulemaking will be to ensure that the final standards meet these criteria of technological feasibility and economic justification.

This section offers an overview of DOE's analytical methodology and discusses the major components of the analyses DOE will conduct. Figure 1 summarizes the analytical components of the standards-setting process, with the planned analyses presented in the center column. Each analysis has a set of key inputs, which are data and information required for the analysis. "Approaches" are the methods DOE will use to obtain key inputs. For example, DOE will collect some key inputs from public databases, stakeholders, or others with special knowledge, and the project team will develop some in support of the rulemaking. The results of each analysis are key outputs, which feed directly into the rulemaking. Dotted lines connecting one analysis to another indicate the flow of information.

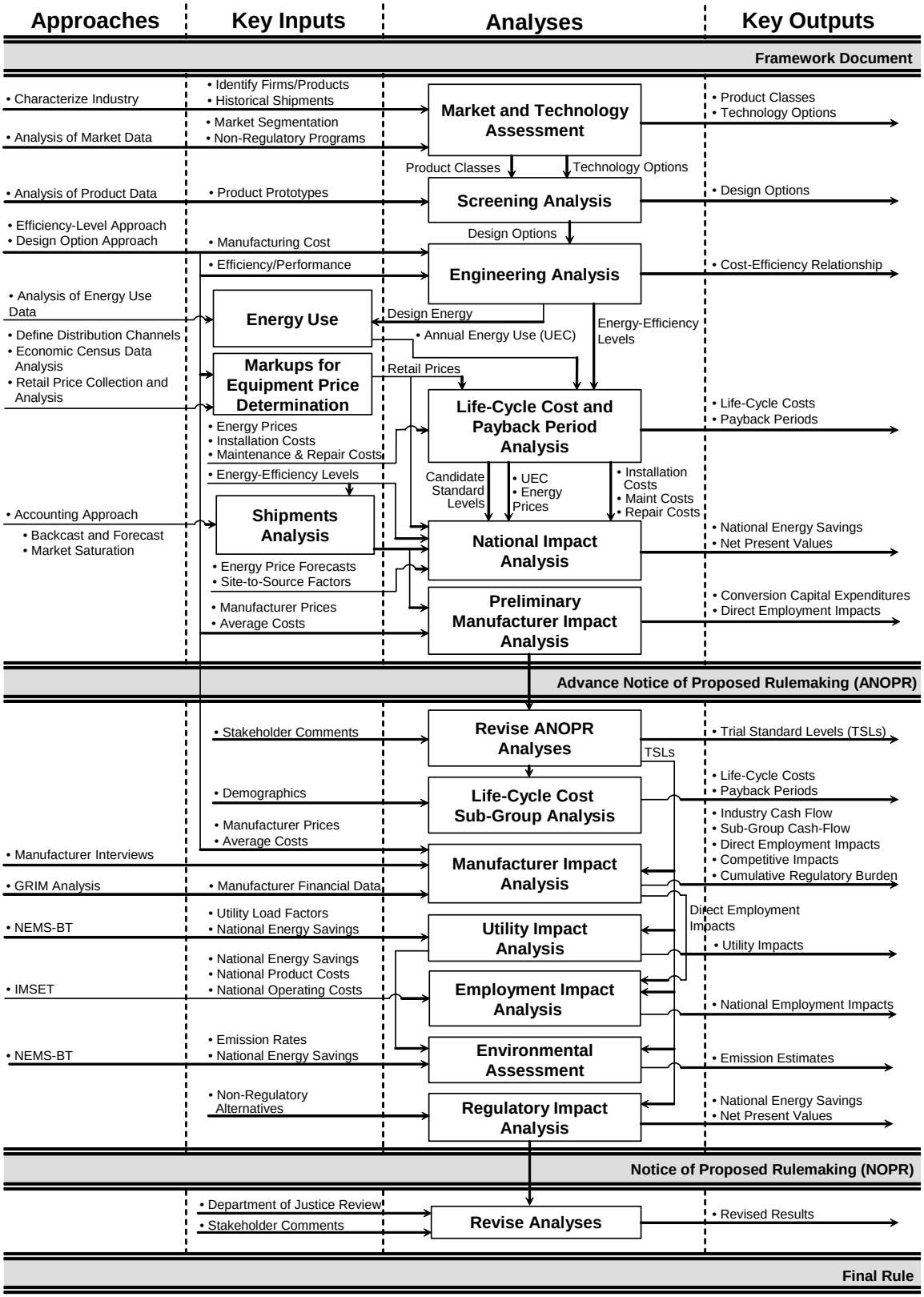

Figure 1. Flow Diagram of Analyses for the Residential Water Heater, Direct Heating Equipment, and Pool Heater Standards Rulemaking Process

3. MARKET AND TECHNOLOGY ASSESSMENT

The market and technology assessment provides vital information about the residential water heater, direct heating equipment, and pool heater markets, technologies, and industries and serves as the basis for much of the analysis. Additionally, this assessment will assist in determining product classes, as well as identifying potential design options or efficiency levels for each product class.

3.1 Market Assessment

DOE will qualitatively and quantitatively characterize the structure of the residential water heater, direct heating equipment, and pool heater industries and markets. In the market assessment, DOE will identify and characterize the manufacturers of each type of equipment; identify typical products for each product class and market channels; estimate market shares and trends in the market; address regulatory and non-regulatory initiatives intended to improve the energy efficiency or reduce the energy consumption of these products; and explore the potential for technological improvements in the design and manufacturing of such equipment.

The market assessment will establish the context for this rulemaking, and serve as a resource to guide the analyses that will follow. For example, DOE plans to use historical equipment shipments and prices as an aid in creating shipment scenarios and predicting future prices. Similarly, DOE will use market structure data for assessing competitive impacts as part of the MIA.

The Gas Appliance Manufacturers Association (GAMA) is the trade association for manufacturers of the equipment covered under this rulemaking. DOE expects that GAMA will play a critical role in providing market information, including input to help DOE characterize current and historical trends in equipment shipment and energy efficiency.

Item 3-1 *DOE seeks information that would contribute to the market assessment.*

Item 3-2 *DOE seeks data on manufacturing costs, distribution channels, and estimates of market shares for the products considered in this rulemaking.*

Item 3-3 *DOE seeks product information such as current product features, efficiencies, and efficiency trends.*

Item 3-4 *DOE seeks data on annual product shipments from 1990 to 2005 (both domestic and imports), and the corresponding average efficiency of these shipments.*

3.2 Product Classes

DOE intends to separate each of the product types (residential water heaters, direct heating equipment, and pool heaters) into product classes and will formulate a separate energy conservation standard for each product class. The criteria for separation into different classes are: (1) the type of energy used, or (2) capacity or other performance-related features, such as those that provide utility to the consumer or other features deemed appropriate by the Secretary that would justify the establishment of a separate energy conservation standard. (42 U.S.C. 6295(q))

For residential water heaters, DOE is basing the product classes on energy source (*i.e.*, gas, oil, or electric) and design (*i.e.*, storage-type, and instantaneous or "tankless," in common industry parlance). DOE plans to analyze the product classes shown in Table 1, which were established by EPCA, under 42 U.S.C. 6295(e)(1), and in the January 2001 final rule at 66 FR 4474, and incorporated into section 430.32(d) of 10 CFR Part 430.

Table 1. Product Classes for Residential Water Heaters*

Residential Water Heater Class	Characteristics
Gas-fired Storage-Type	Nominal input of 75,000 Btu/hour or less; rated-storage-volume from 20 to 100 gallons
Oil-fired Storage-Type	Nominal input of 105,000 Btu/hour or less; rated-storage-volume of 50 gallons or less
Electric Storage-Type	Nominal input of 40,956 Btu/hour or less; rated-storage-volume from 20 to 120 gallons
Gas-fired Instantaneous	Nominal input of over 50,000 Btu/hour up to 200,000 Btu/hour; rated-storage-volume of 2 gallons or less

* Only the product classes covered by this rulemaking are shown. The table does not include tabletop and instantaneous electric water heaters.

For direct heating equipment, DOE is basing the product classes on design (*i.e.*, wall fan, wall gravity, floor, and room) and input capacity. DOE presumes that there are unique design constraints associated with a unit's capacity that warrant the creation of separate classes by input capacity. As part of the standards rulemaking analysis, DOE will conduct an investigation as to whether all of the product classes which are set forth in EPCA (42 U.S.C. 6295(e)(3)) and incorporated into section 430.21(i) of 10 CFR Part 430 are still warranted. Until then, DOE proposes the following product classes shown in Table 2.

Table 2. Product Classes for Direct Heating Equipment*

Direct Heating Equipment Class	Input Capacity (Btu/hour)
Gas wall fan type	Up to 42,000
	Over 42,000
Gas wall gravity type	Up to 10,000
	Over 10,000 up to 12,000
	Over 12,000 up to 15,000
	Over 15,000 up to 19,000
	Over 19,000 up to 27,000
	Over 27,000 up to 46,000
	Over 46,000
Gas floor	Up to 37,000
	Over 37,000
Gas room	Up to 18,000
	Over 18,000 up to 20,000
	Over 20,000 up to 27,000
	Over 27,000 up to 46,000
	Over 46,000

* Table includes all of the product classes set forth in EPCA and codified in 10 CFR Part 430.32(i)

For pool heaters, DOE is basing the product class on fuel type only. DOE plans to analyze only one product class, gas-fired pool heaters. The gas-fired pool heater class which uses thermal efficiency as an efficiency descriptor is set forth in EPCA (42 U.S.C. 6295(e)(2)) and incorporated into section 430.32(k) of 10 CFR Part 430.

Item 3-5 *DOE seeks comment on the classes and criteria used for creating these product classes. Specifically, do the statutory criteria in 42 U.S.C. 6295(q) warrant the development of additional product classes beyond those identified above?*

Item 3-6 *What product classes, if any, can DOE combine for standards-setting analysis because of their similarities?*

Item 3-7 *Can DOE apply or extrapolate analyses for any one of these product classes to another product class?*

Item 3-8 *Should DOE eliminate any of these product classes (e.g., do any of these product classes have few or no shipments)?*

3.3 Technology Assessment

DOE typically uses information about existing and past technology options as well as known prototype designs to identify different energy efficient technologies to attain higher energy efficiency levels. DOE intends to develop a list of technologies that it will consider in the analysis. Initially, this list will include all those technologies considered to be technologically

feasible and will serve to establish the maximum technologically feasible design. In the screening analysis, DOE will eliminate from consideration technologies that are not incorporated in commercial products or in working prototypes or that fail to meet certain criteria regarding: practicability to manufacture, install, and service; impacts on product utility or availability; and health or safety. Process rule, sections 4(a)(4) and 5(b). 61 FR 36974.

For residential water heaters, DOE will consider technologies included in its most recent analysis of amended energy conservation standards for residential water heaters and information from recent trade publications. The following technologies are from the December 2000 *Technical Support Document for Residential Water Heaters* (the 2000 TSD):

- heat traps
- plastic tank
- increased jacket insulation
- insulated tank bottom (electric only)
- improved flue baffle/forced draft
- increased heat exchanger surface area
- flue damper (electromechanical)
- side arm heater
- electronic (or interrupted) ignition
- heat pumps

As described in the 2000 TSD, DOE at that time eliminated from further analysis the following design options: flue damper (buoyancy operated); submerged combustion; directly fired; condensing option; condensing pulse combustion; advanced forms of insulation; u-tube flue; thermophotovoltaic and thermoelectronic generators; reduced burner size (slow recovery); heat pump water heater options; timer controlled; system-application options; sediment-removal features; two-phase thermosiphon design; and air-atomized burner (oil-fired units). DOE will re-examine whether the bases for eliminating these design options from further consideration is still valid.

For direct heating equipment, DOE will consider technologies included in its most recent analysis of energy conservation standards for direct heating equipment and information from recent trade publications. The following technologies are from the 1993 *Technical Support Document for Room Air Conditioners, Water Heaters, Direct Heating Equipment, Mobile Home Furnaces, Kitchen Ranges and Ovens, Pool Heaters, Fluorescent Lamp Ballasts & Television Sets* (DOE/EE-0009):

- increase heat exchanger surface area
- input de-rating and controlling secondary air
- electronic ignition device
- vent damper
- power burner or induced draft
- two-stage or modulating operation
- improved blower motor efficiency
- increased insulation (floor furnaces only)

- condensation of flue gases
- combustion box damper
- air circulation fan (room heaters & floor furnaces only)

For pool heaters, DOE will consider technologies included in its most recent analysis of energy conservation standards for pool heaters, as well as in information provided in recent trade publications. The following technologies are from the 1993 *Technical Support Document for Room Air Conditioners, Water Heaters, Direct Heating Equipment, Mobile Home Furnaces, Kitchen Ranges and Ovens, Pool Heaters, Fluorescent Lamp Ballasts & Television Sets* (DOE/EE-0009):

- electronic ignition
- non-condensing limit
- condensing induced draft
- condensing pulse combustion
- condensing power burner

Item 3-9 *Of the technologies listed above, are there any that DOE should not consider because of their impacts on safety, performance, or consumer utility of the product?*

Item 3-10 *Are there other unlisted technologies that DOE should consider as design options, and what, if any, impacts would these other design options have on safety, performance, and consumer utility?*

3.4 Baseline Models

Once DOE establishes product classes, it will select a baseline model as a reference point for each product class against which it can measure changes resulting from energy conservation standards. DOE defines the baseline model in each product class as a product with an efficiency that just meets the existing Federal minimum energy conservation standards. In addition, baseline models also have commonly available features. DOE proposes to use information provided by stakeholders in selecting appropriate baseline models.

DOE will use the baseline models in the engineering analysis and the LCC and PBP analysis. To determine energy savings and changes in price, DOE will compare each higher energy efficiency or lower energy consumption design option with the baseline model.

Item 3-11 *DOE seeks feedback on how to select a baseline model for each product class.*

In the January 2001 final rule for residential water heaters, DOE established the baseline models according to representative rated-storage-volumes for each fuel type. 66 FR 4480. For this rulemaking, DOE proposes to maintain the representative rated-storage-volume used in the previous rulemaking for gas-fired, oil-fired, and electric storage-type water heaters. The representative rated-storage-volume for gas-fired, storage-type water heaters is 40 gallons. For

oil-fired and electric, storage-type water heaters, the representative size volumes are 30 and 50 gallons, respectively. Gas-fired instantaneous water heaters were not included in the analysis for the January 2001 final rule. The rated-storage-volumes for gas-fired, instantaneous water heaters are commonly listed as zero gallons in manufacturer directories such as the GAMA directory. Therefore, for this rulemaking DOE proposes using zero as the representative rated-storage-volume for the baseline gas-fired, instantaneous water heater model.

For the January 2001 final rule, DOE analyzed not only the representative rated-storage-volumes for gas-fired, oil-fired, and electric, storage-type water heaters, but other rated-storage-volumes as well. Because the energy efficiency standards are a function of rated-storage-volume, the analysis of multiple storage volumes was performed in order to develop the appropriate relationship between energy factor and rated-storage-volume. For gas-fired, storage-type water heaters DOE analyzed rated-storage-volumes of 30, 50, and 75 gallons in addition to the representative volume of 40 gallons. For electric, storage-type water heaters, DOE analyzed rated-storage-volumes of 30, 40, 65, and 80 gallons. And for oil-fired, storage-type water heaters, DOE analyzed a rated-storage-volume of 50 gallons. For this rulemaking, DOE proposes to conduct a detailed analysis to develop the cost versus efficiency relationship for the representative rated-storage-volume only. But as will be discussed in additional detail in the Engineering Analysis (section 5), DOE also plans to extrapolate the cost versus efficiency relationship for the representative rated-storage-volume to the other rated-storage-volumes based on methods developed in the 2000 TSD.

To represent the energy efficiency levels for the baseline models of gas-fired, oil-fired, and electric, storage-type water heaters, DOE proposes to use the existing Federal energy conservation standards, as measured by the energy factor (EF)[11] which became effective on January 20, 2004. These are listed in Table 3, and further specified in section 430.32(d) of 10 CFR Part 430. DOE proposes using a representative input rating to establish a baseline model for gas-fired, instantaneous water heaters. The input rating that was selected for the baseline model was chosen to be representative of the most common input rating of all covered models listed in the March 30, 2006 GAMA directory.[12] The representative input rating for gas-fired instantaneous water heaters is 190,000 Btu per hour.

Item 3-12 *DOE requests input from stakeholders on the defining characteristics, such as rated-storage-volume, thermal properties, the thickness of the insulation, tank geometry, etc., for each of the proposed baseline models for electric, gas-fired, and oil-fired, storage-type water heaters, and gas-fired, instantaneous water heaters.*

[11] The EF is the ratio of the heat delivered to the energy consumed according to the specific test procedure for residential water heaters. The EF accounts for both recovery efficiency and standby losses at prescribed patterns of hot-water draws totaling 64.3 gallons per day.
[12] The GAMA directory is available as a PDF file on the GAMA webpage at: http://www.gamanet.org/gama/inforesources.nsf/vAllDocs/Product+Directories?OpenDocument

Table 3. Existing Federal Minimum Energy Conservation Standards for Residential Water Heaters*

Residential Water Heater Class	Energy Factor (EF)
Gas-fired Storage-Type	0.67 – (0.0019 x Rated Storage Volume in gallons)
Oil-fired Storage-Type	0.59 – (0.0019 x Rated Storage Volume in gallons)
Electric Storage-Type	0.97 – (0.00132 x Rated Storage Volume in gallons)
Gas-fired Instantaneous	0.62 – (0.0019 x Rated Storage Volume in gallons)

* Only the product classes that will be analyzed in this rulemaking are shown in the Table 3. The table does not include tabletop and instantaneous electric water heaters which DOE is proposing to exclude from the analysis, as explained in section 1.3.1 above.

Item 3-13 *DOE seeks comment on whether the rated-storage-volumes (50 gallons for electric, 40 gallons for gas-fired, 30 gallons for oil-fired, and zero gallons for gas-fired instantaneous) are representative of residential storage-type and instantaneous water heaters in the current market and whether DOE should use them as representative baseline models in this rulemaking. DOE also seeks comment on its plan to extrapolate the cost versus efficiency relationship for the representative rated-storage-volume to other storage volumes based on methods developed in the 2000 TSD.*

Item 3-14 *DOE seeks comment on whether the proposed energy efficiencies for gas-fired, oil-fired, and electric storage-type water heaters are representative of the current market and whether DOE should use them as representative baseline models in this rulemaking.*

Item 3-15 *DOE seeks comment on whether the input ratings for instantaneous water heaters are representative of residential instantaneous gas-fired water heaters in the current market and whether DOE should use them as representative baseline models in this rulemaking.*

As identified in section 3.2, DOE proposes to maintain the sixteen product classes for direct heating equipment. Because existing minimum efficiency standards depend on input capacity, DOE plans to complete the engineering and LCC analyses using a single representative product class for each product (*i.e.*, wall fan, wall gravity, floor, and room). DOE plans on selecting the representative product class based on the class with the greatest percentage of shipments. For each design type, DOE then plans on extrapolating the engineering and LCC analysis results for the representative product class to the other classes. Based on shipment data from the 1993 TSD for fan wall, gravity wall, and floor furnaces and the number of available models listed in the March 30, 2006 Residential Direct Heating GAMA directory for room heaters,[13] DOE believes that the following product classes should be chosen as the representative class for each design type:

- Fan Wall Furnaces over 42,000 Btu/hour
- Gravity Wall Furnaces over 27,000 up to 46,000 Btu/hour

[13] Id.

- Floor Furnaces over 37,000 Btu/hour
- Room Heaters over 27,000 up to 46,000 Btu/hour

DOE proposes using representative input ratings to establish baseline models for each product class. For the proposed representative product classes listed above, Table 4 identifies the representative input rating. DOE selected the input rating for the representative product classes by examining the March 30, 2006 Residential Direct Heating GAMA directory. DOE found the most common input rating for each representative class in this directory and is proposing to use it as the representative input rating for DOE's analyses.

Table 4. Representative Input Ratings for Direct Heating Baseline Models

Representative Direct Heating Equipment Class	Representative Input Rating (Baseline Models) (Btu/hour)
Fan Wall Furnace Over 42,000 Btu/hour	55,000
Gravity Wall Furnace Over 27,000 up to 46,000 Btu/hour	35,000
Floor Furnace Over 37,000 Btu/hour	62,000
Room Heater Over 27,000 up to 46,000 Btu/hour	35,000

To represent the baseline model's energy efficiency levels for direct heating equipment, DOE proposes using existing Federal minimum energy conservation standards for direct heating equipment. The existing Federal minimum energy conservation standards for direct heating equipment, as measured by the AFUE,[14] became effective on January 1, 1990. (42 U.S.C. 6295(e)(3)) DOE developed the standards, shown in Table 5, for direct heating equipment as specified in 10 CFR 430.32(i). Table 5 shows the minimum energy conservation standards for all sixteen product classes. The representative product classes which DOE plans on analyzing for the engineering and LCC analyses are indicated with double asterisks.

[14] The AFUE is the measure of seasonal or annual efficiency of a furnace or boiler. The AFUE represents the heat transferred to the conditioned space divided by the fuel energy supplied.

Table 5. Existing Federal Minimum Energy Conservation Standards for Direct Heating Equipment*

Direct Heating Equipment Design Type	Product Class (Btu/hour)	AFUE (%)
Gas wall fan	Up to 42,000	73
	Over 42,000**	74
Gas wall gravity	Up to 10,000	59
	Over 10,000 up to 12,000	60
	Over 12,000 up to 15,000	61
	Over 15,000 up to 19,000	62
	Over 19,000 up to 27,000	63
	Over 27,000 up to 46,000**	64
	Over 46,000	65
Gas floor	Up to 37,000	56
	Over 37,000**	57
Gas room	Up to 18,000	57
	Over 18,000 up to 20,000	58
	Over 20,000 up to 27,000	63
	Over 27,000 up to 46,000	64
	Over 46,000**	65

* Table 5 includes all of the product classes set forth in EPCA and codified at 10 CFR Part 430.32(i).
** Representative product classes that DOE intends on conducting the engineering and LCC analyses.

Item 3-16 *DOE seeks input from stakeholders on possible methods of extrapolating the engineering and LCC analyses from the representative direct heating equipment product class to the other product classes.*

Item 3-17 *DOE seeks comment on whether the proposed input ratings and energy efficiency levels for the direct heating equipment product classes are representative of direct heating equipment in the current market and whether DOE should use them as representative baseline models in this rulemaking.*

For gas-fired pool heaters, DOE proposes using a representative input rating to establish a baseline model for the single product class. The input rating that was selected is representative of the most common input rating of all covered models listed in the May 1, 2005 Federal Trade Commission (FTC) directory.[15] For pool heaters, the representative input rating is 250,000 Btu per hour.

To represent the baseline model's energy efficiency levels for pool heaters, DOE proposes using existing Federal minimum energy conservation standards for pool heaters. EPCA established a uniform pool heater energy conservation standard for products manufactured on or after January

[15] The 2005 FTC directory of pool heater energy data is available as a PDF file on the FTC webpage at: http://www.ftc.gov/bcp/conline/edcams/eande/appliances/data/2005/pool/brand.pdf

1, 1990, using the test procedure defined by ANSI Standard Z21.56-1994, Gas-Fired Pool Heaters; incorporated by reference into Appendix P to Subpart B of 10 CFR Part 430, which includes a thermal efficiency of no less than 78 percent as specified in section 430.32(k) of 10 CFR Part 430.

Item 3-18 *DOE seeks comment on whether the input rating for the pool heater product class is representative of pool heaters in the current market and whether DOE should use it as representative baseline model in this rulemaking.*

Item 3-19 *DOE seeks comment on whether the proposed thermal efficiency level for pool heaters should be used as the baseline model's thermal efficiency in this rulemaking.*

DOE will use the baseline models in the engineering analysis and the LCC and PBP analysis. To determine energy savings and changes in price, DOE will compare each higher-energy-efficiency or lower-energy-consumption design option with the baseline model.

Item 3-20 *DOE seeks information regarding the specific technological characteristics of the baseline model for each product class (e.g., materials, dimensions, insulation, fuel type, ignition type, fans), including the technologies described earlier.*

4. SCREENING ANALYSIS

The purpose of the screening analysis is to identify design options that DOE will not consider in the rulemaking for residential water heaters, direct heating equipment, and pool heaters. DOE will screen out technology design options according to four criteria, as noted below.

In consultation with interested parties, DOE will develop a list of design options for consideration. Initially, the candidate design options will encompass all those technologies considered to be technologically feasible. Following development of this initial list of design options, DOE will review each design option based on the following four criteria, as addressed in sections 4(a)(4) and 5(b) of the Process Rule:

1. *Technological feasibility.* DOE will not consider further technologies that are not incorporated in commercial products or in working prototypes.

2. *Practicability to manufacture, install, and service.* If DOE determines that mass production of a technology in commercial products and reliable installation and servicing of the technology could not be achieved on the scale necessary to serve the relevant market at the time of the effective date of the standard, then it will not consider that technology further.

3. *Impacts on product utility to consumers.* If DOE determines a technology has a significant adverse impact on the utility of the product to significant subgroups of consumers, or will result in the unavailability of any covered product type with

performance characteristics (including reliability), features, size, capacities, and volumes that are substantially the same as products generally available in the United States at the time, then it will not consider that technology further.

4. *Safety of technologies.* If DOE determines that a technology has significant adverse impacts on health or safety, it will not consider that technology further.

DOE will fully document its reasons for eliminating design options during the screening analysis and will publish these as part of the ANOPR.

5. ENGINEERING ANALYSIS

After completing the screening analysis, DOE will perform an engineering analysis based on the remaining design options. The engineering analysis consists of estimating the costs of products at various levels of increased efficiency. This section provides an overview of the engineering analysis (section 5.1), and discusses the approach for determining the cost-efficiency relationship (section 5.2), manufacturer prices (section 5.3), proprietary designs (section 5.4), and outside regulatory changes—*i.e.*, regulatory changes outside the realm of DOE's energy conservation standards process—that affect the engineering analysis (section 5.5). DOE will complete separate engineering analyses for residential water heaters, direct heating equipment, and pool heaters.

5.1 Engineering Analysis Overview

The purpose of the engineering analysis is to determine the relationship between manufacturer selling price and energy efficiency for residential water heaters, direct heating equipment, and pool heaters. In determining this relationship, DOE will estimate the increase in manufacturer selling price associated with technological changes that increase the efficiency of the baseline models.

DOE will obtain cost estimates for the engineering analysis (which it also will use in the MIA) from detailed cost data disaggregated into the cost of incremental material, labor, and overhead. DOE will create an industry-wide analysis based primarily on manufacturer-supplied data. DOE may supplement this analysis with cost estimates of specific design options.

Item 5-1 *For each product class, DOE seeks information on manufacturing components, incremental manufacturing costs, and energy performance for at least five energy-efficiency levels above the baseline (see section 3.4), one of which would be max tech. Detailed data would be welcome on the manufacturing components (e.g., what components are different from the baseline), incremental manufacturing costs (e.g., material costs,[16] labor costs,[17] overhead costs[18] (excluding depreciation), building-conversion-capital expenditures, tooling/equipment-conversion-capital expenditures, R&D expenses, marketing expenses), and energy performance (e.g., energy factor and annual fuel utilization by capacity or volume).*

Item 5-2 *DOE is also interested in any product test data (e.g., test procedure used, rating conditions, rated-storage-volume, input rates). Test data for the baseline model in each product class are particularly important.*

5.2 Proposed Approach for Determining the Cost-Efficiency Relationship

In support of this rulemaking effort, DOE intends to collect incremental cost data for residential water heaters, direct heating equipment, and pool heaters. DOE intends the data to represent the average incremental product cost to improve a baseline model to a specified efficiency level. This methodology constitutes an efficiency-level approach to the engineering analysis because DOE will examine aggregated incremental increases in manufacturer selling price at specified levels of energy efficiency. DOE also intends to supplement the efficiency-level analysis for residential water heaters, where needed, with the design-option approach. The design-option approach examines various technologies that manufacturers could use to increase the efficiency of a baseline model and the effect incorporating these technologies would have on the overall manufacturing cost of the model. The design-option approach was used for residential storage-type water heaters in the January 2001 final rule. 66 FR 4480. For the supplemental analysis for residential storage water heaters, DOE proposes to use detailed water heating simulation programs — WATSIM for electric water heaters and TANK for gas-fired water heaters. Both of these simulations use the current DOE test procedure to evaluate the energy factor of water heaters with various design options as was done in the engineering analysis described in the TSD for the January 2001 final rule. 66 FR 4480. As described earlier in section 3.4, because the efficiency of storage-type water heaters are a function of storage volume, DOE needs to develop cost-efficiency relationships for rated-storage-volumes other than the representative or baseline

---

[16] Material costs are the costs of raw materials, including scrap, that can be traced to final or end products. These costs do not include indirect material costs which are attributed to supplies that may be used in the production process but are not assigned to final products (e.g., lubricating oil for production machinery).

[17] Labor costs are the earnings of workers who assemble parts into a finished good or operate machines in the production process. Direct labor includes the fringe benefits of direct laborers, such as group health care, as well as overtime pay. Direct labor does not include indirect labor, which is defined as the earnings of employees who do not work directly in assembling a product─such as supervisors, janitors, stockroom personnel, inspectors, and forklift operators.

[18] Overhead costs are the factory overhead expenses, excluding depreciation. Factory overhead includes indirect labor, downtime, set-up costs, indirect material, expendable tools, maintenance, property taxes, insurance on assets, and utility costs. Factory overhead does not include selling, general, and administrative costs (SG&A); R&D; interest; or profit (for which DOE accounts separately).

storage volumes. Therefore, DOE also plans on using the design-option approach to assist in the extrapolation of the cost-efficiency relationship for the representative rated-storage-volumes to other storage volumes. DOE plans on using representative rated-storage-volumes of 40, 50, and 30 gallons for gas-fired, electric, and oil-fired, storage-type water heaters, respectively. For gas-fired, storage-type water heaters, the other storage volumes for which DOE plans on developing cost-efficiency relationships are 30, 50, and 75 gallons. For electric, storage-type water heaters the other storage volumes are 30, 40, 65, and 80 gallons. And for oil-fired, storage-type water heaters, the one other storage volume DOE plans on analyzing is 50 gallons.

To analyze the cost-efficiency relationship of electric, storage-type water heaters, DOE plans to analyze a set of efficiency levels consisting of some of the levels presented in its TSD for the January 2001 final rule as well as efficiencies from heat pump models that were once available on the market. DOE is proposing to consider four efficiency levels as summarized in Table 6 below for a 50 gallon rated-storage-volume, spanning the range from the baseline energy factor to the "max tech" level. The "max tech" level corresponds to the efficiency of a heat pump water heater model that was at one time commercially available.

Table 6. Efficiency Levels for 50-gallon Electric, Storage-Type Water Heaters

Efficiency Level	Energy Factor	Recovery Efficiency
Baseline	0.90	0.98
Efficiency Level 1	0.92	0.98
Efficiency Level 2	0.95	0.98
Efficiency Level 3 (Heat Pump)	3.12	-

To analyze the cost-efficiency relationship of gas-fired, storage-type water heaters, DOE plans to analyze a set of efficiency levels consisting of some of the levels presented in its TSD for the January 2001 final rule as well as efficiencies representative of condensing flue-gas models. DOE is proposing to consider five efficiency levels, as summarized in Table 7 below for a 40 gallon rated-storage-volume. DOE intends to analyze a condensing water heater efficiency level to represent the "max tech" level.

Table 7. Efficiency Levels for 40-gallon Gas-fired, Storage-Type Water Heaters

Efficiency Level	Energy Factor	Recovery Efficiency
Baseline	0.59	0.78
Efficiency Level 1	0.62	0.78
Efficiency Level 2	0.65	0.78
Efficiency Level 3	0.68	0.80
Efficiency Level 4 (Condensing)	0.86	0.95

To analyze the cost-efficiency relationship of oil-fired, storage-type water heaters, DOE plans to analyze a set of efficiency levels consisting of some of the levels presented in its TSD for the January 2001 final rule as well as the efficiency of a model currently listed in the GAMA product directory (0.68 EF). As shown in Table 8 below, for a rated-storage-volume of 30 gallons, DOE could consider up to three efficiency levels.

Table 8. Efficiency Levels for 30-gallon Oil-fired, Storage-Type Water Heaters

Efficiency Level	Energy Factor	Recovery Efficiency
Baseline	0.53	0.75
Efficiency Level 1	0.58	0.76
Efficiency Level 2	0.62	0.78
Efficiency Level 3	0.68	0.82

To analyze the cost-efficiency relationship of gas-fired, instantaneous water heaters, DOE plans to analyze five efficiency levels as summarized in Table 9. Each of these levels corresponds to the efficiency of models currently included in the FTC, GAMA and California Energy Commission product directories.

Table 9. Efficiency Levels for Gas-Fired, Instantaneous Water Heaters

Efficiency Level	Energy Factor	Recovery Efficiency
Baseline	0.62	0.78
Efficiency Level 1	0.75	0.80
Efficiency Level 2	0.82	0.85
Efficiency Level 3	0.85	0.85
Efficiency Level 4	0.92	0.93

As discussed in section 3.2, DOE plans to complete the engineering and LCC analyses on the direct heating equipment product class within each design type with the greatest percentage of shipments and then extrapolate the results to the remaining product classes. DOE believes that the product classes identified in Table 11 through 14 are the representative product classes. To analyze the cost-efficiency relationship of direct heating equipment, DOE plans to analyze a set of efficiency levels consisting of levels gathered from a Gas Research Institute (GRI) report[19] and DOE's 1993 TSD.[20] The GRI report was published in response to DOE's 1994 NOPR that covered direct heating equipment. The efficiency levels identified in Tables 11 through 14 are obtained by one or more of the following means: de-rating the product; utilizing electronic ignition; adding combustion box or vent dampers; or incorporating condensing technologies. The condensing level represents the "max tech" efficiency level. With the exception of the condensing efficiency levels, models representing the considered efficiency levels are listed in the March 2006 GAMA directory.

Table 10. Efficiency Levels for Fan Wall Furnace

Efficiency Level	Above 42,000 Btu/hour AFUE (%)
Baseline	74
Efficiency Level 1	75
Efficiency Level 2	80
Efficiency Level 3 (Condensing)	91

[19] Topical Report: Assessment of Technology for Improving the Efficiency of Gravity Direct Heating Equipment, 1994. Prepared by Battellle, Columbus, OH for Gas Research Institute, Chicago, IL, September 1994. GRI-94/0342.

[20] Technical Support Document: Energy Efficiency Standards for Consumer Products. Volume 3: Water Heaters, Pool Heaters, Direct Heating Equipment, and Mobile Home Furnaces, 1993. U.S. Department of Energy, Washington, DC, November 1993. DOE/EE-0009 Vol. 3 of 3.

Table 11. Efficiency Levels for Gravity Wall Furnace

Efficiency Level	27,000 to 46,000 Btu/hour AFUE (%)
Baseline	64
Efficiency Level 1	66
Efficiency Level 2	68
Efficiency Level 3	71
Efficiency Level 4 (Condensing)	85

Table 12. Efficiency Levels for Floor Furnace

Efficiency Level	Above 37,000 Btu/hour AFUE (%)
Baseline	57
Efficiency Level 1	61
Efficiency Level 2	62
Efficiency Level 3	65
Efficiency Level 4 (Condensing)	91

Table 13. Efficiency Levels for Room Heaters

Efficiency Level	27,000 to 46,000 Btu/hour AFUE (%)
Baseline	64
Efficiency Level 1	67
Efficiency Level 2	68
Efficiency Level 3	71
Efficiency Level 4 (Condensing)	91

To analyze the cost-efficiency relationship of pool heaters, DOE plans to analyze a set of efficiency levels corresponding to models with efficiencies currently listed in the FTC product directory. DOE could analyze up to six efficiency levels summarized in Table 10.

Table 14. Efficiency Levels for 250,000 Btu/hour Gas-fired Pool Heaters

Efficiency Level	Thermal Efficiency (%)
Baseline	78
Efficiency Level 1	80
Efficiency Level 2	82
Efficiency Level 3	84
Efficiency Level 4	86
Efficiency Level 5 (Condensing)	95

To be useful in the MIA, manufacturer cost information should reflect the variability in baseline models, design strategies, and cost structures that can exist among manufacturers. DOE will attempt to verify the cost-efficiency data supplied by stakeholders through engineering expertise and consultation with stakeholders or technical experts. Specifically, DOE will supplement the cost data with information obtained through follow-up manufacturer interviews. These confidential interviews will provide a deeper understanding of the various combinations of

technologies used to increase product efficiency, and their associated manufacturing costs. DOE will also use the cost data collected for the engineering analysis in the MIA (see sections 5.3 and 12).

DOE will estimate the contribution of the depreciation of conversion-capital expenditures to the incremental overhead. During the interviews, DOE will gather information about the capital expenditures that would be necessitated by increasing the efficiency of the baseline models to various efficiency levels (*i.e.*, conversion-capital expenditures by efficiency or energy-use level). DOE also will request information about the depreciation method that manufacturers use to expense the conversion capital.

Item 5-3 *DOE requests comment on the use of an efficiency-level approach for determining the relationship between manufacturer cost and the energy efficiency for each of the three product types.*

Item 5-4 *DOE requests comment on the use of the design-option approach to supplement the efficiency-level approach for determining the relationship between manufacturer cost and the energy efficiency for residential water heaters.*

Item 5-5 *DOE requests comment on the proposed efficiency levels for residential water heaters, direct heating equipment, and pool heaters. Are there any efficiency levels DOE should consider that are not shown in the above tables?*

Item 5-6 *DOE requests comment on the proposal to analyze one product class for each of the four types of direct heating equipment.*

Item 5-7 *DOE requests comment on the technologies that classify each of the efficiency levels shown in the tables above.*

5.3 Manufacturer Prices

DOE plans to develop markups to convert manufacturer production costs to manufacturer selling prices. DOE will estimate manufacturer markups from publicly available financial information (e.g., Securities and Exchange Commission (SEC) 10-K reports). Using Current Industrial Reports, DOE can gather data on estimated shipments that it can use to calculate a baseline manufacturer price. DOE will extrapolate direct heating equipment and pool heater shipments and industry data using publicly available shipments data from similar product types, such as residential water heaters and residential furnaces and boilers. It will use the SEC 10-K reports to derive a cost structure for the residential water heating, direct heating, and pool heating manufacturers. Using the baseline manufacturer price and cost structures, DOE will calculate a full production cost (*i.e.*, the sum of the direct material cost, the direct labor cost, and the overhead cost, which includes depreciation). It will then calculate the baseline manufacturer markup using the baseline manufacturer price and the full production cost. Baseline

manufacturer markup is defined as the increase in price over the full production cost of a baseline product, and is calculated as:

$$\text{Baseline Manufacturer Markup} = \frac{\text{Manufacturer Price}}{\text{Full Production Cost}} \qquad \text{Eq. 1.}$$

Using the above proposed procedures and current publicly available industry figures, including 2000, 2001, 2002, and 2003 SEC 10-K reports and 2000, 2001, 2002, and 2003 Statistics for Industry Groups and Industries reports[21] of the residential water heater, direct heating equipment, and pool heater industries, DOE calculated preliminary manufacturer markups and cost structures, which are listed in Tables 15 and 16, as follows:

Table 15. Preliminary Manufacturer Markups*

Heating Product Type	Manufacturer Markup
Residential Water Heaters	1.28
Direct Heating Equipment	1.31
Pool Heaters	1.35

* 2000, 2002, 2003 SEC 10-K reports and 2000, 2001, 2002, 2003 Statistics for Industry Groups and Industries reports.

Table 16. Preliminary Cost Structures (Percent)*

Divisions of Industry Costs	Residential Water Heaters	Direct Heating Equipment	Pool Heaters
Profit Before Financing[22]	6.0	9.2	7.2
SG&A	14.0	12.5	16.0
R&D	2.1	2.0	2.5
Overhead	15.4	16.0	16.0
Labor	10.1	9.4	10.0
Material	52.4	50.9	48.3
Total	**100**	**100**	**100**

* 2000, 2002, 2003 SEC 10-K reports and 2000, 2002, 2003 Statistics for Industry Groups and Industries reports.

DOE recognizes that a majority of the manufacturers of residential water heaters, direct heating equipment, and pool heaters are private companies. In order for DOE to accurately reflect the entire market, it is important to consider all manufacturers (when feasible) when developing the manufacturer markups. DOE requests any additional sources of data that would improve its manufacturer markup analysis.

[21] The Statistics for Industry Group and Industries reports are available as a PDF file on the U.S. Census Bureau webpage at: http://www.census.gov/mcd/asmhome.html
[22] Profit before financing is equal to sales minus the quantity of SG&A plus cost of product.

Item 5-8 *DOE seeks comment on the markup approach proposed for developing estimates of manufacturer selling prices.*

Item 5-9 *DOE seeks comment on whether the preliminary manufacturer markups and cost structures are representative of the residential water heating, direct heating, and pool heating markets.*

Item 5-10 *DOE seeks comment about any additional data sources that it could use in the manufacturer markup estimates.*

5.4 Proprietary Designs

DOE will consider in its engineering and economic analyses all design options that are commercially available or present in a working prototype, including proprietary designs. It will consider a proprietary design subsequent analyses only if there are other design options that manufacturers could use to reach a given efficiency level. If the proprietary design is the only approach available to achieve a given efficiency level, then DOE will reject that efficiency level from further analysis. Furthermore, DOE is sensitive to manufacturer concerns regarding proprietary designs and will make provisions to maintain the confidentiality of any proprietary data submitted by manufacturers. This information will provide input to the competitive impacts assessment and other economic analyses. At this time, DOE plans to examine no proprietary designs.

Item 5-11 *Are there proprietary designs that DOE should consider for any of the products under consideration by this rulemaking? If so, how should DOE acquire the cost data necessary for evaluating these designs?*

5.5 Outside Regulatory Changes Affecting the Engineering Analysis

In conducting an engineering analysis, DOE must consider the effects of regulatory changes outside of DOE's statutory energy conservation standards that can impact the manufacturers of the covered products. Some of these regulations—such as the phaseout of ozone-depleting chemicals previously used in insulation—can also affect the energy efficiency of the covered heating products. DOE will attempt to identify all possible regulatory impacts that could affect the efficiency of the products. The consideration of these regulatory impacts is closely related to the cumulative regulatory burden assessment that DOE will carry out as part of the MIA.

Item 5-12 *DOE seeks comment on whether there are other potential impacts from regulatory action that it should consider in its analysis of residential water heaters, direct heating equipment, and pool heaters.*

6. ENERGY USE

The purpose of the energy use analysis is to assess the energy-savings potential of different product efficiencies. The energy use analysis may require certain engineering assumptions regarding product application, including how the product is operated and under what conditions.

For residential storage-type water heaters, DOE plans to rely on the energy use analysis tools that it used to conduct the prior standards rulemaking that it concluded in 2001. In the prior analysis, DOE developed hot water draw and energy analysis calculation methodologies by relying on data from the Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS). These analysis tools are well developed and are familiar to the stakeholders that participated in the January 2001 final rulemaking process. As described below, use of these analysis tools will allow DOE to establish the variability in water heater energy consumption in the U.S.

For residential instantaneous water heaters, direct heating equipment, and pool heaters, DOE plans to rely on the assumptions in the test procedure to establish the typical annual energy consumption of the product. For residential instantaneous water heaters, DOE will also consider any other available energy use calculation methodologies that better reflect the energy use under actual field operation conditions.

In addition to the assumptions in the test procedure, DOE also needs test data to establish the annual energy use of direct heating equipment, pool heaters, and instantaneous water heaters at each efficiency level. For direct heating equipment, DOE will need to obtain at each efficiency level the steady-state efficiency, the pilot input rate, and, for products that use electricity, the electrical use when the burner is not operating. For pool heaters and for instantaneous water heaters, DOE will need to obtain at each efficiency level the pilot input rate and, for products that use electricity, the electrical use when the burner is not operating. DOE plans to use the current test procedures applicable to water heaters set forth in Appendix E to Subpart B of 10 CFR Part 430, direct heating equipment as set forth in Appendix O to Subpart B of 10 CFR Part 430, and pool heaters as set forth in Appendix P to Subpart B of 10 CFR Part 430.

DOE will use RECS data to establish the energy use variability for all three products, with the exception of instantaneous water heaters. From the RECS data, DOE can define household samples that utilize each of the three products. As just noted, for storage-type water heaters, DOE plans on analyzing the energy consumption of each RECS household using analysis tools developed for the January 2001 final rulemaking process. This analysis of storage-type water heater annual energy consumption using RECS will be conducted as part of DOE's LCC and PBP analysis. As described later in section 8, DOE plans on conducting its LCC and PBP analysis using a simulation approach that relies on Monte Carlo sampling techniques. This will enable DOE to determine the percent of consumers benefiting and being burdened by a potential water heater energy efficiency standard.

For direct heating equipment and pool heaters, DOE plans to use the RECS data sample to define only the high and low estimates of energy use. The reason for selecting this approach is the household samples for direct heating equipment and pool heaters are too small to provide a basis for conducting a statistically representative simulation analysis. For instantaneous water heaters,

a RECS sample is likely not available to establish high and low estimates of energy use. Therefore, DOE will rely on other data sources to establish high and low estimates of instantaneous water heater energy use.

Item 6-1 *DOE seeks comment on the approaches it plans to use for specifying the typical annual energy consumption.*

Item 6-2 *DOE seeks comment on data sources it can use to characterize the variability in annual energy consumption for each of the three products.*

Item 6-3 *DOE seeks sources of data that can provide the specific test data required to establish the annual energy consumption of direct heating equipment, pool heaters, and instantaneous water heaters.*

Item 6-4 *DOE also seeks input from stakeholders on appropriate maximum technologically feasible efficiency levels.*

7. MARKUPS FOR EQUIPMENT PRICE DETERMINATION

DOE uses manufacturer-to-consumer markups to convert the manufacturer's selling price estimates from the engineering analysis to consumer prices. Following that, it uses these consumer prices in the LCC, consumer PBP analysis, and NIA. DOE needs retail prices, that include applicable fees such as delivery, permit and disposal, to calculate the equipment cost at the baseline level as well as the cost at all of the efficiency levels it will consider. DOE will obtain these retail prices by applying manufacturer-to-consumer markups to the manufacturer selling-price estimates. To validate these markups, DOE will attempt to collect data on existing prices in the market either by purchasing large data sets or by downloading data from retailer and distributor internet sites.

Before it can develop markups, DOE must identify distribution channels (*i.e.*, how the product is distributed from the manufacturer to the consumer). For residential water heaters, DOE plans to use the distribution channels described in the January 2001 final rule. 66 FR 4497. In that water heater rule, DOE used two major distribution paths—large, retail, home-supply outlets and plumbing wholesalers. Both sell to contractors who install the equipment. For direct heating equipment and pool heaters, DOE plans to use distribution channels similar to the one used in the residential furnace and boiler rulemaking. 69 FR 45420 (July 29, 2004). These distribution channels involve wholesalers and contractors.

Once it establishes proper distribution channels for each of the products, DOE will rely on economic census data from the U.S. Census Bureau, as well as input from the heating equipment industry and subject matter experts, to develop an understanding of the markups applied to each product as it moves from the manufacturer to the consumer. To the extent possible, DOE also will use retail price data to help determine overall manufacturer-to-consumer markups.

This analysis will generate retail prices for each considered efficiency level, assuming that each level represents a new minimum efficiency standard. Since DOE plans to purchase a large retail price data set for residential water heaters, it expects to be able to generate a range of price estimates and, therefore, will describe the new retail prices within a range of uncertainty. For direct heating equipment and pool heaters, DOE plans to use average retail prices and, if the range of retail prices for each product is large enough, DOE will conduct a sensitivity analysis to determine how high and low estimates of retail price might impact the economic feasibility of potential amended energy conservation standards.

Item 7-1 *DOE seeks suggestions and comment concerning its intended approach to develop estimates of future retail prices.*

Item 7-2 *DOE seeks comment about the distribution channels for water heaters, direct heating equipment, and pool heaters.*

8. LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS

The effects of more stringent energy conservation standards on consumers include a change in operating expense (usually decreased) and a change in purchase price (usually increased). In carrying out rulemakings for other products, DOE has analyzed the net effect on consumers by calculating the LCC and PBP using the engineering performance data (as described in section 5), the energy use data (as described in section 6), and the equipment retail prices (as described in section 7). Inputs to the LCC calculation include the installed cost to the consumer (purchase price plus installation cost), operating expenses (energy expenses, and, if applicable, repair costs and maintenance costs), the lifetime of the product, and discount rates.

For residential storage water heaters, in the ANOPR, DOE will conduct the LCC analysis using Monte Carlo simulations that use probability distributions to reflect conditions in the field for product retail price and lifetime, energy costs, energy usage, and discount rates.

For direct heating equipment, pool heaters, and instantaneous water heaters in the ANOPR, DOE will conduct the LCC analysis using typical values to reflect conditions in the field for product retail price and lifetime, energy costs, energy usage, and discount rates. As explained in section 6, DOE selected this approach for direct heating equipment and pool heaters because the RECS household samples used to develop the energy use are too small to provide a basis for conducting a statistically representative simulation analysis. In the case of instantaneous water heaters, as explained in section 6, a RECS sample is likely not even available. If DOE determines that there is significant variability in any of the above inputs, it will conduct sensitivity analyses to determine how the LCC and PBP are impacted by high and low estimates for each of the inputs. For any sensitivity analyses that it conducts, DOE will account for correlations that may exist between inputs (e.g., energy usage may be correlated to energy prices).

DOE will consider the potential rebound (or take-back) effect that may occur when consumers use a higher-efficiency appliance. The take-back in energy consumption associated with the rebound effect provides consumers with increased value (e.g., a warmer indoor environment or

greater use of hot water, since the increased efficiency enables consumers to use their equipment more intensively). For its LCC analysis, DOE plans to estimate that the increased value to consumers added by the rebound effect 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 are the same.

Based on the results of the LCC analysis, DOE will select candidate standard levels (CSLs) for the ANOPR analysis. The range of CSLs typically will include the efficiency level with the lowest LCC, the highest efficiency level that is technologically feasible, and other candidate standard levels likely to represent intermediate levels.

The detailed impact calculation which DOE will conduct after the ANOPR may include an assessment of impacts on subgroups of consumers, as described in section 11.

For the NOPR, DOE will carefully review all of the comments it received on the ANOPR LCC analysis, make any necessary revisions to the analysis, and evaluate additional parameters not included in the ANOPR analysis, if necessary.

For residential water heaters, direct heating equipment, and pool heaters, DOE will need to determine input values for several variables. The following sections discuss the methodologies DOE plans to use to develop energy prices; discount rates; maintenance, repair, and installation costs; and product lifetimes.

Item 8-1 *DOE seeks comment on its proposed treatment of the rebound effect in the LCC analysis.*

8.1 Energy Prices

DOE will use projections of national average electricity, natural gas, oil, and liquefied petroleum gas prices to residential consumers to estimate future energy prices in its LCC analysis. DOE will use EIA's *Annual Energy Outlook* (*AEO*) as the default source of projections for future energy prices. Since EIA data typically demonstrate a large variability in energy prices, DOE will conduct a sensitivity analysis to determine how high and low energy price estimates impact the economic feasibility of proposed energy conservation standards.

Item 8-2 *DOE seeks comment on the proposed approaches for estimating current and forecasted energy prices.*

8.2 Discount Rates

The calculation of consumer LCC requires the use of an appropriate discount rate. For consumers of residential heating products, DOE plans to use the same approach it relied on for developing discount rates for residential furnaces and boilers. This approach involves deriving the discount rates from estimates of the "finance cost" associated with purchasing residential

products. Applying financial theory, DOE interprets the finance cost to purchase these products as: (1) the financial cost of any debt incurred to purchase products, principally interest charges on debt, or (2) the opportunity cost of any equity used to purchase products, principally interest earnings on household equity. Household equity is represented by holdings in assets such as stocks and bonds, as well as the return on homeowner equity. DOE will obtain much of the data required to determine the cost of debt and equity from the Federal Reserve Board's triennial *Survey of Consumer Finances*.

DOE will publish the discount rates and associated documentation on the derivation of these discount rates when it publishes the ANOPR. It will invite stakeholders to comment specifically on the issue of consumer discount rates during the ANOPR comment period.

Item 8-3 *DOE seeks comment on the proposed approaches for estimating discount rates for residential consumers of heating products.*

8.3 Maintenance, Repair, and Installation Costs

Typically, DOE will take into consideration any expected changes to maintenance, repair, and installation costs for the products covered in a rulemaking. Often, small incremental changes in product efficiency result in either little or no changes in repair and maintenance costs over baseline products. There is a greater probability that products with efficiencies that are significantly greater than baseline products will incur increased repair and maintenance costs since they are more likely to incorporate technologies that are not widely available. DOE will rely on manufacturers and other stakeholders to develop appropriate repair and maintenance cost if stakeholders feel such estimates are necessary.

With regard to installation costs, DOE expects that more efficient residential water heaters, direct heating equipment, and pool heaters will incur installation costs that are dependent on electrical and venting requirements. In its TSD for the January 2001 final rule, DOE estimated that some consumers who purchase gas-fired, storage-type water heaters without an electrical supply cord could incur installation costs for bringing an electric outlet to the unit if they are required to purchase a product that requires electricity to operate. DOE will once again consider this issue when analyzing increased product efficiencies for gas-fired, storage-type water heaters and direct heating equipment. DOE also plans to take into consideration the specifics of the venting systems for gas equipment.

Item 8-4 *DOE seeks input on its assumption that changes in maintenance, repair, and installation costs will be negligible for more-efficient products.*

Item 8-5 *DOE seeks input on its assumption that installation costs will be dependent on electrical and venting requirements.*

8.4 Product Lifetimes

DOE's previous analyses have established product lifetimes for residential water heaters, direct heating equipment, and pool heaters. For residential water heaters, DOE's TSD for the January 2001 final rule estimated an average product lifetime of 9 years for gas-fired and oil-fired, storage-type water heaters, and 14 years for electric water heaters. For conventional direct heating equipment, DOE's 1993 TSD estimated an average product lifetime of 15 years. For hearth product direct heating equipment, DOE estimated an average lifetime of 30 years in its FY2005 Priority Setting. It based this value on a 1997 Gas Research Institute (GRI) report (GRI-97/0298). For pool heaters, DOE's 1993 TSD estimated an average product lifetime of 15 years.

DOE will use information from various literature sources (e.g., *Appliance Magazine*, and Handbooks published by the ASHRAE), as well as input from manufacturers and other stakeholders, to establish whether the above product lifetimes are still representative.

Item 8-6 *DOE seeks comment on appropriate product lifetimes for the products of interest to this rulemaking. DOE specifically seeks comment on appropriate product lifetimes for gas instantaneous water heaters.*

9. SHIPMENTS ANALYSIS

DOE requires shipments forecasts to calculate the national impacts of standards (energy savings and NPV) and to calculate the future cashflows of manufacturers. DOE plans to develop shipments forecasts based on an analysis of key market drivers (such as housing starts) for the particular products.

9.1 Base Case Forecast

To evaluate the impact of standards, DOE must develop a base case against which to compare higher efficiency levels. It designs the base case to depict what would happen to energy consumption and costs over time if DOE does not adopt amended energy conservation standards. In determining the base case, DOE takes into account historical shipments, the mix of efficiencies in the absence of standards, and how that mix would be expected to change over time. To determine the base case, DOE needs data on historical product shipments and the market shares of the different efficiency levels offered for each product class.

For residential water heaters, DOE intends to collect both shipments data and shipment-weighted average efficiency data dating back to 1990. In addition, DOE hopes to collect market share efficiency data (*i.e.*, data on the distribution of product shipments by efficiency) for each of the product classes. Realizing that this information may be difficult to collect, DOE plans to ask only for market share efficiency data from recent years (*i.e.*, 2002–2005). In the cases where shipment-weighted efficiency data are not available, DOE will use efficiency distributions based on available models as a proxy.

For direct heating equipment, DOE is seeking historical product shipments and shipment-weighted efficiency data for each product class considered. In the cases where shipments data by product class are not available, DOE will use estimates by applying trends to the data used in the prior rulemaking. In the cases where shipment-weighted efficiency data are not available, DOE will use efficiency distributions based on available models as a proxy.

For pool heaters, DOE is seeking historical product shipments and shipment-weighted efficiency data. In the cases where shipments data by product class are not available, DOE will use estimates by applying trends to the data used in the prior rulemaking. In the cases where shipment-weighted efficiency data are not available, DOE will use efficiency distributions based on available models as a proxy.

Item 9-1 *DOE seeks to obtain historical shipments data, shipment-weighted average efficiency data, and market-share efficiency data.*

9.2 Accounting Methodology

DOE proposes to use a method for determining annual shipments based on accounting for new building construction and historical rates of product ownership (saturation rates). For product retirements, DOE will use the same product lifetimes that it uses for the LCC and PBP analysis. This method has the distinct advantage of separately accounting for units installed in new construction and existing buildings. More importantly, DOE can express product saturation rates as a function of consumer price and operating cost to capture the impact of these variables on future shipments. DOE plans to rely on EIA's *AEO* to forecast new residential construction. With regard to historical product saturation rates, EIA's RECS provides data for residential storage-type water heaters and direct heating equipment. For pool heaters, DOE plans to use the product saturation rates from the 1993 pool heaters TSD. For instantaneous water heaters, DOE needs to identify sources for establishing product saturation. DOE also will take into consideration any other input provided by stakeholders. DOE especially seeks saturation data for pool heaters and instantaneous water heaters, and it hopes that the industry will be able to provide such data.

Item 9-2 *DOE seeks data on saturation rates for each of the product classes under consideration for this rulemaking.*

9.3 Standards Impact on Product Shipments

Standards-case forecasts evaluate the impact of standards on product shipments. For each product, DOE will develop forecasts for each standard level that is analyzed for the product (standards-case forecasts). The standards-case forecasts are very similar to the base case forecast and DOE uses the same sets of data inputs to derive them. However, because the standards-case forecasts take into account the increase in purchase price and the decrease in operating costs caused by standards, the forecasted shipments typically deviate from the base case. The magnitude of the difference between the standards-case and base-case forecasts depends on the estimated purchase-price increase as well as the operating cost savings resulting from the

standards. Because the purchase price tends to have a larger impact on consumer purchase decisions, standards-case forecasts may show a drop in product shipments relative to the base case.

DOE's past standards analyses have attempted to quantify the sensitivity of shipments to purchase price and operating cost savings. Because the data required to develop these sensitivities are limited and/or difficult to obtain, DOE will consider modeling standards-case shipments forecasts with scenarios (*i.e.*, specified impacts to product shipments) rather than developing sensitivities to purchase price or operating cost savings.

Another factor that affects standards-case forecasts is the existence of market-pull programs, such as consumer rebate programs that encourage the purchase of more-efficient products, and manufacturer tax credits that encourage the production of more-efficient products. When such programs exist, DOE takes into account their impact on the forecast of both standards-case and base-case shipments.

Item 9-3 *As part of its preliminary MIA, DOE will seek input from manufacturers on the potential impact of new energy efficiency standards on product shipments. Other stakeholders are also welcome to provide input. DOE also requests input on any market-pull programs that currently exist to promote the adoption of more-efficient products.*

10. NATIONAL IMPACT ANALYSIS

Section 8 discusses methods for estimating the LCC savings and PBP for individual consumers. This section discusses DOE's assessment of the aggregate impacts at the national level. Measures of impact that DOE will report include the NPV of total consumer LCC and NES.

10.1 Inputs to Forecasts

Analyzing impacts of Federal energy conservation standards requires a comparison of projected U.S. energy consumption with and without new or amended energy conservation standards. The forecasts contain projections of unit energy consumption of new equipment, annual equipment shipments, and the price of purchased equipment. Section 9 discusses the derivations of the shipments forecasts. Section 7 describes the approaches to determine retail prices, while section 6 addresses the approaches to determine unit energy consumption.

10.2 Calculation of Energy Savings

DOE intends to calculate national energy consumption for each year beginning with the expected effective date of the standards. It will calculate national energy consumption by fuel type for the base case and each standard level analyzed. DOE plans to consider in the NES analysis whether there is a rebound (or take-back) effect that occurs when consumers use higher-efficiency direct heating products. DOE will consider using a 15-percent rebound effect for the direct heating equipment. A 15-percent rebound effect is used by EIA for space heating in its energy

forecasting modeling system.[23] For water heaters and pool heaters, DOE will evaluate the literature to determine appropriate values to use for a rebound effect.

In response to comments by stakeholders who asked for a simple, transparent model, DOE developed and has used NES spreadsheet models for its standards rulemakings since 1996. DOE plans to perform the NES calculations through the use of a spreadsheet model that effectively multiplies annual shipment forecasts by unit energy savings at each considered efficiency level. DOE expects the NES spreadsheet model to provide a credible, stand-alone forecast of NES and NPV for water heaters, direct heating equipment, and pool heaters.

DOE has prepared NES spreadsheet models for other products to forecast energy savings and to demonstrate how the growth in efficiency can be accounted for over time. Although these models are specific to each product, their general structure can be applied to water heaters, direct heating equipment, and pool heaters.

Item 10-1 *DOE seeks input on its plan for estimating national impacts of amended energy conservation standards. It invites comments as to the appropriate application of the rebound effect for each product.*

10.3 Net Present Value

DOE calculates the national NPV of the standards in conjunction with the NES. It calculates annual energy expenditures from annual energy consumption by incorporating forecasted energy prices, using the shipments and average unit energy consumption forecasts described in section 6. DOE calculates annual equipment expenditures by multiplying the price per unit times the forecasted shipments. The difference between a base-case and a standards-case scenario gives the national energy bill savings and increased equipment expenditures in dollars. The difference each year between energy bill savings and increased equipment expenditures is the net savings (if positive) or net costs (if negative). DOE discounts these annual values to the present time and sums them to give a NPV.

DOE does not adjust the NPV results to account for the rebound effect. The take-back in energy consumption associated with the rebound effect provides consumers with increased value (e.g., a warmer indoor environment or greater use of hot water, since the increased efficiency enables consumers to use their equipment more intensively). For its analysis, DOE estimates that the increased value to consumers added by the rebound effect is equivalent to the monetary value of the energy savings that would have occurred without the rebound effect. Therefore, the economic impacts on consumers with or without the rebound effect, as measured in the NPV analyses, are the same.

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

11. LIFE-CYCLE COST SUBGROUP ANALYSIS

This section describes how DOE analyzes consumer impacts by dividing consumers into subgroups. A consumer subgroup comprises a subset of the population that is likely to be impacted disproportionately by new standards. The purpose of a subgroup analysis is to determine the extent of this disproportional impact. DOE will work with stakeholders early in the rulemaking process to identify any subgroups for this consideration. However, it will not analyze the consumer subgroups until the NOPR stage of the analysis. In the case of heating products, possible subgroups DOE may choose to consider are low-income households and senior citizens.

In comparing potential impacts on the different consumer subgroups, DOE will evaluate variations in regional energy prices, variations in energy use, and variations in installation costs that might affect the impacts of a standard on the consumer subgroups. DOE does not apply a rebound effect in the LCC subgroup analysis for the reasons discussed in section 8 (*i.e.*, there is no net change in overall consumer benefit with or without the rebound effect). It will discuss with stakeholders the variability in each input variable and likely sources of information.

Item 11-1 *DOE requests comment as to what consumer subgroups are appropriate for heating products.*

12. MANUFACTURER IMPACT ANALYSIS

DOE announced changes to the MIA format in a report issued to Congress on January 31, 2006 (as required by section 141 of EPACT 2005). This report, entitled "Energy Conservation Standards Activities," (Standards Activities) is available on the DOE website at: http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.

Previously, DOE did not report any MIA results during the ANOPR phase. However, under this new format, DOE will collect, evaluate, and report preliminary information and data in the ANOPR. (Standards Activities, p. 48) Such preliminary information includes the anticipated conversion-capital expenditures by efficiency level and the corresponding, anticipated impacts on employment. DOE will invite input on these issues during its ANOPR manufacturer interviews.

DOE intends the analysis of impacts on manufacturers to provide an assessment of the potential impacts of energy conservation standards on manufacturers of residential water heaters, direct heating equipment, and pool heaters. DOE intends to conduct a separate MIA for each of the three products. In addition to financial impacts, a wide range of quantitative and qualitative effects may occur following adoption of a standard that may require changes to the manufacturing practices for these products. DOE will identify these effects through interviews with manufacturers and other experts.

12.1 Sources of Information for the Manufacturer Impact Analysis

Many of the analyses described earlier provide important information that DOE uses as inputs for the MIA. Such information includes financial parameters developed in the market assessment (section 3.1), manufacturing costs and prices from the engineering analysis (sections 5.2 and 5.3), retail price forecasts (section 7), and shipments forecasts (section 9). DOE supplements this information with information gathered during manufacturer interviews. The interview process plays a key role in the MIA, since it provides an opportunity for interested parties to privately express their views on important issues.

DOE will conduct detailed interviews with manufacturers to gain insight into the range of potential impacts from standards. During the interviews, DOE will take note of information on the possible impacts of standards on manufacturing costs, equipment prices, sales, direct employment, capital assets, and industry competitiveness. Both qualitative and quantitative information are valuable. DOE will schedule interviews well in advance to provide every opportunity for key individuals to be available.

DOE will ask interview participants to identify all confidential information provided in writing or orally. It will consider the information gathered, as appropriate, in the energy conservation standard decision-making process. DOE also will ask participants to identify any information that they wish to have included in the public record but that they do not want to have associated with their interview. DOE will incorporate this information into the public record but will report it without attribution.

DOE will collate the completed interview questionnaires and prepare a summary of the major issues and outcomes. This summary will become part of the TSD for this rulemaking.

Item 12-1 *DOE seeks comment on its plans to interview companies to assess manufacturer impacts and on the procedures it should follow when scheduling interviews and requesting information.*

12.2 Industry Cash Flow Analysis

The industry cash flow analysis relies primarily on the Government Regulatory Impact Model (GRIM). DOE uses the GRIM to analyze the financial impacts of more stringent energy conservation standards on the manufacturers that are part of a product industry.

The GRIM analysis uses a number of inputs—annual expected revenues; manufacturer costs such as costs of goods sold; SG&A costs; taxes; and capital expenditures (both ordinary capital expenditures and those related to energy conservation standards)—to arrive at a series of annual cash flows beginning from the announcement of the new standard and continuing for several years after its implementation. DOE compares the results against base case projections involving no new standards. The financial impact of new standards is the difference between the two sets of discounted annual cash flows.

DOE will gather this information from two primary sources: the analyses conducted to this point, and interviews with manufacturers and other stakeholders. Information gathered from previous analyses will include financial parameters, manufacturing costs, price forecasts, and shipments forecasts. Interviews with manufacturers and other stakeholders will be essential in supplementing this information. The information gathered will also be used in the calculation of manufacturer markups.

12.3 Manufacturer Subgroup Analysis

It is possible that the use of average industry cost values will not adequately assess differential impacts among subgroup manufacturers. DOE recognizes that smaller manufacturers, niche players, and manufacturers exhibiting a cost structure that differs largely from the industry average may be more negatively impacted by the imposition of standards. Ideally, DOE would consider the impact on every firm individually. In highly concentrated industries, this may be possible. In industries having numerous participants, however, DOE will use the results of the market and technology assessment to organize manufacturers into subgroups, as appropriate. The detailed manufacturer subgroup impact analysis will entail calculating cash flows separately for each defined class of manufacturer.

Item 12-2 *What are potential subgroups of manufacturers that DOE should consider in the manufacturer subgroup analysis?*

12.4 Competitive Impacts Assessment

EPCA directs DOE to consider any lessening of competition that is likely to result from an imposition of standards. (42 U.S.C. 6295(o)(2)(B)(i)(V)) Further, it directs the Attorney General to determine in writing the impacts, if any, of any lessening of competition. (42 U.S.C. 6295(o)(2)(B)(ii)) DOE will make a determined effort to gather and report firm-specific financial information and impacts. The competitive analysis will focus on assessing the impacts to smaller, yet significant, manufacturers. DOE will provide the Attorney General with a copy of the NOPR for consideration in his evaluation of the impact of standards on the lessening of competition. DOE will base the assessment on manufacturing cost data and on information collected from interviews with manufacturers. The manufacturer interviews will focus on gathering information that would help in assessing the various cost increases to some manufacturers, the potential for increased proportions of fixed costs to increase business risks, and potential barriers to market entry (e.g., proprietary technologies).

12.5 Cumulative Regulatory Burden

DOE will address and seek to mitigate the overlapping effects of amended DOE standards and other regulatory actions on manufacturers of residential water heaters, direct heating equipment, and pool heaters. It will take these issues into consideration during the MIA.

DOE is aware that there are other regulations that could affect this industry. These regulations include:

- Energy conservation standards for residential water heaters, direct heating equipment, and pool heaters enacted since 1990; 66 FR 4497 (January 17, 2001) (42 U.S.C. 6295 (e)(2)-(3))
- Mandatory reduction of nitrogen oxide emissions for certain water heaters;[24]
- Replacement of ozone-depleting chemicals previously used in insulation of water heater storage tanks; and
- Additional voluntary regulations adopted by DOE under ANSI Standard Z21.10.1-2001 that requires all water heaters manufactured after July 2003 to be flammable vapor ignition resistant.

Item 12-3 *DOE seeks comment on what other existing or pending requirements DOE should consider in its examination of cumulative regulatory burden.*

13. UTILITY IMPACT ANALYSIS

To perform the utility impact analysis, which will include an analysis of the electric and gas utility industries, DOE plans to use a variant of the EIA's National Energy Modeling System (NEMS), called NEMS-BT (BT is DOE's Building Technologies Program). NEMS-BT is a large, multi-sectoral, partial equilibrium model of the U.S. energy sector that EIA has developed over several years, primarily for the purpose of preparing the *AEO*. The NEMS-BT produces a widely recognized reference case forecast for the United States through 2030 and is available in the public domain. Outputs of the utility analysis can parallel results that appear in the latest *AEO*, with some additions. Typical outputs include forecasts of sales, price, and avoided capacity. DOE can conduct the entire utility analysis as a scenario based on the *AEO* reference case. Since 1996, DOE has used NEMS-BT to conduct the utility impact analysis for its standards rulemakings.

Item 13-1 *DOE seeks input from stakeholders on its intended use of NEMS-BT to conduct the utility impact analysis.*

Item 13-2 *Should DOE consider using methods other than NEMS in the utility impact analysis?*

14. EMPLOYMENT IMPACT ANALYSIS

The imposition of standards can impact employment both directly and indirectly. Direct employment impacts are changes in the number of employees at the plants that produce the covered equipment along with the affiliated distribution and service companies resulting from the imposition of standards. DOE will evaluate direct employment impacts in the MIA, as described in section 12. Indirect employment impacts may result from expenditures shifting between goods (the substitution effect) and changes in income and overall expenditure levels (the income effect) that occur due to the imposition of standards. DOE will investigate the

[24] South Cost Air Quality Management District Rule 1146.2

combined direct and indirect employment impacts in the employment impact analysis, using the Pacific Northwest National Laboratory (PNNL)'s 'Impact of Sector Energy Technologies' (ImSET) model. Developed by PNNL for DOE's Office of Planning, Budget, and Analysis, the ImSET model estimates the employment and income effects of energy-saving technologies in buildings, industry, and transportation. In comparison with simple economic multiplier approaches, ImSET allows for more complete and automated analysis of the economic impacts of energy-efficiency investments.

Item 14-1 *Is this an acceptable approach to assessing employment impacts?*

15. ENVIRONMENTAL ASSESSMENT

Environmental effects will be reduced emissions resulting from reduced electrical energy consumption due energy conservation standards for heating products. The environmental impact analysis will track the impact of possible standards on three types of energy-related emissions: carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulfur dioxide (SO_2). DOE intends to base these calculations on the NEMS-BT modeling work described in the utility impact analysis. This approach has the advantage of examining the marginal impact of heating product standards on the utility generation mix and subsequent environmental emissions. As discussed in sections 8 and 10.2, DOE also plans to apply a 15 percent rebound effect to all emission savings.

Carbon emissions are tracked in NEMS-BT by a detailed carbon module that produces robust results because of its broad coverage of all sectors and inclusion of interactive effects. The NEMS-BT also includes a module for SO_2 allowance trading and a forecast of SO_2 allowance prices. It is important to note, however, that simulation of SO_2 trading tends to imply that physical emissions effects will be zero because emissions will always be at, or near, the emissions ceiling. However, there is an SO_2 benefit from conservation in the form of a lower allowance price and, if big enough to be calculable by NEMS, DOE can report this value. NEMS-BT also has an algorithm for estimating NO_x emissions from power generation.

While NEMS-BT contains provisions for estimating emissions of NO_x and SO_2 from power generation, it does not estimate household emissions from gas appliances. Therefore, DOE plans to conduct an analysis that includes separate estimates of the effect of energy conservation standards on household NO_x and SO_2 emissions based on simple emissions factors derived from the literature. DOE will report household SO_2 emissions savings, although they are small, because the SO_2 emissions caps do not apply to the residential sector.

Item 15-1 *Are there any other environmental factors DOE should consider in this rulemaking?*

Item 15-2 *Are there other approaches to the environmental assessment that DOE should consider?*

16. REGULATORY IMPACT ANALYSIS

Under the Process Rule, DOE is committed to exploring non-regulatory alternatives to mandatory standards, as described in Appendix A to Subpart C of 10 CFR Part 430. 62 FR 54817. In the NOPR, DOE will prepare a Regulatory Impact Analysis pursuant to Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (October 4, 1993), which is subject to review under the Executive Order by the Office of Information and Regulatory Affairs. The RIA will address the potential for non-regulatory approaches to supplant or augment efficiency standards to improve the efficiency of heating products in the market.

DOE recognizes that voluntary or other non-regulatory efforts by manufacturers, utilities, and other interested parties can result in substantial efficiency improvements. DOE intends to consider the likely effects of non-regulatory initiatives on product energy use, consumer utility, and LCC. DOE will attempt to base its assessment on the actual impacts of any such initiatives to date but also will consider information presented regarding the impacts that any existing initiative might have in the future. In particular, DOE plans to assess the impact on gas water heater efficiency of the South Coast Air Quality Management District's (SCAQMD) regulation of NOx emissions (Rule 1121). This rule, which may have national implications, becomes fully effective on January 1, 2008 and bans the sales (within the district boundaries) of gas water heaters that are not currently certified to satisfy the NOx limits. DOE also plans to assess the impact on gas water heater efficiency of the EPACT 2005 tax credits for water heaters at or above 0.80 EF.

Item 16-1 *DOE is unaware of any current non-regulatory programs that specifically target the products covered under this rulemaking. Are stakeholders aware of any such programs that should be examined as optional, non-regulatory approaches? Are there other approaches to the RIA that DOE should consider?*

Item 16-2 *Are there specific subgroups of end-users DOE should consider in its review of potential adverse impacts from standards developed under this rulemaking?*