DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

10 CFR Part 430

[Docket Number EE–RM–98–440]

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, Energy.

ACTION: Final rule.

SUMMARY: The Department of Energy (DOE or Department) has determined that revised energy conservation standards for central air conditioners and heat pumps will result in significant conservation of energy, are technologically feasible, and are economically justified. On this basis, the Department is today amending the existing energy conservation standards for central air conditioners and heat pumps.

EFFECTIVE DATE: The effective date of this rule is February 21, 2001.

ADDRESSES: A copy of the Technical Support Document (TSD) may be read at the DOE Freedom of Information 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 9:00 a.m. and 4:00 p.m., Monday through Friday, except Federal holidays. Copies of the TSD may be obtained from: the Codes and Standards Internet site at: http://www.eren.doe.gov/buildings/codes_standards/applbrf/central_air_conditioner.html or from the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Forrestal Building, Mail Station EE–41, 1000 Independence Avenue, SW., Washington, DC 20585–0121. (202) 586–9127.

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SUPPLEMENTARY INFORMATION:

I. Introduction

A. Consumer Overview

1. Background

The Department of Energy (DOE or the Department) is directed by the Energy Policy and Conservation Act to consider establishing minimum efficiency standards for various consumer products, including central air conditioners and heat pumps. Today's final rule adopts standards that are consistent with these requirements of the law. The Department is amending the almost ten year old minimum efficiency standards for new central air conditioners and heat pumps. These amended standards take into account a decade of technological advancements and will save consumers and the nation money, significant amounts of energy, and have substantial environmental and economic benefits.

When today's adopted standards go into effect, they will essentially raise the energy efficiency standards to 13 SEER for new central air conditioners and to 13 SEER/7.7 HSPF for new central air conditioning heat pumps (heat pumps). 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. HSPF, Heating Seasonal Performance Factor, is the Department's measure of energy efficiency for the seasonal heating performance of heat pumps. The standards will apply to products manufactured for sale in the United

States, as of January 23, 2006. The standard for split-system air conditioners, the most common type of residential air conditioning equipment, represents a 30 percent improvement in energy efficiency. For split-system heat pumps, the new standard would represent a 30 percent improvement in cooling efficiency and a 13 percent improvement in heating efficiency. The standard will also increase the cooling efficiency of single-package air conditioners and single-package heat pumps by 34 percent and the heating efficiency of single-package heat pumps by 17 percent. Finally, the Department is not yet adopting new standards for some products to ensure that more efficient versions remain available for niche applications. The Department has determined that the new standards are the highest efficiency levels that are technically feasible and economically justified as required by law. Therefore, the Department is amending the energy conservation standards for residential central air conditioners and heat pumps.

2. Central Air Conditioner and Heat Pump Features

The amended efficiency levels can be met by central air conditioner and heat pump designs that are already available in the market. We fully expect variations of these models to exist under the new standards, offering all the features and utility that are found in currently available products.

3. Consumer Benefits

Table I.1 summarizes the ''characteristics'' of today's typical central air conditioners and heat pumps. Table I.2 presents the implications for the average consumer of the standards becoming effective in 2006.

TABLE I.1.—CHARACTERISTICS OF TODAY'S TYPICAL CENTRAL AIR CONDITIONERS AND HEAT PUMPS [1]

	Split system air conditioner	Split system heat pump	Single package air conditioner	Single package heat pump
Average Installed Price	$2,236	$3,668	$2,607	$3,599
Annual Utility Bill [2]	$189	$453	$189	$453
Life Expectancy (years)	18.4	18.4	18.4	18.4
Energy Consumption per year (kWh)	2,305	6,549	2,305	6,549

[1] ''Typical'' equipment have cooling and heating efficiencies of 10 SEER and 6.8 HSPF, respectively.
[2] Utility bill pertains to the energy cost of operating the air conditioner or heat pump.

TABLE I.2.—IMPLICATIONS OF NEW STANDARDS FOR THE AVERAGE CONSUMER

	Split system air conditioner	Split system heat pump	Single package air conditioner	Single package heat pump
Year Standard Comes into Effect	2006	2006	2006	2006
New Average Installed Price	$2,571	$4,000	$3,032	$4,034
Estimated Price Increase	$335	$332	$425	$435
Annual Utility Bill Savings	$42	$70	$42	$70
Average Net Saving over Equipment Life	$113	$372	$29	$353
Energy Savings per Year (kWh)	532	1081	532	1081

The most typical air conditioner (*i.e.,* split system air conditioners which comprise approximately 65 percent of today's central air conditioning and heat pump market) has an installed price of $2,236 and an annual utility cost of $189. In order to meet the 2006 standard, the Department estimates that the installed price of a typical air conditioner will be $2,571, an increase of $335. This price increase will be offset by an annual energy savings of about $42 on the utility bills. The most typical heat pump (*i.e.,* split system heat pump) currently has an installed price of $3,668 and an annual utility cost of $453. In order to meet the 2006 standard, the Department estimates that the installed price of a typical heat pump will be $4,000, an increase of $332. This price increase will be offset by an annual energy savings of about $70 on the utility bills.

The Department recognizes that most consumers pay energy prices that are higher or lower than the ''typical'' consumer and operate their equipment more or less often. Consequently, the Department has investigated the effects of the different energy prices across the nation and different air-conditioning usage patterns. The Department estimates that 61 percent of all consumers purchasing a new typical air conditioner will either save money or will be negligibly impacted as a result of the 2006 standard. In the case of a new typical heat pump, 94 percent of all consumers either save money or will be negligibly impacted.

The Department also investigated how these standards might affect low income consumers. On average, the Department estimates that it is likely that low income air conditioner and heat pump consumers will also save money as a result of the standard.

4. National Benefits

The standards will provide benefits to the nation. DOE estimates the standards will save approximately 4.2 quads of energy over 25 years (2006 through 2030). This is equivalent to all the energy consumed by nearly 26 million American households in a single year. We also estimate this standard will have a net benefit to the nation's consumers of $1 billion over the same period. In 2020, the standards will avoid the construction of five 400 megawatt coal-fired plants and thirty-four 400 megawatt gas-fired plants. These energy savings will result in cumulative greenhouse gas emission reductions of approximately 33 million metric tons (Mt) of carbon, or an amount equal to that produced by approximately 3 million cars every year. Additionally, air pollution will be reduced by the elimination of approximately 94 thousand metric tons of nitrous oxides (NO_X) from 2006 through 2020.

B. 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, Pub. L. 95–619, by the National Appliance Energy Conservation Act, Pub. L. 100–12, by the National Appliance Energy Conservation Amendments of 1988, Pub. L. 100–357, and by the Energy Policy Act of 1992, Pub. L. 102–486 [1] 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.

Under the Act, the program consists essentially of three parts: testing, labeling, and Federal energy conservation standards.

The National Appliance Energy Conservation Act of 1987 (NAECA) prescribed initial Federal energy conservation standards for central air conditioners and heat pumps. EPCA Section 325(d), 42 U.S.C. 6295(d). The Act specifies that the Department is to review the standards January 1, 1994. EPCA Section 325(d)(3)(A), 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).

Section 325(o)(2)(B)(i) provides that before DOE determines whether a standard is economically justified, it must first solicit comments on a proposed standard. After reviewing comments on the proposal, and before it adopts a standard, DOE must then determine whether the benefits of the standard exceed its burdens, based, to the greatest extent practicable, on a weighing of the following seven factors:

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

(ii) 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;

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

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

(v) 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;

(vi) The need for national energy conservation; and

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

In addition, section 325(o)(2)(B)(iii) establishes a rebuttable presumption of economic justification in instances where the Secretary determines 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.

C. Background

The existing standards for residential central air conditioners and heat pumps have been in effect since 1992. As described above, the descriptor for air conditioner and heat pump cooling efficiency is SEER and the descriptor for heat pump heating efficiency is HSPF. The current central air conditioner and heat pump 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

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. During a workshop on June 30, 1998, we presented for comment an analytical framework for the central air conditioner and heat pump standards rulemaking. The analytical framework described the different analyses to be conducted, the method for conducting them, the use of new spreadsheets, and the relationship of the various analyses. On November 24, 1999, DOE published a Supplemental ANOPR. 64 FR 66306. On October 5, 2000, DOE published a Notice of Proposed Rulemaking (NOPR or proposed rule). 65 FR 59590. The energy efficiency standards proposed for residential central air conditioners and central air conditioning heat pumps (heat pumps) were as follows:

—Split system and single-package air conditioners—12 SEER
—Split system and single package heat pumps—13 SEER/7.7 HSPF
—Through-the-Wall air conditioners and heat pumps—11 SEER/7.1 HSPF.

In addition to the increase proposed in SEER and HSPF, the Department requested comments on a proposal to adopt a standard for steady-state cooling efficiency, EER.[2] The proposal on EER was designed to ensure more efficient operation at high outdoor temperature, during periods when electricity use by air conditioners is at its peak.

The proposed rule provided additional background information on the current standards, the history of previous rulemakings and the procedures, interpretations and policies which guide the Department in developing new efficiency standards, which are set forth as the Process Improvement Rule. 61 FR 36974. A public hearing was held in Washington, DC on November 16, 2000, to hear oral views, data and arguments on the proposed rule.

II. General Discussion

A. Technological Feasibility

1. General

There are central air conditioners and heat pumps in the market at all of the efficiency levels prescribed in today's final rule. The Department, therefore, believes all of the efficiency levels adopted by today's final rule are technologically feasible.

2. Maximum Technologically Feasible Levels

Pursuant to section 325(p)(2) of the Act, and as discussed in the proposed rule, the Department determined that 18 SEER is the maximum technologically feasible (Max Tech) level for cooling efficiency for all product classes and capacities covered by this rulemaking. 65 FR 59593. The Max Tech level for heating efficiency, is 9.4 HSPF which is the highest HSPF rating currently available in residential heat pumps.

B. Energy Savings

1. Determination of Savings

The Department forecasted energy savings through the use of a national energy savings (NES) spreadsheet as discussed in the proposed rule. 65 FR 59590, 59593 (October 5, 2000). The

[1] 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 EPCA, or the ''Act.'' 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.

[2] 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.

spreadsheets and assumptions upon which the results of today's final rule is based are unchanged.

2. Significance of Savings

As discussed in the proposed rule, section 325(o)(3)(B) of the Act prohibits the Department from adopting a standard for a product if that standard would not result in ''significant'' energy savings. The energy savings for the standard levels we are adopting today are non-trivial—indeed they are substantial—and therefore we consider them ''significant'' within the meaning of section 325 of the Act.

C. Rebuttable Presumption

The National Appliance Energy Conservation Act established new criteria for determining whether a standard level is economically justified. Section 325(o)(2)(B)(iii) of the Act 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, according to the test procedure, 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. This presumption of economic justification can be rebutted upon a proper showing.

The standard levels we are adopting today do not satisfy the criteria set forth above. Therefore, we cannot presume them to be economically justified and have performed additional analysis to support the Secretary's determination that they are indeed economically justified.

D. 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

We considered the economic impact on manufacturers and consumers as discussed in the proposed rule. 65 FR 59590, 59593 (October 5, 2000).

2. Life-cycle-costs

We considered life-cycle-costs as discussed in the proposed rule. 65 FR 59590, 59594 (October 5, 2000). The installed price and operation and maintenance costs were calculated for a range of consumers around the nation to estimate the range in life cycle cost benefits that consumers would expect to achieve due to new standards.

3. Energy Savings

While significant conservation of energy is a separate statutory requirement for establishing 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.

4. Lessening of Utility or Performance of Products

This factor cannot be quantified. In establishing classes of products, the Department has attempted to eliminate any degradation of utility or performance in the products covered by today's final rule. Attributes that affect utility include the product's ability to cool and dehumidify. In some applications, noise levels may also be an aspect of utility. Product size or configuration can also be considered utility if a change in size would cause the consumer to install the product in a location or in a manner inconsistent with the consumer's preferences.

5. Impact of Lessening of Competition

It is important to note that this factor has two parts; on the one hand, it assumes that there could be some lessening of competition as a result of standards; and on the other hand, it directs the Attorney General to gauge the impact, if any, of that effect.

In order to assist the Attorney General in making such a determination, the Department provided the Attorney General with copies of the proposed rule and the Technical Support Document for review. The Attorney General's response is discussed in section V.D.5 below, and is reprinted at the end of the rule.

6. Need of the Nation To Conserve Energy

The Secretary recognizes that energy conservation benefits the Nation in several important ways. Enhanced energy efficiency improves the Nation's energy security, strengthens the economy, and reduces the environmental impacts of energy production.

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).

Under this factor, we considered the potential improvement to the reliability of the electrical system. Recent summertime electric power outages in various regions of our country resulted in disruption of many peoples' lives and businesses. The schedule contained in the Act called for the Department to revise the standards for central air conditioners and heat pumps by 1994, to be effective in 1999. For reasons explained in the proposed rule and ANOPR, promulgation of many standards including those for central air conditioners and heat pumps was delayed.

While central air conditioning accounts for about 10 percent of residential electricity consumption, it can account for several times this amount during peak hours on hot summer days, when electricity reliability is most strained. A 30 percent improvement in air conditioner efficiency would reduce the nation's total annual electricity use by approximately 2 percent after it was fully phased in. However, the same efficiency improvement would provide a greater percentage reduction in peak loads, reducing the prospect of brownouts and price spikes. These peak load reductions are critical given that the conditions leading to grid instability can occur well before peak demand even equals supply.

The Final Report [3] by the team of experts convened by the Secretary to investigate the electric power problem included the recommendation to increase the energy efficiency of central air conditioners as one means for enhancing reliability. This recommendation led the Secretary to put this rulemaking on the fast track and to advance the publication of today's final rule for central air conditioners and heat pumps. Thus, the Department has considered effects of the rule on electric power system reliability.

III. Methodology

As discussed in the proposed rule, the Department developed new analytical tools for this and other recent rulemakings. The first tool was a

[3] ''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.

spreadsheet that calculates life-cycle-cost (LCC) and payback period. The second calculates national energy savings and national net present value (NPV). The Department also completely revised the methodology used in assessing manufacturer impacts including the adoption of the Government Regulatory Impact Model (GRIM). Additionally, DOE developed a new approach using the National Energy Modeling System (NEMS) to estimate impacts of air conditioner energy efficiency standards on electric utilities and the environment.

In order to estimate production costs for this rulemaking, we used an efficiency level approach, with cost data provided by the Air Conditioning and Refrigeration Institute (ARI) and through our own reverse engineering methods. The ARI cost data presented the minimum, mean, and maximum cost estimates for the sample of ARI members who participated. The data covered each product class at each efficiency level through 15 SEER, and was expressed relative to the base cost for each manufacturer. The reverse engineering methodology, conceived as a way to validate the ARI data, analyzed seventy-one samples, mostly selected by manufacturers, using design data provided by manufacturers. We physically examined three of these models. In refining our results, we reviewed our detailed cost estimates for split air conditioners with a major manufacturer.

The benefits of reverse engineering include the transparency of the methods, data, and assumptions used to produce the estimates, and the insights gained into the design options used to achieve the different efficiency levels. The ARI data provides none of these benefits, but does draw on the considerable expertise of the manufacturers involved in producing the underlying estimates describing all of the products on the market. One benefit of the reverse engineering analysis is that results are expressed in absolute costs instead of relative costs. Absolute costs are needed to represent production costs at the minimum efficiency level and are helpful in representing the production costs at higher efficiency levels.

Regarding the analytical methodology, the Department continues to use the spreadsheets and approaches explained in the proposed rule. 65 FR at 59594–59597. We have applied them to develop the analysis further in this final rule. We added new analysis based on the manufacturing cost estimates that we had derived through reverse engineering techniques. Also, because its results were similar to those derived using our 18.4-year equipment life assumption, we are no longer considering the 14-year equipment lifetime scenarios in the economic analysis. Finally, the emissions reductions analysis now also estimates the discounted value of cumulative emission reductions.

IV. Discussion of Comments

Since we opened the docket for this rulemaking, we have received over 800 comments from a diverse set of interested parties, including manufacturers and their representatives, states, energy conservation advocates, heating and air-conditioning contractors, consumers, electric utilities and others. The comments addressed the burdens and benefits associated with more stringent standards, aspects of our analysis, the merits of the different trial standard levels and standard options we considered, and the DOE rulemaking process. Many comments raised issues that we substantially addressed in the proposed rule and Supplementary ANOPR. Comments received during the most recent comment period are addressed below, and some previous comments are revisited.

A. Burdens and Benefits

This section discusses comments we received on the burdens and benefits associated with more stringent minimum efficiency standards, organized into the seven factors that the Secretary considers as a basis for deciding whether a standard level is economically justified.

1. Economic Impacts

a. *Economic Impacts on Manufacturers.* According to our manufacturer impact analysis, more stringent efficiency standards burden most manufacturers by causing them to make new investments in capacity, research and development, and testing. We also expect most manufacturers to experience lower profitability and sales volumes for several years after the adopted standards become effective. Some manufacturers in our analysis benefit under more stringent standards.

ARI characterizes the financial burdens on the industry overall as severe. They also assert that the hydrochloroflourocarbons (HCFC) phaseout results in cumulative burdens. (ARI, No. 100 at pp. 6 and 13). Some manufacturers noted that EER and thermal expansion valve (TXV) requirements would add to the burden. (York, No. 90, at pp. 4–5). The Natural Resources Defense Council (NRDC) questions whether we considered that reverse engineering-based prices reduce impacts through price elasticity effects, but noted that industry impacts did not seem to change across trial standard levels, and the Oregon Office of Energy (OOE) believes that we have overstated manufacturer impacts since they are already making investments in new technologies to help them improve product efficiency. (NRDC, No. 88 at p. 15; and OOE, No. 84 at p.5).

The reduction in industry net present value does increase with increasing standard levels, particularly since we consider it more likely that the Roll-up[4] scenario will occur under higher standard levels. Individual manufacturers themselves discussed their situations with us at length, and we have incorporated the information they presented to us into our manufacturer impact analysis. In adopting this rule, we have assumed that the Roll-up scenario is the most likely outcome resulting from a new 13 SEER standard for all product classes. We did consider the change in sales volumes driven by changes in the underlying cost assumptions.

Many comments described what they consider disproportionate impacts on manufacturers of niche products. Those comments are discussed in Section IV.4 below.

The Department has considered the manufacturer burdens as described in the manufacturer impact analysis of the TSD in adopting the new standard. These include cumulative burdens. It also considers the extent to which the differences among efficiency scenarios change the implications of more stringent standards.

b. *Economic Impacts on Consumers.* Many comments mention the economic burdens that more stringent efficiency standards can place on consumers who are sensitive to increases in first cost. Many noted that our decision should consider burdens on consumers caused by long median payback periods. Some comments emphasized that disproportionate impacts on low income consumers due to an expected increase in installed price would reduce the number of consumers who would be able to afford new air conditioners. Some comments suggested that this effect could increase health problems and deaths. The Mercatus Center stated that the Department believed consumers pass up energy efficient equipment because they are misinformed about

[4] The Roll-up scenario assumes that the proportion of equipment with efficiency ratings above the new standard level will not increase compared to their proportion today.

operating costs, therefore the Department should construct a program to correct this deficiency. (ARI, No. 100 at pp. 2 and 5; American Public Power Association (APPA), No. 113 at p. 2; Manufactured Home Institute (MHI), No. 99 at p. 1; Lennox, No. 91 at p. 3; Consumer Federation of America (CFA), No. 110 at p. 1; Nebraska Public Power District (NPPD), No. 109 at p. 2; National Association of Home Builders (NAHB), No. 94 at p. 1; Nordyne, No. 101 at p. 2; Trane, No. 93 at p. 4; York, No. 90 at pp. 4–5; and Mercatus Center, No. 115 at pp. 18–19).

CFA considers lower energy bills a benefit and would support regional standards and public assistance programs to mitigate long payback periods and disproportionate impacts on consumers. (CFA, No. 110 at p. 2).

Many comments express the belief that, for various reasons, we either underestimated or overestimated economic impacts on consumers. Those comments are addressed in Section IV.B. below.

We recognize that increases in first cost and long payback periods are generally considered burdens on consumers. Based on the reverse engineering derived manufacturing cost estimates, however, our analysis shows that, at the adopted standard levels, the payback period is shorter than the life of the equipment. This means that over the life of the product, any increase in price will be paid back to the average consumer. Thus, the new efficiency standards should provide the average consumer with a long term economic benefit. Also, we have examined impacts on low income consumers, and found them to benefit overall. Consumers concerned about potential health effects should note that assistance programs are already available to assist them with their air conditioning purchases, and that room air conditioners will continue to be available when cooling in individual rooms could mitigate their health concerns.

2. Life-Cycle Costs

ARI, The Trane Company (Trane), American Electric Power (AEP), Mercatus Center, Southern Company, Dominion Virginia Power (Dominion), and Edison Electric Institute (EEI) asserted that the percent of consumers realizing life-cycle-cost savings at the standard levels issued in the proposed rule were too low and did not warrant an increase in the minimum efficiency standard. (ARI, No. 100 at p. 2; Trane, No. 93 at p. 4; AEP, No. 83 at p. 1; Mercatus Center, No. 115; Southern Company, No. 96 at p. 2; Dominion, No. 103 at p. 3 and Transcript No. 73 at pp. 50–51; and EEI, Transcript No. 73 at pp. 176–178). Carrier Corp. asserted that there were too many consumers incurring life-cycle-cost increases at 12 SEER. (Carrier, No. 92 at p. 5). In contrast, the American Council for an Energy-Efficient Economy (ACEEE), the Alliance to Save Energy (ASE), the Pacific Gas and Electric Company (PG&E), and NRDC argued that the percent of consumers realizing life-cycle-cost savings from a particular standard level is not the appropriate measure for establishing an updated efficiency standard. Because air-conditioning use is highly dependent on climatic conditions and because these are national standards, it is to be expected that some consumers in the Northern part of the U.S. will realize net costs from an increased standard but will be offset by consumers in the Southern part of the U.S. who will realize life-cycle cost savings from more efficient air-conditioning equipment. Due to this disparity, they argue it is better to base the standard on national average life-cycle-cost results. (ACEEE, No. 104 at p. 13; ASE, No. 81 at p.9; PG&E, No. 104 at p. 5; and NRDC, No. 88 at pp. 19–21).

EPCA requires the Department to consider life-cycle-cost as one of the seven factors in determining economic justification. In determining economic justification, the Secretary must determine whether the benefits of a standard exceed the burdens. Life-cycle-cost is just one of the factors to be considered and there is no mathematical formula for weighing the benefits and burdens of the various factors. There are also no mathematical thresholds for life-cycle-cost as implied by EEI and ACEEE. (EEI, Transcript No. 73 at p. 177; and ACEEE, Transcript No. 73 at p. 182). The Department notes that under the standards in today's rule, consumers on average will have lower life-cycle costs. Furthermore, it appears that EPCA, in requiring DOE to set national standards that maximize energy savings for appliances where there will obviously be regional differences in usage and energy costs, contemplated that the level of life cycle cost savings would vary among consumers.

We have quantified the distribution of life cycle costs among consumers and have considered it, along with other information, in the weighing of the benefits and burdens of each standard level we assessed.

3. Energy Savings

ARI states that the Department overestimated the energy savings realized from efficiency standards by basing the savings on source energy consumption at the power plant, rather than site energy consumption at the household or commercial building. (ARI, No. 100 at p. 11). While neither stating that the energy savings estimated by the Department were too great or too low, ASE claims that 70 billion kWh would be saved from a 13 SEER standard coupled with a minimum EER requirement of 11.6 and mandatory use of TXVs. (ASE, No. 81 at p. 12). ACEEE also claims that significant national energy savings will be realized from a 13 SEER standard, an 11.6 minimum EER requirement, mandatory use of TXVs, and an HSPF standard of 7.9.

NAECA prescribes that consumer energy savings be evaluated based on site rather than source energy consumption. However, the Department believes national energy savings evaluated at the source reflects a more accurate representation of the energy consumption being avoided from a standard. Evaluating energy at the source takes into account the efficiency of the generation source as well as the transmission and distribution of the electricity. The Department accounts for site energy consumption in its analysis of consumer life-cycle-cost impacts. With regard to the magnitude of the energy being saved from a standard, the Department is confident in its National Energy Savings (NES) spreadsheet model to forecast the source energy savings realized from all standard levels, including a 13 SEER standard. Discussions with regard to minimum EER standards and TXV requirements are presented later in this Chapter.

4. Lessening of Utility or Performance of Products

Comments regarding lessening of utility related mainly to the impacts that more stringent standards may have on the availability of niche products and some products that are not typically considered "niche". Most comments stated that those products face size constraints that they will find difficult, if not impossible, to conform to under more stringent standards. That result could lead to the removal of the products from the market, or to equipment prices that are higher than the market would be able to sustain. (Friedrich, No. 116 at p. 1; Unico, No. 117 at pp. 1–2; Carrier, No. 92 at p. 8; Lennox, No. 91 at p. 7; Trane, No. 93 at p. 18; Mitsubishi, No. 87 at p. 1; Armstrong, No. 86 at pp. 1–3; and Fujitsu, No. 85 at p. 1).

We recognize that contractors and consumers do take product size into account when making a purchase, and that size constraints can make it more difficult for manufacturers to offer equipment meeting performance needs. This is true for niche products, which we discuss elsewhere, as well as for conventional products. The same was the case when the 10 SEER minimum standards were agreed upon and established in 1987. Manufacturers can attempt to prevent size constraints from degrading performance or utility by offering smaller 13 SEER equipment than they typically offer today. The technical options for achieving that objective include existing and emerging technologies. Therefore, we do not consider it likely that products will be unavailable that meet the new 13 SEER standard, and have substantially the same capacities, performance and range of sizes as today's products.

If the size of 13 SEER equipment does not generally decrease under new standards, some consumers may be required to incur additional installation expense to accommodate the larger equipment. We discuss this in more depth in Section IV.B.2.e. The Department did consider that possibility when adopting today's standards.

Along a separate line, Southern Company is concerned that higher efficiency equipment will reduce dehumidification, which is an important attribute in moderate, humid, climates. (Southern Company, No. 96 at pp. 4–5). The equipment's ability to dehumidify is a function of its design and not necessarily its efficiency. As we stated in the proposed rule, evidence indicates that sensible heat ratios in high efficiency equipment are similar to those at the baseline. We trust that under a more stringent standard, manufacturers will seek to serve the needs of the market with products that dehumidify properly.

5. Impact of Lessening of Competition

The Department of Justice (DOJ) and others commented that the more stringent standards contained in the proposed rule could lessen competition. (DOJ, No. 112; Trane, No. 93 at p. 12; and EEI, No. 80 at p. 8). Aspects of our manufacturer impact analysis support that conclusion. We discuss the DOJ concerns in more depth in Section V.D.5. The letter from the Department of Justice is attached in the Appendix of this rulemaking. We recognize that the standard levels we are adopting could accelerate the consolidation trend among major manufacturers. However, as discussed in the manufacturer impact analysis, we do not expect that any manufacturer or group of manufacturers will be able to use the standards as an opportunity to consolidate their market power. (*See* TSD, Chapter 8). Therefore, we believe that competition will remain vigorous under the adopted standard, and any lessening of competition that does occur will not result in price increases or loss of choice and utility for consumers.

Other comments note that a large fraction of today's models would not be able to meet more stringent standards. (AEP, No. 83 at p. 1; Dominion, No. 68 at p. 2; ARI, No. 100 at p. 11; and EEI, No. 80 at p. 8). In the manufacturer impact analysis, we considered that manufacturers will have to design new products to meet any increased standard level. Furthermore, products are technologically feasible through 18 SEER. So, while many of today's models may not be available under more stringent standards, we fully expect variations of those models to be available, offering all the features and utility of currently available products.

6. Need of the Nation To Conserve Energy

Of the approximately 800 comments we have received, the vast majority were from individuals and organizations who made similar claims regarding the benefits that would be associated with a 13 SEER standard and an EER standard for air conditioners and heat pumps. These benefits included savings for consumers, avoided emissions and electrical capacity, and the reduced occurrence of brownouts and blackouts. Although our analysis is not able to substantiate many of these claims, all of these issues relate to the need of our nation to conserve energy. We recognize that a broad cross-section of citizens and organizations are concerned about these issues and in the potential for more stringent standards to address them.

We discuss more specific comments related to economic benefits and electric system capacity in other sections of this chapter. In this section, we discuss the comments we received regarding environmental benefits.

ASE claims that a 13 SEER standard coupled with an 11.6 EER minimum standard and a mandatory TXV requirement would yield environmental benefits in the form of the following air-borne emission reductions: 15 million metric tons of carbon, 40,000 tons of nitrous oxides, and 200,000 tons of sulfur dioxide in 2020. Northeast Energy Efficiency Partnership (NEEP) also states that significant carbon dioxide emission reductions could be achieved with a 13 SEER standard relative to a 12 SEER standard. (ASE, No. 81 at p. 12; and NEEP, No. 118 at p. 2). The Northwest Power Planning Council (NWPPC) states that the Department used the average heat rate of avoided plants rather than the heat rate of operating plants displaced by the efficiency standards when determining emission reductions. As a result, NWPPC claims that the emissions mitigated by the standards were underestimated (NWPPC, No. 76 at p. 6).

National energy savings realized from central air conditioner and heat pump efficiency standards are directly translated into reduced air-borne emissions at electric power plants. The magnitude of the emission reductions are determined through the use of NEMS–BRS [5], a version of NEMS used for appliance standards analyses. NEMS–BRS 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. Thus, although the Department agrees with ASE that emissions will be avoided from new air conditioner and heat pump efficiency standards, the Department believes that the magnitude of those emission reductions are best estimated with NEMS–BRS. 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. We do not believe there is a potential benefit in reductions in SO_2 emissions from electricity savings as long as emissions of SO_2 are at or near the emission ceilings. With regard to the issue of heat rates, contrary to NWPPC's assertion, the Department did use the heat rates of displaced power plants in determining the emission reductions resulting from efficiency standards.

7. Other Factors

With regard to other factors, the issue of electric system reliability attracted numerous comments. EEI, AEP, and

[5] 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 Modelling System: An Overview 1998. DOE/EIA–0581 (98), February, 1998. BRS is DOE's Office of Building Research and Standards.

Dominion Virginia Power stated many changes are occurring in the electric utility industry at the same time electric load is continuing to grow. As a result, the overall effect of any end-use efficiency measure, such as an air conditioner and heat pump standard, is likely small. (EEI, Transcript, No. 73 at p. 224; AEP, No. 83 at p. 4; and Dominion, No. 103 at p. 4). Southern Company argued that once a standard is established, new load growth forecasts incorporating its effects will likely be made and investment decisions will be accordingly adjusted. In other words, since the effects of this rule do not become noticeable until five or more years after its 2006 effective date, utilities will have ample time to plan and construct capacity in response to expectations of load growth, reserve margin, and, where competition has become normal practice, to prices. (Southern Company, Transcript No. 73 at p. 241). Synapse Energy Economics (Synapse), along with ACEEE, NWPPC, NRDC, ASE, and PG&E noted that there is a real issue in meeting increased demand, due in large part to increased air conditioner usage. Synapse also notes that conventional assumptions about the ability of the power system to meet growing load are increasingly coming into question as the barriers to system expansion are not inadequate price incentives or unwillingness to invest, but rather siting (of generation, transmission, and distribution capability), environmental, and other constraints. (Synapse, Transcript No. 73 at p. 243; ACEEE, No. 104 at pp. 13–15; NWPPC, Transcript No. 73 at p. 253; NRDC, No. 88 at pp. 4 and 6; ASE, No. 81 at pp. 7 and, 10; and PG&E, Transcript No. 73 at p. 251).

In a March 2000 final report, the DOE Power Outage Study Team described several power outages that occurred in the summer of 1999. During early July, a heat storm affected much of the East from New England down past the Mid-Atlantic causing many problems. From July 3 through 8, service was interrupted to a total of 110,000 Long Island Power Authority (LIPA) customers for varying periods. During that period, two new system peak loads were set and LIPA activated its Commercial Peak Reduction Program, appealed to its other large customers to voluntarily curtail their use of electricity and reduced system-wide voltage by five percent. Many organizations and government offices responded by closing early or cutting back on their electricity use. On July 6, the eastern half of the Pennsylvania, New Jersey, Maryland Interconnection grid experienced sudden and steep voltage declines as an all-time-high peak load was recorded. The integrity of the system was maintained by reducing voltage, curtailing contractually interruptible customers and appealing for voluntary load reductions. On that same day, Delmarva Power and Light had a capacity shortfall that resulted in rotating outages from 10:30 a.m. until 7:30 p.m. affecting 138,000 customers. In the Chicago area on July 30, Commonwealth Edison set all-time-peak demand during a period of intense heat and humidity. Resulting system failures caused more than 100,000 customers temporary losses of power for up to several hours. The summer of 2000 has seen similar types of problems in the state of California.

Outages such as these can cost millions of dollars per hour depending on which and how many customers are affected. Although we recognize that system adequacy may only play a small part in ensuring system reliability, the Department is convinced, especially due to recent expansion shortfalls in the Western part of the U.S., that system reliability is an important issue which can be addressed, to some degree, by increased air conditioner and heat pump standards. The impacts of standards could be potentially beneficial in lowering overall system stress and postponing necessary investment. This is especially important since annual investment in transmission has roughly halved since the levels of the 1970's [6]. The potential benefit of air conditioner and heat pump efficiency improvements is a factor in establishing the standards being issued today. In addition, the Department is continuing to establish national equipment standards in the form of the current efficiency descriptors (i.e., SEER and HSPF), as discussed below, it will examine ways to provide additional credit in the test procedure for EER rather than using such additional measures as minimum EER standards and mandatory TXV requirements.

B. Analysis and Assumptions

1. Engineering Analysis

a. Reliance on ARI and Reverse Engineering Cost Estimates. The Department considered primarily two sets of data for relating the manufacturing costs of current baseline (minimum SEER) equipment to the manufacturing costs of higher efficiency equipment which would become baseline equipment under new standards: one source provided by the industry through ARI and the other source determined from the Department's reverse engineering analysis. In the proposed rule, our analyses and conclusions relied heavily on the ARI manufacturing cost estimates, and less on the reverse engineering cost estimates.

However, several comments questioned the validity of the ARI results and recommended we rely more heavily, if not exclusively, on the reverse engineering estimates. They cited various reasons, including retail price information that matched the ARI Mean, the greater transparency of the reverse engineering process and results, and the natural tendencies of manufacturers to overestimate the costs of complying with more stringent standards. The same comments even suggest that the reverse engineering cost estimates may themselves be overestimates. (OOE, No. 84 at p. 3; NRDC, No. 88 at pp. 3–15; ASE, No. 81 at p. 11; and NEEP, No. 188 at p. 3).

Other comments supported the use of the ARI data, citing the experience of the manufacturers and apparent flaws in the assumptions and methodology used in the reverse engineering analysis, which was designed as a validation tool. These perceived flaws included the small number of tear-downs performed. However, ARI and some of its members recognize that the reverse engineering results fall within their range and seem to validate their data to some extent. (ARI, Transcript No. 14 at p. 42, No. 48 at p. 2 and No. 100 at p. 9; Carrier, No. 92; Trane, No. 93; and Lennox, No. 91 at p. 4).

While we recognize the expertise of ARI's members related to projecting the cost of producing central air conditioning equipment, we have several concerns with the ARI data. First, ARI has not satisfactorily explained why their cost data at 12 SEER and higher levels display such a large range between the minimum and maximum values. We are convinced that, in order to remain competitive, manufacturers will have to adopt relatively similar paths to increase the efficiency of their baseline products to meet the new minimum standards. This will tend to result in actual costs that are closer to the ARI Minimum values than to the ARI Mean values.

We are also concerned with how closely the data on recent Wisconsin retail prices, submitted by ACEEE, agrees with the ARI Mean cost estimates. Once we adopt a higher minimum efficiency level, we believe that the retail prices of baseline equipment that must meet that level

[6] "Hirst, E., "Expanding U.S. Transmission Capacity." Paper prepared for Edison Electric Institute, Washington D.C., July 2000: p. 8–9.

will decline below the price of equipment currently at that level. York International Corporation (York) and ARI confirmed, for example, that their markups generally increase on higher efficiency equipment, and Star Supply Company seemed to imply that distributor markups increase with increasing efficiency. (Star Supply Co., No. 95 at p. 2; York, Transcript No. 73 at p. 117; and ARI, No. 100 at p. 3). Those markups are reflected in the current retail prices of those products. Due to competitive pressures at the baseline level, today's markups would not be sustainable for baseline equipment that meets, but does not exceed, a new standard. In addition, as noted by John Compton of Home Excellence, Inc. (HEI), a heating and air-conditioning contractor, the new, more efficient, baseline equipment would likely possess fewer of the premium features found in today's high efficiency equipment. (HEI, Transcript No. 73 at p. 123). For those reasons, current retail price data would overestimate the relative cost of high efficiency products under new standards. The agreement between ARI's mean cost data and the Wisconsin retail price data suggests that the ARI cost data correspond to today's costs of producing high efficiency equipment rather than to the lower production costs we would expect under new standards.

The reverse engineering analysis, on the other hand, is transparent and the results fall within the ARI range and nearer to the ARI Minimum where we expect competitive pressure to drive manufacturing costs. Seventy-one samples were analyzed using bills-of-materials provided manufacturers, supplemented with three physical teardowns, and detailed estimates for split air conditioners were reviewed with a major manufacturer. Our reverse engineering methodology, though originally conceived as a validation exercise, is itself a valid method of estimating equipment production costs, and is well suited for use in this rulemaking as an indicator of the most likely production costs under new standards.

Based on a consideration of the above, we conclude that the reverse engineering cost estimates are more representative of what actual production costs will be under new standards and that the ARI Mean cost data very likely overestimate those costs. For that reason, we are weighing the reverse engineering cost estimates heavily in our decision-making. We continue to provide the results based on the ARI Mean data cost to illustrate an upper bound, which we believe will be quite an unlikely outcome.

b. *Consideration of Emerging Technologies.* ACEEE and others commented we should have included the savings that could result from the use of emerging technologies rather than presenting them separately. The Oregon Energy Office and Thermalex, Inc. also expressed more optimism regarding the applicability and probability of adoption for microchannel heat exchangers than we had expressed in the TSD. (ACEEE, Transcript No. 73 at p. 88; ASE, No. 81 at pp. 8, 9 and 12; OOE, No. 84 at p. 5; and Thermalex, No. 89 at pp. 1–2).

Trane and York dispute some of the claims regarding the potential of emerging technologies. (Trane, No. 93 at p. 7; and York, No. 90 at p.4).

According to our engineering analysis described in Section 4.5 of the TSD, on a system basis, emerging technologies cannot make a significant cost impact below 14 SEER. That explains why they are not in widespread use today. At 14 SEER and above, some emerging technologies could compete quite favorably with the technologies that currently dominate in some applications. We did not analyze standard levels at 14 SEER, instead we examined 13 SEER and 18 SEER, the Max Tech level. ACEEE contends that, had we evaluated life-cycle-costs using reverse engineering analysis combined with emerging technology impacts, a standard level as high as 14 SEER may have been justified after all, and should have been considered. (ACEEE, Transcript No. 73 at p. 171, and No. 101 at p. 7).

From our ANOPR analysis based on ARI mean costs, we concluded that standard levels between 13 SEER and 18 SEER did not warrant further consideration. York had stated that ARI's cost data already included the benefits of emerging technologies although we could not verify the methods they used to incorporate them. (York, Transcript No. 14 at p. 116; and ARI, Transcript No. 14 at p. 115). Economic impact results based on reverse engineering were more favorable, but still were far from compelling. For example, the impact on national net present value was negative $8.4 billion for 14 SEER split air conditioners. We believe that incorporating the modest reduction in cost due to the most likely impact of emerging technologies (about 10 percent for split air conditioners) would not have resulted in a 14 SEER level being economically justified.

Overall, we considered the potential of emerging technologies to penetrate the market in 13 SEER products under a 13 SEER standard to be higher than under lower standard levels. Partially for that reason, we believe that the burdens that could accrue from increases in the size of baseline equipment under a 13 SEER standard can be somewhat mitigated by the use of emerging technologies.

2. Life Cycle Cost (LCC) Analysis

a. *Probability-based analysis.* Trane questioned the use of a Monte Carlo probability-based analysis because they claim that several of the distributions used to characterize the inputs to the analysis are erroneous. (Trane, No. 93 at pp. 4–5).

As part of the process to improve the energy efficiency standards analysis, the Department uses a probability-based analysis to determine a distribution of life-cycle cost impacts for consumers utilizing central air conditioners and heat pumps. Most of the inputs to the analysis are characterized with distributions. While some of the input distributions are based on limited data, no other data have been offered to recharacterize the distributions. Therefore, the Department sees no compelling reason to alter its assumptions regarding the input distributions.

b. *Energy Use.* Trane claimed that the 1997 Residential Energy Consumption Survey (RECS) sample is too small and may not accurately represent the population of central air conditioner and heat pump consumers. In addition, they claimed that the Department is not accurately representing the saturation of air-conditioned households. Trane stated that the saturation reported by the Department (37.6 percent) is inconsistent with the saturation reported by RECS (47 percent). (Trane, No. 93 at pp. 4–5).

As part of the process to improve the energy efficiency standards analysis, the Department is 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. With regard to apparent discrepancies between air-conditioned household saturations, the 37.6 percent saturation value cited by Trane represents only those households with central air conditioners. When including homes with central air-conditioning heat pumps, the household saturation used by the Department in its LCC analysis matches the 47 percent saturation level reported by RECS.

c. *Electricity Prices.* Wholesale electricity cost data for the period of 1998 through October, 2000, presented by experts on behalf of the Appliance Standards Awareness Project (ASAP), demonstrated dramatic variations in seasonal wholesale electricity costs for regions of the country (i.e., California, New England, New York, and the Pennsylvania-New Jersey-Maryland region) that have recently deregulated their electric utility industry. In particular, wholesale costs during summer months and especially certain summer day hours were significantly greater than annual average wholesale costs. Wholesale electricity cost data for the period spanning 1998 through 1999 for six regulated North American Electric Reliability Council (NERC) regions were also presented showing that summer costs were also significantly greater than average annual costs. (Synapse, Transcript, No. 73 at pp.127–137 and No. 108 at p. 5). Asserting that DOE's marginal prices based on 1996 and 1997 data are regulated and do not reflect the marginal cost of electricity under a deregulated market, ASAP, ACEEE, NWPPC, and Synapse argued that based on recent wholesale electricity cost data, marginal costs will significantly exceed average costs during periods when air conditioners are operating.[7] Future marginal electricity prices are also likely to increase as electricity markets through out the U.S. are deregulated. (ASAP, No. 108 at p. 1; ACEEE, Transcript No. 73 at pp. 154–158; NWPPC, No. 76 at pp. 3–4; and Synapse, Transcript No. 73 at pp. 152–153).

Dominion Virginia Power (Dominion), The Southern Company (Southern), and EEI all disagree with the assertion that higher marginal costs will result from higher wholesale electricity costs. Dominion stated that recent deregulation pilot programs in Virginia revealed that residential consumers are not being offered rates that reflect the costs of generation (e.g., time of use rates). Southern warned that it is premature to draw conclusions from wholesale electricity costs this early into the deregulation process. Extremely high wholesale prices now may not be an indicator as what will happen to retail prices in the future. Southern also warned that the specific problems facing California with regard to wholesale electricity costs are not representative of the current situation in the Southeast where peak prices were considerably lower in the summer of 2000 on pooled prices than they were the previous summer because of greater supply availability. EEI argued that flat rate retail pricing will likely continue into the future even under a deregulated market. Electricity suppliers will hedge against any probable summer price spikes by offering high enough flat rates so that financial losses incurred during times of high summer wholesale costs will be more than offset by the profits earned during times when wholesale costs are low (*e.g.,* off peak summer hours or the winter season). (EEI, Transcript No. 73 at pp. 148–150; Dominion, Transcript No. 73 at pp. 158–160; and Southern Company, No. 96 at pp. 6–7).

As was stated in the proposed rule, the 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[8]) was taken from the years 1996 and 1997. For commercial buildings, utility tariffs used to establish marginal prices were collected in the year 1997. On average, residential marginal prices for households with central air conditioners are 3 percent lower than average rates while for households with heat pumps marginal prices are 7 percent lower. Space-cooling marginal prices in commercial buildings are on average 2 percent greater than average commercial rates. Our method for determining marginal prices provides a snapshot of recent retail rates and may or may not accurately reflect what marginal prices will be like in the future. Although wholesale electricity costs for four deregulated electricity markets demonstrate higher wholesale electricity costs during times when air conditioners are likely to be used, we cannot speculate as to how wholesale electricity prices will be translated into retail prices to residential consumers. Thus, rather than speculating as to how electricity deregulation may impact marginal electricity prices, we are retaining our existing method for establishing marginal prices.

With the above said, the Department investigated the sensitivity of consumer life-cycle costs (aggregated to a national level in the form of a net present value (NPV)) to increases in the marginal electricity price. As will be reported in Chapter V, Analytical Results, the NPV of a 13 SEER standard based on Reverse Engineering manufacturing costs is a savings to the nation of $1 billion. An increase in the marginal electricity price of 3 cents/kWh yields a further increase in the operating cost savings so that the NPV equals $5 billion. Although the Department will continue to rely on its existing method for establishing marginal electricity prices, we recognize that future changes in the electric utility industry due to deregulation could significantly change future electricity prices and, as a result, improve the economic benefits of the standards being issued today.

d. *Product Life.* ARI, Carrier Corp., and The Trane Company all asserted that the 18.4-year average equipment lifetime assumed by the Department is not representative of actual central air conditioner and heat pump life. Both Carrier and Trane believed the lifetime is 15 years while ARI stated that the lifetime is even lower at 13 years. (ARI, No. 100 at p. 4; Carrier, No. 92 at p. 5; and Trane, No. 93 at p. 8).

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.[9]. 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. Since the heat pump survey clearly indicates that the original compressor is replaced once in a system's life, DOE's analysis was based on the inclusion of a repair cost for the 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. Although a shorter equipment lifetime is possible, the Department has not been provided with more substantive data to support discontinuing its use of the above mentioned survey data. The Department believes that the survey

[7] Marginal prices exclude fixed charges, average prices include fixed charges.

[8] Residential Energy Consumption Survey.

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

data provides an accurate representation of central air conditioner and heat pump life. In addition, an average lifetime of 14 years was run as a scenario for the analyses conducted for the proposed rulemaking showing that the resulting consumer economics were very close to the results generated with the 18.4-year average life coupled with compressor replacement costs.

e. *Installation Cost.* International Comfort Products (ICP) and HEI stated that the consumer's installation costs, *e.g,* labor and materials costs, exclusive of equipment cost, for installing a central air conditioner or heat pump will increase with product efficiency. (ICP, Transcript No. 73 at pp. 126–127; and HEI, Transcript No. 73 at pp. 92–93). ICP specifically voiced concerns over the installation cost differences between baseline (10 SEER) and 14 SEER equipment stating that the more efficient equipment, due its increased physical size, would incur higher labor expenses as a result of needing extra personnel to install the equipment. Other comments claimed that installation costs would be impacted by larger and more efficient units for those installations with size constraints such as equipment closets in manufactured homes and certain replacement installations in single-family homes. (MHI, No. 99 at p. 4; York, No. 90 at p. 5; and Lennox, No. 91 at p. 7).

Throughout the analysis we have assumed that installation costs would remain constant as efficiency increased. We remain unconvinced based on the comments we have received that our assumption is necessarily incorrect. Even if installation costs do generally rise as the size and weight of equipment increases, manufacturers will have the incentive under new standards to reduce the size of 13 SEER equipment using various approaches at their disposal. These include existing design options that we have mentioned, such as adopting variable speed and modulating capacity technologies, converting to microchannel heat exchangers, increasing the size of the unconstrained outdoor unit or indoor unit only, or changing the footprint or elevation of the unit. These possible solutions are applicable to manufactured homes as well as site-built homes.

For those reasons, we are retaining our assumption that installation costs remain constant as efficiency levels rise.

f. *Markups.* ARI, York, Carrier and Trane commented that we had apparently assumed that markups decreased as efficiency levels increased, and provided evidence to the contrary. (ARI, No. 100 at p. 3; York, No. 90 at p. 4; Carrier, No. 92 at p. 5; and Trane, No. 93 at p. 12).

In fact, we did assume for the Manufacturer Impact Analysis that markups increase with increasing efficiency under a given standard level. This agrees with the comments. However, for the consumer economic analyses, as the minimum standard level increases, we assumed that some of the markups on the baseline product do decrease. Comments did not address that issue, and we believe our assumption is correct. Appendix D of the TSD provides more information on this issue.

3. Shipments/National Energy Savings

a. Adjustments to NAECA Shipment Scenario. ACEEE and the NEEP assert that the NAECA efficiency scenario we developed is not at all representative of the effect of the NAECA standard as we claim. (ACEEE; Transcript No. 73 at p. 213 and No. 118 at p. 4). They point out that the distribution of equipment higher than 10 SEER in 1993 was 18 percent, and that our NAECA scenarios apply much smaller fractions of shipments than 18 percent.

As we mentioned in the TSD for the proposed rule (section 8.3.5), the NAECA scenario represents the effect that NAECA had on equipment efficiency in the market. A further explanation is warranted. While sales of equipment rated higher than 10 SEER was indeed 18 percent in 1993, it was 10 percent in 1992, 7 percent in 1991, 5 percent in 1990 and 3 percent in 1989. A trend of improving efficiency had already been in place since the late 1970's. NAECA, which became effective in 1992, clearly did not cause all the high efficiency shipments that existed in 1993. However, NAECA did seem to stimulate more high efficiency shipments than could have been explained by the ongoing trend. It is that enhancement to the status quo that our NAECA scenario attempts to reproduce. Thus, under our NAECA scenario, shipments above the 13 SEER level increase from 1 percent under the base case to 7 percent with a 13 SEER standard. Expecting them to increase from 1 percent to 18 percent as ACEEE and NEEP seem to assert is not at all representative of the NAECA experience and is more in line with the Shift scenario that we developed.

b. *Fuel Switching.* Several comments noted the potential for fuel- or equipment-switching from heat pumps to either gas-fired or electric resistance heating equipment due to the disparity in the standards proposed for central air conditioners (12 SEER) and heat pumps (13 SEER). The comments stated that the incremental purchase price of a 13 SEER heat pump relative to a 12 SEER air conditioner with either a gas-fired or electric resistance heating system is great enough to drive heat pump consumers to an alternative space-conditioning system. (ARI, No. 100 at p. 10; Southern Company, No. 96 at p. 3; AEP, No. 83 at p. 2; Carrier, No. 92 at p. 4; EEI, No. 80 at p. 8; York, No. 90 at p. 7; and Lennox, No. 91 at pp. 4–6).

Acknowledging the potential for fuel- or equipment-switching, both ASE and ACEEE recommended setting both air conditioner and heat pump standards to 13 SEER. (ASE, Transcript No. 73 at p. 197; and ACEEE, Transcript No. 73 at pp. 202–203).

From the perspective of saving the maximum amount of energy that is economically justifiable, the biggest ''fuel'' switching concern is from heat pumps to a combination of central air conditioners and electric resistance heating. This may occur in households that have only electric service and where the incremental purchase price of heat pumps is too great. Such a price increase might occur if the standard on heat pumps is significantly higher than the standard for central air conditioners.

Based on data from the 1997 RECS, a little over 14 percent of households have either baseboard or forced air electric resistance heating with room or central air conditioning compared to almost 10 percent of households which have heat pumps. Because there are already such a large percentage of households that utilize a combination of central or room air-conditioning with resistance heat to meet their space-conditioning needs, this supports the possibility that some purchasers would choose to switch to resistance heat from heat pumps.

Compared to heat pumps meeting the standards issued in the proposed rule (*i.e.,* 13 SEER and 7.7 HSPF), electric resistance heating uses over 225 percent of the energy for the same amount of heating. Therefore, if a standard of 13 SEER and 7.7 HSPF is issued for heat pumps while a 12 SEER standard is set for central air conditioners, a mere 4 percent of heat pump households would need to switch to central air conditioners and electric resistance heating to negate the energy savings achieved from increasing the heat pump standard from 12 SEER/7.4 HSPF to 13 SEER/7.7 HSPF.

If heat pump and air conditioner standards were set at different levels, the price differential between the two would increase on the order of $200. Under those conditions, we consider it likely that at least 4 percent of prospective heat pump owners would switch to lower-priced resistance heat. Therefore, we have weighed this concern in adopting today's standard levels, which require air conditioners and heat pumps to meet the same minimum efficiency standard so as to reduce the likelihood of switching to resistance heating.

A larger price differential between heat pumps and air conditioners will also tend to encourage switching to gas or oil fired furnaces. It is not our objective to encourage or discourage that type of fuel switching. Therefore, we also considered this potential effect in our decision to establish air conditioner and heat pump efficiency standards at the same SEER level.

c. *Drop in Shipments in New Construction Market.* ACEEE argued that DOE's forecasts for more efficient air-conditioning equipment estimated too large of a drop in shipments to the new construction market. They state that because the new construction market already has an 80 percent saturation rate it is unlikely that this market will forego the installation of more efficient air-conditioning equipment due to its associated increased purchase price. (ACEEE, Transcript No. 73 at pp. 219–221). This is effectively an argument that the price elasticity of air conditioners and heat pumps in the new construction market should be much lower than we have assumed.

Historical saturation data, however, seems to confirm that the price elasticity in the new construction market is closer to what was derived for the Shipments Analysis, which is already much lower than the elasticity we assumed in the replacement market, for example. As the price of air conditioners and heat pumps has dropped over time relative to household income, the saturation of air-conditioning and heat pump equipment has increased in the new housing market to its current value of 80 percent. Because of the high saturation in the new construction market, the purchase price elasticity for the new housing market is small relative to the replacement market. But although the price elasticity is small, a decrease in shipments to the new construction market will still be likely when equipment prices increase (as we expect to occur under a new efficiency standard). As a result, for the case of a 13 SEER standard for split system air conditioners for example, shipments to the new construction market drop by approximately 3 percent based on reverse engineering manufacturing cost data. For comparison purposes, shipments to the early replacement market drop much more significantly (approximately 15 percent) as this market is far less saturated and the resulting purchase price elasticity is much more elastic. For those reasons, we retained our assumed price elasticity in the analysis.

4. Manufacturer Impact Analysis

A few comments addressed the manufacturer impact analysis. Trane disputes our assumed manufacturer markups. ARI commented that a survey of their members revealed that our markup assumptions are grossly underestimated, but the TSD (Table 8.7) reveals that, in fact, their survey data agrees with the markups we used in the GRIM analysis to estimate manufacturer impacts. (Trane, No. 93 at pp. 12 and 22; and ARI, No. 100 at p. 3).

Trane also pointed out several oversights and simplifications relating to our characterization of manufacturers and our apparent failure to present cash flow results and other important indicators of financial strength. (Trane, No. 93 at pp. 6, 11–13 and 23). We believe that Chapter 8 of the TSD addresses most of Trane's concerns. No evidence cited in the comments suggest that our assumptions contain errors that would warrant significant change in our conclusions regarding manufacturing impacts.

5. Utility Impacts

a. *Peak Demand Impacts.* ACEEE asserts that the peak power impacts presented in the proposed rule underestimate the true peak generation impacts due to central air conditioner and heat pump standards. ACEEE's assertion is based on what they consider as more accurate and significantly greater peak impacts as estimated by the Appliance Standards Awareness Project (ASAP).[10] (ACEEE, No. 104 at pp. 5–6). APPA warned that excessively high SEER standards could increase peak demand. (APPA, No. 113 at p. 1).

For purposes of comparing the estimated peak impacts from the Department's analysis based on the use of NEMS–BRS and those from ASAP, it is helpful to consider the concept of a conservation load factor (CLF). The CLF was first introduced by researchers at Lawrence Berkeley National Laboratory to allow for the straightforward calculation of the peak demand avoided from a given amount of energy savings.[11] The CLF is defined as:

$$\text{CLF} = \frac{\text{Annual Site Energy Savings (kWh)}}{\text{Peak Load Savings (kW)} \cdot \text{8760 hours}}$$

Thus, a conservation technology that saves a constant amount of power on a continuous basis has a CLF of 1.0. Because air conditioning use occurs most often during times of peak demand, the CLF is significantly lower. The lower the CLF, the greater the amount of peak load savings achieved for a given amount of annual energy savings.

For a 13 SEER central air conditioner and heat pump standard, NEMS–BRS forecasts peak demand savings which result in a nationally representative CLF of 0.22. In contrast, for the same 13 SEER standard, ASAP forecasts energy and peak demand savings which result in CLFs ranging from 0.08 to 0.14. Based on the above discrepancy in the CLF, ACEEE asserts that the peak demand savings forecasted by NEMS–BRS are too low. The Department disagrees with ACEEE's position for two reasons: (1) ASAP's peak savings estimates rely on suspect air conditioner demand data, and (2) metered end-use data from air-conditioned households in California and Florida indicate that the NEMS–BRS-based CLF value of 0.22 is reasonable.

With regard to ASAP's peak demand estimates, regional calculations are based on peak demand data from a single 1988 study by the Narragansett Electric Co. (an electric utility in the Northeast).[12] Although ASAP increased

[10] Staying cool: How Energy-Efficient Air Conditioners Can Prevent Blackouts, Cut Pollution and Save Money, Appliance Standards Awareness Project, July 2000, Authors: J. Thone, T. Kubo, and S. Nadel.

[11] Conservation Screening Curves to Compare Efficiency Investments to Power Plants: Applications to Commercial Sector Conservation Programs, Lawrence Berkeley National Laboratory, Berkeley, CA, August 1990, published in the Proceedings of the 1990 ACEEE Summer Study on Energy Efficiency in Buildings, Authors: J. Koomey, A. Rosenfeld, and A. Gadgil.

[12] Personal communication with Steve Nadel, ACEEE, October, 2000.

the Northeast peak demand data by 25 percent for the two Southern divisions and decreased it by 25 percent for the Pacific division, no basis for these adjustments are provided. Because of ASAP's reliance on peak demand data from only one region of the country, we do not place much confidence in the peak generation savings provided by ASAP.

As opposed to the ASAP results, metered end-use data from Southern California and Florida indicate that climate has a much larger affect on the CLF than reported by ASAP. In Southern California, a metered end-use study conducted on 132 air-conditioned households in Southern California Edison's service area revealed that the CLF for this region is likely 0.08.[13] In Homestead, Florida, a metered end-use study conducted on ten air-conditioned homes indicated that the CLF is likely 0.42.[14] Although strong conclusions cannot be drawn from only two studies, the metered end-use results do provide the Department with some confidence that the NEMS–BRS CLF estimate of 0.22 is reasonable since it falls between the CLF range provided by the two metered end-use studies. Therefore, we have reason to believe that our assumption is more valid than ASAP's.

Obviously more research needs to be conducted in the area of peak demand impacts due to increased air conditioner efficiency. But until such extensive research is conducted, the Department sees no reason to discontinue its use of NEMS-BRS to estimate peak demand savings.

6. Projection of Trends

Several comments suggested or asserted that we should project historical trends that they believe exist. These include price reductions or productivity improvements in manufacturing. (ACEEE, Transcript No. 73 at pp. 64 and 88–90; and NRDC, Transcript No. 73 at pp. 105 and 115), post-standard product efficiencies (ACEEE, Transcript No. 73 at p. 210), and electricity prices. (ASAP, No. 108 at p. 1; ACEEE, Transcript No. 73 at pp. 154–158; NWPPC, No. 76 at pp. 3–4; and Synapse, Transcript No. 73 at pp. 152–153).

Other comments responded to some of these suggestions. With regard to the issue of price reductions or productivity improvements, some contend that reductions are due to declining commodity metals prices rather than any increases in production efficiency. (Lennox, No. 91 at pp. 4–5). On the issue of efficiency trends, EEI claims that rather than post-standard efficiency increases, the Department neglected to account for pre-standard efficiency increases. (EEI, Transcript No. 73 at pp. 206–208). Counter to claims that electricity prices will increase in the future due to the deregulation of the electric utility industry, others state that the future path of deregulation is so uncertain that it is unknown as to whether prices will decline or increase. (EEI, Transcript No. 73 at pp. 148–150; Dominion, Transcript No. 73 at pp. 158–160; and Southern Company, No. 96 at pp. 6–7).

In these instances where we have conflicting opinions about what is responsible for creating a trend, we have no basis for changing our initial assumption. Usually, we rely on the most recent set of data we have available to us to make projections into the future. In the case of efficiency trends, we rely on existing trends that seem to indicate that efficiency will remain static after a new standard becomes effective. In the case of electricity prices, we rely on the projections provided in the Annual Energy Outlook, which is publicly and readily available, and which we assume is unbiased with respect to parties interested in the outcome of this rulemaking. Since this is the case for all the supposed trends listed above, we have not changed any of our projections.

C. Other Comments

1. HCFC Phaseout

Comments noted that as efficiency increases, refrigerant charge may increase also. This could cause the United States to reach its cap on HCFC–22 use earlier, resulting in higher prices for HCFC–22 than we have considered. (Carrier, No. 92 at p. 4). We would point out that occurrence would likely accelerate the transition to HCFC-free refrigerants. There are also other options available for manufacturers to improve equipment efficiency without increasing equipment size or charge. Both of these factors will have the effect of suppressing increases in refrigerant prices over the long term.

2. Ozone Reduction Catalyst Requirement

ARI and its members remind us to consider the potential impact on the industry of Texas' proposed requirement to mandate the application of ozone reduction technology in its most severe non-attainment areas. (ARI, No. 100 at p. 13; and Carrier, No. 92 at p. 4).

We understand that Texas has since withdrawn its proposal. However, the TSD does include a preliminary estimate of the burden of this requirement on the industry and, to the extent that other states may pursue the same course of action, included that in our consideration of cumulative burden. We consider that widespread requirements for this technology will not be likely, due to its apparently high cost, questionable efficacy, and possible reduction in energy efficiency.

D. Additional Standard Requirements

1. EER Standard

In the proposed rule, we discussed including a requirement for a new standard based on a system's energy efficiency ratio (EER) in addition to its seasonal energy efficiency ratio (SEER). That new standard was to be established at the median of available EER ratings at a particular SEER level. Our objective was to ensure that any increase in the SEER standard also resulted in an increase in equipment efficiency under the warmer conditions best measured by EER. That resulting drop in peak power demand would then help avoid the need for new power plants and, in the view of many stakeholders, improve power system reliability. We asked whether an EER standard would impose a significant burden on manufacturers, would significantly affect the cost of equipment considered in our analysis, would negatively impact the sale of modulating equipment, or would significantly improve power system reliability.

Several comments, including those of environmental advocacy groups and some utilities, supported adding an EER standard and urged us to adopt the median EER standards we proposed. They cited potential benefits that would accrue from avoidance of new power plant capacity and a reduction in the occurrence of blackouts. NRDC believes that the Act requires us to adopt an EER-based standard. Underlying these comments is a belief that SEER standards alone cannot guarantee those benefits. Carrier supports an EER-based standard only in lieu of a SEER-based standard because it would harmonize with International Standards Organization testing requirements. (ACEEE, Transcript No. 73 at p. 62; NWPPC, Transcript No. 73 at p. 161; ASE, No. 81 at p. 1; NPPD, No. 109 at p. 1; OOE, No. 84 at p. 2; NRDC, No. 88

[13] Residential Appliance End-Use Survey; Collection of Residential Appliance Time-of-Use Energy Load Profiles; 1991 Results, prepared by Quantum Consulting Inc., Berkeley, CA for Southern California Edison Co., San Dimas, CA, November, 1992.

[14] Monitored Energy Use Patterns in Low-Income Housing (FSEC-PF–300), Florida Solar Energy Center, Cocoa, FL, 1996, Authors: D. S. Parker, M. D. Mazzara, and J. R. Sherwin.

at p. 3; Omaha Public Power District (OPPD), No. 111 at p. 2; and Carrier, No. 92 at p. 8).

Other comments took an opposing position on the grounds that including an EER standard would impede the application of modulating components; that we are not permitted to adopt a standard other than SEER and have not sufficiently analyzed the validity of an EER-based standard; that an EER standard would eliminate products from the market; that an EER standard will not improve electric system reliability, particularly nationwide; and that there are burdens associated with testing and certifying EER. (National Comfort Products (NCP), No. 77 at p. 3; EEI, Transcript No. 73 at p. 327 and No. 80 at pp. 3 and 9; Dominion, Transcript No. 73 at p. 264 and No. 68 at p. 2; Trane, No. 93 at p. 14; York, No. 90 at pp. 1–4; ARI, Transcript No. 73 at p. 320 and No. 100 at p. 16; Goodman, Transcript No. 73 at p. 302; and Southern, Transcript No. 73 at p. 243).

It is true that under the efficiency level approach, we assume that all equipment at the same SEER level costs the same to produce regardless of the combination of design options chosen to achieve that SEER level. These options include those that raise EER, including compressor and heat exchanger upgrades, as well as those that do not raise EER, such as thermostatic expansion valves. For any given SEER and HSPF levels, the efficiency level approach cannot differentiate equipment cost based on different EER choices.

Underlying the efficiency level approach, however, is the assumption that manufacturers make cost-optimal choices based on their own unique situations. Therefore, a manufacturer who was required to raise the EER of its equipment from the 10th percentile to the 50th percentile (median) would indeed incur added costs since its design choices would no longer be cost-optimal for its own circumstances. Since efficiency levels are expressed in terms of SEER and HSPF only, we would have to depart from the efficiency level approach in order to quantify those costs.

We are still convinced that the stringent physical relationship between EER and SEER in equipment rated through 12 SEER, which is comprised exclusively of non-modulating equipment, would remain intact under new standards and for the foreseeable future. Under the adopted 13 SEER standard, we have less certainty since there are counteracting incentives. On the one hand, to reduce warranty claims, manufacturers have a strong incentive to simplify the design of baseline equipment. This suggests they will favor heat exchanger or compressor improvements that improve EER.

On the other hand, manufacturers will have a strong incentive to reduce the size of 13 SEER baseline equipment. Although microchannel heat exchangers could reduce size and improve EER, manufacturers could also choose to introduce variable speed or capacity modulation technologies that can induce them to lower EER at a given SEER level. As the cost of power electronics and control technologies come down, this possibility becomes more likely.

However, even if variable speed or modulating technologies eventually predominate, and thereby reduce EERs in typical equipment, they would still reduce peak demand compared to today's 10 SEER baseline equipment. Furthermore, because variable speed and modulating equipment mitigate the cyclic losses that are due to widespread over sizing, the aggregated peak demand of a group of modulating air conditioners with lower EERs will likely be lower than that of a similar group of non-modulating air conditioners with higher EERs at the same SEER level. Also, utilities have the opportunity with modulating equipment to offer customers the option to allow the utility to ''lock'' the equipment into low-capacity operation in return for a lower electricity price.

Finally, although the Department is interested in reducing peak demand, the primary purpose of appliance efficiency standards is to save energy. An EER standard could be counterproductive by discouraging variable speed and modulation, which can save substantial amounts of energy over the cooling season while providing consumers with additional benefits not found in single speed and non-modulating equipment.

Although the Department believes that EPCA permits adoption of an EER standard, for the foregoing reasons, we do not believe that the Act requires or suggests that we establish such a standard under the circumstances here. Given the adopted standard levels, a national EER standard is both unnecessary and undesirable. Most benefits accruing from an EER standard will likely accrue from the SEER standards alone, without the associated burdens on manufacturers and the disincentives to apply energy-saving modulating technologies. Therefore, we have not adopted an EER standard in this rule.

2. TXV Requirement

In the proposed rule, we discussed the issues associated with mandating thermostatic expansion valves, or TXVs. We did not propose such a requirement, but we recognized that such a requirement may be capable of saving a great deal of energy. We discussed our options for encouraging their use.

Many comments continue to express strong support for a TXV requirement. Many cite a report submitted by Proctor Engineering (Proctor) that describes the results of a field study covering 4,000 units in California. The study concluded that 62 percent of equipment is mischarged by more than 5 percent, and that TXVs, which perform better than fixed orifices in undercharged conditions, could save 11 percent of the energy used by that equipment. (Proctor No. 105; OOE, No. 84 at p. 2; NRDC, No. 88; California Energy Commission (CEC), No. 98 at p. 1; ACEEE, No. 101 at p. 8; PG&E No. 104 at p. 1; and ASAP, Transcript No. 73 at p. 4).

Other comments expressed some resistance to a TXV requirement, particularly regarding our authority to establish one. Some also express concerns about problems associated with TXVs. (NCP, No. 77 at p. 4; Trane, No. 93 at p. 19; York, No. 90 at pp. 4–5; Lennox, No. 91 at p. 3; EEI No. 80 at p. 3; and Carrier, No. 92 at p. 10).

In response to our concern that mandating TXVs would stifle the development of other, perhaps preferable, technologies, Proctor and ACEEE suggested performance tests that could be applied in lieu of a TXV requirement. They would reward equipment that possessed a TXV or performed as well while undercharged or when airflow is restricted. This approach is at least partially endorsed by others. (NRDC No. 88 at p. 17; CEC No. 199 at p. 1; and OOE, No. 84 at p. 8). Some of the commenters preferred that we initially specify TXVs but then phase out that requirement in favor of a performance-based approach.

As we alluded to in the proposed rule, a performance-based approach is also our preference and is certainly in the spirit of EPCA. As such, the SEER test procedure, not a TXV requirement, appears to be the most appropriate vehicle for assuring that an equipment's efficiency rating is based on its performance characteristics. In fact, TXVs already receive credit in the test procedure because of their superior cyclic performance. We are not eager to circumvent the test procedure, particularly when the key data either are not available or have not been thoroughly reviewed by all interested parties. That said, we favor a SEER test procedure that fairly evaluates equipment performance under conditions that represent those encountered in the field. We would prefer to encourage correct charging or proper airflow, but we recognize that practical barriers exist, and we will take steps to evaluate whether the SEER test procedure can and should be amended to better reflect equipment performance under improper charge or airflow.

In sum, we are not adopting a TXV requirement in this rulemaking. Any alterations in the SEER test procedure to further encourage the use of TXVs will be undertaken in a separate process. In addition to pursuing modifications to the test procedure, we encourage parties interested in encouraging the broader application of TXVs to pursue other avenues. These include voluntary programs like Energy Star, tax incentives, and other state and local initiatives, which can all be tied to the presence of a device like a TXV. States also have the opportunity to apply to us for an exemption from preemption that would allow them to implement their own requirements based on their own unique circumstances.

3. HSPF Levels

Some comments urged us to reconsider our proposed HSPF levels, particularly to reflect differences among the HSPF-SEER relationships across capacity ratings. Trane commented that HSPF-SEER factors for heat pumps are lower with 410A refrigerant than with HCFC–22, and that the current proposal for HSPF is too high for 410A by as much as 3 to 5 percent. (ARI, No. 100 at p. 11; Carrier, No. 92 at p. 7; and Trane, No. 93 at p. 8). Others urged us to adopt HSPF levels at the median for each SEER level we considered. (OOE, No. 84 at p. 11; and ACEEE, No. 104 at p. 12).

As we explained in the proposed rule, we established the HSPF levels corresponding to SEER levels in an attempt to maintain the existing offset between the minimum HSPF and the minimum SEER. Heating energy is a large fraction of total heat pump energy consumption, so we prefer not to relax that relationship without sound evidence regarding the burdens that would be mitigated. We are reluctant to adopt a more stringent level since we are aware that heat pump design is difficult and costly, and that improvements in HSPF typically are associated with a reduction in SEER. Too stringent a standard would impose considerable design and testing burdens on manufacturers, could result in the permanent loss of heat pump market share to electric resistance heat, and could encourage fuel switching.

For those reasons, we are retaining our proposed minimum HSPF levels in the standards adopted today.

V. Analytical Results and Conclusions

A. Trial Standard Levels

We examined five standard levels. Table V.1 presents the trial standards levels analyzed for today's final 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 V.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

For each trial standard level examined, several different scenarios were analyzed consisting of variations on: (1) Electricity price and housing projections; (2) equipment efficiency distributions; (3) manufacturer cost estimates; and (4) 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. Under the standard levels we are adopting, we believe that the Roll-up scenario most closely represents the most likely impact of the new standards, as explained in Chapter 8 of the TSD. We analyzed two manufacturer cost scenarios: (1) Based on reverse engineering data, and (2) based on ARI-provided mean cost data. For the reasons expressed in Parts III and IV of this document, we believe that the reverse engineering data most closely represents the costs as they will actually be under the new standards. We assumed a societal discount rate of 7 percent for calculating net present value (NPV). However, a 3 percent 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.

Our decision on today's final rule was arrived at by placing more emphasis on some scenarios rather than others. Our estimates of electricity price and housing projections relied primarily on the AEO2000 reference case. We considered primarily the NAECA and Roll-up efficiency scenarios with an increasing expectation of the Roll-up scenario occurring for more stringent trial standard levels. Finally, we expect manufacturer costs to lie closer to the reverse engineering estimates (which lie between the ARI minimum and ARI mean values).

The results presented in this chapter include only those that are needed to supplement or replace the results we presented in the proposed rule, which still form a basis for our decision with the exception that we are no longer considering the 14-year life scenarios. We believe that the 18.4-year life with a compressor replacement in the 14th year addresses the concerns of those who believe that actual equipment life is closer to 14 years and achieves substantially the same analytical results. Therefore, all analyses below assume an 18.4-year average equipment lifetime with a compressor replacement in the 14th year.

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.

Table V.2 shows the range of cumulative energy savings based on the AEO 2000 Reference, High Growth, and Low Growth cases for each trial standard level. The parameters shown are the two manufacturing costs and the three equipment shipment efficiency scenarios.

TABLE V.2.—RANGE OF NATIONAL ENERGY SAVINGS WITH AEO PRICE FORECAST

Range of national energy savings for units sold from 2006 to 2030 (quads)						
Trial standard level	Reverse engineering costs			ARI mean costs		
	NAECA	Roll-up	Shift	NAECA	Roll-up	Shift
1	1.7 to 1.8	1.5 to 1.6	1.9 to 2.0	1.7 to 1.8	1.5 to 1.6	1.9 to 20
2	2.9 to 3.2	2.8 to 3.0	3.4 to 3.6	2.9 to 3.2	2.8 to 3.0	3.4 to 3.6
3	3.4 to 3.7	3.3 to 3.5	3.8 to 4.1	3.4 to 3.6	3.3 to 3.5	3.8 to 4.1
4	4.3 to 4.6	4.1 to 4.4	4.7 to 5.0	4.2 to 4.5	4.1 to 4.4	4.6 to 4.9
5	8.4 to 9.0	8.4 to 9.0	8.4 to 9.0	8.1 to 8.7	8.1 to 8.7	8.1 to 8.7

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 percent greater than the weighted-average energy consumption data used in the life-cycle-cost (LCC) analysis. The LCC data are based on the 1997 RECS for residential buildings and hourly simulations for commercial buildings. Since the test procedure assumes higher annual operating hours than the RECS data implied, the use of test procedure energy consumption results in rebuttable payback periods which are shorter than median payback periods calculated from the LCC analysis.

In Table V.3, we list the rebuttable payback periods versus SEER efficiency level for the four product classes, using the 1997 RECS energy consumption data. This information shows that both classes of heat pumps are presumed to be economically justified up to a 12 SEER efficiency level, using the reverse engineering cost estimates.

TABLE V.3.—SUMMARY OF REBUTTABLE PAYBACK PERIOD (YEARS)

Product class/efficiency level	Reverse engineering costs	ARI mean costs
Split System Central Air Conditioner:		
11	3.5	4.7
12	4.5	5.8
13	5.2	7.6
18	7.3	11.3
Split System Heat Pump:		
11	1.3	2.5
12	1.8	3.3
13	3.2	4.5
18	5.8	6.8
Single Package Air Conditioner:		
11	3.5	7.3
12	3.3	6.2
13	6.8	9.8
18	8.6	13.3
Single Package Heat Pump:		
11	2.1	3.7
12	1.8	4.0
13	4.3	6.5
18	5.4	7.2

D. Economic Justification

1. Economic Impact on Manufacturers and Consumers

Estimated economic impacts of standards on manufacturers are based on the methodology described in the proposed rule; however, in today's final rule the manufacturer impact analysis has been expanded to include impacts based on reverse engineering cost estimates as well as ARI manufacturing cost data. The economic impacts on manufacturers are presented in terms of industry net present value (INPV) as well as change in INPV. INPV is calculated by summing the stream of annual discounted cash flows beginning from the base year of the analysis (2000) and continuing explicitly for ten years after the implementation of the standard and adding the discounted value of the industry at the end of the ten-year period (see TSD Section 8.4.4 and Appendix G). The discount rate is based on the industry's weighted average cost of capital. This method of calculating INPV provides one measure of the fair value of the industry in today's dollars. The impact of new standards on INPV is then the difference between the INPV in the base case (no new standards) and the INPV is the standards case (with new standards).

Data are presented for the base case and for trial standard levels 1 through 4, in Tables V.4 through V.9. As can be observed, manufacturer impacts are relatively insensitive between the manufacturing cost estimates, but sensitive to the shipment scenarios. The proposed rule provides additional information on the methodology, assumptions and results.

TABLE V.4.—CHANGES IN INDUSTRY NET PRESENT VALUE—REVERSE ENGINEERING RELATIVE COST, 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 V.5.—CHANGES IN INDUSTRY NET PRESENT VALUE—REVERSE ENGINEERING RELATIVE COST, ROLL-UP EFFICIENCY MIX

Standard level	Industry net present value ($ million)	Change in INPV from base case	
		$ million	Percent
Base	1,539		
1	1,379	(160)	−10
2	1,226	(313)	−20
3	1,220	(319)	−21
4	1,236	(303)	−20

TABLE V.6.—CHANGES IN INDUSTRY NET PRESENT VALUE—REVERSE ENGINEERING RELATIVE COST, SHIFT EFFICIENCY MIX

Standard level	Industry net present value ($ million)	Change in INPV from base case	
		$ million	Percent
Base	1,539		
1	1,658	119	8
2	1,772	233	15
3	1,776	237	15
4	1,824	285	19

TABLE V.7.—CHANGES IN INDUSTRY NET PRESENT VALUE—ARI MEAN MANUFACTURING COST, 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 V.8.—CHANGES IN INDUSTRY NET PRESENT VALUE—ARI MEAN MANUFACTURING COST, 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 V.9.—CHANGES IN INDUSTRY NET PRESENT VALUE—ARI MEAN MANUFACTURING COST, 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

Table V.10 provides the change in INPV relative to the base case (with no change in standards) for trial standard levels 1 through 4. Data are presented for two industry segments (lower cost manufacturers and higher cost manufacturers), and for the three shipment efficiency scenarios.

TABLE V.10.—CHANGE IN INDUSTRY NET PRESENT VALUE (PERCENT) RELATIVE TO BASE—COMPARISON BETWEEN LOWER (L) AND HIGHER (H) COST MANUFACTURERS

Standard level	Reverse engineering relative cost (in percent)						ARI mean manufacturing cost (in percent)					
	NAECA		Roll-up		Shift		NAECA		Roll-up		Shift	
	L	H	L	H	L	H	L	H	L	H	L	H
1	5	−4	3	−15	6	8	5	−5	3	−16	7	9
2	7	−16	5	−28	13	16	7	−17	5	−31	12	14
3	8	−17	6	−29	14	16	9	−19	6	−32	14	16
4	12	−18	10	−29	19	18	15	−19	13	−31	21	19

For the group most negatively impacted, *i.e.,* the higher cost group, Table V.11 presents the Return on Invested Capital (ROIC) in year 2011 associated with the base case, and with each new standard level for the NAECA and Roll-up shipment efficiency scenarios.

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

Standard level	Reverse engineering (in percent)		ARI manufacturing costs (in percent)	
	NAECA	Roll-up	NAECA	Roll-up
Base	13.0	13.0	13.3	13.3
1	12.2	10.7	12.3	10.7
2	10.2	8.5	0.2	8.4
3	10.0	8.4	10.0	8.3
4	9.7	8.4	9.6	8.3

Consumers will also be affected by increased efficiency standards in that they will experience higher purchase prices and lower operating costs. These impacts are best captured by changes in life cycle costs which are discussed below.

2. Life-Cycle-Cost (LCC)

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 prices, electricity price trends, repair costs, maintenance costs, equipment lifetime, and discount rates.

The output of the LCC model is the 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 final rule employs a concept described in the proposed rule with regard to the percentage of consumers (both residential and commercial) that are impacted to a substantial degree by an increase in the minimum efficiency standard.

Table V.12 summarizes the LCCs for baseline split systems and single package central air conditioners and heat pumps and also shows a 2 percent threshold which helped us identify those consumers who are impacted to a more substantial degree.

TABLE V.12.—BASELINE LIFE-CYCLE-COSTS

Product Class	Baseline LCC	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

Tables V.13 and V.14 depict the LCC results for split system and single package central air conditioners and heat pumps. The tables show 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. The data in Tables V.13 and V.14 also present 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 tables show the subset of consumers (both residential and commercial) at each efficiency level who are impacted in one of three ways: consumers who achieve net LCC savings in excess of 2 percent of the baseline LCC, consumers whose change in LCC is within ±2 percent of the baseline LCC, and consumers who achieve a net LCC increase exceeding 2 percent of the baseline LCC.

TABLE V.13.—SUMMARY OF LCC RESULTS BASED ON REVERSE ENGINEERING MANUFACTURING COSTS

Product Class/Efficiency Level	Average LCC	Average LCC Savings (Costs)	Percent of consumers with		
			Net Savings (>2 %)	Net Savings or Costs (±2%)	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 V.14.—SUMMARY OF LCC RESULTS BASED ON ARI MEAN MANUFACTURING COSTS

Product class/efficiency level	Average LCC	Average LCC savings (costs)	Percent of consumers with		
			Net savings (> 2%)	Net savings or (costs) (± 2%)	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
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

TABLE V.14.—SUMMARY OF LCC RESULTS BASED ON ARI MEAN MANUFACTURING COSTS—Continued

Product class/efficiency level	Average LCC	Average LCC savings (costs)	Percent of consumers with		
			Net savings (> 2%)	Net savings or (costs) (± 2%)	Net costs (> 2%)
18	9,922	(296)	24	10	66

Consumer subgroup impacts have been estimated by determining the LCC impacts of the trial standard levels on those consumers who are 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.[15] Table V.15 and V.16 summarize the impacts on low-income consumers who utilize central air conditioners and heat pumps.

TABLE V.15.—SUMMARY OF LCC RESULTS ON LOW-INCOME CONSUMERS BASED ON REVERSE ENGINEERING MANUFACTURING COSTS

Product class/efficiency level	Average LCC	Average LCC savings (costs)	Percent of consumers with		
			Net savings (> 2%)	Net Savings or (costs) (± 2%)	Net costs (> 2%)
Split System Central Air Conditioner:					
10	$4,906				
11	4,855	$51	21	74	5
12	4,841	65	28	38	34
13	4,863	43	26	24	50
18	5,176	(270)	17	6	77
Split System Heat Pump:					
10	8,965				
11	8,836	129	26	74	0
12	8,742	223	44	56	0
13	8,780	185	39	49	12
18	9,389	(424)	15	10	75
Single Package Air Conditioner:					
10	5,327				
11	5,272	55	21	77	2
12	5,202	125	34	52	14
13	5,364	(37)	21	18	61
18	5,704	(377)	15	5	80
Single Package Heat Pump:					
10	9,149				
11	9,057	118	24	76	0
12	8,973	265	53	47	0
13	9,145	148	36	44	20
18	9,619	(284)	20	14	66

TABLE V.16.—SUMMARY OF LCC RESULTS ON LOW-INCOME CONSUMERS BASED ON ARI MEAN MANUFACTURING COSTS

Product class/efficiency level	Average LCC	Average LCC savings (costs)	Percent of consumers with		
			Net savings (> 2%)	Savings/costs (± 2%)	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				
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				

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

TABLE V.16.—SUMMARY OF LCC RESULTS ON LOW-INCOME CONSUMERS BASED ON ARI MEAN MANUFACTURING COSTS—Continued

Product class/efficiency level	Average LCC	Average LCC savings (costs)	Percent of consumers with		
			Net savings (> 2%)	Savings/costs (± 2%)	Net costs (> 2%)
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 (Tables V.15 and V.16) versus all central air conditioner and heat pump consumers (Tables V.13 and 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.17 directly compares the LCC impacts of the final rule on both the low-income subgroup and all consumers.

TABLE V.17.—COMPARISON OF LCC IMPACTS OF THE FINAL RULE ON ALL CONSUMERS VS. LOW-INCOME CONSUMERS

Product class	SEER	Reverse engineering costs				ARI mean costs			
		Average LCC savings (costs)		Percent of consumers with net costs (>2% of baseline LCC)		Average LCC savings (costs)		Percent of consumers with net costs (>2% of baseline LCC)	
		All consumers	Low-income	All consumers	Low-income	All consumers	Low-income	All consumers	Low-income
Split System A/C	13	$113	$43	39	50	($29)	($101)	58	69
Split System HP	13	372	185	6	12	215	17	22	35
Single Package A/C	13	29	(37)	52	61	(175)	(241)	71	79
Single Package HP	13	353	148	12	20	112	4	36	48

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 that would result from more stringent standards. As with the determination of national energy savings, four different scenarios were analyzed for each trial standard level consisting of variations on: (1) Electricity price and housing projections; (2) shipment efficiency distributions; (3) manufacturer cost estimates; and (4) 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 shipment efficiency distribution after new standards: (1) NAECA scenario, (2) Roll-up scenario, and (3) Shift scenario. For these results the equipment lifetime was assumed to be 18.4 years, coupled with the inclusion of compressor replacement costs and an assumed societal discount rate of 7 percent. The range of NPVs are reported in Table V.18.

TABLE V.18: RANGE OF NET PRESENT VALUE WITH ELECTRICITY PRICE AND HOUSING PROJECTIONS

Trial standard level	Net present value for unites sold from 2006 to 2030 (billion 98$)					
	Reverse engineering costs			ARI mean costs		
	NAECA	Rool-up	Shift	NAECA	Roll-up	Shift
1	1 to 2	2	1 to 2	0	1	0 to −1
2	2	2 to 3	0 to −1	−1	0 to 1	−3 to −4
3	1 to 2	2 to 3	−1 to −2	−1 to −2	0 to −1	−5
4	0 to 1	1 to 2	−3 to −4	−5 to −6	−4	−10
5	−10 to −11	−10 to −11	−10 to −11	−22	−22	−22

In order to show the sensitivity of the NPVs in Table V.18 to the various input assumptions, Tables V.19 through V.22 report the range of NPV results for a range of assumptions and scenarios relative to the base case national equipment and operating costs for all central air-conditioning and heat pump equipment. By the ‘‘base case’’ we mean the case of no new efficiency standards. The results in Table V.19 and V.20 are 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. The discount rate is 7 percent. 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 V.19.—NET PRESENT VALUES RESULTS RELATIVE TO BASE CASE TOTAL EQUIPMENT AND OPERATING COSTS BASED ON REVERSE ENGINEERING MANUFACTURING COSTS

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	379	378	2	0.4	377	2	0.5	378	1	0.4
2	379	377	2	0.5	377	3	0.7	380	(1)	0.2
3	379	378	1	0.4	377	2	0.6	381	(2)	0.5
4	379	379	0	0.0	378	1	0.3	383	(4)	0.9
5	379	390	(10)	−2.7	390	(10)	−2.7	390	(10)	−2.7

TABLE V.20.—NET PRESENT VALUES RELATIVE TO BASE CASE TOTAL EQUIPMENT AND OPERATING COSTS BASED ON ARI MEAN MANUFACTURING COSTS

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

Table V.21 shows how a 3 percent discount rate[16] impacts the net present value. Only the Roll-up efficiency scenario and the AEO Reference Case electricity price and housing projection were considered in analyzing the impacts from a 3 percent discount rate.

TABLE V.21: NET PRESENT VALUES RESULTS BASED ON 3-PERCENT DISCOUNT RATE

TSL	Reverse engineering costs				ARI mean costs			
	Base case total costs billion 98$	Trial standard level			Base case total costs billion 98$	Trial standard level		
		Total cost billion 98$	Net present value 98$	As percent of base case total costs		Total cost billion 98$	Net present value billion 98$	As percent of base cast total costs
1	708	701	7	0.9	712	707	4	0.6
2	708	697	11	1.6	712	705	6	0.9
3	708	697	11	1.6	712	706	6	0.8
4	708	697	11	1.5	712	711	0	0.0
5	708	716	(8)	−1.2	712	746	(35)	−4.9

The proposed rule also estimated the national employment impacts due to each of the five trial standard levels. As discussed in the proposed rule, the energy efficiency standards for central air conditioners and heat pumps are expected to reduce electricity bills for residential and commercial consumers and the resulting net savings are expected to be redirected to other forms of economic activity. These shifts in

[16] A societal discount rate of 3 percent 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.

spending and economic activity are expected to affect the demand for labor.

As we did for the proposed rule, the Department estimated the impacts of the new standards on national labor demand using an input/output model of the U.S. economy. The model characterizes the interconnections among 35 economic sectors using data from the Bureau of Labor Statistics. For some years after the new standards go into effect, new consumer expenditure on air conditioners and heat pumps each year outpaces their annual energy savings. This activity redirects expenditures into the manufacturing sector, which is less labor intensive than other sectors of the economy,[17] producing a loss of jobs in those sectors that is larger than the gain of jobs in manufacturing. Also, a loss of jobs results in the utility sector due to its loss of revenues. As annual consumer energy savings begin to exceed annual new expenditures on air conditioners, eventually the new standards will produce a net gain in national employment.

The increases or decreases in the net demand for labor in the economy estimated by the input/output model due to air conditioner and heat pumps standards are likely to be very small relative to total national employment. For the following reasons any modest changes in employment are in doubt:

- Unemployment is now at the lowest rate in 30 years. If unemployment remains very low during the period when the standards are put into effect, it is unlikely that the standards alone could result in any change 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. The losses or gains from any potential employment change may be offset if job quality and pay also change; and
- The net benefits or losses from potential employment changes are a result of the estimated net present value of benefits or losses likely to result from air conditioner and heat pump 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 legitimate 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.

4. Impact on Utility or Performance of Products

As detailed in Section V of the proposed rule, in establishing classes of products we believe the adopted standards will not result in any degradation of utility or performance in the covered products.

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 provided the Department of Justice (DOJ) with copies of the proposed rule 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.

As previously discussed in section II.D.4 above, the Department of Justice concluded that the residential central air conditioner and heat pump standards contained in the proposed rule could have an adverse impact on competition. The proposed standards would have changed the current central air conditioner and heat pump efficiency standards of 10 SEER/6.8 HSPF for split system air conditioners and heat pumps and 9.7 SEER/6.6 HSPF for single package air conditioners and heat pumps to 12 SEER for air conditioners and 13 SEER/7.7 HSPF for heat pumps. Through-the-wall equipment was the only exception. We proposed an 11 SEER standard for that class.

DOJ identified three possible competitive problems presented by the proposed standards. First, DOJ stated that the proposed 13 SEER heat pump standard would have a disproportionate impact on smaller manufacturers. They stated that currently less than 20 percent of the total current product lines meet the proposed standards, but for some small manufacturers, 100 percent of their product lines fail to satisfy the proposed standard.

Second, DOJ stated that the proposed standard for heat pumps, and in some instances for air conditioners, would have an adverse impact on some manufacturers of products (including those products referred to in the proposed rule as ''niche products'') used to retrofit existing housing and used in manufactured housing. These manufacturers could not, according to DOJ, make units that comply with the rule and fit into the available space.

Third, DOJ expressed concern that the proposed heat pump standard of 13 SEER could make heat pumps less competitive with alternative heating and cooling systems. Because the standard would result in increases in the size and cost of heat pumps, it is possible that purchasers would shift away from heat pumps to other systems that inc1ude electric resistance heat, reducing the competition that presently exists between heat pumps and those other systems.[18]

The Department of Justice urged the Department of Energy to take into account these possible impacts on competition in determining its final energy efficiency standard for air conditioners and heat pumps. DOJ wrote that the Department of Energy should consider setting a lower SEER standard for heat pumps, such as the standard included in Trial Standard Level 2, and a lower SEER standard for air conditioners for retrofit markets where there are space constraints (such as markets served by niche products) and for manufactured housing.

As we noted in the Supplementary ANOPR and proposed rule, nearly all small manufacturers produce only niche products. DOJ's first concern relates to disproportionate impacts on small manufacturers, which are substantially the same group as the niche product manufacturers. Furthermore, niche products almost exclusively serve applications with severe space constraints. Today's final rule prescribes standards only for those products that are not severely space-constrained, and therefore substantially eliminates their first concern regarding the impact of more stringent standards on small manufacturers.

[17] Bureau of Economic Analysis, Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)

[18] DOJ also wrote about our request for comments on a proposal to adopt a standard for steady-state cooling efficiency (EER). The regulation language in the proposed rule did not include a provision regarding an EER standard, and DOJ limited its views to the standards set forth in the proposed regulation language, indicating that if the Department proposes rule language in the future incorporating an EER standard, DOJ would address the competitive impact of that standard.

DOJ's second concern about products intended for space constrained markets are more difficult to address since the standards apply to products at the point of manufacture and not the point of installation. We have removed one element of this concern by not specifying new standards for niche products, primarily due to our concern over their continued viability in replacement applications. However, we recognize that larger conventional equipment also poses problems in replacement applications and that these problems may be more complex in manufactured homes. Nevertheless, air conditioner and heat pump manufacturers do have options for increasing the efficiency of equipment without increasing the size of both the indoor and outdoor units, and we expect products utilizing those options to be available to consumers during the time when the standards we are adopting today are in effect.

As to DOJ's third concern regarding possible shifting in the market from heat pumps to resistance heaters, we have adopted the same minimum SEER requirement for heat pumps as we have for air conditioners. That action substantially reduces the incentive for consumers to switch, thereby addressing that concern.

In summary, the standards we are adopting should effectively eliminate most of DOJ's concerns regarding the lessening of competition, even under TSL 4. To the extent that we have not fully eliminated all their concerns, however, we have considered the remaining possibility for lessening of competition as we weighed the burdens of today's adopted standards.

6. Need of the Nation To Save Energy

The Secretary recognizes the 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 15-year period modeled are shown in Table V.22. The results presented in Table V.22 are based only on the AEO 2000 Reference Case for electricity price and housing projections and the NAECA efficiency scenario.

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

Trial standard level	Reverse engineering costs		ARI mean costs	
	Carbon (Mt)	NO_X (kt)	Carbon (Mt)	NO_X (kt)
1	13.2	36.7	13.4	37.2
2	23.8	72.7	23.7	67.9
3	27.7	84.4	27.4	78.8
4	32.6	85.8	33.6	102.5
5	63.0	184.2	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 for the Trial Standard Level 4. Table V.23 shows how carbon and NO_X emissions are impacted by the different projections and scenarios.

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

Electricity price and housing projection	Efficiency scenario	Reverse engineering costs		ARI mean costs	
		Carbon (Mt)	NO_X (kt)	Carbon (Mt)	NO_X (kt)
AEO reference case	NAECA	32.6	85.8	33.6	102.5
AEO reference case	Roll-up	32.7	93.8	31.3	87.5
AEO reference case	Shift	36.0	107.1	34.9	97.9
AEO low growth case	NAECA	28.5	97.2	27.5	95.8
AEO high growth case	NAECA	42.2	92.4	42.8	103.1

The annual carbon emission reductions range up to 6.8 Mt in 2020 and the NO_X emissions reductions up to 27.0 kt in 2015.[19] [20] Total carbon and NO_X emissions for each trial standard level are reported in the Environmental Assessment, in the TSD.

The Department makes no effort to monetize the benefits of the actual emission reductions, but there may be time related differences in the perceived value of the emissions depending on when they occur, as with monetized benefits that accumulate over time. Emission reductions that occur sooner are often more desirable than equivalent reductions that occur later. Like monetary benefits, the health, recreational and ecosystem benefits that result from emission reductions are often perceived to have a greater value if they occur sooner, rather than later. To the extent that the different trial standard levels have slightly different shipment distributions over time, some trial standard levels might have a slightly higher proportion of earlier emission reductions than another trial standard level. To show the possible effect of the different timing patterns of the emissions, the Department is also presenting discounted emissions. These calculations were done using the same seven percent discount rate as was used for discounting monetized benefits. We show discounted cumulative emission savings from 2006 through 2030 in Table V.24.

[19] Million metric tons (Mt).

[20] Thousand metric tons (kt).

TABLE V.24.—CUMULATIVE DISCOUNTED EMISSIONS REDUCTIONS BASED ON AEO 2000 REFERENCE CASE AND NAECA EFFICIENCY SCENARIO (2006–2020)

Trial standard level	Reverse engineering costs		ARI mean costs	
	Carbon (Mt)	NO_X (kt)	Carbon (Mt)	NO_X (kt)
1	4.7	15.7	4.8	15.7
2	8.5	30.3	8.5	29.2
3	9.8	35.2	9.8	33.8
4	11.6	36.7	12.0	43.3
5	22.3	77.1	22.7	81.1

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 to consider the impact on peak power requirements and electric utility system reliability.

Peak power impacts on electric utilities from increases in the central air conditioner and heat pump standard are calculated using the NEMS–BRS model. NEMS–BRS is used to estimate peak power impacts by calculating the reduction in planned generation capacity due to an increase in the minimum efficiency standard. Table V.25 shows the estimated reductions in installed generation capacity, in gigawatts (GW), in the year 2020, due to each of the trial standard levels. Of the installed generating capacity avoided, 13 percent would have been provided by coal power plants. The remaining percentage (87 percent) would have been supplied by either gas-fired, oil-fired, or dual-fired power plants. The results presented in Table V.25 are based only on the AEO 2000 Reference Case for electricity price and housing projections and the NAECA efficiency scenario.

TABLE V.25.—INSTALLED GENERATION CAPACITY REDUCTIONS IN THE YEAR 2020 BASED ON AEO 2000 REFERENCE CASE AND NAECA EFFICIENCY SCENARIO

Trial standard level	Reverse engineering costs	ARI mean costs
	Installed generating capacity reduction (GW)	Installed generating capacity reduction (GW)
1	6.5	6.4
2	10.6	10.6
3	12.4	12.3
4	15.5	15.4
5	28.8	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 final standard (trial standard level 4). Table V.26 shows how installed generation capacity is impacted by the different projections and scenarios.

TABLE V.26.—INSTALLED GENERATION CAPACITY REDUCTIONS IN THE YEAR 2020 FOR FINAL STANDARD AND THE IMPACT OF DIFFERENT ELECTRICITY PRICE/HOUSING PROJECTIONS AND EFFICIENCY SCENARIOS

Electricity price and housing projection	Efficiency scenario	Reverse engineering costs	ARI mean costs
		Installed generating capacity reduction (GW)	Installed generating capacity reduction (GW)
AEO reference case	NAECA	15.5	15.4
AEO reference case	Roll-up	15.5	15.0
AEO reference case	Shift	16.6	16.4
AEO low growth case	NAECA	14.5	13.9
AEO high growth case	NAECA	16.0	15.6

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 beginning with the max tech level, i.e., Trial Standard Level 5. We then consider less efficient levels until we reach the level which is technologically feasible and economically justified.

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 Table V.27.[21] Table V.27 presents a summary of quantitative analysis results for each Trial Standard Level based on the assumptions we consider most plausible. These include manufacturing cost estimates from the reverse engineering, an 18.4-year equipment lifetime with one compressor replacement at 14 years, and electricity prices based on the AEO2000 Reference Case.

TABLE V.27.—SUMMARY OF QUANTITATIVE RESULTS [1]

	Trial std 1	Trial std 2	Trial std 3	Trial std 4	Trial std 5
Primary energy saved (quads)[2]	1.5	2.9	3.4	4.2	8.6
Generation capacity offset (GW)[3]	6.5	10.6	12.4	15.5	28.8
NPV ($billion):.					
7% Discount rate, roll-up	2	3	2	1	(10)
7% Discount rate, NAECA	2	2	1	0	(10)
3% Discount rate, roll-up	7	11	11	11	(8)
Cumulative emissions reductions through 2020:					
Carbon equivalent (Mt)[3]	13.2	23.8	27.7	32.7	63.0
NO_X (kt)[3]	36.7	72.7	84.4	93.8	184.2
Cumulative change in INPV ($ million)[4]:					
Roll-up	(160)	(313)	(319)	(303)	....
NAECA	(30)	(159)	(171)	(169)	....
Life cycle cost savings ($)[5]:					
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)[6]:					
Split AC	7.8	9.8	9.8	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	12.8

[1] Parentheses indicate negative (−) values.
[2] Energy savings based on Roll-up efficiency scenario.
[3] Values based on NAECA efficiency scenario with the exception of TSL 4 which is based on the Roll-up scenario.
[4] Not calculated at Trial Standard Level 5.
[5] Negative values indicate LCC increases.
[6] Payback periods are median values.

In addition to the quantitative results, we also consider other burdens and benefits that affect economic justification. The potential to improve the reliability of the electricity system is the major benefit we have not quantified explicitly. In areas where the occurrence of blackouts (and brownouts) can be reduced through expansion of system capacity, the economic value of avoided blackouts associated with reductions in peak load cannot exceed the value of the avoided capacity expansion. That value is already captured in our analysis as savings in consumer utility bills. However, in areas that do not expect to be able to maintain adequate capacity reserves, the value of avoided blackouts associated with reductions in peak demand can far exceed the normal costs of capacity expansion.[22]

We also recognize that the adopted standards could result in additional burdens. These include a possible increase in health problems caused by consumers forgoing air conditioner purchases, a possible reduction in the ability of the product to dehumidify, a possible lessening of competition, and possible difficulty in installing the new baseline products into replacement applications. However, we generally believe that these burdens are capable of being mitigated at any standard level, except possibly Trial Standard Level 5. Section IV discusses our response to comments regarding benefits and burdens and explains our viewpoints on those issues.

First we considered Trial Standard Level 5, the maximum technologically achievable efficiency level for each of four classes, representing uniform 18 SEER requirements. The manufacturing cost we assume for Trial Standard Level 5 is equal to 15 SEER equipment, although we would expect that assumption to understate the cost and price of the product. Trial Standard Level 5 will likely save 8.6 quads of energy which the Department considers significant. These savings will result in the avoidance of approximately 29 GW of installed generation capacity. For comparison, the generating capacity is equivalent to roughly 75 large, 400 megawatt, power plants,[23] approximately 3.7 percent of current installed generating capacity nationwide

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

[22] For instance, if capacity-related blackouts cost a region $1 billion, society would be willing to pay up to $1 billion to prevent them. If those blackouts can be prevented through either a capacity expansion or a reduction in peak demand, and the new capacity would cost $100 million, the value of the reduction in peak demand can be no more than $100 million, If the region is short on capacity and cannot add new capacity quickly, however, the same reduction in peak demand then can equal the value of the avoided blackout ($1 billion) since there is no feasible alternative.

[23] DOE estimates 9 coal-fired power plants and 66 gas-fired power plants can be avoided. *See* TSD, Chapter 11 and Appendix H.

and more than 13 percent of the anticipated growth in capacity needed by 2020. The emissions reductions are 63.0 Mt of carbon equivalent and 184.2 kt of NO_X.

At Trial Standard Level 5, the average consumer would experience an increase in LCC. Purchasers of split central air-conditioners, the predominant class of central air conditioner with 65 percent of the sales of central air conditioners and heat pumps, would lose on average $137 over the life of the appliance. Purchasers of split heat pumps, the predominant class of heat pump, would lose on average $41. Again, these results do not include the additional price the consumer would pay over the price of a 15 SEER product, which would increase the life cycle cost considerably. Furthermore, for the nation as a whole, Trial Standard Level 5 would result in a net cost of $10 billion in NPV. We did not calculate manufacturer impacts at this trial standard level, determining based on preliminary evaluation that they would be severe and unacceptable.

The Secretary concludes that at Trial Standard Level 5, the benefits of energy savings, generating capacity reductions and emission reductions would be outweighed by the burdens of negative economic impacts to the nation, to the vast majority of consumers and to the manufacturers. Consequently, the Secretary has concluded that 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. In considering Trial Standard Level 4 the Roll-up efficiency scenario and reverse engineering cost data are the assumptions we consider to be the most probable as discussed in Part V.A, Trial Standard Levels. Primary energy savings would likely be 4.2 quads which the Department considers significant. The estimated reduction in installed generating capacity is approximately 15 GW, and reduced emissions would range up to 32.7 Mt of carbon equivalent and up to 93.8 kt of NO_X.

The average air conditioner owner would save $113 over the life of a split air conditioner and $29 over the life of a packaged air conditioner. These equate to median payback periods of 11.3 years and 14.5 years, respectively. Low income consumers of split air conditioners and split heat pumps also incur LCC savings ($43 for split air conditioner owners and $185 savings for split heat pump owners). In addition, the average heat pump owner would benefit, saving $372 over the life of a split heat pump and $353 over the life of a packaged heat pump. These equate to median payback periods between 6.4 and 8.4 years, respectively. Trial Standard Level 4 will lower peak electricity demand compared to the base case. That will allow utility service areas to either avoid new capacity or, to the extent that peak loads contribute to reliability problems, improve system reliability. The increase in national net present value is expected to be $1 billion. The decrease in the net present value of the air conditioning and heat pump manufacturing industry is expected to be $300 million.

After carefully considering the analysis, comments, and benefits versus burdens, the Department is amending the energy conservation standards for central air conditioners and central air conditioning heat pumps at Trial Standard Level 4. The Department concludes this standard saves a significant amount of energy and is technologically feasible and economically justified. In determining economic justification, the Department finds that the benefits of energy savings, the projected amount of avoided power plant capacity or improvement in system reliability that accompanies expected reduction in peak demand, consumer life cycle cost savings, national net present value increase and emission reductions resulting from the standards outweigh the burdens. The burdens include the loss of manufacturer net present value, increases in consumer life cycle cost for some users of products covered by today's final rule, any possible increase in health problems caused by consumers forgoing air conditioner purchases, any possible reduction in the ability of the product to dehumidify, any possible lessening of competition, and any possible difficulty in installing the new baseline products into replacement applications.

In the proposed rule, we proposed to adopt Trial Standard Level 3. The Department's decision to instead adopt the more stringent standards represented by Trial Standard Level 4 was influenced by comments we received during the intervening comment period. First, comments we received regarding the prices and markups applied to today's equipment persuaded us that the reverse engineering cost data are much more likely than the ARI Mean cost data to represent the actual costs of producing equipment under more stringent standards. Placing more weight on the costs represented by the reverse engineering data substantially improved the economic benefits to air conditioner owners, demonstrating that the benefits of Trial Standard Level 4 outweigh the burdens. Second, many comments expressed concern that adopting heat pump standards that were more stringent than air conditioner standards would encourage more consumers to purchase electric resistance furnaces and air conditioners instead of heat pumps. In response to those comments, we verified that the energy savings from the more efficient heat pumps would be eliminated if only a small fraction of heat pump owners (4 percent) switched to resistance heating. That possibility provided added justification for adopting the same minimum standards for heat pumps as for air conditioners.

Given our decision to adopt a 13 SEER standard for both central air conditioners and central air conditioning heat pumps, we believe further evaluation is needed before we can issue final standards for air conditioners or heat pumps that currently are intended to serve applications with severe space constraints, exemplified by what we have referred to as ''niche'' products. Based on our preliminary assessment of ''highest viable efficiency levels'' we identified for these products in the TSD (Table 4.23), the comments stating that these products would have difficulty in meeting the standards proposed in the proposed rule, and the concerns expressed by the Department of Justice, we have serious concerns about whether 13 SEER is an appropriate standard for most such products. On the other hand, we are uncertain whether it would be prudent for us to apply the standards contained in the proposed rule to niche products in light of the 13 SEER standard we are adopting today for other products. Doing so may create a strong tendency for niche products, with lower minimum efficiency standards than conventional products, to be applied in conventional applications.

Therefore, today's final rule provides efficiency standards for all residential central air conditioners and heat pumps, except the niche products. We are referring to these products more generally as ''space-constrained products'', since they are specifically intended for severely space-constrained applications. We define them as having the following characteristics:

(1) Rated cooling capacities no greater than 30,000 BTU/hr

(2) An outdoor or indoor unit having at least two overall exterior dimensions or an overall displacement that:

(a) are (is) substantially smaller than those of other units that are (i) currently usually installed in site-built single family homes, and (ii) of a similar cooling, and, if a heat pump, heating, capacity, and

(b) if increased, would certainly result in a considerable increase in the cost of installation or would certainly result in a significant loss in the utility of the product to the consumer.

(3) Of a product type that was available for purchase in the United States as of December 1, 2000.

Based on the information we have gathered thus far in this rulemaking, we believe space-constrained products would include equipment described as:

- through-the-wall packaged and split
- ductless split
- single package and non-weatherized

Small duct, high velocity equipment is covered by today's standards. As discussed in the proposed rule (65 FR at 59609–10), DOE addressed the concerns for that equipment by modifying the test procedure to allow those products to be tested as coil-only equipment. Also, the standards in today's rule will clearly apply to the types of central air conditioners and heat pumps normally installed in site-built single family homes.

The Department will re-open the comment period in this rulemaking to address standards for space-constrained products, and plans to publish a final rule in the **Federal Register** no later than eighteen (18) months from the date of publication of today's rule. The rule covering space-constrained products will establish new product classes, to the extent necessary, and minimum efficiency standards for these products. It will also contain an assessment of technical feasibility and economic justification in accordance with the requirements of the Act. The Department intends to make the rule for space-constrained products effective on January 23, 2006.

Before reopening the comment period, we will initially identify those product types we believe should be treated as space-constrained products, and will begin to assess the impact of a rulemaking for these products on small businesses. To aid in this process, we will seek shortly the following information from each manufacturer of those products that we believe may meet the definition of space-constrained products:

(1) the number of employees employed by the company as of December 31, 2000 (to assist us in determining whether we should consider the company to be a small business entity);

(2) a list of proposed space-constrained products, providing for each type of product:

(a) a description of its intended applications

(b) a description based on physical characteristics, manufacturing characteristics, capacity, and performance attributes that would distinguish it from other types of products, and which would be enforceable at the point of manufacture

(c) a list of models produced of that product type by the manufacturer, containing for each model: Physical dimensions, rated capacities, and range of efficiency ratings available;

(3) a statement of whether the number of units produced by the manufacturer was less than or greater than 100,000 units in the year 2000; and

(4) an estimate of the percentage of units produced by the manufacturer that the manufacturer estimates are installed as replacements for similar units.

The Department encourages companies that believe they manufacture space-constrained products to immediately submit this information, without awaiting a request from DOE, to Ms. Geraldine Paige at the address indicated at the beginning of this notice.

We will make the information we obtain publicly available (excluding confidential information) through a **Federal Register** notice. A comment period will follow during which time the public will have an opportunity to review the published information and respond to the Department. Following the close of the comment period, we will issue in the **Federal Register** our determination of which of the published products we believe are space-constrained products and which we believe are not. We expect these steps to proceed simultaneously with the other activities to set standards for such products.

VI. Procedural Issues and Regulatory Review

A. Review Under the National Environmental Policy Act

The Department prepared an Environmental Assessment (EA) (DOE/EA–1352) available from: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Forrestal Building, Mail Station EE–41, 1000 Independence Avenue, SW, Washington, DC 20585–0121, (202) 586–0854. We found the environmental effects associated with various standard efficiency levels for central air conditioners and heat pumps to be not significant, and therefore we are publishing, elsewhere in this issue of the **Federal Register**, a Finding of No Significant Impact (FONSI) pursuant to the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. 4321 *et seq.*, the regulations of the Council of 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''

Today's regulatory action has been determined to be an ''economically significant regulatory action'' under Executive Order 12866, ''Regulatory Planning and Review.'' 58 FR 51735 (October 4, 1993). Accordingly, today's action was subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) of the Office of Management and Budget.

The draft submitted to OIRA and other documents submitted to OIRA for review have been made 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, telephone (202) 586–3142.

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

C. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act, 5 U.S.C. 601 *et seq.*, requires an assessment of the impact of regulations on small businesses. To be categorized as a ''small'' air conditioning and warm air heating equipment manufacturer, a firm must employ no more than 750 employees.

The Department prepared a manufacturing impact analysis which was made public and available to all residential central air conditioner and heat pump manufacturers. Other impacts on small businesses were previously discussed in the proposed rule. 65 FR 59590, 59629–30 (October 5, 2000). The Department reaffirms its certification in the proposed rule.

Today's rule will not have a significant impact on a substantial number of small entities, and preparation of a regulatory flexibility analysis is unnecessary.

Most small businesses engaged in the manufacture of central air conditioners and heat pumps produce products that we have called ''niche'' products. To address the concerns of the Department of Justice and many commenters regarding the impacts of more stringent standards on small manufacturers, we are continuing our evaluation of standards for those products and have not issued new standards for them as part of this rule.

D. Review Under the Paperwork Reduction Act

No new information or record keeping requirements are imposed by 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 final rule under the standards of section 3 of the Executive Order and determined that, to the extent permitted by law, the final regulations meet the relevant standards.

F. ''Takings'' Assessment Review

DOE has determined pursuant to Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights,'' 52 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) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or 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. Agencies also must have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. DOE published its intergovernmental consultation policy on March 14, 2000. 65 FR 13735. DOE has examined today's final 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 final rule were preempted by the Federal standards established in NAECA. States can petition the Department for exemption from such preemption to the extent, and based on criteria, set forth in EPCA.

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), section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA) requires a Federal agency to publish estimates of the resulting costs, benefits and other effects on the national economy. 2 U.S.C. 1532(a), (b). UMRA also requires each Federal agency to develop an effective process to permit timely input by state, local, and tribal governments on a proposed significant intergovernmental mandate. The Department's consultation process is described in a notice published in the **Federal Register** on March 18, 1997 (62 FR 12820). Today's final rule may impose expenditures of $100 million or more on the private sector. It does not contain a Federal intergovernmental mandate.

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 Final Rulemaking and ''Regulatory Impact Analysis'' section of the TSD for this Final Rule responds to those requirements.

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise or the selection of such an alternative is inconsistent with law. As required by section 325(o) of the Energy Policy and Conservation Act (42 U.S.C. 6295(o)), today's final rule establishes 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 today's final rule.

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 final rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

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 plain language in all proposed and final rulemaking documents published in the **Federal Register.**

Today's 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:

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

K. Congressional Notification

As required by 5 U.S.C. 801, DOE will submit to Congress a report regarding the issuance of today's final rule prior to the effective date set forth at the outset of this notice. DOE also will submit the supporting analyses to the Comptroller General (GAO) and make them available to each House of Congress. The report will state that it has been determined that the rule is a ''major rule'' as defined by 5 U.S.C. 804(2).

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

Issued in Washington, DC, on January 16, 2001.

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 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 ''space-constrained products'' in alphabetical order to read as follows:

§ 430.2 Definitions.

* * * * *

Space constrained product means a central air conditioner or heat pump:

(1) That has rated cooling capacities no greater than 30,000 BTU/hr;

(2) That has an outdoor or indoor unit having at least two overall exterior dimensions or an overall displacement that:

(i) Are (is) substantially smaller than those of other units that are (i) currently usually installed in site-built single family homes, and (ii) of a similar cooling, and, if a heat pump, heating, capacity, and

(ii) If increased, would certainly result in a considerable increase in the usual cost of installation or would certainly result in a significant loss in the utility of the product to the consumer; and

(3) Of a product type that was available for purchase in the United States as of December 1, 2000.

* * * * *

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 23, 2006, and single package central air conditioners and central air conditioning heat pumps manufactured after January 1, 1993, and before January 23, 2006, shall have Seasonal Energy Efficiency Ratio and Heating Seasonal Performance Factor no less than:

Product class	Seasonal energy efficiency ratio	Heating seasonal perform-ance factor
(i) Split systems	10.0	6.8
(ii) Single package systems	9.7	6.6

(2) Central air conditioners and central air conditioning heat pumps manufactured on or after January 23, 2006, shall have Seasonal Energy Efficiency Ratio and Heating Seasonal Performance Factor no less than:

Product class	Seasonal energy efficiency ratio (SEER)	Heating seasonal perform-ance factor (HSPF)
(i) Split system air conditioners	13	....
(ii) Split system heat pumps	13	7.7
(iii) Single package air conditioners	13	....
(iv) Single package heat pumps	13	7.7
(v) Space constrained products	[reserved]	[reserved]

* * * * *

Appendix

[The following letter from the Department of Justice will not appear in the Code of Federal Regulations.]

DEPARTMENT OF JUSTICE,

Antitrust Division, Main Justice Building, 950 Pennsylvania Avenue NW., Washington, DC 20530–0001, (202) 514–2401/(202) 616–2645 (f), antitrust@justice.usdoj.gov (internet), http://www.usdoj.gov (World Wide Web).

December 4, 2000.

Mary Anne Sullivan, General Counsel, Department of Energy, Washington, DC 20585.

Dear General Counsel Sullivan:

I am responding to your October 16, 2000 letter seeking the views of the Attorney General about the potential impact on competition of two proposed energy efficiency standards: one for clothes washers and the other for residential central air conditioners and heat pumps. Your request was submitted pursuant to Section 325(o)(2)(B)(i) of the Energy Policy and Conservation Act, 42 U.S.C. § 6291, 6295 (''EPCA''), which requires the Attorney General to make a determination of the impact of any lessening of competition that is likely to result from the imposition of proposed energy efficiency standards. The Attorney General's responsibility for responding to requests from other departments about the effect of a program on competition has been delegated to the Assistant Attorney General for the Antitrust Division in 28 CFR § 0.40(g).

We have reviewed the proposed standards and the supplementary information published in the Federal Register notices and submitted to the Attorney General, which include information provided to the Department of Energy by manufacturers. We have additionally conducted interviews with members of the industries.

We have concluded that the proposed clothes washer standard would not adversely affect competition. In reaching this conclusion, we note that the proposed standard is based on a joint recommendation submitted to the Department of Energy by manufacturers and energy conservation advocates. That recommendation states that virtually all manufacturers of clothes washers who sell in the United States participated in arriving at the recommendation through their trade association, that the recommendation was developed in consultation with small manufacturers, and that the manufacturers believe the new standard would not likely reduce competition. We note further that, as the industry recommended, the proposed standard will be phased in over six years, which will allow companies that do not already have products that meet the proposed standard sufficient time to redesign their product lines.

With respect to the proposed residential central air conditioner and heat pump standard, we have concluded that there could be an adverse impact on competition. The proposed standard, Trial Standard Level 3, is expressed in terms of two industry measurements: SEER (Seasonal Energy Efficiency Ratio) and HSPF (Heating Seasonal Performance Factor).[1] These standards would change from the current central air conditioner and heat pump efficiency standards of 10 SEER/6.8 HSPF for split system air conditioners and heat pumps and 9.7 SEER/6.6 HPSF for single package air conditioners and heat pumps to 12 SEER for air conditioners and 13 SEER/7.7 HPSF for heat pumps.

We have identified three possible competitive problems presented by the proposed standards. First, the proposed 13 SEER heat pump standard would have a disproportionate impact on smaller manufacturers. Currently less than 20% of the total current product lines meet the proposed standards, but for some small manufacturers, 100% of their product lines fail to satisfy the proposed standard.

Second, the proposed standard for heat pumps, and in some instances for air conditioners, would have an adverse impact on some manufacturers of these products (including those products referred to in the Federal Register notice as ''niche products'') used to retrofit existing housing and used in manufactured housing. These manufacturers could not make units that comply with the rule and fit into the available space.

Third, the proposed heat pump standard of 13 SEER could make heat pumps less competitive with alternative heating and cooling systems. Because the standard will result in increases in the size and cost of heat pumps, it is possible that purchasers will shift away from heat pumps to other systems that include electric resistance heat, reducing the competition that presently exists between heat pumps and those other systems.

The Department of Justice urges the Department of Energy to take into account these possible impacts on competition in determining its final energy efficiency standard for air conditioners and heat pumps. The Department of Energy should consider setting a lower SEER standard for heat pumps, such as the standard included in Trial Standard Level 2, and a lower SEER standard for air conditioners for retrofit markets where there are space constraints (such as markets served by niche products) and for manufactured housing.

Sincerely,

A. Douglas Melamed,

Acting Assistant Attorney General.

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[1] The **Federal Register** notice also requested comments on a proposal to adopt a standard for steady-state cooling efficiency (EER) and discussed several options the Department of Energy is considering. The proposed rule set forth in the notice does not, however, include a provision regarding an EER standard, and the views of the Department of Justice expressed in this letter are limited to the impact of any lessening of competition * * * that is likely to result from the imposition of the [proposed] standard,'' as required by EPCA. If the Department of Energy proposes a rule in the future incorporating an EER standard, the Department will then evaluate that proposed rule and express its views about the competitive impact of that standard.