DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

10 CFR Part 430

[Docket Number EE–RM–97–500]

RIN: 1904–AA77

Energy Conservation Program for Consumer Products: Central Air Conditioners and Heat Pumps Energy Conservation Standards

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

ACTION: Notice of proposed rulemaking and public hearing.

SUMMARY: Pursuant to the Energy Policy and Conservation Act, as amended, the Department of Energy (DOE, Department, or we) is proposing to amend the energy conservation standards for residential central air conditioners and heat pumps to require them to be more energy efficient, and is announcing a public hearing on the proposal.

DATES: Comments must be received on or before December 4, 2000. DOE is requesting a signed original, a computer diskette (WordPerfect 8) and 10 copies of the written comments. The Department will also accept e-mailed comments, but you must send a signed original. Oral views, data, and arguments may be presented at the public hearing (workshop) in Washington, DC beginning at 9 a.m. on November 16, 2000.

The Department must receive requests to speak at the public hearing and a copy of your statements no later than 4 p.m., November 1, 2000, and we request that you provide a computer diskette (WordPerfect 8) of each statement at that time.

ADDRESSES: Please submit written comments, oral statements, and requests to speak at the public hearing to: Brenda Edwards-Jones, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Energy Conservation Program for Consumer Products: Central Air Conditioners and Heat Pumps, Docket No. EE-RM/STD–97–500, 1000 Independence Avenue, SW., Washington, DC 20585–0121. You may send emails to: brenda.edwards-jones@ee.doe.gov.

The hearing will begin at 9 a.m., in Room 1E–245 at the U.S. Department of Energy, Forrestal Building, 1000 Independence Avenue, SW., Washington DC. You can find more information concerning public participation in this rulemaking proceeding in Section VIII, ''Public Comment Procedures,'' of this notice of proposed rulemaking.

You may read copies of the public comments, the Technical Support Document for Energy Efficiency Standards for Consumer Products: Central Air Conditioners and Heat Pumps (TSD), the transcript of the public hearing, and previous workshop transcripts in this proceeding at the DOE Freedom of Information (FOI) Reading Room, U.S. Department of Energy, Forrestal Building, Room 1E–190, 1000 Independence Avenue, SW., Washington, DC 20585, (202–586-3142, between the hours of 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. You may obtain copies of the TSD and analysis spreadsheets from the Office of Energy Efficiency and Renewable Energy's (EERE) web site at: http://www.eren.doe.gov/buildings/codes_standards/applbrf/central_air_conditioner.html.

FOR FURTHER INFORMATION CONTACT: Dr. Michael E. McCabe, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Forrestal Building, EE–41, 1000 Independence Avenue, SW., Washington, DC 20585–0121, (202) 586–0854, e-mail: michael.e.mccabe@ee.doe.gov, or Edward Levy, Esq., U.S. Department of Energy, Office of General Counsel, Forrestal Building, GC–72, 1000 Independence Avenue, SW., Washington, DC 20585, (202) 586–9507, e-mail: edward.levy@hq.doe.gov.

SUPPLEMENTARY INFORMATION:

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I. Summary of Proposed Rule

The Department is proposing to raise the energy efficiency standards for residential air conditioners and central air conditioning heat pumps (heat pumps) to 12 SEER [1] for air conditioners and to 13 SEER/7.7 HSPF [2] for heat pumps. The proposed standards would apply to all covered products offered for sale in the United States, effective on January 1, 2006. The proposed standard for split system air conditioners, the most common type of residential air conditioning equipment represents a 20% improvement in energy efficiency. For split system heat pumps, the new standards would represent a 30% improvement in cooling efficiency and a 13% improvement in heating efficiency. The proposed standards would also increase the efficiency of packaged air conditioners and packaged heat pumps by 24% and 17%, respectively. Finally, the Department is proposing provisions for some special products to ensure that more efficient versions remain available for niche applications.

The proposed standards would save a significant amount of energy and, as a result of less electricity being produced, result in a cleaner environment. In the 25-year period after the new standards become effective, the nation would save over 3.4 Quads [3] of primary energy, equivalent to all the energy consumed by nearly 18 million American households in a single year. These energy savings would also significantly reduce the emissions of air pollutants and greenhouse gases associated with electricity production, by avoiding the emission of 56 million tons (Mt) of Carbon and 52 thousand tons (kt) nitrogen oxides (NO_X). Also, the standards are expected to eliminate the need for the construction of approximately 31 (4 coal-fired and 27 natural gas-fired) new large, 400 megaWatt (MW), power plants in 2020.

In addition to the increase proposed in SEER and HSPF, we are proposing and requesting public comments on a proposal to adopt a standard for steady-state cooling efficiency, EER.[4] A requirement on EER would ensure more efficient operation at high outdoor temperature, during periods when electricity use by air conditioners is at its peak. This would help to further alleviate the need for new electric power plants and reduce the demands placed on the electric transmission and distribution systems during periods of high usage, thereby, improving system reliability.

Finally, consumers would see benefits from the proposed standards. For example, while the initial cost of a typical central air conditioner would increase by $122 to $153 or about 10–12%, the higher efficiency equipment would save enough over its life to pay for the increase in the price of the equipment plus an extra $45. Many consumers, especially air conditioner owners in warmer parts of the country and heat pump owners, would save even more.

While the higher efficiency units are widely available today and promoted through the Department of Energy and the Environmental Protection Agency (EPA) Energy Star® program, as well as utility rebate programs, manufacturers would be redesigning their product line to meet the efficiency standards. At the same time they would be redesigning their products to respond to the phase-out hydrochloroflourocarbons (HCFC's) refrigerants required by EPA. By making both changes at once, *i.e.,* efficiency and HCFC refrigerants, manufacturers will be able to plan and apply their resources in a cost-effective manner, resulting in lower burdens and costs.

II. Introduction

A. Authority

Part B of Title III of the Energy Policy and Conservation Act (EPCA), Pub. L. 94–163, as amended by the National Energy Conservation Policy Act of 1978, Pub. L. 95–619, the National Appliance Energy Conservation Act, Pub. L. 100–12, the National Appliance Energy Conservation Amendments of 1988, Pub. L. 100–357, and the Energy Policy Act of 1992, Pub. L. 102–486 [5] created the Energy Conservation Program for Consumer Products other than Automobiles. The consumer products subject to this program (often referred to hereafter as ''covered products'') include central air conditioners and heat pumps. EPCA section 322(a)(4), 42 U.S.C. 6292(a)(4).

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

The Act prescribes initial Federal energy conservation standards for each of the listed covered products, except television sets. EPCA section 325 (b)–(k), 42 U.S.C. 6295 (b)–(k). For central air conditioners and heat pumps, EPCA section 325(d)(3)(A) specifies that the

[1] SEER, Seasonal Energy Efficiency Ratio, is the Department's measure of energy efficiency for the seasonal cooling performance of central air conditioners and heat pumps.

[2] HSPF, Heating Seasonal Performance Factor, is the Department's measure of energy efficiency for the seasonal heating performance of heat pumps.

[3] Quad, means quadrillion (10^{15} Btus).

[4] EER, Energy Efficiency Ratio, is a steady-state measure of energy efficiency which measures efficiency at a prescribed outdoor temperature (95°F), and is one of the test conditions in the Department's test procedure used to develop the SEER.

[5] Part B of Title III of the Energy Policy and Conservation Act, as amended by the National Energy Conservation Policy Act, the National Appliance Energy Conservation Act, the National Appliance Energy Conservation Amendments of 1988, and the Energy Policy Act of 1992, is referred to in this notice as the ''Act,'' or ''EPCA.'' Part B of Title III is codified at 42 U.S.C. 6291 *et seq.* Part B of Title III of the Energy Policy and Conservation Act, as amended by the National Energy Conservation Policy Act only, is referred to in this notice as the National Energy Conservation Policy Act.

standards are to be reviewed by the Department no later than January 1, 1994. 42 U.S.C. 6295(d)(3)(A).

Any new or amended standard must be designed so as to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. EPCA section 325(o)(2)(A), 42 U.S.C. 6295(o)(2)(A). Moreover, the Department may not prescribe a standard for: (1) Certain products, including central air conditioners and heat pumps, if no test procedure has been established for the product, or (2) any product, if DOE determines by rule that a standard for the product either would not result in significant conservation of energy, or is not technologically feasible or economically justified. EPCA section 325(o)(3), 42 U.S.C. 6295(o)(3).

Section 325(o)(2)(B)(i), 42 U.S.C. 6295(o)(2)(B)(i) provides that DOE must determine whether a standard is economically justified, after receiving comments on the proposed standard, and whether the benefits of the standard exceed its burdens, based, to the greatest extent practicable, on a weighing of the following seven factors:

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

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

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

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

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

(6) The need for national energy conservation; and

(7) Other factors the Secretary considers relevant.''

In addition, Section 325(o)(2)(B)(iii) of the Act, 42 U.S.C. 6295(o)(2)(B)(iii), establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that ''the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy * * * savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure * * * '' The rebuttable presumption test is an alternative path to establishing economic justification.

Section 327 of the Act, 42 U.S.C. 6297, provides that generally the Federal energy efficiency requirements supersede State laws or regulations concerning energy conservation testing, labeling, and standards, and specifies limited exceptions to this general rule. EPCA Section 327(a) through (c), 42 U.S.C. 6297 (a) through (c). The Department can grant a waiver of preemption in accordance with the procedures and other provisions of Section 327(d) of the Act. 42 U.S.C. 6297(d).

B. Background

1. Current Standards

The existing standards for residential central air conditioners and heat pumps have been in effect since 1992. Energy efficiency for air conditioner and heat pump cooling has been defined by the descriptor SEER. Energy efficiency for heat pumps has been defined by the descriptor, Heating Seasonal Performance Factor (HSPF) while operating during the heating season and by SEER while operating during the cooling season. The current central air conditioners and heat pumps efficiency standards are as follows:

—Split system air conditioners and heat pumps—10 SEER/6.8 HSPF
—Single package air conditioners and heat pumps—9.7 SEER/6.6 HSPF

2. History of Previous Rulemakings

On September 8, 1993, DOE published an Advance Notice of Proposed Rulemaking (ANOPR) announcing the Department's intention to revise the existing central air conditioner and heat pump efficiency standard. (58 FR 47326). On November 24, 1999, DOE published a Supplemental ANOPR (hereinafter referred to as the Supplemental ANOPR). 64 FR 66306. In the Supplemental ANOPR and during the December 9, 1999, public workshop, we provided interested persons an opportunity to comment on several issues, including:

(1) The product classes that the Department planned to analyze;

(2) The analytical framework, models (*e.g.,* the Government Regulatory Impact Model (GRIM)), and tools (*e.g.,* a Monte Carlo sampling methodology, and the life-cycle cost (LCC) and national energy savings (NES) spreadsheets) that the Department was using in performing analyses of the impacts of energy conservation standards;

(3) The results of preliminary analyses for the engineering, LCC, payback and NES; and

(4) The candidate energy conservation standard levels that the Department had developed from these analyses.

3. Process Improvement

The fiscal year (FY) 1996 appropriations legislation imposed a moratorium on proposed or final rules for appliance efficiency standards for FY 1996. Pub. L. 104–134. During the moratorium, the Department examined the appliance standards program and how it was working. Congress advised DOE to correct the standards-setting process and to bring together stakeholders (such as manufacturers and environmentalists) for assistance. Therefore, we consulted with energy efficiency groups, manufacturers, trade associations, state agencies, utilities and other interested parties to provide input to the process used to develop appliance efficiency standards. As a result, on July 15, 1996, the Department published a final rule: Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products (referred to as the Process Rule) (61 FR 36974), codified at 10 CFR part 430, subpart C, Appendix A.

The Process Rule states that for products, such as central air conditioners and heat pumps, for which DOE issued a proposed rule prior to August 14, 1996, DOE would conduct a review to decide whether any of the analytical or procedural steps already completed should be repeated. (61 FR 36982). DOE completed this review and decided to use the Process Rule, to the extent possible, in the development of the revised central air conditioners and heat pumps standards.

We developed an analytical framework for the central air conditioners and heat pumps standards rulemaking for our stakeholders, which we presented during a workshop on June 30, 1998. The analytical framework described the different analyses (*e.g.,* LCC, payback and manufacturing impact analyses (MIA)) to be conducted, the method for conducting them, the use of new LCC and NES spreadsheets, and the relationship of the various analyses.

III. General Discussion

A. Test Procedures

Section 7(b) of the Process Rule states that necessary modifications to test procedures concerning efficiency standards will be proposed before issuance of a proposed rule. Section 7(c) of the Process Rule states that a final modified test procedure will be issued prior to issuing a proposed rule regarding energy conservation standards. The residential central air conditioner and heat pump test procedure is being revised to improve its organization and ease of use, with a proposed rule to be published. This revision of the test procedure is not expected to alter the measured efficiencies as determined under the existing test procedure. Therefore, the revised test procedure would not affect development of revised efficiency standards. For these reasons, revisions to the test procedure are not a ''necessary modification'' as that term is used in the Process Rule, but rather a routine update, and hence need not be finalized before issuance of the proposed rule for these standards.

B. Technological Feasibility

1. General

There are central air conditioners and heat pumps in the market at all of the efficiency levels analyzed in today's notice. The Department, therefore, believes all of the efficiency levels discussed in today's notice are technologically feasible.

2. Maximum Technologically Feasible Levels

The Act requires the Department, in a proposed rule that sets forth new or amended standards, to ''determine the maximum improvement in energy efficiency * * * that is technologically feasible for each type (or class) of covered products.'' EPCA section 325 (p)(2), 42 U.S.C. 6295(p)(2). Accordingly, for each class of product under consideration in this rulemaking, a maximum technologically feasible (Max Tech) level was identified.

As previously stated in Section II.B, residential central air conditioner and heat pump cooling efficiency is expressed as a SEER. Heating efficiency is expressed as a HSPF. The most efficient technology presently available is a 3-ton 18 SEER central air conditioner. The Department has determined that at this time 18 SEER is the Max Tech level for cooling efficiency for all product classes and capacities in this analysis. The Max Tech level for heating efficiency, corresponding to the 18 SEER level, is 9.4 HSPF which is the highest HSPF rating currently available in residential heat pumps.

C. Energy Savings

1. Determination of Savings

The Department estimated energy savings through the use of the NES spreadsheet, which forecasted energy savings over the period of analysis for candidate standards relative to the base case. The Department quantified the energy savings that would be attributable to a standard as the difference in energy consumption between the candidate standards case and the base case. The base case represents the forecast of energy consumption in the absence of amended mandatory efficiency standards.

The NES spreadsheet model is described in Section IV.B of this notice, Appendix of the Technical Support Document and also in the Supplemental ANOPR. (64 FR 66306). The NES spreadsheet model calculates the energy savings in site energy or kilowatt-hours (kWh). Site energy is the energy directly consumed at building sites by the central air conditioner or heat pump. National energy savings are expressed in terms of the source energy savings which is the savings in energy used to generate and transmit the electricity consumed at the site. Chapter 7 of the TSD contains a table of factors used to convert kWh to Btu. These conversion factors, which change with time, are derived from DOE's Energy Information Administration's (EIA) Annual Energy Outlook 2000 (AEO2000).

2. Significance of Savings

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

D. Rebuttable Presumption

The National Appliance Energy Conservation Act established new criteria for determining whether a standard level is economically justified. EPCA section 325(o)(2)(B)(iii) states:

''If the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy * * * savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure, there shall be a rebuttable presumption that such standard level is economically justified. A determination by the Secretary that such criterion is not met shall not be taken into consideration in the Secretary's determination of whether a standard is economically justified.''

If the increase in initial price of an appliance due to a conservation standard would repay itself to the consumer in energy savings in less than three years, then we presume that such standard is economically justified.[6] This presumption of economic justification can be rebutted upon a proper showing.

E. Economic Justification

As noted earlier, section 325(o)(2)(B)(i) of the Act provides seven factors to be evaluated in determining whether a conservation standard is economically justified.

1. Economic Impact on Manufacturers and Consumers

The Process Rule established procedures, interpretations and policies to guide the Department in the consideration of new or revised appliance efficiency standards. The provisions of the rule have direct bearing on the implementation of manufacturer impact analyses. First, the Department will use an annual cash flow approach in determining the quantitative impacts on manufacturers. This includes a short-term assessment based on the cost and capital requirements during the period between the announcement of a regulation and the time when the regulation comes into effect, and a long-term assessment. Impacts analyzed include industry net present value, cash flows by year, changes in revenue and income, and other measures of impact, as appropriate. Second, the Department will analyze and report the impacts on different types of manufacturers, with particular attention to impacts on small manufacturers. Third, the Department will consider the impact of standards on domestic manufacturer employment, manufacturing capacity, plant closures and loss of capital investment. Finally, the Department will take into account cumulative impacts of different DOE regulations on manufacturers.

For consumers, measures of economic impact are the changes in installed cost and annual operating costs, *i.e.*, LCC. The life-cycle cost of the product at each standard level are presented in Chapter

[6] For this calculation, the Department calculated cost-of-operation based on the DOE test procedure, with the test procedure assumed annual hours of operation. Consumers that use the central air conditioner or heat pump fewer hours will experience a longer payback while those that use them more will have a shorter payback.

5 of the TSD. Under section 325 of the Act, the life-cycle cost analysis is a separate factor to be considered in determining economic justification.

2. Life-Cycle Costs

The life-cycle cost is the sum of the purchase price, including the installation, and the operating expense, including operating energy, maintenance, and repair expenditures, discounted over the lifetime of the appliance.

For each central air conditioner and heat pump product class, we calculated both life-cycle costs and life cycle cost savings for the following space-cooling efficiency levels: 11, 12, 13, and 18 SEER. For heat pumps, the following space-heating efficiency levels correspond to the above SEER values: 7.1, 7.4, 7.7, and 8.8 HSPF, respectively. The calculated life-cycle cost savings is given as a distribution, with a mean value and a range. We used a distribution of real discount rates ranging from 0.1 to 18% for the calculations. The assumption is that the consumer purchases the central air conditioner and/or heat pump in 2006. For the probability-based LCC analysis, a building-by-building analysis is performed for purposes of generating a distribution of life-cycle costs for each efficiency level analyzed. The building stock is composed of both residential and commercial buildings under the assumption that 90% of single-phase central air conditioners and heat pumps are utilized in residential buildings with the remaining 10% in commercial buildings. The 1997 Residential Energy Consumption Survey (RECS) is used to represent the residential building stock while 77 commercial buildings are used to represent the commercial building stock based on assumptions consistent with those used in the process to update ASHRAE Standard 90.1–1999. Annual energy costs are based on marginal electricity prices which are developed for each residential and commercial building. Electricity price forecasts are taken from the AEO2000 (DOE/EIA–0383). The LCC calculations include markup structures developed for both the new construction and replacement/retrofit markets. Chapter 5 of the TSD contains the details of the LCC calculations including those considered under factor seven below.

3. Energy Savings

While significant conservation of energy is a separate statutory requirement for imposing an energy conservation standard, the Act requires DOE, in determining the economic justification of a standard, to consider the total projected energy savings that are expected to result directly from revised standards. The Department used the NES spreadsheet results, discussed earlier, in its consideration of total projected savings. The savings are provided in section V of this notice.

4. Lessening, if Any, of Utility or Performance of Products

This factor cannot be quantified. In establishing classes of products, and in evaluating design options and the impact of potential standard levels, the Department tried to eliminate any degradation of utility or performance in the products under consideration in this rulemaking. None of the proposed trial standard levels reduces the performance of central air conditioners and heat pumps.

5. Impact of Any Lessening of Competition

The Act directs the Department to consider any lessening of competition that is likely to result from standards. It further directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and transmit such determination to the Secretary, not later than 60 days after the publication of a proposed rule, together with an analysis of the nature and extent of such impact. Section 325(o)(2)(B)(i)(V) and (B)(ii), 42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii).

In order to assist the Attorney General in making such a determination, the Department has provided the Attorney General with copies of this notice and the Technical Support Document for review.

6. Need of the Nation To Conserve Energy

We report the environmental effects from each standard level for each product under this factor in Section VI of this notice.

7. Other Factors

During the extreme periods of heat and humidity that took place in the summer of 1999, electric power outages and other system disturbances disrupted the lives of millions of people and thousands of businesses in various regions of our country. In response to public concerns about this problem, the Secretary of Energy formed a team of experts to investigate the problem and to recommend actions that the Federal government can take to help avoid future power outages by improving the reliability of the U.S. electric power system. One of the actions proposed by the Secretary at that time was to accelerate the rulemaking process and advance the publication of a final rule for central air conditioners by six months.

The Final Report [7] by the team of experts, issued in March, 2000, included the recommendation to increase the energy efficiency of central air conditioners as one means for enhancing reliability. The report stated, ''Technologies and practices that reduce loads during times of peak demand, such as high-efficiency air conditioning and lighting equipment, are especially valuable.'' This was based on the finding that in several of the affected regions ''Retail customers have limited mechanisms and incentives to conserve energy or resort to alternatives during electricity shortages.'' Included in the federal activities that promote energy efficiency recommended to the Secretary was to promulgate standards for more efficient technologies.

As an additional element to consider under this factor, the Secretary has decided to evaluate the life-cycle cost impacts on those subgroups of consumers who are at or below the poverty line (*e.g.*, for a family of four, this constitutes a household income of less than $16,036).

IV. Methodology

The Process Rule outlines the procedural improvements identified by the interested parties. 61 FR 36974. The process improvement effort also included a review of the: (1) Economic models; (2) analytical tools; (3) methodologies; (4) non-regulatory approaches; and (5) prioritization of future rules.

The Department continues to use two spreadsheet tools to meet the objectives of the Process Rule. The first spreadsheet calculates life-cycle-costs and payback periods of potential new energy conservation standards. The second conducts shipments forecasts and then calculates national energy savings and net present value impacts of potential new energy conservation standards. The Department also completely revised the methodology used in assessing manufacturer impacts including the adoption of the GRIM.

Additionally, DOE has estimated the impacts of central air conditioner and heat pump energy efficiency standards on electric utilities and the environment. The Department used a version of EIA's National Energy Modeling System (NEMS) for the utility

[7] ''Report of the U.S. Department of Energy's Power Outage Study Team: Findings and Recommendations to Enhance Reliability from the Summer of 1999'', March 2000.

and environmental analyses. NEMS simulates the energy economy of the U.S. and has been developed over several years by the EIA primarily for the purpose of preparing the AEO. NEMS produces a widely-known baseline forecast for the U.S. through 2020 that is available in the public domain. The version of NEMS used for appliance standards analysis is called NEMS–BRS,[8] and is based on the AEO2000 version with minor modifications. NEMS offers a sophisticated picture of the effect of standards since its scope allows it to measure the interactions between the various energy supply and demand sectors and the economy as a whole.

A. Life-Cycle Cost and Payback Period Analysis

This section describes the LCC and payback period analysis and the spreadsheet model used for analyzing the economic impacts of possible standards on individual residential and commercial consumers. Details of the spreadsheet model can be found in Chapters 5 in the TSD. We conduct the LCC and payback period analysis with a spreadsheet model developed in Microsoft Excel for Windows 95 or above. When combined with Crystal Ball (a commercially available software program), the LCC and payback period generates a Monte Carlo simulation to perform the analysis by incorporating uncertainty and variability considerations.

The LCC is the total consumer expense over the life of the appliance, including purchase expense and operating costs (including energy expenditures). Future operating costs are discounted to the time of purchase and summed over the lifetime of the appliance. The payback period is the change in purchase expense due to an increased efficiency standard divided by the change in annual operating cost that results from the standard. For today's proposed rule, both the LCC and payback period are based on a building-by-building analysis of a nationally representative set of residential and commercial buildings.

The set of residential buildings are taken from those households in the 1997 RECS equipped with either a central air conditioner or heat pump. Of the 5,900 households surveyed in the 1997 RECS, 2,003 households representing 37.6% of the housing population have a central air conditioner while 579 households representing 11.1% of the housing population have heat pumps.[9] RECS specifies the annual space-cooling energy consumption and, in the case of heat pumps, the annual space-heating energy consumption associated with the space-conditioning equipment. Also provided is the age of the space-conditioning equipment which, when coupled with historical equipment efficiency data provided by the Air-Conditioning and Refrigeration Institute (ARI), allows for the imputation of the household's space-conditioning equipment efficiency (*i.e.*, the SEER and, in the case of heat pumps, the HSPF). With both the annual energy use and the efficiency of the central air conditioner or heat pump specified, the annual energy use associated with equipment at higher efficiency levels is simply determined by multiplying the household's existing annual energy use by the ratio of the existing equipment efficiency divided by the efficiency of the more efficient equipment. Household utility billing data in RECS allows for the determination of average and marginal electricity prices. The electricity price data along with the annual energy use data allows for the determination of annual electricity cost savings for any efficiency level.

The set of commercial buildings are based on assumptions consistent with those used to develop the American Society of Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) Standard 90.1–1999. The commercial building data set consists of seven building types located in eleven different geographic regions yielding a total of 77 buildings. An hourly simulation program is used to calculate the annual full-load equivalent operating hours (FLEOH) of the space-cooling and space-heating equipment in each building. The FLEOHs are used with the Department of Energy's test procedure equations for central air conditioners and heat pumps to obtain each building's annual space-cooling and space-heating energy consumption. Similar to the analysis for residential buildings, the energy use associated with equipment at higher efficiency levels is simply determined by multiplying the building's simulated annual energy use by the ratio of the building's assumed equipment efficiency (*i.e.*, 10 SEER) divided by the efficiency of the more efficient equipment. Average and marginal electricity prices for each commercial building are determined by applying a national sample of electric utility tariffs to the simulated load and demand. The electricity price data along with the annual energy use data allows for the determination of annual electricity cost savings for any efficiency level for each commercial building.

The probability-based LCC and payback period analysis samples buildings from the residential and commercial building data set in order to produce a distribution of LCC results for a given standard level. The LCC and payback period analysis takes 10,000 samples to create a distribution of results based on the assumption that 90% of the single-phase central air conditioning and heat pump equipment stock are in residential buildings with the remaining 10% in commercial buildings.

The spreadsheet model is organized so that ranges or distributions can be entered for each input variable needed to perform the calculations. The LCC and payback period output can be either a point value when we use the average value of the inputs or a distribution when we use distributions for some or all of the inputs. Inputs for determining the total installed cost include: Baseline manufacturer costs, manufacturer cost multipliers for each efficiency level, manufacturer markups, distributor or wholesaler markups, dealer or contractor markups, builder markups, sales taxes, and installation costs. Of the above total installed cost inputs, the manufacturer, dealer, distributor, and builder markups, as well as the sales tax and installation price are described with distributions. Inputs for determining operating expenses include: Annual energy consumption, average electricity prices, marginal electricity prices, electricity price projections, repair costs, maintenance costs, equipment lifetime, discount rates, and the year standards take effect. Of the above operating expense inputs, the discount rate and equipment lifetime are described with distributions (note that neither the discount rate nor lifetime are needed to determine the payback period). Operating expense, annual

[8] EIA approves use of the name NEMS to describe only an AEO version of the model without any modification to code or data. Because our analysis entails some minor code modifications and the model is run under various policy scenarios that deviate from AEO assumptions, the name NEMS–BRS refers to the model as used here. For more information on NEMS, please refer to the National Energy Modeling System: An Overview 1998. DOE/EIA–0581 (98), February, 1998. BRS is DOE's Office of Building Research and Standards.

[9] The number of households actually used in the central air conditioner and heat pump LCC and Payback period analyses were 1218 and 308, respectively. Some central air-conditioned households were dropped from the analysis for one or more of the following reasons: (1) The central air conditioner was not used, (2) a room air conditioner was present and used, or (3) marginal energy prices could not be determined for the household. With regard to households with heat pumps, they were dropped from the analysis for one or more of the following reasons: (1) The heat pump was not used or (2) marginal energy prices could not be determined for the household.

energy use and electricity prices, although represented by point-values for each residential and commercial building, are highly variable when looking at the entire building data set. Chapter 5 of the TSD contains the details of all the inputs to the LCC and payback period analysis.

In addition to determining payback periods with the spreadsheet model, the Act requires us to determine a rebuttable payback period. The Act requires the Department to examine payback periods to determine if the three year rebuttable presumption of economic justification applies. As prescribed by the Act, the rebuttable payback period is ''calculated under the applicable test procedure, * * * .''

The annual space-cooling and space-heating energy consumption calculated based on the Department's test procedure are on the order of 50% greater than the weighted-average values from the LCC analysis (*i.e.*, analyses based on the 1997 RECS for residential buildings and hourly simulations for commercial buildings). As will be shown in Section VI (Analytical Results), the payback value calculated from the Department's test procedure equations will be significantly lower than the average payback value calculated from the LCC analysis, for any standard level.

B. National Energy Savings and Net Present Value Analysis

In order to make the analysis more accessible and transparent to all stakeholders, we continue to use an Excel spreadsheet model to calculate the energy savings and the national economic costs and savings from new standards. Various input quantities within the spreadsheet can be changed. Unlike the LCC analysis, the NES spreadsheet does not use distributions for inputs or outputs. We conduct sensitivities by running different scenarios.

DOE uses the NES spreadsheet to perform calculations of energy savings and net present value (NPV) based on user inputs similar to those for the LCC spreadsheet. The energy savings, energy cost savings, equipment costs, and NPV of benefits for several product classes are forecast from the chosen start year through 2030. The forecasts provide annual and cumulative values for all four output parameters.

The Department calculates the national energy savings by subtracting energy use under a standards scenario from energy use in a base case (no new standards scenario). Energy use is reduced when the baseline central air conditioner or heat pump (*i.e*, 10 SEER) is replaced by a more efficient piece of equipment. Unit energy savings for each product class are the same weighted-average values as calculated in the LCC and Payback period spreadsheet. Additional information about the NES spreadsheet can be found in Chapter 7 of the TSD.

User inputs include: (1) A choice from among several electricity price projections: (2) effective date of the central air conditioners and heat pumps standard; (3) discount rate and discount year; (4) a standards case efficiency level; (5) an equipment price; (6) an equipment price and housing projection; and (7) an efficiency scenario. Additionally, we use a time series of conversion factors to change from site to source energy.

The efficiency scenario specifies the equipment efficiency distribution after new standards would take effect. Three efficiency scenarios were used to forecast the impact new standards would have after they take effect: (1) National Appliance Energy Conservation Act (NAECA) scenario,[10] (2) Roll-up scenario,[11] and (3) Shift scenario.[12] As opposed to the Supplemental ANOPR where weighted-average equipment efficiencies were forecasted, an actual distribution of efficiencies (*i.e.*, the percentage of shipments which occur in incremental SEER bins over the range from the minimum standard to 18 SEER) were used in the analysis for the proposed rule.

One of the more important components of any estimate of future impact is shipments. Forecasts of shipments for the base case and standards case are determined within the NES spreadsheet. The shipments portion of the spreadsheet forecasts central air conditioner and heat pump shipments from 2000 to 2030. Shipments forecasts are developed by accounting for: (1) The combined effects of equipment price, operating cost, and household income; (2) different market segments (*e.g.*, new housing, replacement decisions, and non-owners adding a central air conditioner or heat pump); (3) decisions to repair rather than replace; and (4) different equipment age categories. Additional details on the various shipments forecasts are provided in Chapter 6 of the TSD.

C. Manufacturer Impact Analysis

The MIA estimates the financial impact of standards on manufacturers and calculates impacts on employment and manufacturing capacity.

The Department published the proposed MIA approach as part of the **Federal Register** publication of the Supplemental ANOPR, and received no comments suggesting substantive changes in the methodology. As proposed, the MIA was conducted in three phases. Phase 1, ''Industry Profile,'' consisted of the preparation of an industry characterization. Phase 2, ''Industry Cash Flow,'' focused on the industry as a whole, including both major and niche-product manufacturers. The GRIM was used to prepare an industry cash flow analysis. The Department used publicly available information developed in Phase 1 to adapt the GRIM structure to facilitate the analysis of new central air conditioner and central air conditioning heat pump standards.

In Phase 3, ''Sub-Group Impact Analysis,'' the Department conducted interviews with several niche-product manufacturers to determine the financial impacts of revised standards. Phase 3 also entailed documenting additional impacts on employment and manufacturing capacity through a structured interview process.

1. Phase 1, Industry Profile

Phase 1 of the MIA consisted of preparing an Industry Profile. Prior to initiating the detailed impact studies, DOE collected information on the present and past structure and market characteristics of the central air conditioning industry. This activity involved both quantitative and qualitative efforts to assess the industry and products to be analyzed. The information collected included manufacturer market shares and characteristics and financial information, market trends, and product characteristics.

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[10] Under the NAECA scenario, equipment efficiencies after the adoption of new standards are forecasted to change in the same pattern as the efficiency changes that occurred in 1992 when minimum efficiency standards first took effect. This results in weighted average equipment efficiencies, based on minimum efficiency standards of 11, 12, and 13 SEER, of 11.6 SEER, 12.4 SEER, and 13.4 SEER, respectively.

[11] Under the Roll-up scenario, equipment that in the base case were forecast to be less efficient than the trial standard level are assumed to move up to the standard level, and equipment forecasted in the base case to be at or above the trial standard level are assumed not to increase in efficiency. This results in weighted-average equipment efficiencies, based on minimum efficiency standards of 11, 12, and 13 SEER, of 11.5 SEER, 12.3 SEER, and 13.3 SEER, respectively.

[12] Under the Shift scenario, equipment efficiencies after the adoption of new standards are forecast to have the same pattern, at and above the standard levels, as the current distribution of efficiencies. This results in weighted-average equipment efficiencies, based on minimum efficiency standards of 11, 12, and 13 SEER, of 11.7 SEER, 12.7 SEER, and 13.7 SEER, respectively.

The industry profile included a top-down cost analysis of the central air conditioner manufacturing industry that was used to derive cost and financial inputs for the GRIM, *e.g.,* revenues, and material, labor, overhead, depreciation, Sales General & Administration (SG&A), and Research & Development (R&D) expenses. The Department also utilized additional sources of information to further characterize the industry. These included company Securities and Exchange Commission (SEC) 10–K reports, Moody's company data reports, Standard & Poor's (S&P) stock reports, Value Line industry composites, and Dow Jones Financial Services.

2. Phase 2, Industry Cash Flow Analysis

Phase 2 of the MIA focused on the financial impacts of new standards on the industry as a whole. The analytical tool used for calculating the financial impacts of standards on manufacturers is the GRIM. As part of the analysis, DOE interviewed several of the major manufacturers. For the Industry Cash Flow Analysis, DOE used the financial values determined during Phase 1 and the shipment scenarios used in the LCC and NES analyses.

3. Phase 3, Sub-Group Impact Analysis

The Department has received many comments during workshops and interviews, and in writing, suggesting that manufacturers of niche products, representing less than 3% of industry shipments, could be more negatively impacted by new standards than major manufacturers. To assess the differential impacts, the Department interviewed two manufacturers of niche products, in addition to those conducted during the Engineering Analysis. The focus of the interviews was to determine which GRIM parameters differed for niche manufacturers by virtue of their smaller revenue base and more limited markets.

From a financial standpoint, the common distinguishing characteristic of niche product manufacturers was their need to spread the costs of converting to new standards over smaller production volumes, as well as the product size constraints identified during the Engineering Analysis which make their shipments more sensitive to increases in product size. During the interviews, small manufacturers demonstrated that several of the costs necessary to meet any new regulation are largely independent of the product volume produced. The most apparent are the costs necessary to design a new product meeting the proposed energy standards. Other costs, such as plant engineering, some tooling, and other capital costs, have significant portions that are independent of final production volumes.

4. GRIM Analysis

An increase in standards affects a manufacturer's cash flow in three distinct ways: (1) Increased investment; (2) higher production costs per unit; and (3) altered revenue by virtue of higher per unit prices and changes in sales volumes. As mentioned, the Department uses the GRIM to quantify the changes in cash flow that result in a higher or lower industry value.

The GRIM analysis uses a number of inputs—annual shipments; prices; manufacturer costs such as materials and labor, selling and general administration costs, taxes, and capital expenditures—to arrive at a series of annual net cash flows beginning today and continuing ten years past the implementation of new standards. This information was collected from a number of sources, including publically available data, as well as interviews with of the major manufacturers and two specialty manufacturers. Industry net present values are calculated by discounting and summing the annual net cash flows. Additional information about the GRIM spreadsheet can be found in Chapter 8 of the TSD.

D. NEMS Environmental Analysis

The environmental analysis provides estimates of changes in emissions of nitrogen oxides (NO_X) and carbon from carbon dioxide (CO_2). The Department used NEMS–BRS for central air conditioner and heat pump analyses (as well as the utility analyses). NEMS–BRS is run similar to the AEO2000 NEMS except that central air conditioner and heat pump energy usages are reduced by the amount of energy (electricity) saved due to the proposed trial standard levels. The input of energy savings are obtained from the NES spreadsheet. For the environmental analysis, the output is the forecasted physical emissions. The net benefits of the standard is the difference between emissions estimated by NEM–BRS and the AEO2000 Reference Case.

The environmental analysis is relatively straightforward from NEMS–BRS. Carbon emissions are tracked in NEMS–BRS using a detailed carbon module that provides robust results because of its broad coverage of all sectors and inclusion of interactive effects. The only form of carbon tracked by NEMS–BRS is CO_2. However, in this report the carbon savings are reported as elemental carbon.

The two airborne pollutant emissions that have been reported in past analyses, sulfur dioxide (SO_2) and NO_X, are reported by NEMS–BRS. NO_X results are based on forecasts of compliance with existing legislation. In the case of SO_2, the Clean Air Act Amendments of 1990 set an emissions cap on all power generation. The attainment of this target, however, is flexible among generators and is enforced by applying market forces, through the use of emissions allowances and tradable permits. As a result, accurate simulation of SO_2 trading tends to imply that physical emissions effects will be zero because emissions will always be at, or near, the ceiling. This fact has caused considerable confusion in the past. There is virtually no real possible SO_2 environmental benefit from electricity savings as long as there is enforcement of the emission ceilings. See the TSD, Environmental Assessment, for a discussion of this issue.

Alternative price forecasts corresponding to the high and low economic growth side cases found in AEO 2000 have also been generated for use by NEMS–BRS, and were used as alternative scenarios, and are presented in the TSD. (See TSD, Environmental Assessment.)

V. Discussion of Comments

As noted above, DOE published the Supplemental ANOPR regarding central air conditioners and heat pumps on November 24, 1999, and conducted a public workshop to present the analyses and to solicit comments on December 9, 1999. The Department requested comments on the following twelve issues:

1. Differences between the industry and the reverse engineering cost data:
2. The incorporation of emerging technologies into the Engineering Analysis;
3. The assessment of the impacts on steady-state efficiency, *i.e.* EER, due to increases in the SEER;
4. For heat pump systems, the relationship between SEER and HSPF;
5. Additional product classes based on system capacity;
6. Niche product classes
   (a) Ductless split
   (b) High-velocity, small-duct
   (c) Vertical-package, wall-mounted
   (d) Split, through-the-wall-condenser;
7. The impact of alternative refrigerants for HCFC–22;
8. Data on retail mark-up assumptions;
9. Information relating to the determination of price and operating cost elasticities in conducting shipment forecasts;
10. Data on the possible adverse affects of standards on identifiable groups of consumers that experience below-average utility or usage rates;

11. Information on what non-regulatory alternatives to standards need to be reviewed; and

12. Comments on the candidate standard levels and the alternative standard scenarios.

Based on responses and comments received since that workshop, we provide the following discussion.

A. Engineering Cost Data

1. Reverse Engineering Cost Estimates

The Department's reverse engineering analysis prepared as a basis for the Supplemental ANOPR received a broad range of comments, both supportive and critical. ARI and the Natural Resources Defense Council (NRDC) commented on the apparent accuracy of the split air conditioner cost estimates and the ease with which the results are able to be scrutinized by outside parties. (Wethje, ARI, Transcript, p. 42; ARI, No. 11 at 1; Goldstein, NRDC, Transcript, p. 94).

The Department also received comments criticizing the reverse engineering results for split heat pumps and for packaged air conditioners and heat pumps, noting the lack of design detail and the aggregation of the results into an efficiency level-based analysis. (Hodges, ARI, Transcript, p. 85; Madera, York International (York), Transcript, pp. 90, 91, 93; Goldstein, NRDC, Transcript p. 96 and California Energy Commission (CEC) No. 47 at 7). The comments observed that the relative cost results for split heat pumps and packaged equipment differed significantly from those of split air conditioners, and that those analyses were less rigorous than the split air conditioner analysis. They also noted that the split heat pump and packaged equipment analysis was based on fewer equipment samples; did not include a detailed tear-down of a 10 SEER split heat pump or packaged air conditioner; and was based on questionable production volume assumptions.

The Department agreed that those deficiencies were likely to cause some of the differences between the ARI cost and the reverse engineering cost estimates, and revised its analysis of split heat pumps and packaged equipment.

In responding to the comment on sample size for split heat pumps and packaged equipment, the Department took guidance from a review of the engineering analysis performed by DOE consultant, Joseph Pietsch. Mr. Pietsch presented five guidelines for comparing the production cost of equipment for different product classes. (Pietsch, No 36 at 2–5).

- At each cooling capacity and SEER level, the same outside unit will likely be used for split air conditioners (fancoil) and split air conditioners (cased coil);
- At each cooling capacity and SEER level, the same fancoil will likely be used for split air conditioners (fancoil) and split heat pumps;
- At each cooling capacity and SEER level, the same cabinet will likely be used for packaged air conditioners and packaged heat pumps;
- There should be some degree of consistency in the cost to ''convert'' an air conditioner into a heat pump; and
- Split systems with fan coils and single package units at the same cooling capacity and SEER level should have nearly identical costs for the major functional components.

Based on the above guidelines, DOE revised the analysis of split heat pumps and packaged equipment. Table V.1 provides the original and the revised production dollar cost estimates resulting from this new approach. Table V.2 provides the same information, but in terms of relative costs. Revised production costs are generally lower than the original costs, particularly at the baseline 10 SEER level. The most significant change is that the new analysis includes nine additional estimates that were not presented originally.

TABLE V.1.—ENGINEERING PRODUCTION COST ESTIMATES FOR 3-TON UNITARY EQUIPMENT

Efficiency level (SEER)	Split air conditioner (cased coil)		Split air conditioner (fancoil)		Split heat pump		Packaged air conditioner		Packaged heat pump	
	Original	Revised	Original	Revised	Original	Revised	Original	Revised	Original	Revised
10	$367	$367	$456	$449	$622	$572	$552	$511	$643	$593
11	412	412	550	519	....	602	....	555	....	638
12	468	468	....	563	690	648	627	595	708	668
13	529	529	756	637	840	743	809	730	....	820
14	588	588	802	815	1,011	1,023	....	889	....	1,029
15	....	....	893	893	1,147	1,107	....	955	....	1,100

The only significant departures are found in split air conditioners with fancoils, where the new estimates are lower, and in 14 SEER and 15 SEER equipment where the new results are higher.

TABLE V.2.—REVISED REVERSE ENGINEERING PRODUCTION

Efficiency leval (SEER)	Split air conditioner (cased coil)		Split air conditioner (fancoil)		Split heat pump		Packaged air conditioner		Packaged heat pump	
	Original	Revised	Original	Revised	Original	Revised	Original	Revised	Original	Revised
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.12	1.12	1.21	1.16	....	1.05	....	1.09	....	1.08
12	1.28	1.28	....	1.25	1.11	1.13	1.14	1.16	1.10	1.13
13	1.44	1.44	1.66	1.42	1.35	1.30	1.47	1.43	....	1.38
14	1.60	1.60	1.76	1.82	1.63	1.79	....	1.74	....	1.74
15	....	....	1.96	1.99	1.84	1.94	....	1.87	....	1.86

In response to comments on its production volume assumptions prior to the publication of the Supplemental ANOPR, the Department had reduced its heat pump production volume from 125,000 units per year to 25,000 units per year. However, since heat pumps and air conditioners are typically produced with the same plant equipment, reducing the production volume significantly increases the overhead allocated to each heat pump produced. The higher overhead allocation raises the cost of the baseline heat pump, lowering the relative cost of producing equipment at higher efficiency levels. To compensate for this overestimate of overhead allocation, we set the split heat pump overhead allocation equal to that of the split air conditioner at each efficiency level.

The Department believes that the revisions to the split heat pump and packaged equipment production costs have improved the cost estimates for those product classes and that no additional equipment samples need to be subjected to tear-down or reverse engineering analysis. The revised reverse engineering cost estimates were used in the analysis for today's proposed rule.

2. Productivity Efficiency Improvements

According to the American Council for an Energy Efficient Economy (ACEEE), Census Bureau Current Industrial Report (CIR) data suggest that the unit price of equipment shipments below 65,000 Btu/hr fell in real terms between 1992 and 1997. (ACEEE, No. 43 at 4). ACEEE suggested that the Department apply an annual deflator of 1.7% to projected prices to account for this apparent productivity improvement.

For other rulemakings, the Department has used production input costs and production technologies based on the best information available at the time. DOE has not made any assumptions about productivity improvements and material cost changes over time. The Department does not believe historical price trends for unitary air conditioners, or other products, can be applied to forecast equipment costs where there are no data to indicate the trends will continue. Therefore, without specific data on the likely costs to manufacture a product, the Department will not apply a productivity improvement factor in this rulemaking or other rulemakings.

3. Emerging Technologies

Emerging technologies that are not established in the residential central air conditioning market have the potential to lower the cost of achieving higher efficiency. In the Supplemental ANOPR, we considered advances in variable speed and variable capacity compressors, and reductions in the cost of variable speed fan motors and parallel-flow, microchannel heat exchangers to be potentially viable methods for increasing the efficiency of equipment at a lower cost than currently established methods.

Bard Manufacturing (Bard), Unico, Inc. (Unico) and NRDC disagreed with this approach, questioning whether some of the technologies considered were commercially and technically viable, but proposed no other technologies for consideration. (Bard Manufacturing, No. 28 at 4; Unico, No. 34 at 1; NRDC No. 35 at 11–12). ARI stated that they considered some compressor and motor advances but not microchannel heat exchangers in their relative production cost data. (ARI No. 48 at 3). The Trane Company (Trane) and Edison Electric Institute (EEI) also expressed concern over some apparent inconsistencies in the emerging technologies analysis presented in Table 4.16 and the use and calculation of the Carnot efficiency on page 4–27 of the Supplemental ANOPR TSD. (Trane, No. 23 at 2; and EEI No. 20 at 3).

Pacific Gas and Electric (PG&E) voiced concern that new technologies, such as the Bristol modulating compressor, could reduce costs to the point that manufacturers may use them at lower SEER levels resulting in a negative impact on peak loads and electrical system reliability. (PG&E, No. 31 at 3).

The emerging technology analysis based on reverse engineering information seems to confirm that, of the technologies considered, only variable capacity compressors and variable speed fan motors have the potential to be cost options for providing additional efficiency compared to today's established technologies. This provides evidence that ARI is justified in not considering the potential benefits of microchannel heat exchangers as part of its relative cost data submission. Therefore, we will apply emerging technologies only to the reverse engineering results and consider the ARI relative cost multipliers to already include the effects of emerging technologies.

We do not believe our original emerging technology analysis was inconsistent, as expressed by Trane and EEI above, although we do recognize that combining the effects of component efficiency improvements does not necessarily lead to a cumulative improvement in the system. The intent of the analysis is not to provide a definitive estimate of the impact of any or all emerging technologies on system cost. It is to provide evidence as to the extent to which reverse engineering overestimates the cost of higher efficiency equipment by neglecting emerging technologies. Therefore, the method used previously for portraying and combining the potential effects of emerging technologies on system costs is carried forward into today's rule. Chapter 2 of the TSD provides the details of the revised emerging technologies analysis.

4. HFC-Based Engineering Analysis

ARI and Trane supported the Department's decision not to explicitly examine the effects of the HCFC phaseout on equipment cost and efficiency. (Wethje, ARI, Transcript p. 145; Crawford, Trane, Transcript p. 143). The Oregon Energy Office (OEO) and NRDC urged the Department to reconsider, given that a large fraction of the equipment sold under the new efficiency standard will likely use a refrigerant other than HCFC–22, even prior to the 2010 phaseout date. (Stevens, OEO, Transcript, p. 144; NRDC, No. 35 at 11–12).

To date, no data presented to the Department indicate that the incremental cost for increasing the efficiency of equipment using either HFC–407c or HFC–410a refrigerants will differ significantly from the incremental cost of increasing efficiency using HCFC–22 equipment. Although the base cost may differ somewhat, the incremental cost determines the life-cycle-cost savings. Furthermore, the Department continues to receive information that much of the market is changing to HFC–410a and that HFC–410a offers little, if any, efficiency benefit over HCFC–22 at the same equipment cost.

For these reasons, the Department will not perform additional engineering analysis related to alternate refrigerants. The costs to manufacturers related to their conversion to the new refrigerant will be considered in the Manufacturer Impact Analysis.

B. Life-Cycle-Cost Parameters

1. Extended Warranty and Service Costs

Energy Market and Policy Analysis, Inc. (EMPA) noted that the Life Cycle Cost analysis did not explicitly address extended warranty and service costs and asserted that they should be taken into account. (Schleede, EMPA, Transcript, p. 221). The Alliance to Save Energy (ASE) stated that the inclusion of extended warranty and service costs would have the impact of reducing repair and maintenance costs. (Prindle, ASE, Transcript, p. 222). Industry consultant Joseph Pietsch stated that manufacturers may provide longer-term warranties for high efficiency systems that cover a wider range of components, to alleviate customer concerns regarding possible future repair cost of the more complex systems. (Pietsch, No. 36 at 22).

Air conditioner manufacturers warranty their equipment against defects, and contractors typically guarantee performance and installation. Manufacturer warranties typically cover parts and labor for one year, with longer warranties applying to the compressor. Mr. Pietsch noted that compared to low-SEER products, high-SEER products have more components, many of which have a relatively short history. Reliability patterns of these new components are less known, so warranty accruals may be significantly higher for these products. (Pietsch, No. 36 at 22). Dealers also may offer extended warranties which are usually underwritten by the manufacturer or a third party.

A product that is less reliable or contains more expensive components will have a higher cost of repair over its lifetime. Either the consumer or the warranty provider will bear that added cost directly through more frequent service calls or higher repair costs. If the cost is covered by warranty, however, the warranty provider passes it back to future warranty holders in the form of slightly higher warranty prices. DOE believes the incremental increase in the price of the warranty is equal to, or just slightly higher, than the discounted present value of the incremental repair costs over the life of the warranty. Over the long term then, the average consumer always incurs the cost of higher repair costs, either directly or through higher warranty prices. Since our analysis considers the present value of consumer life cycle costs on the average consumer, incremental repair costs and incremental warranty costs are the same, and interchangeable.

Since consideration of repair costs is satisfied by considering either repair costs or extended warranties, we limited our consideration to repair costs, which are slightly easier to estimate, communicate, and incorporate into the analysis. Considering them both would require a much more rigorous analysis of service costs since we would have to estimate the service cost incurred on a year-by-year basis. That additional analysis would likely not produce significantly different results. Comments are welcome as to whether explicit consideration of extended warranties would produce significantly different results from those based on service costs alone which we have assumed rise in proportion to the price of the equipment. Since more efficient equipment is also more expensive, we have included the higher cost of repair, or equivalently, the higher warranty cost associated with more efficient equipment, as part of the lifecycle cost analysis.

2. Residential Energy Consumption Survey (RECS)

Both NRDC and EMPA asserted that RECS'' method for estimating end-use energy consumption (*i.e.,* conditional demand analysis) yields unreliable and flawed results. NRDC added that conditional demand analysis methods inherently underestimate central air conditioner energy use due to its treatment of internal loads. EMPA stated that the RECS household sample size is too small to be used in the manner in which it is being treated in the life-cycle cost analysis. (NRDC, No. 35 at 6–7; EMPA, No. 33 at 4–6; Schleede, EMPA, Transcript, pp. 160–161). Virginia Power, EEI, and EMPA all requested that the analysis be updated to use RECS 1997 data rather than RECS 1993 data. EEI added that actual submetered end-use data should be used if possible rather than the end-use data in RECS. (Virgina Power, No. 27 at 2; EEI, No. 20 at 5, Schleede, EMPA, Transcript, pp. 160–161).

As part of the process to improve the new energy efficiency standards analysis, we are committed to use sensitivity analysis tools to evaluate the potential distribution of impacts among different subgroups of consumers. The Department believes that RECS provides a nationally representative household data set which is suited for conducting the type of sensitivity analyses suggested by the Process Rule. Limiting the RECS households to those equipped with either central air conditioners or heat pumps, the LCC analysis performs a household-by-household analysis that predicts the percentage of households that will incur net life-cycle cost savings or costs from an increased efficiency standard.

End-use energy consumption data from past RECS surveys have been compared to submetered end-use data for purposes of validating their conditional demand analysis estimates. Central air conditioning and space-heating energy data from the 1990 RECS were shown to differ by 5% to 22% compared to submetered end-use data from five utility service areas. The Department believes that this range of difference is acceptable considering that the conditional demand analysis utilized by RECS is fully capable of estimating the energy consumption of equipment throughout the nation. Because RECS is a very well suited source of data for performing the analyses suggested by the Process Rule and RECS has been shown to provide reasonable estimates of end-use energy consumption, we will continue to rely on RECS for providing the annual energy consumption data necessary for conducting the life-cycle cost analysis.

The analysis conducted in support of this proposed rule has been revised based on data from the 1997 RECS rather than the 1993 RECS.

3. Equipment Lifetime

Virginia Power, EEI, ARI, Unico, Rheem Co., and Trane commented that the average equipment lifetime of 18.4 years assumed in the Supplemental ANOPR was incorrect, and suggested an actual lifetime between 12 and 15 years. (Virginia Power, No. 27 at 2; EEI, No. 20 at 10; ARI, No. 48 at 3; Unico, No. 34 at 3; Lux, Rheem Co., Transcript, p. 165; Foster, EEI, Transcript, p. 170; Crawford, Trane, Transcript, p. 191; Wethje, ARI, Transcript, p. 193). EMPA asserted that the length of first ownership should be used as the basis for equipment lifetime. (EMPA, No. 33 at 3, Schleede, EMPA, Transcript, p. 162).

NRDC, ACEEE, and the Vermont Energy Investment Corporation (VEIC) all believed that the 18.4 year equipment lifetime was reasonable. They reasoned that a shorter or longer average equipment lifetime would result in less accurate estimates of historical shipments. ACEEE added that unless manufacturers can provide new data, the 18.4 year average lifetime should be retained. (NRDC, No. 35 at 7–8; ACEEE, No. 43 at 6–7; VEIC, No. 32 at 7).

The Department notes that the basis of the 18.4 year equipment lifetime was a survey conducted on more than 2,100 heat pumps in a seven state region of the U.S.[13] The survey determined not only the lifetime of a complete heat pump system, but the life of the original compressor as well. Although the system lifetime is on average over 18 years, the survey also showed that the original compressor lifetime was, on average, 14 years. Thus, the survey indicated that essentially all heat pump owners replaced their original compressor once in the lifetime of system.

In the LCC analysis conducted for the Supplemental ANOPR, we did not include any repair costs associated with replacing the compressor. But since the heat pump survey clearly indicates that the original compressor is replaced once in a system's life, the analysis was revised to include a repair cost for the

[13] ''Bucher, M.E., Grastataro, C.M., and Coleman, W.R., ''Heat Pump Life and Compressor Longevity in Diverse Climates.'' ASHRAE Transactions, 1990. 96(1): p. 1567–1571.

compressor. Conducting the analysis in this manner retains the average system lifetime of 18.4 years but explicitly addresses the replacement cost of the compressor, which is the most expensive component of a system. As indicated by the survey data, the compressor was assumed to be replaced in the 14th year of the system's life. In addition, because more efficient systems tend to use more efficient and, thus, more expensive compressors, the compressor replacement cost was assumed to vary with system efficiency.

Although the revised LCC analysis assumed an 18.4 year average equipment life and one compressor replacement, a shorter equipment lifetime was investigated as an alternative scenario. In this alternative scenario, a retirement function yielding an average lifetime of 14 years was used and compressor replacement costs were not considered. The shorter equipment lifetime is plausible assuming that most, if not all, consumers when faced with replacing a failed compressor would choose to replace the entire system rather than replace the compressor in a relatively old system. LCC results based on both the 18.4 year and 14 year average equipment lifetimes are provided in Section VI as well as Chapter 5 of the TSD.

4. Commercial Applications

NRDC, ACEEE, VEIC, CEC, and the Northwest Power Planning Council (NPPC) commented that DOE should analyze the application of residential central air conditioners and heat pumps (*i.e.,* single-phase equipment) in commercial buildings. All stated that there is a significant portion of this type equipment being used in small commercial buildings. They argued that since the energy use patterns in commercial buildings are distinctly different than those in households, the analysis should include residential equipment use in commercial applications. (NRDC, No. 35 at 12–13; ACEEE, No. 43 at 2; VEIC, No. 32 at 6–7; CEC, No. 47 at 8; Tom Eckman, NPPC, Transcript, p. 166).

EEI requested clarification as to how the commercial application analysis was conducted for the Department's January 14, 2000, LCC Sensitivity Analysis. (EEI, No. 20 at 10).

For today's proposed rule, the use of residential equipment in commercial buildings was analyzed assuming that 10% of all central air conditioners and heat pumps are used in commercial applications. This figure is based on ARI's estimate that approximately 10% of single-phase air conditioning and heat pump shipments are used in commercial buildings. The annual energy consumption of commercially applied air-conditioning and heat pump equipment was based on the simulation of 77 nationally representative commercial buildings consistent with the approach and assumptions utilized to develop the American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE) Standard 90.1–1999. Both average and marginal electricity rates were developed by matching a set of commercial electric utility tariffs to the above simulated building loads and demands.

The LCC spreadsheet models were modified so that commercial buildings with their corresponding annual energy consumption and marginal and average electricity costs represent 10% of the entire residential and commercial building population. Complete details on the procedure to incorporate commercial applications are included in Chapter 5 of the TSD.

5. Marginal Electricity Prices

NRDC, ACEEE, CEC, PG&E, NPCC, and ASE commented that the Supplemental ANOPR analysis underestimated future marginal electricity prices. Several of the comments stated the belief that deregulation of the electric utility industry would result in greater volatility of electricity pricing that eventually would translate into higher electricity prices during peak power periods. (Goldstein, NRDC, Transcript, p. 175; ACEEE, No. 43 at 6; CEC, No. 47 at 8; PG&E, No. 31 at 6–7; Eckman, NPPC, Transcript, pp. 167–168; Prindle, ASE, Transcript, p. 168).

ARI and EEI were not convinced that a deregulated electric utility industry would result in higher electricity prices in the future. ARI noted that under a peak pricing scenario consumers may decline to operate their air-conditioning equipment to avoid incurring high electricity bills. EEI added that currently, there is no mechanism to capture utility capital costs for providing peak power in residential pricing. (Wethje, ARI, Transcript, pp. 168–169; Foster, EEI, Transcript, pp. 169, 175–176).

The current method for establishing marginal electricity prices only allows for defining marginal prices for those years in which data are available. In the case of residential pricing, the data for establishing marginal prices (the 1997 RECS) was taken from the year 1997. The same can be said for commercial buildings. The utility tariffs used to establish marginal prices (as described earlier) were collected in the year 1997. On average, residential marginal prices for households with central air conditioners are 3% lower than average rates while for households with heat pumps marginal prices are 7% lower. Space-cooling marginal prices in commercial buildings are on average 2% greater than average commercial rates. Future marginal prices were in turn based upon the Reference Case electricity price forecast from the AEO2000. The Reference Case forecasts declining electricity rates through the year 2020. Although it is certainly possible that future electricity rates may increase in a deregulated climate, the evidence to date (i.e., residential marginal prices are actually lower than average rates and AEO 2000 forecasts project declining electricity rates) convinces us that our current methods for establishing marginal prices are reasonable. To state that future prices may decrease or increase is speculative. Even in the case of commercial buildings where demand pricing already exists, marginal prices are only 2% greater than average electricity rates. This reenforces our conviction to keep our current methodology for establishing marginal prices. However, the Department seeks comments on its methodology and data for determining the appropriate marginal energy costs to use in future analysis.

6. Forecast of Future Electricity Prices

EMPA asserted that the EIA's forecast of electricity prices as found in the Annual Energy Outlook underestimates the future drop in electricity rates. (EMPA, No. 33 at 2–3; Schleede, EMPA, Transcript, p. 185). Don Dasher stated that any forecast of electricity prices should capture the future use of renewable energy and emerging technologies for generating power. (Dasher, Transcript, pp. 192–193).

Future marginal prices are based upon the Reference Case electricity price forecast from the AEO 2000. The Reference Case forecasts declining electricity rates through the year 2020. Although it is certainly possible that future electricity rates may increase in a deregulated climate, the evidence to date (*i.e.,* residential marginal prices are actually lower than average rates and current AEO forecasts project declining electricity rates) leads us to believe that our current methods for establishing future marginal prices are reasonable.

In addition to the Reference Case, DOE analyzed the effects of two other energy price forecasts, the AEO 2000 High Growth and Low Growth cases. (See TSD, Chapter 5.)

7. Discount Rates

NRDC, ACEEE, VEIC, PG&E, and CEC believe that the discount rate used in the Supplemental ANOPR analysis was too high. Their primary criticism pertained to the breakdown of finance methods which were assumed for establishing the discount rate. The Supplemental ANOPR analysis assumed that 35% of consumers purchasing a central air conditioner or heat pump used a credit card to finance their purchase. The comments argued for a much lower percentage and cited a recent PG&E survey that demonstrated that only 5% of consumers used credit cards. VEIC also cited a survey by Potomac Electric Power Company (PEPCO) that reported lower purchases with credit cards. (NRDC, No. 35 at 10–11; ACEEE, No. 43 at 3; VEIC, No. 32 at 3–4; Neme, VEIC, Transcript, pp. 186–187; PG&E, No. 31 at 7; CEC, No. 47 at 7). Counter to the above assertion, Trane maintained that the Supplemental ANOPR's assumption regarding the percentage of consumers using credit cards to purchase equipment was correct, based on the number of consumers in the U.S. that carry credit card debt. (Crawford, Trane, Transcript, p. 191–192). EEI commented that the interest rates associated with credit card and cash purchases needed to be revisited. (EEI, No. 20 at 6). EMPA asserted that with higher cost air conditioners, consumers' after tax income would be reduced, requiring them to forego the purchase of various household necessities such as food, clothing, and shelter. (EMPA, No. 33 at 3).

The Department performed an extensive review and revision to the methodology that determines consumer discount rate. The Supplemental ANOPR established the share of various finance methods used for purchasing air-conditioning equipment and determined the associated interest rates for each of the finance methods. For equipment obtained through the purchase of a new home, second mortgage, or home equity lines of credit, this approach is reasonable. But for purchases made to replace old or failed equipment where cash or some form of credit is used to finance the acquisition, we determined it more appropriate to establish how the purchase affects a consumer's overall household financial situation. For example, even though the purchase might be financed through a dealer loan or some other low interest financing vehicle, the more probable effect of the purchase is to either cause the consumer to incur additional credit card debt or forego their investment in some type of savings-related asset. Cash that was once available to either pay for household necessities or to invest in an asset like the stock market or a simple savings account now must be earmarked to pay off the equipment purchase loan, thus, either causing the consumer to incur additional credit card debt or to lose the opportunity to earn income from their assets. For today's proposed rule, we have decided to use the above methodology for defining the discount rate for central air conditioner and heat pump purchases. The 1998 Survey of Consumer Finances (SCF) was used to estimate the percentage of households that used second mortgages to finance their equipment purchase as well as those households that either would incur more credit card debt or be forced to forgo their normal course of investing. Data from the Air Conditioning, Heating, and Refrigeration News (December 12, 1998) established the percentage of shipment going to new homes.

After establishing the share captured by each finance method, the range of interest rates due to each method were developed. The 1998 SCF established the range of interest rates for new home mortgages, second mortgages, and credit cards. Rates of return on certificates of deposit, savings bonds, and bonds were based on historical interest rates. A weighted-average discount rate of 5.6% is calculated from the mean interest rates for each finance method. A more detailed discussion of the data sources and how the interest rates were derived is found in Chapter 5 of the TSD.

8. Percentage of Households With LCC Savings

For the Supplemental ANOPR, all consumers having an LCC increase resulting from the standard were considered to be adversely impacted. Several comments expressed concern on how we would use this information on adverse consumer impacts in selecting minimum efficiency standards. ARI, Unico and EMPA asserted that a majority of households would need to benefit from the standard in order to justify its selection. (ARI, No. 48 at 5; Unico, No. 34 at 3; EMPA, No. 33 at 2). NRDC stated that the percentage of households with LCC savings or costs relative to the baseline level should not be a criterion in basing a standard's economic justification. NRDC stated that variations in electricity pricing make it nearly impossible to determine consumer costs on a disaggregated level. (NRDC, No. 35 at 12–15). PG&E commented that the percentage of households at any particular standard level with net LCC costs actually overstates the significance of the negative LCC impacts. Most consumers experience LCC increases of only a few dollars over the life of the equipment. (PG&E, No. 31 at 8).

The Department agrees with PG&E's comment and in formulating today's proposed rule, DOE has redefined the criteria for determining negative impacts. Noting that the baseline LCC is approximately $5,000 for central air conditioners and $10,000 for heat pumps, previously all consumers incurring an LCC increase as small as $10 were considered to be adversely impacted by an increase in the standard. In the revised LCC analysis, the Department defines consumers impacts as follows: consumers who achieve significant net LCC savings (*i.e.,* LCC savings greater than 2% of the baseline LCC), consumers who are impacted in an insignificant manner by having either a small reduction or small increase in LCC (*i.e.,* within ±2% of the baseline LCC), or consumers who achieve a significant net LCC increase (*i.e.,* an LCC increase exceeding 2% of the baseline LCC). Consequently, only consumers (both residential and commercial) having an LCC increase greater than 2% of the baseline are considered to be negatively impacted.

9. Regional Analysis

At the December 9, 1999, public workshop, NRDC and CEC requested further information on regional distributions of households with net LCC savings or costs relative to the regional baseline level. (Goldstein, NRDC, Transcript, pp. 188–189; Martin, CEC, Transcript, p. 274). The Department responded by conducting additional analysis, which was posted to our web site on January 14, 2000, and included LCC analysis disaggregated by region into census divisions. From this regional analysis it could be determined how different parts of the country would be impacted by an increase in the minimum efficiency standard.

10. Rebuttable Payback

EEI asked why the rebuttable payback period is not determined with annual energy use data from RECS. They also requested clarification as to how rebuttable payback periods will factor into the decision to select a new minimum efficiency standard. (EEI, No. 20 at 7–8).

As prescribed by section 325(o)(2)(B)(iii) of EPCA, the rebuttable payback period is calculated under the applicable test procedure. Thus, all rebuttable payback periods are based on an annual energy consumption that is determined through the current

Department of Energy test procedure for central air conditioners and heat pumps. The resulting annual energy use as determined by the test procedure is significantly greater than what is indicated by RECS. Thus, the rebuttable payback periods are significantly shorter than those based on the RECS annual energy consumption data.

The rebuttable presumption test does not consider the full range of impacts of standards, including manufacturer impacts and energy savings. Therefore, the Department bases its decision primarily on the seven factors specified in section 325(o) of the Act.

11. Sensitivity Analyses

ACEEE recommended that several sensitivity analyses be conducted to determine how the LCC varies with changes in certain input variables. (Nadel, ACEEE, Transcript, pp. 233–236; ACEEE, No. 43 at 10). NRDC also requested some of the sensitivity analyses described by ACEEE. (NRDC, No. 35 at 12–13). Trane went on the record as not endorsing all of ACEEE's requested sensitivities. (Crawford, Trane, Transcript, p. 237).

We conducted several of the requested LCC sensitivity analyses, as well as the previously described regional analyses, and posted the results to our web site on January 14, 2000. The sensitivities examined how the LCCs for central air conditioners and heat pumps were impacted by changes in the following: dealer markups, builder markups, repair costs, lifetime, emerging technologies, and the use of single-phase central air conditioning and heat pump equipment in commercial applications. Of the sensitivities examined, the assumption of fixed margins (*i.e.,* no variation in the difference between the equipment price to the consumer and the cost to manufacture with increased efficiency) had the largest impact on the LCC results. Changes in the lifetime had a noticeable affect but not the same order of magnitude as the fixed margin assumption. All other sensitivities had only minor impacts on the LCC results.

In preparing the sensitivity analyses, we found reason to revise our assumptions regarding markups, compressor replacement, and commercial applications. Those revisions are incorporated into the analysis that supports today's proposed rule and are discussed elsewhere in this Section.

C. Shipments Analysis

1. Forecasted Housing Shifts

Both the OEO and NPPC stated that there will likely be significant shifts in regional housing populations. For example, future housing shifts may result in more housing in warmer weather climates where central air conditioning is more prevalent and used more often, thus, impacting the nation's future space-conditioning energy use. Since the Shipment Analysis does not account for regional housing shifts, OEO and NPPC request that it be accounted for in the analysis. (Stephens, OEO, Transcript, pp. 171–172; and Eckman, NPPC, Transcript, pp. 216–217).

Preliminary analysis of regional housing shifts has been examined and determined to have a relatively small effect (*i.e.*, a maximum change of 2% in the cumulative amount of monetary energy savings). This is primarily due to the large size of the housing stock and the fact that changes in the housing stock occur over a long time scale resulting in slow changes in regional housing shifts. A preliminary analysis of historical housing data coupled with worst case forecasts of regional housing and air-conditioning market share shifts demonstrated the small impact on national NPV due to changes in regional housing.

New housing starts are only about 2% of existing housing stock and this is forecast to decrease to about 1% of housing stock by 2030. Historical data over the period from 1980 to 1990 showed the shift in regional shares of housing stock changed by less than 2% (decreased by 1.2% and 1.7% in the Northeast and Midwest, respectively, and increased by 1.7% and 1.2% in the South and West, respectively). If these changes continue at a steady rate, the housing share of the Northeast will decrease another 3.6% over three decades. This translates to a relative decrease of 17% in the Northeast's air-conditioning market share. If the entire loss in the Northeast's market share goes to that portion of the South with the highest annual energy use (Census Region 7), the absolute market share of this region would increase from 15.7% to 17.7%. The result of this change is that the dollar value of energy savings at a 12 SEER standard level would increase from $5.73 billion to $5.85 billion, or about a 2% increase in the dollar energy savings. The actual impact on dollar savings would likely be less than half of this because the above housing shift was assumed to be immediate and to the highest energy use area of the South. As a result, the actual impact would likely be less than 1% on the dollar value of the energy savings. For these reasons, the Department has not revised its Shipments Analysis to account for shifts in regional housing populations.

2. Elasticities

Both ACEEE and NRDC note that the purchase price elasticities are based on data from the 1970s and are likely no longer applicable to current market conditions. Both stated that price elasticities should be developed from more recent data. (ACEEE, No. 43 at 10; Nadel, ACEEE, Transcript, p. 211; Goldstein, NRDC, Transcript, pp.211–212).

This has been corrected for in the analysis underlying today's proposed rule. We have calibrated elasticity for price relative to household income, with historical data from 1970 to 1996. It is worth noting that for forecasting future shipments, consumer purchase decisions are based upon sensitivities to changes in product life-cycle cost relative to income. Life-cycle cost changes are dependent on the purchase price and the present worth of operating cost savings. Operating cost savings are in turn dependent on electricity prices. As electricity prices are forecasted to decrease over time (based on the Annual Energy Outlook 2000), operating cost savings due to a particular increase in equipment efficiency will in turn decrease over time and have less of an impact on consumer purchase decisions.

Usage elasticity expresses how changes in equipment efficiency resulting from higher standards changes consumer behavior regarding air conditioners and heat pumps usage. Because of lower operating costs, consumers may change thermostat settings and/or operate the systems for longer hours to achieve greater comfort. Direct evidence of the magnitude of this effect is limited and the Department is interested in receiving comments. One study [14] indicated that in summer months consumers may take 1–2% of the cooling energy savings back in increased usage, and 9–13% in winter months. Usage elasticity has not been considered in the current analysis but will be considered in the Final Rule.

3. Equipment Efficiency

Several comments received questioned the use of a weighted-average equipment efficiency equaling the SEER of the standard level for

[14] Jeffrey A. Dubin, Allen K. Miedema, and Ram V. Chandran, 1986. "Price effects of energy-efficient technologies: a study of residential demand for heating and cooling," Rand Journal of Economics, Vol 17, No. 3, Autumn, pp 310–324.

forecasting shipments and national energy savings. All asserted that in the event of an increase in the minimum efficiency standard, the actual weighted-average efficiency of equipment in the marketplace would be greater than the minimum efficiency standard. For example, if a 12 SEER standard was set as the new minimum, the weighted-average efficiency would be equal to a value which was greater than 12 SEER. (Neme, VEIC, Transcript, pp. 214, 226–227; Nadel, ACEEE, Transcript, p. 228; NRDC, No. 35 at 8–9; PG&E, No. 31 at 6–7).

The Department has modified several assumptions with regard to future equipment efficiencies. The Shipments Model no longer simply forecasts a weighted-average equipment efficiency, but rather, an actual distribution of efficiencies *i.e.,* the percentage of shipments which occur in incremental SEER bins over the range of the minimum standard 10 to 18 SEER). Also, as discussed in Section IV, three efficiency scenarios are provided to model future equipment efficiencies. The impact of the three different scenarios on national energy savings and national net present values are discussed in Section VI.

EEI asked the reason for assuming the weighted-average efficiency remains fixed at the same SEER level from the year 1997 to the assumed effective date of standard (2006). (EEI, No. 20 at 7–8). Historical data from the years 1994 through 1997 indicate that shipment-weighted efficiencies have remained essentially flat. As a result, weighted-average efficiencies were assumed to remain constant from 1997 through 2006.

4. Fuel Switching

EEI, York, Virginia Power and Southern Company stated that shipment forecasts must account for any fuel switching that might occur as a result of increased heat pump prices to the consumer. The concern is that an increase in the total installed price of a heat pump would cause some consumers to choose a gas-space heating appliance rather than an electric heat pump. (Foster, EEI, Transcript, p.263; Madera, York, Transcript, p.264; Virginia Power, No.27 at 2–3; Southern Company, No. 29 at 1–2). ACEEE stated that any incorporation of fuel switching into the Shipments Model must account for future changes in gas-fired space-heating minimum efficiency standards. (Nadel, ACEEE, Transcript, p.266).

Our examination of the historical data tends to indicate that the relative installed price of heat pumps is not the primary driver in heat pump vs. gas furnace purchase decisions. The more important factor in these decisions seems to be the availability of gas service. In the middle 1980's, there was a large peak in gas prices relative to electricity, but only a small, delayed increase in the relative market share of heat pumps. Besides this one historical event, the relative market share of heat pumps has been relatively constant from 1977 to the present.

D. National Energy Savings Analysis

Changes to the LCC assumptions impact the NES and the National Net Present Value (NPV) analyses directly as the NES analysis uses the same basic data as the LCC analysis for the energy use and cost of the central air-conditioning and heat pump equipment.

As previously mentioned, estimates of NES and NPV also depend on the distribution of product efficiencies among units sold after a standard takes effect in the marketplace. For the Supplemental ANOPR, the assumed product efficiency distribution was based on a weighted-average equipment efficiency equal to the SEER of the new standard level.

1. Uncertainty in NES Results

EEI believes that due to the uncertainty in the electric utility industry and its impact on future electricity prices it is more appropriate to represent the NES results with some degree of uncertainty. (EEI, No. 20 at 8).

Although NES results presented in the Supplemental ANOPR were based only on electricity price estimates from the Reference Case forecast from the 1999 Annual Energy Outlook, our NES spreadsheets have provided users with five different options for estimating future electricity prices; 1999 AEO Reference Case forecast, 1999 AEO High Growth Case forecast, 1999 AEO Low Growth Case forecast, 1998 Gas Research Institute (GRI) forecasts, and constant electricity prices. Providing a number of options for forecasting future prices recognizes the uncertainty in the electric utility industry and how that uncertainty can impact the NES results. The NES uses single point values rather than ranges as used in LCC; consequently, NES provided single point results rather than a range. However, in order to account for the uncertainty in electricity price forecasts, DOE evaluated three energy price scenarios in the NES. The NES Spreadsheets have been made available to all interested parties via our web site to facilitate analysis of sensitivities for assumptions different than those for the Supplemental ANOPR. For today's proposed rule, we continue to provide the same options for forecasting future electricity prices with the exception that AEO 1999 forecasts have been replaced with those from the AEO 2000 as well as the five options for energy prices as described above.

2. Site-to-Source Conversion

Both the Southern Company and EEI questioned the validity of the site-to-source conversions used in the NES spreadsheet model. The Southern Company and EEI asserted that hydroelectric power and renewable forms of electric energy are assigned fossil fuel-fired power plant heat rates. (Southern Company, No. 29 at 4–5; EEI, No. 20 at 7).

We estimated the effects of proposed central air conditioner and heat pump standard levels on both the gas and electric utility industries using a variant of DOE/EIA's NEMS–BRS, together with some exogenous calculations.[15] NEMS–BRS is used to determine site-to-source conversion factors and does not assign fossil-fuel-fired power plant heat rates to hydroelectric or renewable power plants. The site-to-source conversion factors used in the Supplemental ANOPR are average annual values for the residential sector. The average conversion factors are based on all forms of electricity generation with their corresponding heat rates (*e.g.*, heat rates are assigned to fossil-fuel fired power plants which are much different than those assigned to other types of power plants). As a result, the site-to-source conversion factors are significantly lower than if all power plants were assigned the heat rates associated with fossil fuel-fired power plants. For today's proposed rule, site-to-source conversion factors are based on recommendations of the Advisory Committee on Appliance Energy Efficiency Standards. In this analysis, heat rates are based on determining how a deviation in national energy consumption due to standards impacts the type of electricity generation. In other words, heat rates are based on those power plants which are avoided as a result of the standard.

[15] For more information on NEMS, please refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is National Energy Modeling System: An Overview 1998, DOE/EIA–0581(98), February, 1998. DOE/EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because our analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on DOE/EIA assumptions, the name NEMS-BRS refers to the model as used here (BRS is DOE's Building Research and Standards office, under whose aegis this work has been performed).

E. Consumer Sub-Group Analysis-Low Income Renters

NRDC stated that impacts on low-income renters should be investigated, because such renters do not purchase their space-conditioning equipment and they have no choice as to the efficiency of the equipment which is used to space-condition their home. (NRDC, No. 35 at 9).

We have investigated the economic impact of standards on low-income households, and have included such impacts in section VI.D.7 of today's proposed rule and in Chapter 10 of the TSD. But we have not investigated the impacts on low-income renters separately. Renters at each income level are considered to have the same choice in efficiency as new home purchasers at the same level. Regardless of whether a household is occupied by an owner or a renter, we implicitly assume that the occupant incurs all costs of ownership, either directly or through rent payments. Therefore, we believe that our consideration of low income households generally applies to renters as well as owners.

F. Utility and Environmental Analysis

1. Peak Power Impacts—Reliability

The CEC raised concerns over peak power by stating that the western region of the U.S. will soon face a capacity shortfall which will necessitate reductions in peak demand (CEC, No. 47 at 2–4). Leon Neal, Advanced Energy Corporation (AEC), stated that because of a relationship between SEER, EER, and equipment capacity which is not captured by using only the ''nominal 3 ton'' unit and SEER analyses, there were important factors not addressed in the DOE analysis. They argued that with larger capacity units at higher SEER, it is economic for manufacturers to use multi-compressor units and multi-speed compressor units, which results in a penalty in EER. They noted major national trends, *i.e.*, increasing average size of residential dwellings, the tendency to sell bigger systems to increase profits and compensate for poor installations, and the distrust of contractors for higher efficiency equipment. (AEC, No. 17 at 1). EEI stated that the consideration of peak power impacts in setting new efficiency standards departs from the Department's statutory mandate. (Foster, EEI, Transcript, p. 176).

With regard to AEC's concern that an increase in the efficiency standard would be accompanied by an increased air-conditioning power demand, we are not convinced that this situation would occur. Over the last 20 years, while shipment-weighted efficiency has continually increased, usage has remained relatively constant. Therefore, we see no reason that a significant jump in system usage would occur in conjunction with higher efficiency standards.

Regarding EEI's claim that the consideration of peak power impacts departs from the Department's statutory mandate, section 325(o)(2)(B)(i)(VII) of the Act, 42 U.S.C. 6295(o)(2)(B)(i)(VII), allows the Secretary to consider other factors deemed relevant for updating minimum efficiency standards, including peak power impacts.

2. Quantitative Assessment of Impacts on Peak Demand

For purposes of estimating peak demand impacts from an increase in the central air conditioner and heat pump energy efficiency standard, we are using a version of the NEMS, called NEMS–BRS. NEMS–BRS is run similar to the AEO2000 NEMS except that central air conditioner and heat pump energy usages are reduced by the amount of energy (electricity) saved due to the proposed trial standard levels. The input of energy savings are obtained from the NES spreadsheet.

NEMS estimates peak power impacts by determining the reduction in installed generation capacity due to an increase in the minimum efficiency standard. For central air conditioners and heat pumps, NEMS uses a single nationally representative end-use load shape to estimate peak power impacts. The overall end-use load shape is reduced in proportion to the amount of energy savings achieved through an increase in the standard. The reduction in power demand achieved by shaving the end-use load shape is extrapolated to a national scale to come up with nationally representative peak power impacts. Thus, NEMS does not use the equipment's EER performance, per se, to estimate peak power impacts. Rather, because the load shape is shaved in proportion to the energy savings, the EER is implicitly assumed to increase in proportion to the SEER.

The forecasted peak impacts using NEMS–BRS are presented in Section VI of today's proposed rule.

3. Qualitative Assessment of Air Conditioning Standards Impact on Power System Reliability

We also recognize that reducing growth in electricity demand during peak periods may improve the reliability of the U.S. electric power system. But there are number of factors with the electric power system itself that may overwhelm any effect that an improvement in residential air conditioning efficiency might offer. First, investment in system expansion has fallen behind demand growth, and future development may be limited by siting constraints. Second, industry restructuring requires the development of new technologies, operating procedures, and regulatory structures to meet peak demands. And third, the strong demand expansion of recent years may well continue into the future. Within this environment, the potential benefits of a central air conditioner and heat pump standard that could lower growth in peak demand could be desirable. But, due to the existing problems with the electric power system described above, it is difficult to assess, in quantitative terms, the impact of an air conditioner standard on system reliability. Thus, in addition to the planned activities to improve NEMS to forecast more credible peak demand impacts, we plan to assess the reliability of the U.S. electric system to determine what connection exists between end-use peak demand reductions and system reliability. The assessment will focus on three areas: (1) Defining reliability, (2) historic performance of the utility system, and (3) analyzing near- and long-term utility changes and how they might impact reliability. In defining reliability, we will use typical threats (*e.g.*, weather, tree falls, excess load, and inaccurate demand forecasts) to put system reliability into context. In addition, industry indices for the frequency of failures and the number of customers affected will be used. With regard to historic performance, we will attempt to analyze the history of system disturbances and estimate their economic consequences. Finally, we will look at the changes occurring in the utility industry such as restructuring and increasing demand growth to determine to try and assess how these future changes might impact reliability.

4. Competitive Residential Market

EEI asked whether NEMS, the model which is used for forecasting utility and environmental impacts, will be adapted to model more accurately the deregulated electric utility industry. As part of the deregulated industry, EEI stated that consumers will have choice of electricity providers. In addition, the industry will likely build more merchant power plants. (EEI, No. 20 at 9).

Although we recognize that NEMS may not be entirely accurate in its modeling of the changing electric utility industry, we believe it is still the best tool for forecasting the impacts due to increased central air conditioner and heat pump standards. We also recognize the difficulty for any model or tool to forecast changes in the utility industry. Thus, the results from NEMS are used to provide a gross picture of the impacts that can be expected from the imposition of new efficiency standards for central air conditioners and heat pumps. Sensitivities are conducted with the AEO High Growth and Low Growth cases to capture the variability that could arise from changes in the electric utility industry.

G. Manufacturer Impact Analysis—Low Volume Manufacturers

First Company (First Co.) and National Comfort Products commented that the assumptions used in the engineering analysis were not applicable for low volume manufacturers and urged the Department to consider the situations of all firms in the industry. (First Co., No. 40 at 10; National Comfort Products, No. 30 at 1).

Since the engineering analysis is used to assess the impacts on consumers and the nation, it is more appropriate to rely on assumptions reflective of larger manufacturers who control more than 95% of the market. However, we did consider the special circumstances of lower volume manufacturers as part of the manufacturer impact analysis. We interviewed the major manufacturers as well as two smaller manufacturers, and based on this information, estimated the impact of standards on both large and small manufacturers separately.

H. Markups

The Supplemental ANOPR's engineering analysis estimated the cost of producing baseline air conditioners and heat pumps and also estimated the series of markups on that product cost that yield the price of the equipment to the consumer. Four markups were applied: Manufacturer markup (1.18), distributor/wholesaler markup (1.37), dealer/contractor markup (1.54), and sales tax (1.07). In general, these were based on financial reports for each group on a national basis.

NRDC, ACEEE and VEIC commented that instead of applying average markups to the incremental increase in costs resulting from new standards, it was more reasonable to apply a lower markup to those incremental costs. Otherwise, companies would receive a windfall from the new standard, which would surely not be the case in a competitive industry such as heating, ventilation, and air conditioning. (NRDC, No. 35 at 6, ACEEE, No. 43 at 2, VEIC, No. 32 at 2). NRDC also advocated the use of a fixed gross margin in dollars rather than a fixed percentage (NRDC, No. 35 at 6), while EEI stated that the fixed percentage assumption is unreasonable. (EEI, No. 20 at 10). ARI supported the markups the Department used. (ARI, No. 48 at 4).

Department consultant Joseph Pietsch stated that at the distributor level, since no labor is involved to modify the product, the markup is applied to a well-documented material cost. However, the distributor's markup percentage may vary by product type. If the distributor's mark-up prices to the installing trade are not competitive in the market served, the distributor might have to seek price adjustments from the manufacturer. Further, installing contractors typically use a markup procedure for labor that is most likely be at a different percentage than a markup for materials. (Pietsch, No. 36 at 23). Finally, prompted by comments we received, we now distinguish markups based on whether products are sold into new homes or as replacements or retrofits. (Nadel, ACEEE, Transcript pp. 122–123; and Eckman, NPPC, Transcript p. 152–153; CEC, No. 47 at 7).

After reviewing the comments and publishing an interim analysis with fixed dollar margin, the Department undertook a thorough review of its markup assumptions and made one minor and one major revision.

First, at the manufacturer level, the markups were raised slightly (from 1.18 to 1.24) partially to reflect new financial data for a manufacturer who recently completed an initial public offering, and partially to incorporate results from the MIA. The MIA suggests that firms accrue a higher profit margin on baseline equipment than the conservative 1% assumed for the Supplemental ANOPR's Engineering Analysis.

Second, at the distributor and dealer levels, analysis of U.S. Census Bureau data and recent industry financial reports suggest that markups on changes in the unit price of equipment are less than the average markups for those industries. In light of these new findings, the markups for the distributors and dealers on the incremental increase in equipment cost were lowered from 1.37 to 1.09 and 1.54 to 1.27, respectively. For the distributor, the markup on the portion of equipment cost equal to the cost of the baseline equipment remains at 1.37. For the dealer, the 1.27 markup is applied to the total cost. The original 1.54 assumption included the markup on the labor portion of installation, which is not appropriately applied to equipment. We increased our estimate of the markup on installation labor slightly to compensate for the lower markup on equipment price, keeping the overall installed price the same. The Department's pricing information indicates that the total installed price of baseline equipment is accurate as published in the Supplemental ANOPR. The overall effect of these changes is to slightly decrease distributor and dealer equipment markups as the standard level rises.

We introduced a new builder markup of 1.27 for new construction markets only and applied the sales tax rate of 1.07 in only replacement/retrofit markets.

Table V.3 summarizes the changes in markups. The Technical Support Document (Chapter 5) provides more details on the derivation of these new estimates.

TABLE V.3.—COMPARISON OF REVISED MARKUPS AND SUPPLEMENTAL ANOPR MARKUPS

Type	Revised analysis markup	Supplemental ANOPR markup
Manufacturer Markup	1.23	1.18
Wholesaler/Distributor Markups:		
10 SEER	1.37	1.37
11 SEER	1.33	
12 SEER	1.30	
13 SEER	1.26	
Dealer/Contractor:		
Equipment Markup	1.27	1.55
Installation Labor: [a]		
Air Conditioner	$1,279/$1,367	$1,190
Heat Pump	$2,280/$2,160	$2,035

TABLE V.3.—COMPARISON OF REVISED MARKUPS AND SUPPLEMENTAL ANOPR MARKUPS—Continued

Type	Revised analysis markup	Supplemental ANOPR markup
Builder Markup	[b] 1.09	[c] 1.00
Sales Tax	[b] 1.04	[d] 1.07
Overall Markup:		
10 SEER	2.42	2.68
11 SEER	2.35	2.68
12 SEER	2.30	2.68
13 SEER	2.23	2.68

[a] For revised analysis, first value pertains to split systems and second value pertains to single package systems.
[b] Weighted-average markups representing both the new construction and replacement markets.
[c] For the SANOPR, builder markups were not considered.
[d] For the Supplemental ANOPR, sales taxes representing only the replacement market were used.

I. EER-Based Efficiency Standard

The Department received numerous comments on the relationship of steady state efficiency (EER) to increases in SEER. NRDC, ACEEE, VEIC, PG&E, CEC, OEO, Unico and Southern Company support the establishment of minimum efficiency standards based on EER at an outdoor temperature of 95°F, (EER(95°F)) in lieu of, or in addition to, SEER, which is based largely on an outdoor temperature of 82°F. (NRDC, No. 35 at 15–16; ACEEE, No. 43 at 8–9; VEIC, No. 32 at 5; PG&E, No. 31 at 1–4; CEC, No. 47 at 5; OEO, No. 46 at 10–12; Unico, No. 34 at 2; Southern Company, No. 29 at 3).

Their concern is that an increase in SEER does not necessarily correspond to an increase in EER, and that a 95°F rating condition better represents the performance of an air conditioner on hot days when electricity demand is at its highest. They believe that residential air conditioners contribute significantly to this peak demand, particularly in warmer regions of the country. Since electricity generation, transmission, and distribution capacity is determined by the electrical load served during these peak demand times, products that demonstrate improved efficiency under peak conditions can reduce the need for added electrical system capacity. They also believe that reducing peak demand is an important component of any integrated plan to improve the reliability of the nation's electrical system. Recently there have been several well-publicized blackouts and brownouts following, or in the midst of, hot periods. Advocates of an EER-based standard believe that a SEER-only standard does not guarantee the desired improvement in peak-period performance.

1. Current Relationship Between SEER and EER

It is certainly true that SEER is not an ideal indicator of system efficiency in very hot weather, and SEER may not be the best indicator of the seasonal efficiency for equipment operating in the warmest regions of the country. However, the relationship between efficiency at 82°F and at 95°F is fairly close for single-speed, single-capacity equipment, which represents the vast majority of unitary equipment in the marketplace. For other equipment, including variable or multi-speed equipment or equipment with modulating capacity, the 82°F test point is given a great deal of weight in determining the SEER rating. In these cases, the relationship between SEER and EER(95°F) is less certain, and manufacturers have some flexibility and incentive to improve SEER without improving EER(95°F).

The SEER test, representing equipment performance over the entire cooling season, encourages manufacturers to design equipment that consumes less energy throughout the cooling season for the average user. The EER(95°F) test, which is a measure of steady-state performance under only one set of climatic conditions, cannot provide insight into cyclical performance or cooling efficiency at cooler temperatures which represent the bulk of the cooling season nationwide. The Department, therefore, maintains that a SEER-based standard is essential to its effort to reduce national energy consumption. Further, we assume that peak demand savings would accompany any seasonal energy savings resulting from an increase in the required SEER level, because of the relationship between SEER and EER(95°F), and the costs of increasing EER(95°F) are already incorporated into the analysis.

However, the Department is particularly interested in ensuring that the current relationship between EER(95°F) and SEER will remain intact under new efficiency standards, resulting in reduction in growth of peak demand. This additional reduction in peak demand growth would benefit utilities through an eventual and incremental reduction in the need for new capacity. Maintaining higher EER(95°F) would also benefit consumers. Since the cost of electricity is highest during periods of peak demand, any decrease in electricity consumption during peak-periods, could reduce the user's annual electricity bill, particularly if the user pays time-of-day or seasonal rates.

2. Options for Possible EER Standards

The Department has at least four options for ensuring that EER(95°F) performance is maintained under new SEER standards. First, the Department could rely on the physical relationship between EER(95°F) and SEER to ensure that an increase in SEER would result in a corresponding increase in EER. The Department is not aware of any modulating, multi-speed, or variable speed air conditioners (hereafter referred to collectively as modulating equipment) being offered below 13 SEER, and very few of the available 13 SEER products are modulating equipment. Therefore, SEER and EER are closely related in equipment currently available at the efficiency levels that, as discussed below, the Department is proposing today to adopt as minimum levels—12 SEER for air conditioners and 13 SEER for heat pumps. Assuming that relationship holds under such new standards, EER would increase as SEER increases.

The second option would be to establish an EER(95°F) floor that must be met by modulating equipment only or, alternately, all equipment.

The third option would be to establish a minimum EER requirement at each SEER level, even for products exceeding the minimum SEER level. Again, this could be established for modulating equipment only or for all equipment.

The fourth option would be to alter the SEER test procedure to rely more on 95°F performance and less on performance at cooler temperatures. This would provide incentive for manufacturers to optimize their designs to favor the warmer part of the cooling season and warmer regions of the country.

We consider the second and third options to be the most attractive. While we believe that the first option, relying on the current relationship between EER and SEER, would satisfy our concerns in the foreseeable future, this option provides no assurance that manufacturers would not develop and promote equipment in the long term that would seriously reduce EER ratings. The fourth option, altering the SEER test procedure to favor higher temperatures, would require us to embark on a new rulemaking to establish those new procedures and then to redo this rule to incorporate the new SEER values. We would prefer to avoid those delays and the design uncertainty associated with altering the procedures.

Both the second and third options, mandating minimum EER ratings, would guarantee that products under new standards would achieve the same EER ratings as they do today without altering the test procedures. The third option is more aggressive since it would require that products of higher SEER ratings must also meet increasingly stringent EER ratings.

Within the second and third options, we could establish EER requirements of varying degrees of stringency. For example, we could select EER levels equivalent to the ratings of the minimum EER rating of available equipment today at the proposed standard level, the median EER rating, anywhere in between, or even higher.

We prefer the second option, establishing an EER floor equal to the median EER ratings of equipment currently available at each standard level. That would result in a substantial improvement in the EER ratings of the typical product sold while still providing manufacturers with the flexibility to raise SEER ratings through modulation rather than EER improvements in higher efficiency products.

The concern that prevents us from fully endorsing the third option is that it would discourage the development and sale of modulating capacity and variable speed equipment. Modulating equipment realizes a benefit in the SEER test, allowing manufacturers to reduce the cost of the core components compared to non-modulating equipment. This cost reduction partially offsets the cost of the modulation, making modulating equipment more affordable for consumers. Being required to meet the same EER standards as non-modulating equipment would negate this cost benefit.

The Department wishes to encourage, not discourage, the development and sale of modulating equipment. Consumers value the added benefits of modulation, and manufacturers realize this value in the form of higher revenues. For consumers and the nation, modulation mitigates the inefficiencies caused by oversizing the system during installation. Oversizing is a widespread problem that causes frequent equipment cycling, increasing energy consumption. Furthermore, oversizing arguably contributes more to peak power demand than does any reduction in EER associated with modulating equipment.

For DOE to require products to meet median EER values rather than less stringent EER values would also raise some concerns. First, the cost-efficiency relationships used in our analysis may underestimate costs of manufacturing such products, since we did not include the costs of a minimum EER. Second, if an EER standard increases product cost, it would discourage the development and sale of modulating equipment at the baseline levels. We expect any cost increases required to meet median EER levels, however, would be slight and would not significantly alter our analysis.

To determine what the appropriate EER(95°F) requirement might be, the Department assessed ARI performance data on residential unitary equipment certified as of February 1998. The median EERs available for each product class at the minimum SEER levels DOE proposes today, are identified in Table V.4 as the ''Median Available EER at Proposed Minimum SEER.'' In addition to the minimum SEER proposal contained in this notice, the Department is inclined to adopt in the Final Rule minimum EER(95°F) requirements equal to these values. However, since there are very few packaged heat pumps available from which to draw a conclusion concerning EER, DOE believes the minimum EER requirement for packaged heat pumps should be the same as split heat pumps less the 0.3 EER offset seen between packaged and split air conditioners.

TABLE V.4.—MEDIAN AVAILABLE ENERGY EFFICIENCY RATINGS (EER) AND PROPOSED MINIMUM EERS IN RESIDENTIAL UNITARY EQUIPMENT (1998)

Product class	Proposed minimum SEER	Lowest available EER at proposed minimum SEER	10th percentile available EER at proposed minimum SEER	Median available EER at proposed minimum SEER	Proposed minimum EER
Split Air Conditioners	12.0	10.1	10.5	10.8	10.8
Packaged Air Conditioners	12.0	10.1	10.3	10.5	10.5
Split Heat Pumps	13.0	10.8	11.1	11.9	11.9
Packaged Heat Pumps	13.0	11.0	11.0	11.0	11.6

We encourage comments regarding the burdens and benefits that would result from including an EER requirement in the final rule. Of particular interest are comments regarding burdens on manufacturers and benefits regarding reduction in peak electricity demand, including the effect of an EER minimum on costs, on availability and sales of modulating equipment, and on electrical system reliability. In addition, comments are welcome to discuss the pros and cons of any of the other options described above.

J. Niche Products

Several types of central air conditioners and heat pumps are used in particular or unusual applications and have features that differ from those of the vast majority of products available in the marketplace. We refer to these as ''niche products.'' Included are single package units that are designed to be mounted within or immediately adjacent to a fixed-size opening in an outside wall of the structure and split systems where the outdoor unit is designed to be mounted in the same manner. This would be comparable to the classes that have been established for room air conditioners that are defined as ''without louvered sides.'' Also included are non-ducted mini-split air conditioners and heat pumps, and high-velocity, small-duct systems. Typical applications for of niche products may include: existing single family buildings without air ducts and multi-family buildings with fixed-area wall openings and both new and existing manufactured homes.

Several manufacturers have claimed that certain niche products would not be viable if required to meet higher efficiency standards, and have asked the Department to establish new classes for these products, with efficiency standards maintained at current levels. All these products serve relatively small niche markets and as such, the efficiency standards established for these products will have little effect on national energy savings. Further, each is a product with some unique utility. Earlier in this rulemaking the Department sought information on whether higher standards would eliminate these products from the marketplace because of the severity of their constraints.

1. Ductless Split Air Conditioners and Heat Pumps

Ductless split systems, or mini-splits as they are commonly known, consist of a single outdoor unit and one or more indoor fan coil units, each located in the conditioned space. Since consumers may consider the interior units to be more intrusive than a ducted system, manufacturers strive to make them as compact as possible. This cabinet size constraint combined with efficiency losses due to heat transfer between refrigerant lines puts pressure on equipment efficiency.

Mitsubishi and EnviroMaster International (EMI), manufacturers of ductless split systems, commented that ductless products should be assigned a separate product class with a lower standard. (Mitsubishi, No. 18 at 1 and EMI, No. 26 at 1). Their arguments for a separate class are:

- Ductless units are operated like room air conditioners, because the ''compressor delivering air conditioning to a particular room operates only when necessary rather than when a central thermostat calls for cooling in another area;'
- Ductless units do not have the duct losses of a central air conditioning system, and so have greater installed system efficiency. Mitsubishi claims that: ''a 10 SEER ductless unit may be virtually equivalent or even higher in efficiency than a 12 SEER ducted unit';
- The overwhelming portion of the market of ductless mini-splits is in capacities of 18,000 Btu/hr and less. Making significant increases in the efficiency of motors and compressors used in these small units is difficult;
- Ductless air conditioners frequently employ variable speed control of the compressor motors. Mitsubishi claims: ''Controlling the speed of the compressor by inverter will not benefit the 100% capacity rating but it has a tremendous benefit when the compressor begins slowing down. During 50% capacity operation the SEER level would be several points above the 100% capacity SEER. This results in more energy savings, quieter operation, less peak load demands.'' Mitsubishi also argued that an EER rating, like a room air conditioner, would be more appropriate because of the inverter driven system's low cyclic losses; and
- Per ton, (of cooling capacity) a ductless air conditioning system is one of the most expensive HVAC systems in the U.S. today. Some of the reasons for high production costs are: low volumes in the United States, the indoor unit is a ''finished'' product fully visible to the customer so it requires additional cosmetic expenses, and the unit must be small, so complex design of coils is necessary.

After review of the available information, the Department does not believe a separate class is warranted for these products. The evidence presented in the comments does not convince us that these products would not be able to meet the proposed standard level. The constraints on increasing the size of the indoor fan coil units are primarily esthetic, and the Department is unaware of technological limitations to increasing minimum efficiency standards for these products. The esthetic disadvantage of larger cabinet size would be compensated by higher efficiency and lower cost of operation. While the claim that the small capacities make increased efficiencies difficult is a reasonable one, the Department is aware that systems with capacities of up to 44,000 Btu/h are available and believes that providing an exemption for all systems because of difficulty with smaller systems is not justified.

2. Small Duct High Velocity Air Conditioners

Small-duct, high-velocity (SDHV) systems target primarily the retrofit market, where they are installed in attic or closet spaces and distribute conditioned pressurized air through round ducts small enough to fit inside stud walls. Compared with conventional air conditioners and heat pumps that use large ducts, the indoor coil section of an SDHV system is compactly designed to facilitate retrofit installation in tight spaces, resulting in smaller face area and more rows of tubing than conventional systems. The compact fan coil design and small ducts contribute to high static pressure loss that must be overcome by the blower, requiring greater fan power. Manufacturers claim the greater energy consumption of these blower motors and the limited space for installing the fan coils makes it more difficult for SDHV systems to increase energy efficiency. To mitigate the burden on the blowers, designers reduce the required air volume by cooling it more than a conventional air conditioner, which offers an associated benefit of enhanced humidity removal but increases cost. In order to meet the current 10 SEER standard, manufacturers of SDHV systems typically pair the fan coil with high efficiency condensing units (typically 13—14 SEER).

Unico described a number of alternatives to increase system efficiency for their product, including a larger heat exchanger, an improved blower design and a more efficient blower motor, and concluded that the burden of increased initial cost would outweigh the benefits of increased system efficiency. (Unico, No.60 at 5). Unico asked the Department to either: (1) Exempt them from any increase in standards; (2) allow a 15% SEER credit for reduced duct losses associated with their type of system; or (3) allow their system to be tested as a coil only (without a blower) at a conventional airflow, using the test procedure's default fan power to establish a SEER rating but allow them to install systems with a high pressure blower. (Unico, No. 61 at 3).

SpacePak, another major manufacturer of this type of product, commented that they have made the investment to produce more efficient systems. (SpacePak, No. 39 at 1). SpacePak also provided ARI directory data indicating the higher efficiency of their designs. SpacePak claimed to offer many equipment combinations in the 11 to 12 SEER range, with only 17% of their ARI listings at the 10 SEER minimum. (Space Pak, No. 52 at 1).

After review of the available information, the Department does not believe a separate class with an efficiency standard below 12 SEER or a 15% SEER credit, is warranted for these products. Regarding Unico's third alternative, i.e., revise the DOE test procedure to allow SDHV systems to be tested as coil-only products, the Department believes that such a change would recognize the improvements in delivered efficiency of the SDHV system because of reduced duct losses. We are therefore proposing to modify the DOE test procedure to allow small-duct high velocity system manufacturers to test their products as coil only products. We estimate that the impact of this allowance will be 1 to 2.5 SEER points; *i.e.,* a 10 SEER system would become an 11 to 12.5 SEER system. The Department seeks comments on whether the test procedure revision or other proposed changes are needed to maintain the viability of the small-duct, high-velocity systems in the market place.

3. Vertical Packaged, Wall Mounted

These products are factory-assembled single packaged vertical air-conditioners and heat pumps using single phase power but intended for use in commercial and industrial heating and cooling applications. The difficult air flow configuration (each of the condenser and evaporator compartments takes air in and exhausts it through the same face) combined with the attempt to minimize size constrains the ability of these units to attain higher SEERs.

The Department understands that single-package vertical air-conditioners and heat pumps are not distributed for personal use or consumption by individuals, and therefore believes that at present they are commercial products covered by EPACT and not by residential energy efficiency standards. Accordingly, vertical packaged, wall mounted equipment would not be covered by today's proposed rule for residential products.

4. Through-the-Wall Condensers

Through-the-wall (TTW) condensers were popular in new multistory residential construction in the 1960s and 1970s. Major manufacturers have since abandoned the replacement market, providing an opportunity for lower volume manufacturers. Most equipment is in the 1½ to 2½ ton capacity range. These systems take in air through only one face and exhaust air through the same face resulting in reduced efficiency because of increased fan power consumption. Some short-circuiting of exhaust air into the intake may also occur.

Replacements for through-the-wall condensers must fit within the same wall opening as the original units, even though original units may be half as efficient as the new units. Residents or building owners are particularly sensitive to any increase in price or to the cost of enlarging the wall opening to accommodate a larger condenser. Since repair is the only other cost effective alternative to replacement, a new standard that increases cabinet size or results in a significant price increase could be counterproductive, preventing the turnover of old, inefficient equipment.

According to submitted data, 10 SEER TTW split condensing air-conditioners with fan coils (when scaled up to 3-tons) are $206 more expensive (manufacturer price) than 10 SEER pad-mounted split systems. Under a 12 SEER standard for pad-mounted split air conditioners, the $206 differential would be maintained if TTW Condenser systems had to meet an 11 SEER rating (also based on submitted data). This differential increases when wall modifications are necessary. DOE believes 11 SEER is technologically feasible at this time for most configurations of TTW split equipment. TTW condensers come in three sizes (height × weight exterior to the building): 32″ × 24″ (768 sq. in.); 28″ × 26″ (721 sq. in.); and 23″ × 30″ (679 sq. in.). First Co. commented that imposing higher efficiency standards would eliminate through-the-wall products from the marketplace because of the significant increase in the price with a correspondingly small operating cost savings. (First Co., No. 40 at 1).

TTW packaged systems are intended for both new construction and retrofit. First Co's dimensions (new construction) are 43″ × 28″ (1,204 sq. in.). Skymark's retrofit unit is 15″ × 55″ (825 sq. in.). TTW packaged equipment for new construction, which is not severely size-constrained, should be able to reach 12 SEER in its current configuration with component upgrades. The current manufacturer price differential (First Co.) between TTW packaged and conventional packaged equipment (scaled to 3-tons) is $430. According to First Co. data, that differential would be maintained under an 11 SEER standard for TTW packaged with a 12 SEER for conventional packaged.

The Department proposes to establish a separate class for TTW equipment (including packaged and split, cooling only and heat pump) based on a maximum combined surface area of the air inlet and outlet of the condenser of 830 square inches, and a maximum capacity of 30,000 Btu/hr. The purpose of the maximum capacity requirement is to ensure that if new technology reduces the size of the condenser, manufacturers will not offer 3-ton equipment that fits the definition but is intended for use in conventional applications. To maintain the price differential between this new class and conventional equipment, we propose a standard of 11 SEER. Because electric strip heat is popular in TTW equipment, the 11 SEER standard would also apply to TTW heat pumps.

5. Non-Weatherized Single-Package Unit, Mounted Entirely Within the Structure

Another niche product, which was not discussed in the Supplemental ANOPR, is a non-weatherized single-package unit, mounted entirely within the structure (in an attic, basement, or closet), with outdoor air ducted to and from the unit. This unit is used in high-rise and garden apartments, manufactured homes, and other residential applications where locations for placement of outdoor units may be unavailable or too remote, where architectural aesthetics may be compromised by visible outdoor units, where vandalism or theft of outdoor units is a potential problem, or where compliance with local sound ordinances restricts the placement of outdoor air conditioning equipment.

Consolidated Technologies, Inc., manufacturer of the INSIDER, commented, ''For the INSIDER to be used in Manufactured Housing and Modular housing it is important to have the smallest footprint possible.'' (Consolidated Technologies, Inc., No. 42 at 2).

The Department recognizes that this product has space constraints, albeit not as severe as products that must fit a wall opening. Products at the 12 SEER level (the proposed air conditioning standard level) are currently on the market. A very difficult obstacle to establishing a separate class for this product is a definition that could not be used as a loophole to use its lower standard for conventional products. Its salient feature is its indoor location; product class definitions should be based on physical characteristics, and it is nearly impossible to define physical characteristics that would ensure products be installed in a particular location. No separate class is proposed for this product.

6. Request for Comments Regarding Niche Product Standards

The Department encourages comments regarding whether the proposed standards concerning high-velocity, vertically-packaged wall-mounted equipment, and through-the-wall equipment provide a significant advantage to those products versus competing products, whether they are sufficient to preserve the unique features of those products, and whether improvements in the definitions are needed to prevent loopholes. For ductless split equipment and non-weatherized vertical packaged equipment, additional comment is welcome on the impacts that meeting the new standards would have on the availability of those products.

K. Thermostatic Expansion Valves

VEIC, NRDC, ACEEE, and CEC requested that a design standard requiring the use of thermostatic expansion valves (TXVs) be adopted to ensure that energy savings expected from an increase in the minimum efficiency standard are realized in the field. Several of the comments cited studies which demonstrate that TXVs can mitigate adverse effects on efficiency due to field installation problems such as inadequate evaporator airflow and improper refrigerant charge. CEC suggested that separate classes be established for systems with and without TXVs and that more stringent minimum efficiency standards be established for classes not utilizing TXVs, and VEIC suggested mandating the use of TXVs in all new equipment. (VEIC, No. 32 at 4–5; Neme, VEIC, Transcript, pp. 187–189; NRDC, No. 35 at 11–12; ACEEE, No. 43 at 5–6; CEC, No. 47 at 5–6).

At least two regulatory options exist for encouraging the use of TXVs. The first is to require that all equipment contain TXVs, hereafter called TXV requirement. The second is to establish a separate product class for TXV-bearing equipment and to reduce the minimum SEER requirements for those classes from the levels in today's proposed rule.

The EPCA allows the Department to issue a requirement such as mandating the use of TXVs if the Secretary determines that such a requirement is necessary to ensure that the product meets its performance-based standard. In the case of TXVs, the Department's current opinion is that products can meet the proposed SEER requirements without TXVs. This is certainly true in the laboratory. In the field, although many installations could undoubtedly benefit from TXVs, it is unclear whether we could find that TXVs are needed for those systems to perform at their rated efficiencies.

Regarding the second option, EPCA requires the Department to establish separate product classes for products based on a performance related feature (such as a TXV) if the Secretary determines that a higher or lower efficiency standard is justified for those products. Evidence indicates that TXVs maintain system efficiency better than do fixed orifices or capillary tube expansion devices in cases where split system equipment is over- or under-charged with refrigerant. This apparently includes most installations. To encourage the use of TXVs we could consider establishing lower SEER standards for products containing TXVs.

While the evidence of the potential energy-saving benefits of TXVs is certainly persuasive, the current SEER test procedures already encourage their use. For rating a manufacturer's condenser with the evaporator of a different manufacturer, the SEER determination procedures provide a credit for systems that incorporate TXVs. For matched systems, the use of TXVs typically lowers the degradation coefficient, resulting in higher SEER results.

We hesitate to provide stronger support for TXV-bearing equipment than that which is already granted through the test procedures. Unlike fixed orifices, TXVs are mechanical components. Some manufacturers avoid their usage because of reliability concerns, and the additional repair costs incurred by consumers could outweigh their energy-saving benefits. Furthermore, contractors are able to adjust the factory-set TXV in the field, and it is possible that alleviating problems due to over- or under-charging by encouraging the use of TXVs could create another problem—improperly set TXVs. Also, it is not clear that TXVs are the only, or even the best, option for maintaining equipment efficiency in the field. For example, technologies that could mitigate dirty coils or prevent improper charging and airflow may be more attractive options, and we would not want to discourage their development or use by mandating the use of TXVs.

In any case, manufacturers may well find that the SEER benefits offered by TXVs are compelling enough under the new efficiency standards that they would offer TXVs in a substantial amount of baseline equipment without further encouragement by the Department. The Engineering Analysis suggests that manufacturers are currently more likely to incorporate TXVs into their 12 SEER and 13 SEER products than in their 10 SEER products. We would expect, therefore, that TXV use would be much more prevalent under higher efficiency standards.

For these reasons, the Department feels that the current test procedure provides the proper encouragement for manufacturers to incorporate TXVs into their products, and that neither a TXV requirement nor a lower standard for TXV-bearing products are justified at this time. We welcome additional comments on this issue, particularly regarding whether our concerns regarding the perceived reliability problems and potential misuses associated with widespread use of TXVs are valid.

L. Other Comments

1. Latent Heat Removal

The Southern Company, Virginia Power, and R.B. Stotz insisted that increased equipment efficiency impacts the equipment's ability to properly dehumidify (i.e., remove latent heat). Virginia Power specifically wants assurances that any increase in the standard will maintain current humidity control capabilities. In addition, it asserts that the costs of maintaining humidity control should be included in the analysis. (Virginia Power, No. 27 at 2). The Southern Company claims that higher SEER values will lead to larger indoor coils which in turn will result in higher air temperatures leaving the indoor coil. The higher the air temperature, the less dehumidification occurs. They also claim that while more efficient systems may dehumidify properly at rated test conditions, their ability to dehumidify under high indoor humidity conditions are worse than less efficient equipment. (Southern Company, No. 29 at 3–4; R.B. Stotz, No. 24 at 1). Trane counters the claims made by the Southern Company and Virginia Power by stating that there is absolutely no evidence to support the claim that more efficient equipment has less latent heat removal capability. (Crawford, Trane, Transcript, pp. 272–273).

Trane's claim that there is no relationship between equipment efficiency and its ability to dehumidify is substantiated by research conducted by ARI. From this research, ARI demonstrated for hundreds of systems that latent heat removal is not obviously impacted by increases in equipment efficiency at rated conditions (*i.e.,* 95°F outdoor temperature). [16] Not to dismiss the concerns of Virginia Power and the Southern Company, we recognize the humidity control problems that exist in the southern region of the U.S. For the excessive humidity conditions commonly experienced in the South, the equipment may very likely not provide adequate dehumidification. But rather than focusing on the equipment efficiency as the source of the problem,

[16] D. Godwin. 1998. ''Latent Capacity of Unitary Equipment.'' ASHRAE Transactions 98(2).

proper installation and maintenance practices also likely play a large role in the equipment's performance. Other factors to consider are the duct system as well as the building shell characteristics. All these factors play a role in how a system dehumidifies. To lay blame only on the efficiency of the equipment ignores how other factors contribute to the system's ability to properly dehumidify.

2. 3-Phase Equipment

ACEEE asserted that if an identical standard is to be set for both single-phase and 3-phase central air conditioners and heat pumps under 65,000 Btu/hr, then 3-phase equipment should be incorporated into the rulemaking analysis. Alternatively, if 3-phase equipment is excluded from the analysis, it should be made clear that a new standard on 3-phase equipment will be set based on a new analysis covering 3-phase equipment.

EPACT provides for DOE to amend the standards for these products when ASHRAE amends the standards found in ASHRAE Standard 90.1. When ASHRAE has completed its consideration of standards for these products, DOE will analyze 3-phase equipment under a separate rulemaking pertaining to commercial air-conditioning and heat pump equipment.

3. SEER–HSPF Relationship

ARI supported the Department's HSPF–SEER standard pairings proposed in the Supplemental ANOPR. (ARI No. 48 at 4). Pietsch proposed maintaining the current minimum requirements for HSPF at 6.8 for future levels of minimum SEER, which would allow manufacturers to continue to place more emphasis on improving SEER. He based this recommendation on the strong competition that heat pumps face in the market place with electric resistance heat, noting that the increased first-cost of heat pumps that have higher minimum HSPFs makes it more difficult for heat pumps to compete against the much lower first-cost of electric resistance heating systems. (Pietsch No. 36 at 41). ACEEE, VEIC, and PG&E noted that the Department's definition of HSPF–SEER pairing for the standard levels it analyzed seemed arbitrary or too lenient and preferred that the Department establish higher HSPF levels. (ACEEE, No. 43 at 5; VEIC, No. 32 at 6; PG&E, No. 31 at 4).

The Department plotted the relationship between HSPF and SEER for all 3-ton split heat pumps listed in the Spring 1998 ARI Directory of Certified Unitary Equipment. At 10 SEER, the difference between the minimum HSPF (6.8) and the median (7.1) was 0.3 HSPF. The Department then determined the equation of the line that ran generally parallel with the median HSPF at each SEER level, while passing through the 10 SEER, 6.8 HSPF point. Table V.5 reviews the derivation of the SEER–HSPF pairings.

TABLE V.5.—COMPARISON OF PROPOSED HSPF STANDARD LEVELS WITH MEDIAN HSPFS OF EQUIPMENT LISTED IN THE ARI UNITARY DIRECTORY

Cooling efficiency (SEER)	10	11	12	13	14	15	16	17
Median Heating Efficiency (HSPF)	7.1	7.4	7.9	7.9	7.9	8.9	8.2	8.4
Recommended Heating Efficiency Standard (HSPF)	6.8	7.1	7.4	7.7	8.0	8.2	8.4	8.6
Offset from Median (HSPF)	−0.3	−0.3	−0.5	−0.2	+0.1	−0.7	+0.2	+0.2

Even though the Department does not have information on the distribution of heat pump sales by HSPF at each SEER level, it is apparent that the market currently favors products that exceed the minimum allowable HSPF level. This is due both to the natural relationship between HSPF and SEER and the preference in the market for high HSPF heat pumps in cooler climates. The Department believes that establishing an HSPF standard equal to the current median at a given SEER level would impose an undue design constraint on manufacturers, adding to the cost and burden of designing, producing, testing, and qualifying the product without resulting in a significant increase in the average HSPF of equipment sold. Also, the Department does not want to encourage substitution of electric resistance heating systems for heat pumps. Without further information on the cost of attaining higher HSPFs or the shipments of heat pumps by HSPF level, the Department has no basis for modifying its current HSPF–SEER standard combinations.

4. Max Tech

The Supplemental ANOPR analysis proposed a Max Tech level of 20 SEER. ARI, Trane, and York commented that a prototype hasn't been built that has exceeded 18 SEER. (Wethje, ARI, Transcript p. 66; Crawford, Trane, Transcript p. 69; and Madera, York, Transcript p. 71). The Department also understands that 18 SEER is the highest efficiency level currently available for sale.

While the Department believes improvements to the 18 SEER design are certainly possible, it agrees with the industry that any analysis based on a design higher than 18 SEER would be pure speculation. Therefore, the Department considers 18 SEER to be the Max Tech at this time for cooling performance. The Max Tech level for heating efficiency is 9.4 HSPF, which is the highest HSPF rating currently available in residential heat pumps. Any parties possessing knowledge of prototype central air conditioners or heat pumps that exceed 18 SEER or 9.4 HSPF levels are encourage to provide such information in comment on today's proposed rule.

DOE does not have relative cost data for 18 SEER units as ARI did not provide the Department data for equipment exceeding 15 SEER. In lieu of performing a reverse engineering analysis on an 18 SEER design, the Department is proceeding as if the 18 SEER equipment cost and price were equal to those of the 15 SEER equipment. DOE believes the 18 SEER cost would be higher because the product is more complex.

VI. Analytical Results

A. Trial Standard Levels

Table VI.1 presents the trial standards levels analyzed for today's proposed rule and the corresponding efficiency level for each class of product. Trial standard level 5 is the max tech level for each class of product.

TABLE VI.1.—TRIAL STANDARDS LEVELS FOR CENTRAL AIR CONDITIONERS AND HEAT PUMPS (SEER)

Trial standard level	Split air conditioners	Packaged air conditioners	Split heat pumps	Packaged heat pumps
1	11	11	11	11
2	12	12	12	12
3	12	12	13	13
4	13	13	13	13
5	18	18	18	18

B. Significance of Energy Savings

To estimate the energy savings through 2030 due to revised standards, we compared the energy consumption of central air conditioners and heat pumps under the base case to energy consumption of central air conditioners and heat pumps under the revised standard. We examined five standard levels. For each trial standard examined, several different scenarios were analyzed consisting of variations on: (1) Electricity price and housing projections; (2) equipment efficiency distributions; (3) manufacturer cost estimates; (4) equipment lifetime; and (5) societal discount rate. Electricity price and housing projections were based on three different AEO 2000 forecasts: (1) Reference Case, (2) High Growth Case, and (3) Low Growth Case. We analyzed three efficiency scenarios, each of which assumed a different efficiency distribution after new standards would take effect: (1) NAECA scenario, (2) Roll-up scenario, and (3) Shift scenario. Manufacturer costs were based on ARI-provided mean cost data. Since several comments suggested that the industry-provided cost estimates were overstated, cost data from the reverse engineering analysis were analyzed as an alternative scenario. Equipment lifetime was based on a retirement function with an 18.4 year average lifetime coupled with the inclusion of compressor replacement costs. However, since several comments suggested that the equipment life is actually shorter, a retirement function yielding an average lifetime of 14 years without the inclusion of compressor replacement costs was analyzed as an alternative scenario.

For calculating NPV, a societal discount rate of 7% was assumed. However, a 3% value was investigated as an alternative scenario in accordance with the Office of Management and Budget's (OMB) Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements.

Table VI.2 shows the range of energy savings for each of the three shipments scenarios for each trial standard level based on varying electricity and housing projections. The energy savings assume the ARI mean manufacturer cost estimate, an 18.4-year average lifetime with compressor replacement and a 7% societal discount rate. The electricity scenarios are the AEO 2000 Reference, High Growth, and Low Growth cases.

TABLE VI.2.—ENERGY SAVINGS BASED ON ARI MEAN MANUFACTURER COSTS, 18.4 YEAR RETIREMENT FUNCTION WITH COMPRESSOR REPLACEMENT, AND A 7% DISCOUNT RATE

[Energy savings for units sold from 2006 to 2030]

Trial standard level	Energy savings (quads)		
	NAECA	Roll-up	Shift
1	1.7 to 1.8	1.5 to 1.6	1.9 to 2.0
2	2.9 to 3.2	2.8 to 3.0	3.4 to 3.6
3	3.4 to 3.6	3.3 to 3.5	3.8 to 4.1
4	4.2 to 4.5	4.1 to 4.4	4.6 to 4.9
5	8.1 to 8.7	8.1 to 8.7	8.1 to 8.7

Table VI.3 shows how each of the three scenarios described above (reverse engineering costs, 14 year average life, and 3% discount rate) impact the energy savings. The three scenarios were investigated only for the NAECA efficiency scenario and the AEO 2000 Reference Case electricity price and housing projection.

TABLE VI.3.—ENERGY SAVINGS BASED ON THE NAECA EFFICIENCY SCENARIO AND AEO REFERENCE CASE

[Energy savings for units sold from 2006 to 2030]

Trial standard level	Energy savings (quads)		
	Reverse engineering manufac-turing cost	14 year lifetime	3% discount rate
1	1.7	1.7	1.7
2	3.0	2.9	3.0
3	3.5	3.4	3.5
4	4.3	4.2	4.3
5	8.7	8.2	8.3

C. Payback Period

As discussed above, the Act requires the Department to examine payback periods to determine if the three year rebuttable presumption of economic justification applies. As prescribed by the Act, the rebuttable payback period is ''calculated under the applicable test procedure, * * *''.

The annual space-cooling and space-heating energy consumption calculated based on the hours of use in the test procedure are on the order of 50% greater than the weighted-average values from the LCC analysis (*i.e.,* analyses based on the 1997 RECS for residential buildings and hourly simulations for commercial buildings). This means that, for any given standard level, the payback period calculated from the test procedure will be significantly shorter than the average payback value calculated from the LCC analysis which was based on the 1997 RECS data.

In Table VI.4a, we list the median payback periods for product classes and efficiency levels according to the methods employed by the LCC analysis. Table VI.4b is the rebuttable presumption payback period based on the Department of Energy's test procedure.

TABLE VI.4A.—SUMMARY OF LCC PAYBACK MEDIAN PERIOD

Product class	Efficiency level	ARI mean manufacturing cost [1]	Reverse engineering manufacturing cost scenario [1]	14-year lifetime scenario/ARI mean manufacturing cost
Split System Central Air Conditioner	11	10.6	7.8	10.5
	12	12.6	9.8	12.8
	13	16.0	11.3	16.2
	18	36.0	19.6	50.4
Split System Heat Pump	11	5.5	2.7	5.5
	12	7.2	3.9	7.3
	13	9.3	6.4	9.5
	18	17.3	14.0	19.9
Single Package Air Conditioner	11	6.1	7.7	16.6
	12	14.0	7.5	14.2
	13	21.8	14.5	21.8
	18	48.8	25.1	88.1
Single Package Heat Pump	11	8.1	4.6	8.1
	12	8.7	4.0	8.7
	13	13.2	8.4	13.4
	18	19.4	12.8	23.1

[1] Assumes a 18.4-year lifetime with a compressor replacement at 14 years.

TABLE VI.4B.—SUMMARY OF REBUTTABLE PAYBACK PERIOD

Product class	Efficiency level	ARI mean manufacturing cost [1]
Split System Central Air Conditioner	11	4.7
	12	5.8
	13	7.6
	18	11.3
Split System Heat Pump	11	2.5
	12	3.3
	13	4.5
	18	6.8
Single Package Air Conditioner	11	7.3
	12	6.2
	13	9.8
	18	13.3
Single Package Heat Pump	11	3.7
	12	4.0
	13	6.5
	18	7.2

[1] Assumes a 18.4-year lifetime with a compressor replacement at 14 years.

D. Economic Justification

1. Economic Impact on Manufacturers

a. Background. We performed a Manufacturer Impact Analysis (MIA) to estimate the impact of higher efficiency standards on air conditioner manufacturers. The TSD explains the analysis in further detail. As part of the MIA, we discussed potential impacts with six major manufacturers responsible for approximately 90% of the residential air conditioner and heat pump sales. We also interviewed two niche manufacturers to understand how their financial situation differs from that of their larger counterparts. These interviews are in addition to those we conducted as part of the Supplemental ANOPR. The interviews provided valuable information used to evaluate the impacts of a new standard on manufacturers' cash flows, manufacturing capacities and employment levels.

The MIA has both quantitative and qualitative aspects. Quantitative analysis primarily relies on the GRIM, an industry cash flow model customized for this rulemaking. The GRIM inputs are assumptions regarding the industry cost structure, shipments, and revenues. The key output is the industry net present value (INPV). Different sets of assumptions (scenarios) produce different results as described below.

In the GRIM we evaluated each of the shipment scenarios, *i.e.,* ''NAECA'', ''Rollup'', and ''Shift''. Changes in efficiency mix by efficiency standard level are a key driver of manufacturer finances since costs and revenues are both tied to shipments.

Two cost scenarios, ''Industry Relative Cost'' and ''Reverse-Engineering Relative Cost'', were also examined. These relative costs are also used as the basis for deriving the production costs of equipment above the minimum efficiency level. The ''Reverse-Engineering Relative Cost'' scenario was applied only to the ''NAECA'' product mix scenario in order to determine the effects of lower production costs on the MIA results.

The equipment lifetime scenarios assumptions, ''18-year life'' and ''14-year life'', were considered. The ''14-year life'' assumption applied only to the ''NAECA'' and ''Industry Relative Cost'' scenarios to isolate the effects of a shorter product life on the results.

The interviews revealed that manufacturers use different pricing strategies and place different levels of emphasis on the sale of higher efficiency products. Manufacturers fall into two basic groups in this regard. The first group has lower operating and production costs than its competitors and targets such price-sensitive consumers as new home builders. This focus on low price limits the ability and desire of these manufacturers to sell premium equipment. Because they have a cost advantage over their competitors, the lower cost manufacturers can achieve a higher operating profit margin on their baseline equipment and still maintain a price advantage. They then apply a fairly consistent markup across efficiency levels.

The higher cost manufacturers typically place more of an emphasis on marketing, service, and research than do their lower cost competitors. Faced with stiff price competition from the lower cost manufacturers in price-sensitive markets, the higher cost manufacturers are forced to reduce their price (and markup) on their baseline equipment to the minimum level sustainable. They then target less price sensitive customers by offering products with premium features and higher efficiency. These products carry higher markups.

Since higher efficiency standards will affect each group of manufacturers differently, we set up two versions of the GRIM to model each group independently. To represent the lower cost manufacturers, we reduced the operating expense ratio and research and development expense ratio to below the industry averages. We also assumed that a single markup applies to products across all efficiency levels. To model higher cost manufacturers, we raised the operating expense ratio and research and development ratios to above the industry average. We then assumed that markups increase roughly linearly as the efficiency level increases. This represents two effects: selling a greater fraction of higher margin premium product as efficiency level rises, and being able to secure a higher profit margin on products by virtue of the higher efficiency.

To represent the industry in aggregate, we combined the results of the two GRIM versions, giving 25% weight to the results of the lower-operating-cost group and 75% weight to the results of the higher-operating-cost group. This ratio reflects the prevalence of each strategy in the marketplace. Many companies may pursue both strategies simultaneously through different brands and divisions.

b. Industry Cash Flow Analysis Results. Tables VI.5 through VI.7 present the GRIM results for the unitary air conditioning industry for the three shipment scenarios based on the industry provided mean cost multipliers and an 18-year product life. The corporate discount rate used in the analysis is 6.2% based on an estimate of the weighted average cost of capital for the industry over a five-year period. Results assume that manufacturers with lower operating costs control 25% of the market and those with higher operating costs control 75%. Since we did not collect information regarding the cost or investments involved in manufacturing product at 18 SEER, we did not assess impacts under Max Tech.

TABLE VI.5.—CHANGES IN INDUSTRY NET PRESENT VALUE—INDUSTRY RELATIVE COST, 18 YEAR LIFE, NAECA EFFICIENCY MIX

Standard level	Industry net present value ($ million)	Change in INPV from base case	
		$ million	Percent
Base	1,603		
1	1,566	(37)	−2
2	1,417	(186)	−12
3	1,406	(197)	−12
4	1,420	(183)	−11

TABLE VI.6.—CHANGES IN INDUSTRY NET PRESENT VALUE—INDUSTRY RELATIVE COST, 18 YEAR LIFE, ROLL-UP EFFICIENCY MIX

Standard level	Industry net present value ($ million)	Change in INPV from base case	
		$ million	Percent
Base	1,603		
1	1,422	(181)	−11
2	1,241	(362)	−23
3	1,236	(367)	−23
4	1,268	(335)	−21

TABLE VI.7.—CHANGES IN INDUSTRY NET PRESENT VALUE—INDUSTRY RELATIVE COST, 18 YEAR LIFE, SHIFT EFFICIENCY MIX

Standard level	Industry net present value ($ million)	Change in INPV from base case	
		$ million	Percent
Base	$1,603		
1	1,740	$137	9
2	1,825	222	14
3	1,854	251	16
4	1,914	311	19

The NAECA and Roll-up scenarios reduce INPV while the Shift scenario increases INPV. This result occurs because we assume the higher-operating cost manufacturers accrue much of their profits from the sale of higher efficiency equipment. As the standard level increases, they earn lower profit margins on that equipment. The loss in profits can be offset by the combination of more sales and more expensive equipment. The Shift scenario provides a much more favorable projection of high-efficiency equipment sales than do the NAECA and Rollup scenarios.

Tables VI.8 and VI.9 present the results for the 14-year life assumption and the Reverse Engineering Relative Cost scenario with the NAECA Efficiency Mix scenario.

TABLE VI.8.—CHANGES IN INDUSTRY NET PRESENT VALUE—INDUSTRY RELATIVE COST, 14 YEAR LIFE, NAECA EFFICIENCY MIX

Standard level	Industry net present value ($ million)	Change in INPV from base case	
		$ million	Percent
Base	$1,726		
1	1,701	$ (25)	−1
2	1,558	(168)	−10
3	1,555	(171)	−10
4	1,598	(128)	−7

TABLE VI.9.—CHANGES IN INDUSTRY NET PRESENT VALUE—REVERSE ENGINEERING RELATIVE COST, 18 YEAR LIFE, NAECA EFFICIENCY MIX

Standard level	Industry net present value ($ million)	Change in INPV from base case	
		$ million	Percent
Base	$1,539		
1	1,509	$ (30)	−2
2	1,380	(159)	−10
3	1,368	(171)	−11
4	1,370	(169)	−11

Table VI.10 presents the differential impacts between the groups of manufacturers with lower and higher operating costs. The lower operating cost manufacturers benefit under all scenarios and trial standard levels, and the higher operating cost manufacturers benefit only under the Shift scenario. The reason, again, is that we assume that lower operating cost manufacturers accrue the same profit margin regardless of the efficiency level, so as the cost of the product increases, profits also increase. The higher operating cost manufacturers, on the other hand, lose profits as the standard level rises and the products face pricing pressure from the lower cost manufacturers.

TABLE VI.10.—CHANGE IN INDUSTRY NET PRESENT VALUE (%) RELATIVE TO BASE—COMPARISON BETWEEN LOWER AND HIGHER COST MANUFACTURERS

Standard level	Industry relative cost [1]								Reverse engineering relative cost	
	NAECA		NAECA—14 year life		Roll-up		Shift		NAECA	
	Lower cost	Higher cost	Lower cost	Higher cost	Lower cost	Higher cost	Lower cost	Higher cost	Lower cost	Higher cost
1	5	−5	6	−4	3	−16	7	9	5	−4
2	7	−17	9	−16	5	−31	12	14	7	−16

TABLE VI.10.—CHANGE IN INDUSTRY NET PRESENT VALUE (%) RELATIVE TO BASE—COMPARISON BETWEEN LOWER AND HIGHER COST MANUFACTURERS—Continued

Standard level	Industry relative cost[1]								Reverse engineering relative cost	
	NAECA		NAECA—14 year life		Roll-up		Shift		NAECA	
	Lower cost	Higher cost	Lower cost	Higher cost	Lower cost	Higher cost	Lower cost	Higher cost	Lower cost	Higher cost
3	9	−19	11	−16	6	−32	14	16	8	−17
4	15	−19	19	−16	13	−31	21	19	12	−18

[1] 18-year lifetime unless otherwise noted.

For the group most negatively impacted, *i.e.,* the higher cost group, Table VI.11 presents the Return on Invested Capital (ROIC) associated with the base case, and with each new standard level for the NAECA and Roll-up efficiency mix scenarios, for industry relative costs and an 18-year lifetime. A reduction in ROIC increases the likelihood that the company will choose to exit the market or sell its assets rather than to make the investments required to move to the new efficiency level.

TABLE VI.11.—RETURN ON INVESTED CAPITAL (ROIC) IN 2011 FOR HIGHER COST MANUFACTURERS

Standard level	NAECA (in percent)	Roll-up (in percent)
Base	13.3	13.3
1	12.3	10.7
2	10.2	8.4
3	10.0	8.3
4	9.6	8.3

Table VI.12 provides a summary of the total investment required for each trial standard level. Product conversion expenses include mostly product development and testing costs. Capital investments include new equipment, tooling, and floor space. Since these investments occur in the years leading up to the effective date of the new standard, larger investments equate to a more serious strain on cash flows in the near-term.

TABLE VI.12.—MANUFACTURER EXPENDITURES RELATED TO NEW EFFICIENCY STANDARDS (MILLION 1999 $)

Trial standard level	Product conversion expenses	Capital investments	Total investment
Base			
1	$ 31	$ 54	$ 85
2	93	109	202
3	110	138	248
4	157	167	324

The TSD which accompanies today's proposed rule provides more details on the MIA assumptions, methodology, results, and conclusions, including the assessments of impacts on lower volume equipment manufacturers and compressor manufacturers, which we estimate to be similar in proportion to the impacts described above.

c. Impacts on Employment. Manufacturers stated uniformly that labor requirements track materials costs. Since a new standard will increase the amount and cost of material in each product, labor requirements are expected to rise proportionally. However, the industry has recently been experiencing rapid growth in sales volume and is now faced with production capacity constraints. Since new efficiency standards will increase the product's size and complexity, many manufacturers will need to add additional capacity to accommodate the new products and retain their sales volumes. It is possible that those companies will choose to add the new capacity outside of the United States. This effect could keep domestic employment levels flat or result in employment loss if companies choose to shift current production to new facilities in other countries.

d. Impacts on Manufacturing Capacity. It is likely that a central air conditioner and heat pump standard would increase central air conditioner and heat pump production capacity in the United States. Since more efficient conventional heat exchangers are also larger, plants that now face capacity constraints will be unable to produce as many heat exchangers as they can under existing standards. Five of the six manufacturers we interviewed identified capacity constraints during peak production periods.

e. Impact on Lower Volume Manufacturers. Converting from a company's current basic product line involves creating, testing, and moving a new design into production. These tasks have associated capital investments. Manufacturers of niche products and those who produce only coils and fancoils, because of their need to spread these investments over smaller production volumes, may be affected more negatively than major manufacturers by an increase in efficiency standards. This is particularly true for those manufacturers that compete head-to-head with major manufacturers in some product lines, and less true for coil-only manufacturers. These results occur separately from any technical considerations related to the manufacturer's ability to modify its products to bring them into compliance with a new standard. Technical considerations are typically more important for niche manufacturers than for major manufacturers and have more severe consequences related to increased production costs or loss of sales volume due to increased price. Overall, if provisions are made in the standard for niche products that face severe technological constraints, we would not expect the impacts on lower-volume manufacturers as a group to be disproportionate with those of the industry as a whole.

2. Life-Cycle Cost

More efficient central air conditioners and heat pumps would affect consumers in two ways: Annual operating expense would decrease and purchase price would increase. We analyzed the net effect by calculating the LCC. Inputs required for calculating LCC include total installed costs (*i.e.*, equipment price plus installation costs), annual energy savings, average and marginal electricity rates, electricity price trends, repair costs, maintenance costs, equipment lifetime, and discount rates.

The output of the LCC model is a mean LCC savings for each product class as well as a probability distribution or likelihood of LCC reduction or increase. The LCC analysis for today's proposed rule introduces a new concept with regard to the percentage of consumers (both residential and commercial) that are negatively impacted by an increase in the minimum efficiency standard. (For the Supplemental ANOPR, all consumers that would incur an LCC increase were considered to be adversely impacted by an increase in the standard. This included even consumers that would incur a relatively small LCC increase *e.g.*, as small as $10, as compared to a relatively large baseline level total LCC. Note that the baseline LCC is approximately $5,000 for central air conditioners and $10,000 for heat pumps.)

The revised analysis defines negative impacts by including in this category only those consumers which incur LCC increases greater than 2% of the baseline LCC. For central air conditioners, this translates to an LCC increase of approximately $100 or an annual expense of approximately $5 over the lifetime of the system. Table VI.13 summarizes the baseline LCCs for split system and single package central air conditioners and heat pumps and also provides the 2% threshold at which consumers are considered to be adversely impacted.

TABLE VI.13.—BASELINE LIFE-CYCLE COSTS AND THRESHOLD FOR ADVERSE IMPACTS

Product class	Baseline life-cycle cost	Threshold for adverse impacts: 2% of Baseline LCC
Split Air Conditioners	$5,170	$103
Split Heat Pumps	9,679	194
Single Package Air Conditioners	5,629	113
Single Package Heat Pumps	9,626	193

Table VI.14 depicts the LCC results for split system and single package central air conditioners and heat pumps. The table shows the average LCC values for the baseline and each Trial Standard Level. Since manufacturer cost data were not available for the 18 SEER efficiency levels, 15 SEER cost data were used for all 18 SEER calculations resulting in 18 SEER LCC results which underestimate their true cost level. Table VI.14 also provides for each product class the difference in LCC at each efficiency level relative to the baseline. The differences represent either an LCC savings or an LCC cost increase. In addition, the table shows the subset of consumers (both residential and commercial) at each efficiency level who are impacted in one of three ways: Consumers who achieve significant net LCC savings (*i.e.,* LCC savings greater than 2% of the baseline LCC), consumers who are impacted in an insignificant manner by having either a small reduction or small increase in LCC (*i.e.,* within ±2% of the baseline LCC), or consumers who achieve a significant net LCC increase (*i.e.,* an LCC increase exceeding 2% of the baseline LCC).

TABLE VI.14.—SUMMARY OF LCC RESULTS BASED ON ARI MEAN MANUFACTURER COSTS AND A 18.4 YEAR AVERAGE LIFETIME

Product class	Efficiency level	Average LCC	Average LCC (savings) costs	Percent of consumers with		
				Net savings (>2%)	No significant impact	Net costs (>2%)
Split System Central Air Conditioner	10	$5,170				
	11	5,126	($44)	23	68	9
	12	5,125	(45)	27	34	39
	13	5,199	29	25	17	58
	18	5,725	555	15	4	81
Split System Heat Pump	10	9,679				
	11	9,529	(150)	30	70	0
	12	9,437	(242)	42	55	3
	13	9,464	(215)	39	39	22
	18	9,955	276	23	11	66

TABLE VI.14.—SUMMARY OF LCC RESULTS BASED ON ARI MEAN MANUFACTURER COSTS AND A 18.4 YEAR AVERAGE LIFETIME—Continued

Product class	Efficiency level	Average LCC	Average LCC (savings) costs	Percent of consumers with		
				Net savings (>2%)	No significant impact	Net costs (>2%)
Single Package Air Conditioner	10	5,629				
	11	5,649	20	16	47	37
	12	5,600	(29)	26	30	44
	13	5,804	175	18	11	71
	18	6,370	741	12	4	84
Single Package Heat Pump	10	9,626				
	11	9,492	(134)	28	72	0
	12	9,372	(254)	44	49	7
	13	9,514	(112)	33	31	36
	18	9,922	296	24	10	66

As discussed previously for the presentation of energy savings and payback period results, we have investigated two scenarios where lower estimates of the manufacturer costs (reverse engineering) and system lifetime (retirement function with 14 year average lifetime without compressor replacement costs) were analyzed. Table VI.15 presents the results for the manufacturer cost scenario while Table VI.16 presents the results for the lifetime scenario.

TABLE VI.15.—SUMMARY OF LCC RESULTS BASED ON REVERSE ENGINEERING MANUFACTURER COSTS

Product class	Efficiency level	Average LCC	Average LCC (savings) costs	Percent of consumers with		
				Net savings (>2%)	No significant impact	Net costs (>2%)
Split System Central Air Conditioner	10	$5,170				
	11	5,095	($75)	28	70	2
	12	5,057	(113)	35	40	25
	13	5,057	(113)	34	27	39
	18	5,307	137	25	7	68
Split System Heat Pump	10	9,679				
	11	9,470	(209)	40	60	0
	12	9,314	(365)	58	42	0
	13	9,307	(372)	52	42	6
	18	9,720	41	28	15	57
Single Package Air Conditioner	10	5,629				
	11	5,551	(78)	27	72	1
	12	5,466	(163)	40	51	9
	13	5,600	(29)	28	20	52
	18	5,905	276	21	6	73
Single Package Heat Pump	10	9,626				
	11	9,419	(207)	39	61	0
	12	9,205	(421)	66	34	0
	13	9,273	(353)	50	38	12
	18	9,460	(166)	37	15	48

TABLE VI.16.—SUMMARY OF LCC RESULTS BASED ON ARI MEAN MANUFACTURER COST AND 14-YEAR AVERAGE LIFETIME

Product class	Efficiency level	Average LCC	Average LCC (savings) costs (in dollars)	Percent of consumers with		
				Net savings (>2%)	No significant impact	Net costs (>2%)
Split System Central Air Conditioner	10	$4,682				
	11	4,650	$(32)	22	69	9
	12	4,672	(10)	24	31	45
	13	4,769	87	21	15	64
	18	5,336	654	12	3	85
Split System Heat Pump	10	8,747				
	11	8,623	(124)	27	73	0
	12	8,587	(160)	35	58	7
	13	8,630	(117)	33	37	30
	18	9,184	437	18	9	73
Single Package Air Conditioner	10	5,150				
	11	5,182	32	14	46	40

TABLE VI.16.—SUMMARY OF LCC RESULTS BASED ON ARI MEAN MANUFACTURER COST AND 14-YEAR AVERAGE LIFETIME

Product class	Efficiency level	Average LCC	Average LCC (savings) costs (in dollars)	Percent of consumers with		
				Net savings (>2%)	No significant impact	Net costs (>2%)
	12	5,157	7	22	29	49
	13	5,378	228	14	10	76
	18	6,011	861	9	3	88
Single Package Heat Pump	10	8,747				
	11	8,623	(124)	27	73	0
	12	8,587	(160)	35	58	7
	13	8,630	(117)	33	37	30
	18	9,184	437	18	9	73

3. Net Present Value and Net National Employment

The net present value analysis is a measure of the cumulative benefit or cost to the Nation of standards. As with the determination of national energy savings, five different scenarios were analyzed for each trial standard level consisting of variations on: (1) Electricity price and housing projections; (2) equipment efficiency distributions; (3) manufacturer cost estimates; (4) equipment lifetime; and (5) societal discount rate. Electricity price and housing projections were based on three different AEO 2000 forecasts: (1) Reference Case, (2) High Growth Case, and (3) Low Growth Case. Three efficiency scenarios were analyzed which forecast the equipment efficiency distribution after new standards were assumed to take effect: (1) NAECA scenario, (2) Roll-up scenario, and (3) Shift scenario. Manufacturer costs were based on ARI mean cost estimates. Equipment lifetime was assumed to be 18.4 years, coupled with the inclusion of compressor replacement costs. A societal discount rate of 7 was assumed. The range of NPVs are reported in Table VI.17.

TABLE VI.17.—NET PRESENT VALUE VARIATION WITH ELECTRICITY PRICE AND HOUSING PROJECTIONS

Trial standard level	Net present value for units sold from 2006 to 2030 (billion 98$)[1]		
	NAECA	Roll-up	Shift
1	0	1	0 to –1.
2	–1	0 to 1	–3 to –4.
3	–1 to –2	0 to –1	–5.
4	–5 to –6	–4	–10.
5	–22	–22	–22.

[1] Based on ARI mean manufacturer costs, 18.4-year retirement function with compressor replacement, and a 7% discount rate.

In order to show the significance of the NPVs in Table V.17 to the various input assumptions, Tables VI.18 through VI.21 report the range of NPV results for a range of assumptions and scenarios relative to the total national equipment and operating costs for all central air-conditioning and heat pump equipment under the base case (i.e., in the absence of new efficiency standards). The results in Table VI.18 are based on the AEO 2000 Reference Case forecast of electricity prices and housing. The total costs are presented for the base case and each Trial Standard Level. In addition, the NPV (the difference in total costs between the base case and trial standard level), as well as the NPV as a percentage of the ''Base Case Total Costs,'' are calculated for each trial standard level.

TABLE VI.18.—NET PRESENT VALUES RELATIVE TO BASE CASE TOTAL EQUIPMENT AND OPERATING COSTS[1]

TSL	Base case total costs (billion 98$)	Efficiency scenario								
		NAECA			Roll-up			Shift		
		Total costs (billion 98$)	NPV		Total costs (billion 98$)	NPV		Total costs (billion 98$)	NPV	
			(billion 98$)	as percent of base case total		(billion 98$)	as percent of base case total		(billion 98$)	as percent of base case total
1	381	381	0	0.0	381	1	0.2	385	0	–0.1
2	381	382	–1	–0.3	381	0	0.0	388	–3	–0.9
3	381	383	–2	–0.5	382	–1	–0.2	390	–5	–1.4
4	381	387	–5	–1.4	386	–4	–1.1	395	–10	–2.5
5	381	403	–22	–5.8	403	–22	–5.8	407	–22	–5.8

[1] Based on AEO 2000 Reference Case, ARI mean manufacturer costs, 18.4-year retirement function with compressor replacement, and a 7% discount rate. Values rounded to the nearest $1 billion.

Tables VI.19 through VI.21 show how the three scenarios, *i.e.,* reverse engineering costs, 14-year average life, and 3% discount rate,[17] impact the net present value. The three scenarios were investigated only for the NAECA efficiency scenario and the AEO Reference Case electricity price and housing projection.

TABLE V.19.—NET PRESENT VALUES RESULTS BASED ON REVERSE ENGINEERING MANUFACTURER COSTS [1]

Trial standard level	Base case total costs (billion 98$)	Trial standard level		
		Total cost (billion 98$)	Net present value (billion 98$)	As percent of base case total costs
1	379	378	2	0.4
2	379	377	2	0.5
3	379	378	1	0.4
4	379	379	0	0.0
5	379	390	–10	–2.7

[1] Based on AEO 2000 Reference Case, NAECA efficiency scenario, 18.4-year retirement function with compressor replacement, and a 7% discount rate. Values rounded to the nearest $1 billion.

TABLE V1.20.—NET PRESENT VALUES RESULTS BASED ON 14-YEAR AVERAGE LIFETIME [1]

Trial standard level	Base case total costs (billion 98$)	Trial standard level		
		Total cost (billion 98$)	Net present value (billion 98$)	As percent of base case total costs
1	363	364	0	0.0
2	363	365	–2	–0.5
3	363	366	–3	–0.8
4	363	370	–7	–1.9
5	363	389	–25	–6.9

[1] Based on AEO 2000 Reference Case, NAECA efficiency scenrio, ARI mean manufacturer costs, and a 7% discount rate. Values rounded to the nearest $1 billion.

TABLE VI.21.—NET PRESENT VALUES RESULTS BASED ON 3% DISCOUNT RATE [1]

Trial standard level	Base case total costs (billion 98$)	Trial standard level		
		Total cost (billion 98$)	Net present value (billion 98$)	As percent of base case total costs
1	712	708	3	0.5
2	712	708	4	0.5
3	712	708	3	0.4
4	712	714	–3	–0.4
5	712	746	–35	–4.9

[1] Based on AEO 2000 Reference Case, NAECA efficiency scenario, ARI mean manufacturer costs, and 18.4-year retirement function with compressor replacement. Values rounded to the nearest $1 billion.

The Department committed in its 1996 Process Improvement Rule to develop estimates of the employment impacts of proposed standards in the economy in general. 61 FR 36983.

As discussed above, energy efficiency standards for central air conditioners and heat pumps are expected to reduce electricity bills for residential and commercial consumers. The resulting net savings are expected to be redirected to other forms of economic activity. These shifts in spending and economic activity are expected to affect the demand for labor, but there is no generally accepted method for estimating these effects.

One method to assess the possible effects on the demand for labor of such shifts in economic activity is to compare sectoral employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS). The BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. BLS data indicate that expenditures in the electric sector generally are associated with fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy. There are many reasons for these differences, including the capital-intensity of the utility sector and wage differences.

In developing this proposed rule, the Department attempted a more precise analysis of the impacts on national labor demand using an input/output model of the U.S. economy. The model characterizes the interconnections among 35 economic sectors using the data from the Bureau of Labor Statistics. Since the electric utility sector is more capital-intensive and less labor-intensive than other sectors (see Bureau of Economic Analysis, Regional Multipliers: A User Handbook for the

[17] A societal discount rate of 3% value was investigated as a scenario in accordance with the Office of Management and Budget's (OMB) Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements.

Regional Input-Output Modeling System (RIMS II), Washington, D.C., U.S. Department of Commerce, 1992), a shift in spending away from energy bills into other sectors would be expected to increase overall employment. But for this analysis, since the increased manufacturing costs to the nation of meeting a new efficiency standard are relatively large, there is an overall decrease in national employment. The results of the Department's analysis are shown in Chapter 12 of the TSD.

While this input/output model suggests the proposed central air conditioner and heat pump standards are likely to decrease the net demand for labor in the economy, the losses would most likely be very small relative to total national employment. For several reasons, however, even these modest losses are in doubt:

- Unemployment is now at the lowest rate in 30 years. If unemployment remains very low during the period when the proposed standards are put into effect, it is unlikely that the standards alone could result in any net decrease in national employment levels.
- Neither the BLS data nor the input-output model used by DOE include the quality or wage level of the jobs. One reason that the demand for labor decreases in the model may be that the jobs expected to be created pay more than the jobs being lost. The losses from any potential employment reduction would be offset if job quality and pay are increased.
- The net benefits from potential employment changes are a result of the estimated net present value of benefits or losses likely to result from the proposed standards. It may not be appropriate to separately identify and consider any employment impacts beyond the calculation of net present value.

Taking into consideration these concerns regarding the interpretation and use of the employment impacts analysis, the Department concludes only that the proposed central air conditioner and heat pump standards are likely to result in no appreciable job losses to the nation.

Public comments are solicited on the validity of the analytical methods used and the appropriate interpretation and use of the results of this analysis.

4. Impact on Utility or Performance of Products

As detailed in Section V, in establishing classes of products we have tried to eliminate any degradation of utility or performance in the products under consideration in this rulemaking.

5. Impact of Any Lessening of Competition

The Act directs the Department to consider any lessening of competition that is likely to result from standards. It further directs the Attorney General to determine the impact, if any, of any lessening of competition likely to result from a proposed standard and transmit such determination to the Secretary, not later than 60 days after the publication of a proposed rule, together with an analysis of the nature and extent of such impact. EPCA section 325(o)(2)(B)(i)(V) and (B)(ii), 42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii).

In order to assist the Attorney General in making such a determination, the Department has provided the Department of Justice (DOJ) with copies of this notice and the TSD for review. At DOE's request, the DOJ reviewed the manufacturer impact analysis interview questionnaire to ensure that it would provide insight concerning any lessening of competition due to any proposed trial standard levels.

6. Need of the Nation to Save Energy

Enhanced energy efficiency improves the nation's energy security, and reduces the environmental impacts of energy production. Improved efficiency of central air conditioners and heat pumps is also likely to improve the reliability of the nation's electric system. The energy savings from central air conditioner and heat pump standards result in reduced emissions of carbon and NO_X. Cumulative emissions savings over the 16-year period modeled are shown in Table VI.22. Emission savings are based on the use of: (1) The ARI mean manufacturer cost data and (2) an 18.4–year average lifetime. The results presented in Table VI.22 are based only on the AEO 2000 Reference Case for electricity price and housing projections and the NAECA efficiency scenario.

TABLE VI.22.—CUMULATIVE EMISSIONS REDUCTIONS BASED ON AEO 2000 REFERENCE CASE AND NAECA EFFICIENCY SCENARIO (2006–2020)

Trial standard level	Emissions reductions	
	Carbon (Mt)	NO_X (kt)
1	13.4	37.2
2	23.7	67.9
3	27.4	78.8
4	33.6	102.5
5	63.7	193.7

The impact of varying electricity price and housing projections (*i.e.,* different AEO cases) as well as different efficiency scenarios were considered only for the Trial Standard Level 3. Table VI.23 shows how carbon and NO_X emissions are impacted by the different projections and scenarios.

TABLE VI.23.—CUMULATIVE EMISSIONS REDUCTIONS FOR PROPOSED STANDARD (2006–2020) AND THE IMPACT OF DIFFERENT ELECTRICITY PRICE/HOUSING PROJECTIONS AND EFFICIENCY SCENARIOS

Electricity price and housing projection	Efficiency scenario	Emission	
		Carbon (Mt)	NO_X (kt)
AEO Reference Case	NAECA	27.4	78.8
AEO Reference Case	Roll-up	26.2	77.8
AEO Reference Case	Shift	30.2	89.3
AEO Low Growth Case	NAECA	23.4	80.8
AEO High Growth Case	NAECA	34.1	75.8

The annual carbon emission reductions range up to 6.6 Mt in 2020 and the NO_X emissions reductions up to 24.5 kt in 2015.;[18 19] Total carbon and NO_X emissions for each trial standard level are reported in the Environmental Assessment, in the TSD.

7. Other Factors

This provision allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. EPCA Section 325(o)(2)(B)(i)(VI), 42 U.S.C. 6295(o)(2)(B)(i)(VI). The Secretary has decided that the impacts of the proposed standards on peak power requirements and electric utility system reliability, the impacts of proposed standards on those subgroups of consumers who are at or below the poverty line, and the impacts of proposed standards on consumers and manufacturers which might be required by proposed environmental regulations to incorporate ozone reduction technologies in air conditioning and heat pump equipment, are relevant to the economic justification of the standards, and has decided to consider such impacts in this rulemaking.

Peak power impacts are determined as part of the analysis to estimate impacts on electric utilities from increases in the central air conditioner and heat pump standard. NEMS–BRS is used to estimate peak power impacts by calculating the reduction in installed generation capacity due to an increase in the minimum efficiency standard. Table VI.24 shows the estimated reductions in installed generation capacity, in giga-watts (GW), in the year 2020 due to each of the trial standard levels. Of the installed generating capacity avoided, 13% would have been provided by coal power plants. The remaining percentage (87%) would have been supplied by either gas-fired, oil-fired, or dual-fired power plants. The results presented in Table VI.24 are based only on the AEO 2000 Reference Case for electricity price and housing projections and the NAECA efficiency scenario.

TABLE VI.24.—INSTALLED GENERATION CAPACITY REDUCTIONS IN THE YEAR 2020 BASED ON AEO 2000 REFERENCE CASE AND NAECA EFFICIENCY SCENARIO

Trial standard level	Installed generating capacity reduction (GW)
1	6.4
2	10.6
3	12.3
4	15.4
5	28.6

The impact of varying electricity price and housing projections (*i.e.,* different AEO cases) as well as different efficiency scenarios were considered only for the proposed standard (trial standard level 3). Table VI.25 shows how installed generation capacity is impacted by the different projections and scenarios.

TABLE VI.25.—INSTALLED GENERATION CAPACITY REDUCTIONS IN THE YEAR 2020 FOR TRIAL STANDARD LEVEL 3 AND THE IMPACT OF DIFFERENT ELECTRICITY PRICE/HOUSING PROJECTIONS AND EFFICIENCY SCENARIOS

Electricity price and housing projection	Efficiency scenario	Installed generating capacity reduction (GW)
AEO Reference Case	NAECA	12.3
AEO Reference Case	Roll-up	11.9
AEO Reference Case	Shift	13.6
AEO Low Growth Case	NAECA	11.4
AEO High Growth Case	NAECA	12.5

As discussed above, the impact of the peak power requirements of any single end-use on electric utility system reliability is highly uncertain. Thus, we plan on conducting further research to determine what connection, if any, exists between end-use peak demand reductions and system reliability. If such research is completed and applicable to this rulemaking, we will make it available for public review during the comment period on today's proposed rule.

Consumer subgroup impacts have been estimated by determining the LCC impacts of the trial standard levels on those consumers who are at or below the poverty line (*e.g.,* for a family of four, this constitutes a household income of less than $16,036). To perform this calculation, we used the subset of RECS 97 data for households that are considered low-income.[20] Table VI.26 summarizes the LCC impacts on those low-income consumers who utilize central air conditioners and heat pumps. The results in Table VI.26 are based on ARI mean manufacturer costs and an 18.4-year average lifetime.

TABLE VI.26.—SUMMARY OF LCC RESULTS ON LOW-INCOME CONSUMERS BASED ON ARI MEAN MANUFACTURER COSTS AND AN 18.4-YEAR AVERAGE LIFETIME

Product class	Efficiency level	Average LCC	Average LCC (savings) costs	Percent of consumers with		
				Net savings (>2 %)	No significant impact	Net costs (>2 %)
Split System Central Air Conditioner	10	$4,906				
	11	4,887	(19)	17	66	17
	12	4,903	(3)	20	29	51
	13	5,007	101	17	14	69
	18	5,598	692	10	2	88
Split System Heat Pump	10	8,965				

[18] Million metric tons (Mt).

[19] Thousand metric tons (kt).

[20] Approximately 7% of the RECS 97 households with central air conditioners and 9% of the households with heat pumps met this criteria.

TABLE VI.26.—SUMMARY OF LCC RESULTS ON LOW-INCOME CONSUMERS BASED ON ARI MEAN MANUFACTURER COSTS AND AN 18.4-YEAR AVERAGE LIFETIME—Continued

Product class	Efficiency level	Average LCC	Average LCC (savings) costs	Percent of consumers with Net savings (>2 %)	Percent of consumers with No significant impact	Percent of consumers with Net costs (>2 %)
	11	8,890	(75)	16	84	0
	12	8,862	(103)	27	64	9
	13	8,948	(17)	25	40	35
	18	9,610	645	11	8	81
Single Package Air Conditioner	10	5,327				
	11	5,283	(44)	11	42	47
	12	5,313	(14)	20	27	53
	13	5,568	241	12	9	79
	18	6,158	831	10	2	88
Single Package Heat Pump	10	9,149				
	11	9,057	(92)	21	78	1
	12	8,973	(176)	35	53	12
	13	9,145	(4)	25	27	48
	18	9,619	470	18	8	74

In comparing the LCC results on the subgroup of consumers who are low-income (Table V.26) versus all central air conditioner and heat pump consumers (Table V.14), it appears that low-income consumers have lower savings at the different trial standard levels than the general population of central air conditioner and heat pump consumers. Table V.27 directly compares the LCC impacts of the proposed standard on low-income and all consumers.

TABLE VI.27.—COMPARISON OF LCC IMPACTS OF THE PROPOSED STANDARD ON ALL CONSUMERS VS. LOW-INCOME CONSUMERS

Product class	Efficiency level	Average LCC (savings) costs		Percent of consumers with net costs (>2 % of baseline LCC)	
		All consumers	Low-income	All consumers	Low-income
Split System Central Air Conditioner	12	($45)	($3)	39	51
Split System Heat Pump	13	(215)	(17)	22	35
Single Package Air Conditioner	12	(29)	(14)	44	53
Single Package Heat Pump	13	(112)	(4)	36	48

The U.S. Environmental Protection Agency (EPA) requires states to develop a state implementation plan (SIP) for most areas that are not in compliance with the National Ambient Air Quality Standards (NAAQS), or classified as nonattainment. In Texas, four areas are in nonattainment of the EPA's one-hour NAAQS for ozone: Beaumont-Port Arthur, El Paso, Dallas-Fort Worth, and Houston-Galveston. On August 9, 2000, The Texas Natural Resource Conservation Commission (TNRCC), the lead environmental agency for the state of Texas, approved for publication and public hearing proposed revisions to the state implementation plan (SIP), in order to reduce ground-level ozone in the Houston/Galveston (HGA), Dallas/Fort Worth (DFW), and Beaumont/Port Arthur (BPA) ozone nonattainment areas, as well as in the 95-county central and eastern Texas. The proposed rules consist of 23 separate requirements applying to various regions of the state. One of the proposals mandates the use of a technology in the affected areas that will reduce ozone from ambient air that is drawn across the external heat exchanger units of air-cooled air conditioning units, including heat pumps. The proposed rule would require, after January 1, 2002, that all central air conditioners sold in the specified areas of Texas have ozone reduction technology installed.

The ozone reduction technology is a proprietary catalyst called PremAir, manufactured by the Engelhard Corporation. The catalyst is incorporated in air conditioners in two ways: by coating the condenser coils, or by installing an insert next to the condenser coil. The Department is required, by the Process Rule, to understand the costs and benefits of standards, and the distribution of those costs among consumers, manufacturers and others, and the uncertainty associated with these costs and benefits. Any adverse impacts on significant subgroups and uncertainty concerning adverse impacts must be fully considered in selecting a standard. If the introduction of this technology in Texas, and possibly other jurisdictions, would create new consumer subgroups or would significantly change the ability of equipment manufacturers to meet the new efficiency standard or the cost required to do so, the Department would factor that information into its decision making for this rule.

This technology has the potential for affecting the price and efficiency of central air conditioners. For example, DOE is aware of a range of estimates of what this technology would add to the cost of central air conditioners. The costs of this technology are estimated to range between $42 and $446 per 12,000 Btu/hr of air conditioner capacity. As to possible effects of the technology on the efficiency of central air conditioners, DOE understands several designs of catalyst-treated air conditioners have been tested by Intertek Testing Services (ITS). DOE understands the test results show no impact on efficiency for coated condenser coils, and a roughly 2%

reduction in efficiency for the catalyst insert.

Manufacturers could also be affected by the ozone reduction requirement. The higher purchase costs of new air conditioners could alter consumers' decisions on repairing or replacing equipment, which would affect air conditioner sales and impact manufacturers. If the effect applies to a significant fraction of units sold each year, the Department's current manufacturer impact analysis may underestimate the impact on manufacturers.

After reviewing the available information, DOE is not certain as to the impacts of any ozone reduction requirements that the TNRCC may adopt. The proposal is one of 23 requirements TNRCC may adopt and it is uncertain whether this requirement will be included in their final rule. Even if the requirement is adopted, it is unclear what, if any, effect the requirement would have on efficiency. Finally, DOE believes such a requirement may have an impact on manufacturers. DOE estimates a potential impact on 800,000 central air conditioner shipments per year covered by the TNRCC proposal, or approximately 13% of total shipments. This potential requirement was not included in today's proposed rule because of uncertainty about whether the TNRCC will include the catalyst requirement in their SIP. DOE invites comments on the status of the TNRCC deliberations and whether this potential requirement should be considered.

E. Conclusion

Section 325(o)(2)(A) of the Act, 42 U.S.C. 6295(o)(2)(A), specifies that any new or amended energy conservation standard for any type (or class) of covered product shall be designed to achieve the maximum improvement in energy efficiency which the Secretary determines is technologically feasible and economically justified. In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens. EPCA section 325(o)(2)(B)(i), 42 U.S.C. 6295(o)(2)(B)(i). The amended standard must ''result in significant conservation of energy.'' EPCA section 325(o)(3)(B), 42 U.S.C. 6295(o)(3)(B).

We consider the impacts of standards at each of five trial standards levels, beginning with the Max Tech Level, *i.e.*, Trial Standard Level 5. We then consider less efficient levels. Trial Standard Level 3 is a combination of different efficiency levels for the different classes. It combines the SEER values for air conditioners from Trial Standard Level 2 (12 SEER) with the SEER values for heat pumps from Trial Standard Level 4 (13 SEER). By combining efficiency levels in this way, the Department is able to evaluate the impacts of different combinations of standard levels to make an informed decision on the merits of different efficiency combinations.

To aid the reader as we discuss the benefits or burdens of the trial levels, we have included a summary of the analysis results in Tables VI.28 and VI.29.[21] Table VI.28 presents a summary of analysis results based on ARI mean manufacturing costs, NAECA and Roll-up efficiency scenarios and 7% and 3% societal discount rate scenarios. Table VI.29 presents a summary of analysis results based on manufacturing costs obtained from the reverse engineering analysis for the NAECA efficiency scenario and 7% and 3% societal discount rate scenario. Both tables assume an 18.4-year equipment lifetime, including one compressor replacement. The reverse engineering scenario results in Table VI.29 are limited to single scenarios which highlight the impact of manufacturing costs on the consumer, manufacturers, national energy savings, and NPV.

TABLE VI.28.—SUMMARY OF ANALYSIS RESULTS BASED ON ARI MEAN MANUFACTURER COSTS [1]

	Trial std 1	Trial std 2	Trial std 3	Trial std 4	Trial std 5
Total Quads Saved [2]	1.7–1.8	2.9–3.2	3.4–3.6	4.2–4.5	8.1–8.7
Generation Capacity Offset (GW)[3]	6.4	10.6	12.3	15.4	28.6
NPV ($billion): [4]					
7% Discount Rate	0	−1	−1 to −2	−5 to −6	−22
3% Discount Rate	3	4	3	−3	−35
Emissions: [5]					
Carbon Equivalent (Mt)	13.4	23.7	27.4	33.6	63.7
NO_X (kt)	37.2	67.9	78.8	102.5	193.7
Cumulative Change in INPV ($ million): [6]					
NAECA	(37)	(186)	(197)	(183)	
Roll-up	(181)	(362)	(367)	(335)	
Life Cycle Cost ($):					
Split AC	($44)	($45)	($45)	$29	$555
Packaged AC	$20	($29)	($29)	$175	$741
Split HP	($150)	($242)	($215)	($215)	$276
Packaged HP	($134)	($254)	($112)	($112)	$296
Payback (years):					
Split AC	10.6	12.6	12.6	16	36
Packaged AC	16.1	14	14	21.8	48.8
Split HP	5.5	7.2	9.3	9.3	17.3
Packaged Heat Pump	8.1	8.7	13.2	13.2	19.4

[1] Estimates are based on 18.4-year lifetime.
[2] Based on AEO 2000 reference, high and low growth cases, and NAECA efficiency distributions.
[3] Reductions in installed generation capacity in the year 2020, based on AEO 2000 reference case, NAECA efficiency scenario.
[4] Based on NAECA efficiency distribution and 7 % discount rate. Range reflects AEO 2000 reference, high and low growth cases.
[5] Based on AEO 2000 reference case, NAECA efficiency scenario, and ARI mean manufacturing costs.
[6] Not calculated at Trial Standard Level 5.

[21] All cumulative effects that are not monetary are not discounted. Monetary effects are discounted to 1998 dollars.

TABLE VI.29.—SUMMARY OF ANALYSIS RESULTS BASED ON REVERSE ENGINEERING MANUFACTURING COSTS)[1]

	Trial std 1	Trial std 2	Trial std 3	Trial std 4	Trial std 5
Total Quads Saved[2]	1.7–1.8	2.9–3.2	3.4–3.7	4.3–4.6	8.4–9.0
Generation Capacity Offset (GW)[3]	6.4	10.6	12.3	15.4	28.6
NPV ($billion):					
7% Discount Rate[2]	1 to 2	2	1 to 2	0 to 1	−10 to −11
3% Discount Rate	6	10	10	9	−8
Emissions:[3]					
Carbon Equivalent (Mt)	13.4	23.7	27.4	33.6	63.7
NO_X (kt)	37.2	67.9	78.8	102.5	193.7
Cumulative Change in INPV ($ million):					
NAECA	(30)	(159)	(171)	(169)	
Roll-up[3]	(181)	(362)	(367)	(335)	
Life Cycle Cost ($):					
Split AC	($75)	($113)	($113)	($113)	$137
Packaged AC	($78)	($163)	($163)	($29)	$276
Split HP	($209)	($365)	($372)	($372)	$41
Packaged HP	($207)	($421)	($353)	($353)	($166)
Payback (years):					
Split AC	7.8	9.8	11.3	11.3	19.6
Packaged AC	7.7	7.5	7.5	14.5	25.1
Split HP	2.7	3.9	6.4	6.4	14.0
Packaged Heat Pump	4.6	4.0	8.4	8.4	12.81

[1] Based on 18 year lifetime, NAECA efficiency scenario and AEO 2000 reference case.
[2] Variation based on AEO 2000 reference, low and high growth case.
[3] Based on ARI mean manufacturer costs as reported in Table VI.28.

First we considered Trial Standard Level 5, the most efficient level for each of four classes, representing uniform 18 SEER requirements. Trial Standard Level 5 saves between 8.1 and 8.7 Quads of energy, a significant amount. The estimated reduction in installed generating capacity is 28.6 GW, or roughly 73 large, 400 megawatt, power plants.[22] The forecasted reduction in generating capacity is approximately 3.7% of current installed generating capacity and more than 13% of the anticipated growth in capacity needed by 2020. The emissions reductions of 63.7 Mt of carbon equivalent and 193.7 kt of NO_X are also significant. However, at this level, the vast majority of consumers would experience an increase in LCC costs. Purchasers of split central air-conditioners, the predominate class of central air conditioner with 65% of the sales of central air conditioners and heat pumps, would lose $555 over the life of their appliance.[23] Purchasers of split heat pumps, the predominate class of heat pump, would lose $276.[24] Moreover, the Department believes these LCC results overstate the benefits of this trial standard level. Because we did not have equipment cost estimates at this level, we used instead the costs of 15 SEER equipment. DOE believes the costs of 18 SEER equipment would be higher than the 15 SEER costs and that, as a result, the increase in life-cycle-costs would actually be greater than our LCC analysis indicates. For the nation as a whole Trial Standard Level 5 would have a net cost 22 billion dollars in NPV.[25] The Department did not calculate manufacturer impacts at this trial standard level. The Department concludes that at this trial standard level, the benefits of energy savings, generating capacity reductions and emission reductions would be outweighed by the negative economic impacts to the nation, to the vast majority of consumers and to the manufacturers. Consequently, the Department concludes Trial Standard Level 5, the Max Tech Level, is not economically justified.

Next, we considered Trial Standard Level 4. This level specifies 13 SEER equipment for all product classes and would save between 4.2 and 4.5 Quads of energy, a significant amount. The estimated reduction in installed generating capacity is 15.4 GW, or roughly 39 large, 400 megawatt, power plants.[26] The forecasted reduction in generating capacity is approximately 2% of current installed generating capacity and more than 7% of the anticipated growth in capacity needed in 2020. The emissions reductions would also be significant: 33.6 Mt of carbon equivalent and 102.5 kt of NO_X. The NPV of Trial Standard Level 4 would have a net cost of between 5 and 6 billion dollars.[27] The average LCC savings for consumers with split heat pumps would be $215, based on ARI equipment costs.[28] Owners of split air conditioners could see their LCC increase by $29, based on ARI costs.[29]

Under Trial Standard Level 4, the air conditioning industry would experience a NPV loss of between 169 and 335 million dollars. The range of impacts is driven primarily by the assumption regarding the distribution of air conditioner and heat pump efficiencies in the market after implementation of the standard (NAECA or Roll-up). The Department recognizes that the ability to maintain a full product line is more difficult at higher standard levels and therefore places more weight on the Roll-up scenario at Trial Standard Level 4. The Department concludes that at Trial Standard Level 4 the benefits of energy savings, generating capacity

[22] DOE estimates 9 coal-fired power plants and 64 gas-fired power plants can be avoided. See TSD, Chapter 11 and Appendix H.

[23] Consumers would experience a $137 increase in life-cycle-costs based on the Department's reverse engineering manufacturing costs.

[24] Consumers would experience a $41 increase in life-cycle-costs based on the Department's reverse engineering manufacturing costs.

[25] At the 3% societal discount rate scenario, the nation would have a net cost of 35 billion dollars. With the reverse engineering equipment cost, the NPV is a net cost of 10 to 11 billion dollars at the 7% discount rate and 8 billion dollars at 3%.

[26] DOE estimates 5 coal-fired power plants and 34 gas-fired power plants can be avoided. See TSD, Chapter 11 and Appendix H.

[27] At the 3% societal discount rate scenario, the nation would have a net cost of 3 billion dollars. With the reverse engineering equipment cost, the NPV has a no net cost at the 7% discount rate and a savings of 9 billion dollars at 3%.

[28] Consumers would experience a $372 savings in life-cycle-costs based on the Department's reverse engineering costs.

[29] Consumers would experience a $133 savings in life-cycle-costs based on the Department's reverse engineering manufacturing costs.

reductions and emission reductions and the reduction in LCC for some consumers are outweighed by the negative economic impacts on the nation, increase in LCC for most consumers and manufacturer loss in NPV. Consequently, the Department concludes Trial Standard Level 4 is not economically justified.

Next, we considered Trial Standard Level 3. This level specifies 12 SEER for air conditioners and 13 SEER for heat pumps. The energy savings are estimated to be between 3.4 and 3.6 quads, a significant amount. The estimated reduction in installed generating capacity is 12.3 GW, or roughly 31 large, 400 megawatt, power plants.[30] The forecasted reduction in generating capacity is approximately 1.6% of current installed generating capacity and more than 5% of the anticipated growth in capacity needed in 2020. The emissions reductions would also be significant: 27.4 Mt of carbon equivalent and 78.8 kt of NO_X. The national NPV of this trial standard level has a range of net costs from 1 to 2 billion dollars, using ARI costs.[31 32] All classes of product would have mean LCC savings. The average LCC savings for consumers with split air conditioners would be $45, using ARI costs.[33] The average LCC savings for consumers with split heat pumps would be $215, using ARI costs.[34] As an additional LCC analysis, DOE considered the effect of standards on low-income consumers. DOE expects low-income consumers will experience less savings than the population as a whole. (See TSD, Chapter 10). Under this trial standard level, the air conditioning industry would experience a NPV loss of between 171 and 367 million dollars depending on whether the Roll-up or NAECA efficiency distribution scenario is considered.

Given the benefits and burdens of Trial Standard Level 3 as discussed above, and observing the reduction in NPV compared to Trial Standard Level 2, the Department compared the benefits and burdens of the two trial standard levels. Adopting Trial Standard Level 3, instead of Trial Level 2, would save the nation an additional 0.5 Quads of energy, and further reduce installed generating capacity by 1.7 GW, or roughly 5 large, 400 megawatt, power plants.[35] The incremental emission reductions of carbon equivalent and NO_X are 3.7 Mt and 10.9 kt, respectively. Trial Standard Level 3 would, however, reduce the national NPV by up to 1 billion dollars, depending on the cost estimates used.[36 37] The consumer LCC savings are not changed for central air conditioners, but are reduced by $27 for split heat pumps using ARI costs.[38]

In determining the economic justification of Trial Standard Level 3, the Department has weighed the benefits of energy savings, generating capacity reductions, reduced average consumer LCC, and emissions reductions against the burdens of a loss in manufacturer net present value, consumer LCC increases for some households and the potential loss in national NPV. We find the benefits to be substantial. Although the loss in manufacturer net present value is also substantial, the projected LCC increases and loss in national NPV are relatively small, and these burdens of Trial Standard Level 3 would be outweighed by its benefits. Moreover, in light of the reverse engineering analysis, we believe the equipment costs will be lower than the ARI estimates on which we have relied and that the loss in national NPV would be less than estimated.

Comparing Trial Standard Level 3 to Trial Standard Level 2, DOE found the potential decrease in national NPV is outweighed by other factors not included in the national NPV calculations. For example, the national NPV calculation does not include quantitative estimates for the value of emission reductions.[39] Furthermore, as an added benefit, the standard may improve the reliability of the electric distribution system. The Department finds that, compared with Trial Standard Level 2, the incremental benefits of generating capacity reductions and emission reductions of Trial Standard Level 3 to be greater than the potential loss in national NPV and increase in life-cycle-costs to some consumers, including a relatively small number of low-income consumers.

After considering the benefits and burdens of Trial Standard Level 3 and comparing the impacts of Trial Standard Levels 2 and 3, the Department finds Trial Standard Level 3 to be maximum improvement in efficiency that is technologically feasible and economically justified. Therefore, the Department today proposes to adopt the energy conservation standards for air conditioners and heat pumps at Trial Standard Level 3.

VII. Procedural Issues and Regulatory Review

A. Review Under the National Environmental Policy Act

The Department is preparing an Environmental Assessment of the impacts of the proposed rule and DOE anticipates completing a Finding of No Significant Impact (FONSI) before publishing the final rule on Energy Conservation Standards for central air conditioners and heat pumps, pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 *et seq.*), the regulations of the Council on Environmental Quality (40 CFR Parts 1500–1508), and the Department's regulations for compliance with NEPA (10 CFR Part 1021).

B. Review under Executive Order 12866, ''Regulatory Planning and Review''

The Department has determined today's regulatory action is a significant regulatory action within the scope of section 3(f)(1) of Executive Order 12866, ''Regulatory Planning and Review.'' (58 FR 51735, October 4, 1993). Therefore, this proposal requires a regulatory analysis. Such an analysis presents major alternatives to the proposed regulation that could achieve substantially the same goal, as well as a description of the cost and benefits

[30] DOE estimates 4 coal-fired power plants and 27 gas-fired power plants can be avoided. *See* TSD, Chapter 11 and Appendix H.

[31] At the 3% societal discount rate scenario, the nation would have a net savings of 3 billion dollars. With the reverse engineering equipment cost, the NPV has a net savings of 1 billion dollars at the 7% discount rate and 10 billion dollars at 3%.

[32] DOE observes that the average LCC savings for all classes at this trial standard level are positive and at the same time the NPV is negative. This is a counterintuitive result since the NPV can be described as a sum of individual consumer LCCs. The negative NPV is caused by a number of factors, including the assumption in the NES that some consumers will purchase more efficient products than is required by the standard, *e.g.,* 14 SEER. Since the NES uses average usage rates and average marginal energy prices for these consumers, it may overstate the life-cycle-costs for consumers that voluntarily purchase products which, based on average values, would seem not to be cost-effective. Furthermore, the NES does not consider factors such as utility rebate programs which would have a effect on total discounted costs.

[33] Consumers would experience a $113 savings in life-cycle-costs based on the Department's reverse engineering costs.

[34] Consumers would experience a $372 increase in life-cycle-costs based on the Department's reverse engineering costs.

[35] DOE estimates one coal-fired power plants and four gas-fired power plants can be avoided.

[36] At the 3% societal discount rate, the national NPV is reduced by 1 billion dollars. With the reverse engineering equipment cost, the NPV is not changed.

[37] The total national discounted cost of owning and operating central air conditioners and heat pumps at this Trial Standard Level 3 is 382 billion dollars.

[38] Using the reverse engineering costs the savings are increased by $7.

[39] It is possible the NPV does not include the value of avoided power plants. It should be

[36] At the 3% societal discount rate, the national NPV is reduced by 1 billion dollars. With the reverse engineering equipment cost, the NPV is not changed.

(including potential net benefits) of the proposed rule. Accordingly, the Office of Information and Regulatory Affairs (OIRA) reviewed today's action under the Executive Order.

There were no substantive changes between the draft we submitted to OIRA and today's action. The draft and other documents we submitted to OIRA for review are a part of the rulemaking record and are available for public review in the Department's Freedom of Information Reading Room, 1000 Independence Avenue, SW., Washington, DC 20585, between the hours of 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays, telephone (202) 586–3142.

The following summary of the Regulatory Impact Analysis (RIA) focuses on the major alternatives considered in arriving at the proposed approach to improving the energy efficiency of consumer products. The reader is referred to the complete RIA, which is contained in the TSD, available as indicated at the beginning of today's proposed rule. The RIA consists of: (1) A statement of the problem addressed by this regulation, and the mandate for government action; (2) a description and analysis of the feasible policy alternatives to this regulation; (3) a quantitative comparison of the impacts of the alternatives; and (4) the economic impact of the proposed standard.

The RIA calculates the effects of feasible policy alternatives to central air conditioner and heat pump energy efficiency standards, and provides a quantitative comparison of the impacts of the alternatives. We evaluate each alternative in terms of its ability to achieve significant energy savings at reasonable costs, and we compare it to the effectiveness of the proposed rule.

We created the RIA using a series of regulatory scenarios (with various assumptions), which we used as input to the shipments model for central air conditioners and heat pumps. We used the results from the shipments model as inputs to the NES spreadsheet calculations.

DOE identified the following seven major policy alternatives for achieving consumer product energy efficiency. These alternatives include:

- No New Regulatory Action
- Informational Action
  —Product Labeling
  —Consumer Education
- Prescriptive Standards
- Financial Incentives
  —Tax credits
  —Rebates
  —Low income and seniors subsidy
- Voluntary Energy Efficiency Targets (5 Years, 10 Years)
- Mass Government Purchases
- The Proposed Approach (Performance Standards)

We have evaluated each alternative in terms of its ability to achieve significant energy savings at reasonable costs (Table VII.1), and have compared it to the effectiveness of the proposed rule. All of the results below have been determined with the AEO Reference Case and the NAECA efficiency scenario.

TABLE VII.1.—ALTERNATIVES CONSIDERED

Policy alternatives	NPV (billions 98$)	Energy Savings (Quads)
Consumer Product Labeling	0	0.1
Consumer Education	0	0.1
Prescriptive Standards	0	1.1
Consumer Tax Credits	0	0.1
Consumer Rebates	0	0.2
Manufacturer Tax Credits	0	0.0
Voluntary Efficiency Target (5 year delay)	−1	3.1
Voluntary Efficiency Target (10 year delay)	−1	1.9
Low Income Subsidy	0	0.1
Mass Government Purchases	0	0
Performance Standards	−2	4.4

NPV = Net Present Value (2006–2030, in billion 1998$) (does not include government expenses).
Savings = Energy Savings (Source Quads).

If we imposed no new regulatory action, then we would implement no new standards for this product. This is essentially the ''base case'' for central air conditioners and heat pumps. In this case, between the years 2006 and 2030, there would be an expected energy use of 39 Quads of primary energy, with no energy savings and a zero NPV.

We grouped several alternatives to the base case under the heading of informational action. They include consumer product labeling and DOE public education and information programs. Both of these alternatives are already mandated by, and are being implemented under EPCA sections 324 and 337, 42 U.S.C. 6294, 6297. One base case alternative would be to estimate the energy conservation potential of enhancing consumer product labeling. To model this possibility, the Department estimated that 5% of the consumers purchasing 10 SEER equipment and 5% of the consumers purchasing 12 SEER equipment would change their decisions and purchase 12 SEER and 13 SEER systems, respectively. It is assumed that the program would last six years and upon its expiration consumers would revert back to their prior purchase decisions. The consumer product labeling alternative resulted in 0.1 Quad of energy savings with no impact on the NPV.

Another approach, called consumer education, is to consider an Energy Star® program for 12 SEER and 13 SEER central air conditioners and heat pumps. We assume, under this program, there would be a 20% increase in the sales of both 12 SEER and 13 SEER systems. As with the consumer product labeling program, it is assumed that the education program would last six years and upon its expiration sales would drop back to their market share levels prior to the program's implementation. This consumer education program results in energy savings equal to 0.1 Quad with no impact on the NPV.

Another method of setting standards would entail requiring that certain design options be used on each product, *i.e.,* for DOE to impose prescriptive standards. For this approach, we assume that a prescriptive standard is implemented to ensure that all central air conditioners and heat pumps are equipped with thermostatic expansion valves (TXVs). The resulting efficiency increase is 0.5 SEER. That is, the baseline efficiency of 10 SEER is assumed to increase to 10.5 SEER as a result of the prescriptive standard. Manufacturer costs associated with this standard were arrived by linearly interpolating between those costs associated with the baseline (*i.e.,* 10 SEER) and 11 SEER efficiency levels. This resulted in energy savings of 1.1 Quad and no impact on the NPV.

We tested various financial incentive alternatives. These included tax credits and rebates to consumers, as well as tax credits to manufacturers. We assumed the tax credits to consumers were 50% of the incremental purchase price for higher energy-efficiency equipment. The incremental price is based on the difference between the 2006 baseline price and the price of 12 SEER equipment. We estimate the impact of this policy would be to move 5% of the market share from the 2006 baseline to 12 SEER models. These tax credits would start in 2006 and run for six years. We assume people stop buying these more efficient and more expensive central air conditioners and heat pumps when the tax credits stop. The tax credits to consumers showed a change from the base case, saving 0.1 Quad with no impact to the NPV.

To estimate the impact of consumer rebates, we assumed rebates of 35% of the incremental retail prices for higher energy-efficiency equipment. The incremental cost is based on the difference between the 2006 baseline cost and the cost of 12 SEER equipment. We estimate the impact of this policy would be to move 10% of market share from the 2006 baseline to the 12 SEER models. These rebates would start in 2006 and run for six years. We assume people stop buying these more efficient and more expensive central air conditioners and heat pumps when the rebates stop. The rebates to consumers showed a change from the base case, would save 0.2 Quad with no impact to the NPV.

Another financial incentive we considered was a tax credit to manufacturers for the production of energy-efficient models of central air conditioners and heat pumps. We assumed an investment tax credit of 20%, applicable to the tooling and machinery costs of the manufacturers. These are tooling costs as they relate to producing 12 SEER central air conditioners and heat pumps. We estimate the impact of this policy would be to move 1% of the market share from the 2006 baseline to the 12 SEER models. These tax credits would start in 2006 and run for six years. We assume no persistence in the market once they stop. Tax credits to manufacturers would save no energy and have no impact on the NPV. The impact of this scenario would be negligible because the investment tax credit was applicable only to the tooling and machinery costs of the firms. The firms' fixed costs and some of the design improvements that would likely be adopted to manufacture more efficient versions of this product would involve purchased parts. Expenses for purchased parts would not be eligible for an investment tax credit.

We examined two scenarios of voluntary energy efficiency targets. In the first one, we assumed all the relevant manufacturers voluntarily adopted the proposed energy conservation standards in five years. In the second scenario, we assumed the proposed standards were adopted in 10 years. In these scenarios, voluntary improvements having a five-year delay, compared to implementation of mandatory standards, would result in energy savings of 3.1 Quads and −$1 billion NPV; voluntary improvements having a 10-year delay would result in 1.9 Quads being saved and −$1 billion NPV. These scenarios assume that there would be universal voluntary adoption of the energy conservation standards by these appliance manufacturers, an assumption for which there is no assurance.

One of the market barriers to higher efficiency central air conditioners and heat pumps is the expense to upgrading to a more efficient system. Since these expenses can be a particular burden on low income households, we considered a low income subsidy of $500 to make higher efficiency central air-conditioning and heat pump equipment available and cost effective for these households. We determined the number of low income households with central air-conditioning from the RECS public use data. We assumed that half of these households would take advantage of the program. The program would start in 2006 and run for six years. This subsidy would save 0.1 Quad with no impact to the NPV.

Another policy alternative we reviewed was that of large purchases of high efficiency central air conditioners and heat pumps by Federal, State, and local governments. We modeled this policy by assuming these governmental entities (*e.g.,* U.S. Department of Housing and Urban Development at the Federal level) purchased 12 SEER equipment for 5% of the low income, rented housing stock utilizing central air-conditioning and heat pump equipment. This policy alternative resulted in no energy savings with no impact to the NPV.

Lastly, all of these alternatives must be gauged against the performance standards we are proposing in today's proposed rule. Such performance standards would result in energy savings under the AEO Reference Case and NAECA efficiency scenario of 3.5 Quads, and the NPV estimates range from an increase of $3 billion to a cost of $2 billion.

As indicated in the paragraphs above, none of the alternatives we examined for these products would save as much energy as today's proposed rule. Also, several of the alternatives would require new enabling legislation, since authority to carry out those alternatives does not presently exist.

C. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) requires an assessment of the impact of regulations on small businesses. For air conditioning and warm air heating equipment manufacturing, a ''firm'' is defined by the Small Business Administration as a small business if it (including affliates) has 750 or fewer employees.

The residential air-conditioner industry is characterized by seven firms accounting for nearly 95% of sales. DOE understands that each of these firms, including its affiliates, has more than 750 employees. Smaller businesses and firms, which make specialty air-conditioning products and supply niche markets, share 5% of the market.

In this industry, average production cost is inversely related to firm size. The industry displays economies of scale, and large firms (to the extent that their facilities are modernized) have lower average production costs than small firms. This fact, coupled with increasing competitiveness of the national market, probably accounts for the consolidation that has occurred for several decades. The fact that the consolidation has been producing larger firms strongly corroborates the finding that large firms have a cost advantage.

A principal implication of consolidation is that the smaller of the firms will be, on average, more vulnerable to the financial impacts of higher efficiency standards. Any decrease in average profitability is more likely to mean the difference between success and failure for a smaller firm.

The impact of higher efficiency standards on small firms is likely to be mixed. Those firms that face a large technological challenge in meeting the new standards may face a disproportionate burden, because smaller firms have more limited research and development capabilities than their larger competitors. Some smaller manufacturers indicated the potential for a negative economic impact of any higher standard level on their firms. However, since these concerns apply primarily to small manufacturers of niche products, they benefit from the provisions proposed by the Department to somewhat protect those products from the new standards. For example, a separate product class is being proposed for through-the-wall equipment, many of which are manufactured by small manufacturers. Also, the Department has acknowledged that small manufacturers of high velocity distribution systems may potentially be adversely affected by the proposed standard level. The Department is considering modifications to the SEER test procedure, which would grant these manufacturers some relief. Vertical-packaged, wall-mounted equipment is another product manufactured by small firms, and, as stated in Section V.J.3 of this notice, the Department intends to consider those to be commercial products under EPACT. These provisions should eliminate any potential for significant economic impact on small manufacturers related to the proposed standard level.

Many small manufacturers produce coils only. Since there are no intensive incremental technological or capital requirements for these companies to increase the efficiency of their products, we do not expect them to face any incremental burden as a result of the new standards.

In view of these conclusions, the Department has determined and hereby certifies pursuant to section 605(b) of the Regulatory Flexibility Act that, for this particular industry, the proposed standard levels in today's proposed rule will not ''have a significant economic impact on a substantial number of small entities,'' and it is not necessary to prepare a regulatory flexibility analysis.

D. Review Under the Paperwork Reduction Act

No new information or record keeping requirements are proposed in this rulemaking. Accordingly, no Office of Management and Budget clearance is required under the Paperwork Reduction Act. 44 U.S.C. 3501 *et seq.*

E. Review Under Executive Order 12988, ''Civil Justice Reform''

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

F. ''Takings'' Assessment Review

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

G. Review Under Executive Order 13132

Executive Order 13132 (64 FR 43255, August 4, 1999) requires agencies to develop an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have ''federalism implications.'' Agencies are required to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and carefully assess the necessity for such actions. DOE has examined today's proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. State regulations that may have existed on the products that are the subject of today's proposed rule were preempted by the Federal standards established in NAECA 1987. States can petition the Department for exemption from such preemption based on criteria set forth in EPCA. No further action is required by Executive Order 13132.

H. Review Under the Unfunded Mandates Reform Act

With respect to a proposed regulatory action that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more (adjusted annually for inflation) in any one year, section 202(a) of the Unfunded Mandates Reform Action of 1995 (UMRA), 2 U.S.C. 1531 *et seq.* requires a Federal agency to publish a written statement concerning estimates of the resulting costs, benefits and other effects on the national economy. 2 U.S.C. 1532(a),(b). DOE estimates that the proposed standards, if adopted, would not result in the expenditure by the private sector of $100 million or more in a year, with the possible exception of one year in which industry expenditures could total approximately $110 million.

Section 202 of UMRA authorizes an agency to respond to the content requirements of UMRA in any other statement or analysis that accompanies the proposed rule. 2 U.S.C. 1532(c). The content requirements of section 202(b) of UMRA relevant to a private sector mandate substantially overlap the economic analysis requirements that apply under section 325(o) of EPCA and Executive Order 12866. The Supplementary Information section of the Notice of Proposed Rulemaking and ''Regulatory Impact Analysis'' section of the TSD for today's proposed rule responds to those requirements.

DOE is obligated by Section 205 of UMRA, 2 U.S.C. 1535, to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. From those alternatives, DOE must select the least costly, more cost-effective or least burdensome alternative that achieves the objectives of the rule, unless DOE publishes an explanation of why a different alternative is selected. As required by section 325(o) of the Energy Policy and Conservation Act (42 U.S.C. 6295(o)), this proposed rule would establish energy conservation standards for central air conditioners and heat pumps that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the ''Regulatory Impact Analysis'' section of the TSD for this notice.

I. Review Under the Treasury and General Government Appropriations Act of 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. No. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any proposed rule or policy that may affect family well-being. Today's proposal would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

J. Review Under the Plain Language Directives

Section 1(b)(12) of Executive Order 12866 requires that each agency draft its regulations to be simple and easy to understand, with the goal of minimizing the potential for uncertainty and litigation arising from such uncertainty. Similarly, the Presidential memorandum of June 1, 1998 (63 FR 31883) directs the heads of executive departments and agencies to use, by January 1, 1999, plain language in all proposed and final rulemaking documents published in the **Federal Register**, unless the rule was proposed before that date.

Today's proposed rule uses the following general techniques to abide by section 1(b)(12) of Executive Order 12866 and the Presidential memorandum of June 1, 1998 (63 FR 31883):

- Organization of the material to serve the needs of the readers (stakeholders).
- Use of common, everyday words in short sentences.
- Shorter sentences and sections.

We invite your comments on how to make this proposed rule easier to understand.

VIII. Public Comment

A. Written Comment Procedures

The Department invites interested persons to participate in the proposed rulemaking by submitting data, comments, or information with respect to the proposed issues set forth in today's proposed rule to Ms. Brenda Edwards-Jones, at the address indicated at the beginning of this notice. We will consider all submittals received by the date specified at the beginning of this notice in developing the final rule.

According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit one complete copy of the document and ten (10) copies, if possible, from which the information believed to be confidential has been deleted. The Department of Energy will make its own determination with regard to the confidential status of the information and treat it according to its determination.

Factors of interest to the Department when evaluating requests to treat as confidential information that has been submitted include: (1) A description of the items; (2) an indication as to whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) an indication as to when such information might lose its confidential character due to the passage of time; and (7) whether disclosure of the information would be contrary to the public interest.

B. Public Workshop/Hearing

1. Procedure for Submitting Requests To Speak

You will find the time and place of the public hearing listed at the beginning of this notice. We invite any person who has an interest in today's notice, or who is a representative of a group or class of persons that has an interest in these issues, to request an opportunity to make an oral presentation. If you would like to attend the public hearing, please notify Ms. Brenda Edwards-Jones at (202) 586–2945. You may hand deliver requests to speak to the address indicated at the beginning of this notice between the hours of 8 a.m. and 4 p.m., Monday through Friday, except Federal holidays. You may also send them by mail or E-mail to brenda.edwards-jones@ee.doe.gov.

The person making the request should state why he or she, either individually or as a representative of a group or class of persons, is an appropriate spokesperson, briefly describe the nature of the interest in the rulemaking, and provide a telephone number for contact. We request each person selected to be heard to submit an advance copy of his or her statement at least two weeks prior to the date of this hearing as indicated at the beginning of this notice. At our discretion, we may permit any person who cannot do this to participate if that person has made alternative arrangements with the Office of Building Research and Standards in advance. The request to give an oral presentation should ask for such alternative arrangements.

2. Conduct of Hearing

The Department will designate a Department official to preside at the workshop and we may also use a professional facilitator to facilitate discussion. The workshop will not be a judicial or evidentiary-type hearing, but the Department will conduct it in accordance with 5 U.S.C. 553 and Section 336 of the Act and a court reporter will be present to record the transcript of the workshop. We reserve the right to schedule the presentations by workshop participants, and to establish the procedures governing the conduct of the workshop.

The Department will permit each participant to make a prepared general statement, limited to five (5) minutes, prior to the discussion of specific topics. The general statement should not address these specific topics, but may cover any other issues pertinent to this rulemaking. The Department will permit other participants to briefly comment on any general statements. We will divide the remainder of the hearing into segments, with each segment consisting of one or more of the following specific topics covered by this notice:

- Engineering analysis, including mark-up;
- Life-Cycle-Cost and payback analysis;
- National Energy Savings and Net Present Value;
- Manufacturer impacts;
- Utility impacts;
- Proposed standards, including an EER-based standard and TXV considerations; and
- Other issues.

The Department will introduce each topic with a brief summary of the relevant parts of our analysis and of the proposed rule, and the significant issues involved. We will then permit participants in the hearing to make a prepared statement limited to five (5) minutes on that topic. At the end of all prepared statements on a topic, the Department will permit each participant to briefly clarify his or her statement and comment on statements made by others. Participants should be prepared to answer questions by us and by other participants concerning these issues. Our representatives may also ask questions of participants concerning other matters relevant to the hearing. The total cumulative amount of time allowed for each participant to make prepared statements will be 20 minutes.

The official conducting the hearing will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further procedural rules, or modification of the above procedures, needed for the proper conduct of the hearing.

We will make the entire record of this rulemaking, including the transcript, available for inspection in the Department's Freedom of Information Reading Room. Any person may purchase a copy of the transcript from the transcribing reporter.

C. Issues for Which DOE Seeks Comment

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

(1) Whether explicit consideration of extended warranties would produce significantly different results from those based on service costs alone;

(2) The Department's methodology and data for determining the appropriate marginal energy costs;

(3) The burdens and benefits that would result from including an EER requirement in the final rule. Of particular interest are comments regarding burdens on manufacturers, benefits regarding reduction in peak electricity demand, the effect of more stringent standards on the cost and availability of modulating equipment, and the effect that an EER floor would have on electrical system reliability. In addition, comments are welcome to discuss the pros and cons of any of the options described in Section V.I.2 above, as well as other approaches;

(4) Whether the proposed standards concerning high-velocity, vertically-packaged wall-mounted equipment, and through-the-wall equipment provide a significant advantage to those products versus competing products and are sufficient to preserve the unique features of those products, and whether improvements in the definitions are needed to prevent loopholes. For ductless split equipment and non-weatherized vertical packaged equipment, additional comment is welcome on the impacts that meeting the new standards would have on the availability of those products;

(5) The issue of thermal expansion valves (TXV), particularly whether our concerns regarding the perceived reliability problems and potential misuses associated with widespread use of TXVs are valid;

(6) The validity of the analytical methods used and the appropriate interpretation and use of the results of this analysis;

(7) The Draft Environmental Assessment, which is printed within the TSD prepared for today's proposed rule; and

(8) The impacts on manufacturers and consumers if the levels in today's proposed rule were applied to commercial three-phase unitary air conditioners less than 65K Btu/hr as well.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

Issued in Washington, DC, on September 27, 2000.

Dan W. Reicher,

Assistant Secretary, Energy Efficiency and Renewable Energy.

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

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

2. Section 430.2 is amended by adding a definition for ''through-the-wall air conditioner and heat pump'' in alphabetical order to read as follows:

§ 430.2 Definitions.

* * * * *

Through-the-wall air conditioner and heat pump means a central air conditioner or heat pump, having a rated capacity between 18,000 Btu/hr and 30,000 Btu/hr that is:

(1) Designed to be installed partially within, or mounted against, a fixed-size opening in an exterior wall; and

(2) Designed so that air for the outdoor coil is taken in and discharged at the same surface.

* * * * *

3. Section 430.32 of Subpart C is amended by revising paragraph (c) to read as follows:

§ 430.32 Energy and water conservation standards and effective dates.

* * * * *

(c) *Central air conditioners and central air conditioning heat pumps.* (1) Split system central air conditioners and central air conditioning heat pumps manufactured after January 1, 1992, and before January 1, 2006, and single package central air conditioners and central air conditioning heat pumps manufactured after January 1, 1993, and before January 1, 2006, shall have Seasonal Energy Efficiency Ratio and Heating Seasonal Performance Factor no less than:

Product class	Seasonal energy efficiency ratio	Heating seasonal performance factor
1. Split systems	10.0	6.8
2. Single package systems ..	9.7	6.6

(2) Central air conditioners and central air conditioning heat pumps manufactured on or after January 1, 2006, shall have Seasonal Energy Efficiency Ratio and Heating Seasonal Performance Factor no less than:

Product class	Seasonal energy efficiency ratio (SEER)	Heating seasonal performance factor (HSPF)
1. Split system air conditioners	12	....
2. Split system heat pumps ...	13	7.7
3. Single package air conditioners	12	....
4. Single package heat pumps	13	7.7
5. Through the wall air conditioners and heat pumps ...	11	7.1

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[FR Doc. 00–25336 Filed 9–29–00; 9:42 am]

BILLING CODE 6450–01–P