radioactive material in effluents within the numerical guides for design objectives.

* * * * *

C. If the data developed in the surveillance and monitoring program described in paragraph B of Section III or from other monitoring programs show that the relationship between the quantities of radioactive material released in liquid and gaseous effluents and the dose to individuals in unrestricted areas is significantly different from that assumed in the calculations used to determine design objectives pursuant to Sections II and III, the Commission may modify the quantities in the technical specifications defining the limiting conditions in a license to operate a light-water-cooled nuclear power reactor or a license whose holder has submitted a certification of permanent cessation of operations under § 50.82(a)(1).

* * * * *

PART 51—ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS

32. The authority cite is revised to read as follows:

Authority: Sec. 161, 68 Stat. 948, as amended, sec. 1701, 106 Stat. 2951, 2952, 2953, (42 U.S.C. 2201, 2297f); secs. 201, as amended, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842).

Subpart A also issued under National Environmental Policy Act of 1969, secs. 102, 104, 105, 83 Stat. 853–854, as amended (42 U.S.C. 4332, 4334, 4335); and Pub. L. 95–604, Title II, 92 Stat. 3033–3041; and sec. 193, Pub. L. 101–575, 104 Stat. 2835 42 U.S.C. 2243). Sections 51.20, 51.30, 51.60, 51.80. and 51.97 also issued under secs. 135, 141, Pub. L. 97–425, 96 Stat. 2232, 2241, and sec. 148, Pub. L. 100–203, 101 Stat. 1330–223 (42 U.S.C. 10155, 10161, 10168). Section 51.22 also issued under sec. 274, 73 Stat. 688, as amended by 92 Stat. 3036–3038 (42 U.S.C. 2021) and under Nuclear Waste Policy Act of 1982, sec 121, 96 Stat. 2228 (42 U.S.C. 10141). Sections 51.43, 51.67, and 51.109 also under Nuclear Waste Policy Act of 1982, sec 114(f), 96 Stat. 2216, as amended (42 U.S.C. 10134(f)).

33. In § 51.53, paragraph (b) is revised to read as follows:

§ 51.53 Supplement to environmental report.

* * * * *

(b) *Post operating license stage.* Each applicant for a license amendment authorizing decommissioning activities for a production or utilization facility either for unrestricted use or based on continuing use restrictions applicable to the site; and each applicant for a license amendment approving a license termination plan or decommissioning plan under § 50.82 of this chapter either for unrestricted use or based on continuing use restrictions applicable to the site; and each applicant for a license or license amendment to store spent fuel at a nuclear power reactor after expiration of the operating license for the nuclear power shall submit with its application the number of copies, as specified in § 51.55, of a separate document, entitled ‘‘Supplement to Applicant's Environmental Report—Post Operating License Stage,’’ which will update ‘‘Applicants Environmental Report—Operating License Stage,’’ as appropriate, to reflect any new information or significant environmental change associated with the applicants proposed decommissioning activities or with the applicants proposed activities with respect to the planned storage of spent fuel. Unless otherwise required by the Commission, in accordance with the generic determination in § 51.23(a) and the provisions in § 51.23(b), the applicant shall only address the environmental impact of spent fuel storage for the term of the license applied for. The ‘‘Supplement to Applicant's Environmental Report—Post Operating License Stage’’ may incorporate by reference any information contained in ‘‘Applicant's Environmental Report—Construction Permit Stage,’’ ‘‘Supplement to Applicant's Environmental Report—Operating License Stage,’’ final environmental impact statement, supplement to final environmental statement of records of decision previously prepared in connection with the construction permit of the operating license.

34. In § 51.95, paragraph (b) is revised to read as follows:

§ 51.95 Supplement to final environmental impact statement.

(b) Post operating license stage. In connection with the amendment of an operating license authorizing decommissioning activities at a production or utilization facility covered by § 51.20, either for unrestricted use or based on continuing use restrictions applicable to the site, or with the issuance, amendment or renewal of a license to store spent fuel at a nuclear power reactor after expiration of the operating license for the nuclear power reactor, the NRC staff will prepare a supplemental environmental impact statement for the post operating license stage or an environmental assessment, as appropriate, which will update the prior environmental review. The supplement or assessment may incorporate by reference any information contained in the final environmental impact statement, the supplement to the final environmental impact statement—operating license stage, or in the records of decision prepared in connection with the construction permit or the operating license for that facility. The supplement will include a request for comments as provided in § 51.73. Unless otherwise required by the Commission, in accordance with the generic determination in § 51.23(a) and the provisions of § 51.23(b), a supplemental environmental impact statement for the post operating license stage or an environmental assessment, as appropriate, will address the environmental impacts of spent fuel storage only for the term of the license, license amendment or license renewal applied for.

Dated at Rockville, Maryland, this 13th day of July, 1995.

For the Nuclear Regulatory Commission.

John C. Hoyle,

Secretary of the Commission.

[FR Doc. 95–17718 Filed 7–19–95; 8:45 am]

BILLING CODE 7590–01–P

DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy

10 CFR Part 430

[Docket No. EE–RM–93–801]

Energy Conservation Program for Consumer Products: Proposed Rulemaking Regarding Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy (DOE).

ACTION: Notice of Proposed Rulemaking and Public Hearing.

SUMMARY: The purpose of this notice of proposed rulemaking (NOPR) is to provide interested persons an opportunity to comment on this proposal amending the energy conservation standards for refrigerators, refrigerator-freezers, and freezers, and to invite interested persons to participate in the appliance energy conservation standards rulemaking process.

DATES: Written comments on the proposed rule must be received by the Department by October 3, 1995. The Department requests 10 copies of the written comments and, if possible, a computer disk.

Oral views, data, and arguments may be presented at the public hearing to be held in Washington, DC, on September 12 and 13, 1995. Requests to speak at the hearing must be received by the Department by 4 p.m., August 25, 1995. Ten copies of statements to be given at the public hearing must be received by the Department by 4 p.m., September 1, 1995.

The hearing will begin at 9:30 a.m., on September 12 and 13, 1995, and will be held at the U.S. Department of Energy, Forrestal Building, Room 1E–245, 1000 Independence Avenue, SW., Washington, DC 20585. The length of each presentation is limited to 20 minutes.

ADDRESSES: Written comments, oral statements, requests to speak at the hearing and requests for speaker lists are to be submitted to: Refrigerator Rulemaking (Docket No. EE–RM–93–801), U.S. Department of Energy, Office of Codes and Standards, Appliance Division, EE–431, 1000 Independence Avenue, SW., Rm 1J–018, Washington, DC 20585, (202) 586–7574.

Copies of the *Technical Support Document: Energy Efficiency Standards for Consumer Products: Refrigerators, Refrigerator-Freezers, and Freezers* (TSD) may be obtained from: U.S. Department of Energy, Office of Codes and Standards, Appliance Division, EE–431, 1000 Independence Avenue, S.W., Rm 1J–018, Washington, D.C. 20585. (202) 586–9127.

Copies of the TSD, transcript of the public hearing and public comments received 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) 586–6020 between the hours of 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. For more information concerning public participation in this rulemaking proceeding see Section VI, ''Public Comment Procedures,'' of this NOPR.

FOR FURTHER INFORMATION CONTACT:

Edward O. Pollock Jr., U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Forrestal Building, Mail Station EE–431, 1000 Independence Avenue, SW., Washington, DC 20585, (202) 586–5778.

Eugene Margolis, Esq., U.S. Department of Energy, Office of General Counsel, Forrestal Building, Mail Station GC–72, 1000 Independence Avenue, SW., Washington, DC 20585, (202) 586–9507.

SUPPLEMENTARY INFORMATION:

I. Introduction

A. *Authority*

Part B of Title III of the Energy Policy and Conservation Act (EPCA), Pub. L. 94–163, as amended by the National Energy Conservation Policy Act (NECPA), Pub. L. 95–619, by the National Appliance Energy Conservation Act (NAECA), 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 are called ''covered products.'' The residential covered products are: Refrigerators, refrigerator-freezers and freezers; dishwashers; clothes dryers; water heaters; central air conditioners

[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 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.

and central air-conditioning heat pumps; furnaces; direct heating equipment; television sets; kitchen ranges and ovens; clothes washers; room air conditioners; and pool heaters. The Act specifies that other consumer products may be classified as covered products by the Secretary of Energy. To date, the Secretary has not so classified any additional products.

DOE published a final rule amending standards established by NAECA for refrigerators, refrigerator-freezers, and freezers (refrigerator products) on November 17, 1989 (hereinafter, referred to as the 1989 Final Rule). 54 FR 47916. The Act directs DOE to review the 1989 Final Rule for possible amendment and to issue final rules based on that review no later than November 17, 1994.

B. *Background*

As directed by the Act, DOE published an Advance Notice of Proposed Rulemaking (hereinafter referred to as the 1993 Advance Notice) proposing standards for refrigerator products, as well as other products, on September 8, 1993. 58 FR 47326. The 1993 Advance Notice presented the product classes that DOE planned to analyze, and provided a detailed discussion of the analytical methodology and models that the Department expected to use in doing the analysis to support this rulemaking. The Department invited comments and data on the accuracy and feasibility of the planned methodology and encouraged interested persons to recommend improvements or alternatives to the approach taken by DOE. The original comment period on the 1993 Advance Notice was extended to February 7, 1994, in response to a request from the Gas Appliance Manufacturers Association (GAMA), the Air-Conditioning and Refrigeration Institute (ARI), and the Association of Home Appliance Manufacturers (AHAM). 58 FR 59418 (November 9, 1993).

This NOPR addresses only the refrigerator products covered by the 1993 Advance Notice. The 1989 Final Rule divided the refrigerator products into 10 classes based on various characteristics (e.g., freezer location). This NOPR proposes new classes for eight different compact refrigerator configurations and 18 new classes for those refrigerator products which are free of HCFCs. A complete list of the proposed classes and the proposed standards for each class is found in the table at the end of this NOPR.

The comments to the 1993 Advance Notice are addressed in Section III below. The last comment to be received was the ‘‘Joint Comments of the Association of Home Appliance Manufacturers, the Natural Resources Defense Council, the American Council for an Energy Efficient Economy, the New York State Energy Office, the California Energy Commission, Pacific Gas and Electric, and Southern California Edison Relating to Energy Conservation Standards for Refrigerator/Freezers.’’ (Hereinafter referred to as the ‘‘Joint Comments.’’)[2] This group of refrigerator manufacturers, electric utilities, and energy conservation advocates, acting on its own initiative, negotiated intensively for 2 years to develop a common recommendation for an energy conservation standard that meets the NAECA requirements for refrigerators, refrigerator-freezers and freezers. Although DOE neither organized nor was a member of the group, DOE responded to group requests to send DOE staff observers to some meetings and to make available its contractors to perform data processing. Without prior commitment to accept the negotiated conclusions, the Department has been receptive to this group effort to reach agreement among representatives of industry, consumers and environmentalists. The resulting joint comments have been very valuable to the Department’s review of this issue. The Joint Comments contains important data and analyses for the Department to consider, and realistic recommendations.

II. General Discussion

A. Technological Feasibility

1. General. For those products and classes of products discussed in today’s NOPR, DOE believes that the efficiency levels analyzed, while not necessarily being realized in current production, are technologically possible. The technological feasibility of the design options is addressed in the product-specific discussion. The criteria used by the Department for evaluating design options for technological feasibility are that the design options are already in use by the industry, or that research has progressed to the likely development of a prototype.

a. Maximum Technologically Feasible Levels. The Act requires the Department, in considering any new or amended standard, to consider the standard that is ‘‘designed to achieve the maximum improvement in energy efficiency which the Secretary determines is technologically feasible and economically justified.’’ EPCA, section 325(o)(2)(A), 42 U.S.C. 6295(o)(2)(A). Accordingly, for each class of product under consideration in this rulemaking, a maximum technologically feasible design option (‘‘max tech’’) was identified. The max tech level is one that can be achieved by the addition of energy conserving design options to the baseline units.[3] DOE believes that in identifying the max tech level a unit can be assembled, but not necessarily manufactured, by the effective date of the amended standards. The ability to manufacture is considered under the economic justification analysis. For example, in the 1989 Final Rule, DOE concluded that evacuated panels for refrigerators were a technically feasible design option because refrigerators had been produced on a limited scale with this technology. However, DOE concluded that this technology was not economically justified because the chemical industry probably could not provide sufficient quantities of the necessary raw materials by the effective date of the standard.

The max tech levels were derived by adding energy-conserving engineering design options for each of the respective classes in order of decreasing consumer payback. A brief discussion of the max tech level for each class analyzed is found in the ‘‘Analysis’’ section of this NOPR. A complete discussion of each max tech level, and the design options included in each, is found in the Engineering Analysis. (See TSD, Chapter 3.)

B. Economic Justification

The Act provides seven factors to be evaluated in determining whether a conservation standard is economically justified. EPCA, section 325(o)(2)(B)(i), 42 U.S.C. 6295(o)(2)(B)(i).

1. Economic Impact on Manufacturers and Consumers. The engineering analysis identified options for improvement in efficiency along with the associated costs to manufacturers for each class of product. For each design option, these costs constitute the increased per-unit cost to manufacturers to achieve the indicated energy efficiency levels. Manufacturer, wholesaler, and retailer markups will result in a consumer purchase price higher than the manufacturer cost.

To assess the likely impacts of standards on manufacturers, and to determine the effects of standards on different-sized firms, the Department used a computer model that simulates

[2] The Department considered the Joint Comments to supersede earlier comments by the listed parties regarding issues subsequently discussed in the Joint Comments.

[3] The baseline unit is the most commonly used combination of engineering design options which are found in appliances that meet the existing standards.

hypothetical firms in the industry under consideration. This model, the Manufacturer Analysis Model (MAM), is explained in the TSD. (See TSD, Appendix C.) The Manufacturer Analysis Model consists of version 1.2, dated March 1, 1993, of the Government Regulatory Impact Model (GRIM) which has been integrated into the earlier Lawrence Berkeley Laboratory (LBL) Manufacturer Impact Model (LBL–MIM). The GRIM model was developed by Arthur D. Little Consulting Company (ADL) under contract to AHAM, GAMA, and ARI. It provides a broad array of outputs, including shipments, price, revenue, net income, and short- and long-run returns on equity. An ''Output Table'' lists values for all these outputs in the base case and in each of the standards cases under consideration. It also gives a range for each of these estimates. The base case represents the forecasts of outputs without new or amended standards. A ''Sensitivity Chart'' (TSD, Appendix C) shows how returns on equity would be affected by a change in any one of the nine control variables of the model.

For consumers, measures of economic impact are the changes in purchase price and annual energy expense. The purchase price and energy expense, i.e., life-cycle cost, of each standard level are presented in Chapter 4 of the TSD. Under section 325 of EPCA, the life-cycle cost analysis is a separate factor to be considered in determining economic justification.

2. Life-cycle Costs. One measure of the effect of proposed standards on consumers is the change in operating expense and purchase price resulting from the new standards. For the average consumer, this is quantified by the difference in the life-cycle costs between the base and standards cases for the refrigerator classes analyzed. The life-cycle cost is the sum of the purchase price and the operating expense, including installation and maintenance expenditures, discounted over the lifetime of the appliance.

The life-cycle cost was calculated for the range of efficiencies in the Engineering Analysis for each class in the year standards are imposed, using a real consumer discount rate of 6 percent. The purchase price is based on the factory costs in the Engineering Analysis and includes a factory markup plus a distributor and retailer markup. Energy price forecasts are taken from the 1994 *Annual Energy Outlook* of the Energy Information Administration. (DOE/EIA–0383(94)). In the analysis for the final rule, energy price forecasts included in the most recent *Annual Energy Outlook* will be used. Appliance usage inputs are taken from the relevant test procedures.

3. Energy Savings. The Act requires DOE to consider the total projected energy savings that result from revised standards. The Department used the LBL Residential Energy Model (LBL–REM) results in its consideration of total projected savings. The savings for refrigerators, refrigerator-freezers and freezers are provided in the ''Analysis'' section of this NOPR, *supra.*

a. Determination of Savings. The Department forecasts energy consumption by using the LBL–REM, which forecasts energy consumption over the period of analysis for candidate standards and the base case. The Department quantified the energy savings that would be attributable to a standard as the difference in energy consumption between the candidate standard and the base case.

The Lawrence Berkeley Laboratory Residential Energy Model was used by DOE in previous standards rulemakings. (See TSD, Appendix B for a detailed discussion of the LBL–REM.) The LBL–REM contains algorithms to project average efficiencies, usage behavior, and market shares for each product. Long-term market share elasticities have been assumed with respect to equipment price, operating expense, and income. The effects of standards are expected to be lower operating expense and increased equipment price. The percentage changes in these quantities and the elasticities are used to determine changes in sales volumes resulting from standards. Higher equipment prices will decrease, and lower operating expenses will increase sales volumes. The net result depends on the standard level selected and its associated equipment prices and operating expenses.

The Lawrence Berkeley Laboratory Residential Energy Model is used to project energy use over the relevant periods for refrigerator products with and without amended standards. The Department estimated the projected energy savings during the period 1998–2030 [4], by comparing the energy consumption projections at alternative standard levels against the projections at current standards which is the base case. The energy saved is expressed in quads, i.e., quadrillions of British thermal units (Btu), and exajoules (EJ). With respect to electricity, the savings are quads of source or primary energy, which is the energy necessary to generate and transmit electricity. From data that remain rather constant over the years, the amount of electrical energy consumed at the site is less than one-third of the amount of source energy required to generate and transmit the electrical energy to the site.[5]

The Lawrence Berkeley Laboratory Residential Energy Model projections are dependent on many assumptions. Among the most important are the responsiveness of household appliance purchasers to changes in residential energy prices and consumer income, future energy prices, future levels of housing construction, and options that exist for improving the energy efficiency of appliances.

b. Significance of Savings. Under section 325(o)(3)(B) of the Act, 42 U.S.C. 6295(o)(3)(B), the Department is prohibited from adopting a standard for a product if that standard would not result in ''significant conservation of energy.'' While the term ''significant'' is not defined in the Act, the U.S. Court of Appeals concluded that Congress intended the word ''significant'' to mean ''non-trivial.'' *Natural Resources Defense Council* v. *Herrington*, 768 F.2d 1355, 1373 (D.C. Cir. 1985).

4. Lessening of Utility or Performance of Products. In establishing classes of products and design options, the Department tried to eliminate any degradation of utility or performance in the products under consideration in this rulemaking. That is, to the extent that comments or research showed that a product included a utility or performance-related feature that affected energy efficiency, a separate class with a different efficiency standard was created for that product. In this way, the Department attempted to minimize any lessening of utility or performance resulting from amended standards.

5. Impact of Lessening of Competition. The Act directs the Department to consider any lessening of competition that is likely to result from the standards. It further directs the Attorney General to gauge the impact, if any, of any lessening of competition.

To assist the Attorney General in making such a determination, the Department studied the affected appliance industries to determine their

[4] The Lawrence Berkeley Laboratory Residential Energy Model was programmed to analyze a single standard level or alternate standard levels over the entire period. That is, the fact that a standard might be revised during subsequent rulemakings was not considered by the model. The Department believes that it is not possible to predict what result such reviews may have, and therefore it would be speculative to model any particular result. Therefore, for purposes of this rulemaking, each standard level that was analyzed was projected to have been in place from the time of implementation to the year 2030.

[5] Energy Information Administration, *Electric Power Annual 1987*, Tables 25 and 82, DOE/EIA–0348(87), 1987.

existing concentrations, levels of competitiveness, and financial performances. This information will be sent to the Attorney General. (See TSD, Chapter 6.) The Department also will give the Attorney General copies of this NOPR and the TSD for review.

6. Need of the Nation to Conserve Energy. The estimated energy security and environmental effects from each standard level for each class is reported under this factor in the Product Specific Discussion (Section IV. B. 6) of this NOPR.

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.

Each efficiency level was evaluated according to the economic justification factors specified in the Act to determine economic justification. The Department rejected energy conservation standards for which the burdens outweighed the benefits (e.g., savings in operating costs were outweighed by significant increases in first costs and substantially adverse effects on manufacturers' returns on equity).

C. Rebuttable Presumption

Section 325(o)(2)(B)(iii) of EPCA, 42 U.S.C. 6925 (o)(2)(B)(iii), states:

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

If the increase in initial price of an appliance due to a conservation standard would repay itself to the consumer in energy savings in less than 3 years, then it is presumed that such standard is economically justified.[6] This presumption of economic justification can be rebutted upon a proper showing.

III. Discussion of Comments

The Department received 49 written comments in response to the 1993 Advance Notice.[7] This section addresses the general analytical issues raised by the comments, and then addresses the product-specific issues.

A. *General Analytical Comments*

1. Discount Rates. The proposals of the Department concerning the appropriate discount rates to use in the analysis of the standards drew more comments than any other issue.

In view of the apparent differences in the cost of financing, average rate of return on investments and the time value of money among various categories of consumers, and between consumers, manufacturers and society as a whole, the Department proposed to use different discount rates for the consumer life-cycle cost analysis, the manufacturer impact analysis, and net national benefits calculation, with sensitivity analyses designed to describe the range of impact.

Based on the comments received, the Department has made some modifications in this proposal, but has retained the specification of different discount rates for different types of impact analyses and the use of sensitivity analyses.

a. Consumer Discount Rate. In the 1989 Final Rule, DOE used a 7 percent discount rate, based on the range of real financing rates experienced by consumers. At the time, rates ranged from less than 1 percent to slightly more than 15 percent. DOE selected 7 percent because it was near the midpoint of the potential consumer discount rates.

In its comments on the Advance Notice of Proposed Rulemaking on Energy Conservation Standards for Nine Products (55 FR 39624, 39631, September 28, 1990), Whirlpool Corporation (Whirlpool) offered estimates of the percentages of appliance purchasers that used different types of financing: 40 percent of retail purchasers pay in cash; 35 percent use credit cards; 25 percent use retailer loans. These figures excluded new home construction, which accounts for approximately 25 percent of Whirlpool's total sales. (Whirlpool, No. 31 at 1–2).

These percentage shares were used to weight the different real finance rates experienced by consumers: Just over 3 percent for appliances purchased as part of a new home (whose finance rate is a tax-deductible mortgage interest rate), to slightly less than 1 percent for cash purchases, to more than 15 percent for credit card purchases. As a result, the weighted-average, real finance rate experienced by consumers was estimated to be 6 percent. In the 1993 Advance Notice to this proposed rulemaking, the Department stated that it believed that the average consumer rate was between 4 and 10 percent and that it intended to perform sensitivity analyses using this range. DOE specifically solicited comments on a range of issues concerning consumer discount rates: Including the usefulness of the Whirlpool data, the methods used to finance retail purchases, the possible use of data on rates of return required by consumers, the possible use of data on the implicit discount rates revealed by consumer purchasing decisions, and the extent to which the special requirements of low-income consumers should be taken into account.

The American Council for an Energy Efficient Economy (ACEEE) supported this weighted-average approach using the Whirlpool data. However, ACEEE and the Natural Resources Defense Council (NRDC) both stated that consumer discount rates based upon how appliances are actually purchased may represent constrained choices or choices of convenience; for example, consumers who pay off credit card balances early, or default on their payments, are not counted correctly. (ACEEE, No. 50 at 1, 2 and NRDC, No. 18 at 24).

The American Council for an Energy Efficient Economy also stated that higher discount rates should not be used for low-income households. Low-income households are particularly prone to market failures (e.g., many low-income households live in rental housing where landlords purchase the refrigerator-freezers, and tenants pay the operating costs) but receive benefits equal to those for all other households from higher standards. (ACEEE, No. 50 at 1, 2).

The Edison Electric Institute (EEI) argued that implicit discount rates estimated through an examination of actual consumer purchases of appliances and related consumer equipment is the most appropriate basis for the consumer discount rate used under this program. (EEI, No. 35 at 4). On the other hand, NRDC and ACEEE supported the Department proposal not to use implicit discount rates in the analysis of the cost-effectiveness of potential minimum efficiency standards. (ACEEE, No. 50 at 1,2, and NRDC, No. 8 at 24).

DOE has further investigated various indicators of the opportunity costs that consumers purchasing appliances might experience. For example, the average real rate of return on residential property during the 1980s varied

[6] For this calculation, the Department calculated cost-of-operation based on the DOE test procedures. Therefore, the consumer is assumed to be an ''average'' consumer as defined by the DOE test procedures. Consumers that use the products less than the test procedure assumes will experience a longer payback while those that use them more than the test procedure assumes will have a shorter payback.

[7] Comments on the ANOPR have been assigned docket numbers and have been numbered consecutively.

between 3.6 and 4.5 percent annually. The annual real rate of return (nonfinancial) on corporate stocks during this period varied from 5.9 to 8.8 percent, but was generally less than this for nearly all other forms of investment readily available to consumers. DOE believes such opportunity costs are relevant indicators of the appropriate discount rates for consumers with significant personal savings or investments.

For consumers with little or no personal savings, DOE believes that the costs of credit-card financing and the willingness of consumers to forego current consumption in favor of future savings should be taken into account. According to the data derived from a 1992 Survey of Consumer Finances performed by the National Opinion Research Center for the Federal Reserve Bank, 30 percent of all U.S. households have less than $500 in savings, checking and money market accounts, or have no such account. Also, according to the survey, 13 percent of all U.S. households have a net worth of less than $1000. These two survey results suggest that many households may be forced, because of their financial circumstances, to finance any increased appliance costs resulting from efficiency standards through credit cards or other high interest sources of financing, or by reducing (or postponing) their current consumption of goods and services. Limited empirical research [8] suggests that low-income households exhibit higher-than-average discount rates (i.e., required rates of return or time values of money) across all of their time-sensitive decisions, including (but not limited to) their appliance purchases. Real credit-card financing rates remain above 10 percent for most consumers.

The Department continues to believe that appropriately weighted, real financing rates are a useful indicator of consumer discount rates, although it recognizes that there are considerable limitations to the data concerning consumer financing provided by Whirlpool.

Regarding implicit discount rates, various studies have shown that they range from as low as 3 percent to as high as 100 percent (or more) for certain appliances. However, because implicit discount rates are based on actual consumer purchase behavior, they also reflect the extent to which there are market failures, such as inadequate information, conflicting owner/renter incentives, and second party (builder/contractor) purchases that inhibit consumers from making energy efficiency investments they would otherwise consider to be worthwhile. One major reason Federal appliance efficiency standards were originally established was to overcome these market failures regarding investment in energy efficiency.

For these reasons, DOE does not believe unadjusted (i.e., not corrected for potential biases) discount rates derived from actual consumer behavior should be used in evaluating the economic impact of proposed standards on consumers. DOE believes the intent of the legislation that established the appliance standards program is to achieve energy savings which are being foregone because of market failures that hinder or discourage consumer investments in energy efficiency. This conclusion is supported by the findings of the District Court in *Natural Resources Defense Council* v. *Herrington*, 768 F. 2d 1355, 1406–07 (D.C. Cir. 1985), where the court stated that ''the entire point of a mandatory program was to change consumer behavior'' and ''the fact that consumers demand short payback periods was itself a major cause of the market failure that Congress hoped to correct.''

Based on the comments received and the further investigation of issues raised in the Notice of Proposed Rulemaking on Energy Conservation Standards for Eight Products (59 FR 10464, 10532, March 4, 1994), the Department has concluded that a 6 percent discount rate is an appropriate mid-range estimate of the ranges of real financing rates, opportunity costs and time values of money experienced or exhibited by residential consumers. However, because of the considerable variability among different categories of consumers, the Department intends to place increased emphasis on assessing the sensitivity of the life-cycle cost analyses to the use of low (2 percent) and high (15 percent) discount rates.

b. Manufacturer Discount Rate. The real discount rate used to assess the impacts of the proposed refrigerator standards on manufacturers is 12 percent. It is the discount rate used to calculate the net present value of the series of estimated net cash flows expected to be experienced by industry, as calculated by the GRIM module of the MAM.

The Manufacturer Analysis Model also uses a ''market discount rate'' for forecasting the impact of standards on future appliance sales, as distinct from the 12 percent rate used to calculate industry net present values. This implicit market rate is a higher rate derived from empirical analysis of historical efficiency choice decisions, and is used as an indicator of the extent to which consumers implicitly value operating costs compared with first costs.

c. Social Discount Rate. In identifying a discount rate that is appropriate for use in calculating benefits to the Nation as a whole, the Department considered the opportunity costs of devoting more economic resources to the production and purchase of more energy-efficient appliances and fewer national resources to other types of investment. Since differentiating among specific classes of consumers or businesses is not necessary, the Department considered a broad measure of the average rates of return earned by economic investment throughout the U.S. to be an appropriate basis for the social discount rate.

Using this approach, the Office of Management and Budget (OMB) prepared a *Background on OMB's Discount Rate Guidance* in November of 1992, containing an analysis of the average annual real rate of return earned on investments made since 1960 in nonfinancial corporations, noncorporate farm and nonfarm proprietorships, and owner-occupied housing in the U.S. The results of this analysis showed that since 1980, the annual real rate of return for these categories of investments averaged slightly more than 7 percent, ranging from a low of about 4 percent for owner-occupied housing (which represented about 43 percent of total capital assets in 1991 of about $15 trillion) to a high of about 9 percent on noncorporate farm and nonfarm capital (which represented about 23 percent of the total). Between 1960 and 1980, the average real rate of return on capital was higher, averaging about 8.5 percent in the 1970s and about 11.2 percent in the 1960s. Because of this analysis, OMB chose to designate 7 percent as the social discount rate specified in revisions to OMB Circular A–94 issued on November 10, 1992, 57 FR 53519.

Because the Department believes the methods and data used by OMB to develop this guidance are appropriate bases for a social discount rate, the 1993 Advance Notice to this proposed rule said that it was the intent of the Department to use 7 percent as the discount rate in the calculation of the net national benefits and costs of the proposed standards.

The New York State Energy Office (NYSEO) stated that the average rate of 7 percent for the societal perspective is too high and suggested an average rate of 3 to 4 percent real, based upon current 30-year U.S. Treasury bond interest rates. (NYSEO, No. 26 at 17–19).

[8] Train, Kenneth, Discount Rates in Consumers' Energy-Related Decisions: A Review of the Literature; Energy, December 1985.

The Natural Resources Defense Council stated that, in principle, societal discount rates should be lower than consumer discount rates, but that it cannot quantify the difference. It also stated real discount rates should be based upon long-term (hundred-year) averages, which are in the range of 0 to 5 percent. (NRDC, No. 18 at 11).

Because the proposed appliance efficiency standards will primarily affect private, rather than public, investment, the Department continues to believe that using the average real rate of return on private investment as the basis for the social discount rate is most appropriate. If the primary impact of the standards were on Federal or other public expenditures, DOE agrees that real interest rates on long term government securities would likely be a better basis.

The Department disagrees with the contention that the average social discount rate should necessarily be lower than the average consumer discount rates, although it agrees that social rates are often lower than those experienced by many consumers and businesses. The increased risk faced by individual consumers or businesses is one reason many believe social discount rates should be lower. The Department believes that taking into account such variation in risk in determining the appropriate social, consumer, or other discount rate is inappropriate.

For these reasons, DOE proposes to continue to use a 7 percent social discount rate in national net present value calculations. The Department has performed sensitivity analyses at 4 and 10 percent and finds that while the social discount rate used has a significant impact on the estimated national net present value, there are only small differences in the national net present value for each of the trial standard levels being considered at any one of the three social discount rates evaluated.

2. Appliance Lifetimes. Three comments discussed product lifetimes. Maytag stated that the lifetime for refrigerator products should be 15 years, based on a National Family Opinion survey of first owners carried out by AHAM. (Maytag, Transcript at 328). AHAM provided a survey showing that lifetimes of refrigerator products at replacement are shorter than previously assumed by the Department. (AHAM, No. 17 at 32). NRDC believes that savings should be estimated throughout the lifetime of the appliance, not over the period that the first owner keeps the appliance. (NRDC, No. 18 at 40).

The Act provides that the savings should be estimated throughout the average lifetime of the appliance, not the time the first owner keeps the appliance. EPCA, section 325(o)(2)(B)(i)(II), 42 U.S.C. 6295(o)(2)(B)(i)(II). The Department decided to retain the 19-year baseline for refrigerators and refrigerator-freezers, based on its study of saturations and purchases of new household refrigerators and refrigerator-freezers. The 19-year lifetime of refrigerator-freezers is consistent with observed purchases in the marketplace since 1980. For compacts, the Department is using the industry-supplied value of 11 years since no other data are available.

3. Methodology.

a. Lawrence Berkeley Laboratory Residential Energy Model. The Association of Home Appliance Manufacturers criticized the LBL–REM as theoretical and based upon obsolete (1970s) data. It further stated no model does an adequate job of forecasting the price-volume effects leading to a payback analysis. In particular, AHAM commented that demand in the current LBL–REM refrigerator products equations does not appear to drop fast enough with increasing prices to meet the test of real world experience and therefore LBL–REM should not be used to compute demand functions. It commented that more accurate results are generated by recent empirical data rather than by theories about the effects of regulations on demand. (AHAM, No. 17 at 22).

The Department believes that individual manufacturers observe greater price sensitivity because they are analyzing shifts among manufacturers, rather than a response of the entire market (total national sales) to a market-wide price change due to standards. The forecasting methodology used in LBL–REM has been validated by comparison with historical shipments over the 1981–1993 time period.

b. Lawrence Berkeley Laboratory Manufacturer Impact Model/ Government Regulatory Impact Model. Most of the comments recommended that the Department adopt the GRIM cash-flow model. A comparison of GRIM and LBL–MIM, using LBL–MIM price and quantity data, has been conducted by DOE, and the results show that differences between these two models are small enough to be inconsequential in almost all cases. GRIM has been incorporated into LBL–MIM to calculate the impact of standards on industry net present values.

Arthur D. Little, Inc. submitted comments for three major industry trade associations: AHAM, ARI, and GAMA. Arthur D. Little, Inc. stated ''there is no generally acceptable approach for forecasting annual shipments and prices of products using quantitative models.'' Further, ADL said that forecasting the annual shipments and prices of products is a difficult task, but there are basic principles for addressing the issue. (ADL, No. 19 at 3).

In order to be useful, models analyzing industry impacts must forecast shipments and prices. While ADL may not consider any of these approaches generally acceptable, DOE is in favor of using a quantitative method rather than a subjective approach.

c. Demand Functions. Arthur D. Little, Inc. commented that the Department analyses use demand functions limited to consumer demand as a function of price, payback period, and consumer income, while omitting nonfinancial considerations (such as utility to consumers). (ADL, No. 19 at 3).

The Department assumes there is no difference in consumer utility between the various design options used to meet different trial standards levels. This is intentional because the Act does not allow the setting of a standard that diminishes consumer utility. EPCA, section 325(o)(2)(B)(i)(IV), 42 U.S.C. 6295(o)(2)(B)(i)(IV). It is an issue analyzed and initially determined by the engineering analysis before its consideration as part of a standard level. This issue is further addressed in the discussion of the various design options considered found later in this NOPR.

d. Data Sources. Arthur D. Little, Inc. commented that the empirical data relating to price and consumer demand (i.e., price elasticities of demand) were estimated in the 1970s, before ''major changes in the actual marketplace'' and, therefore, are not reliable. (ADL, No. 19 at 4). The Association of Home Appliance Manufacturers stated that DOE should develop an acceptable approach to demand elasticity because ''neither LBL–REM nor LBL–MIM are acceptable as predictors of volume and price elasticities.'' (AHAM, No. 17 at 35).

The Lawrence Berkeley Laboratory Residential Energy Model is not a source of volume or price elasticity. The elasticities used in the LBL–MIM were originally estimated by the LBL–REM based on data and results estimated in the 1970s by Oak Ridge National Laboratory (ORNL).[9] They have been subsequently revised based on historical shipments or other relevant information where available. DOE agrees that it

[9] The original Oak Ridge National Laboratory data is documented in *Consumer Products Efficiency Standards Economic Analysis Document,* U.S. Department of Energy, DOE/CE–0029, March 1982.

would be useful to have updated data for estimating elasticities and any other information which explains major changes in the marketplace. DOE notes that GRIM does not use such elasticities. The Department encourages AHAM, ADL, or other parties to provide evidence about whether the elasticities used in the analysis are reasonable, and how they may obtain more accurate elasticities.

4. Cost Pass-Through. Several comments, including ADL, AHAM, Amana Corporation (Amana), and General Electric Appliances (GEA), raise issues regarding cost pass-through and the relationship between cost and price. According to ADL, manufacturers have not passed through a significant portion of their costs as evidenced by the Consumer and Producer Price Indices, which show that prices have risen by less than the increase in costs. This means that firms have reduced operating costs rather than increase costs to consumers. Therefore any model that assumes or concludes that firms can pass on costs with any reasonable probability is ''not acceptable and inconsistent with observed behavior.'' (ADL, No. 19 at 4–5).

The Gas Appliance Manufacturers Association stated that DOE should not assume that all equipment cost increases can be passed through to the consumer, partly as a result of the option of deferring purchases and repairing existing equipment. (GAMA. No. 28 at 3).

The Association of Home Appliance Manufacturers noted that historically the price of appliances has risen much more slowly than the price of some production inputs. They concluded that this observation shows an inability of firms to pass on cost increases. (AHAM, No. 17 at 6).

The relevant issue regarding cost pass-through is how appliance prices have risen relative to the increased costs of all manufacturer inputs. A more plausible explanation of why passing on their costs has been increasingly difficult for firms is because of the rise of monopsony power on the purchasing side of the market as AHAM has noted in earlier comments.[10] The growth of large and sophisticated ''power'' retailers that have significant and increasing power in the marketplace has resulted in increased downward price pressure on manufacturers.

5. Small Firms. Several commenters stated that DOE needs to be concerned about the impacts of standards on small manufacturers. General Electric Appliances wrote that an analysis using an ''average'' firm may not show the impacts of standards on small firms or on industry concentration. (GEA, No. 39 at 21).

PVI Industries commented that ''a smaller company, with lower volume, may be affected very differently from a larger, higher volume producer. In particular, the smaller company can probably implement significant design changes more quickly and at much lower cost because of lower volume production and less automation. Therefore, the GRIM model may not suitably reflect the financial impact of a change across the broad spectrum of appliance manufacturers.'' (PVI Industries, No. 43 at 1).

The Department is interested in the impact of standards on the different types of firms in the industry. The Department is aware that the compact refrigerator industry has cost functions that are much different than the full-size product manufacturers, and partly for this reason, DOE is proposing less stringent standards for compact refrigerator products than for full-sized refrigerator products.

6. Multiple Standards. Three comments, from AHAM, Amana, and GEA, raised the issue of the cumulative costs of multiple regulations. (AHAM, No. 17 at 7, Amana, No. 21 at 2, and GEA, No. 39 at 3). They stated that the Department needs to consider and analyze the cumulative costs of multiple regulations on industry. Some of these costs include chlorofluorocarbon (CFC) phaseout, successive efficiency standards, and demands on human and financial resources. General Electric Appliances suggested the use of the GRIM because it includes a module that analyzes the cumulative effects of multiple regulations. (GEA, No. 39 at 21–2).

The Department has considered the impact of costs due to regulations concerning the phaseout of CFC and HCFC materials. The Manufacturer Analysis Model is designed to analyze the impact of standards on industry profitability for an individual appliance. To date, this has involved treating each manufacturer of a subject product as a separate company. Recognizing, however, that many manufacturers produce more than one appliance type subject to appliance standards and the companies have limited resources, the Department is presently seeking approaches to account for the cumulative effects on a multi-product company of the appliance conservation standards that it promulgates, and requests comments in this regard. Such an analysis will require both a manageable analytical method and relevant cost data.

7. External Costs and Benefits. A number of comments on the ANOPR urged the Department to consider external costs and benefits in its economic analyses of the efficiency standards proposed in this NOPR. (ACEEE, No. 50 at 2; Gas Research Institute (GRI), No.10 in Appendix H at 6; NRDC, No. 18 at 28; Pacific Gas and Electric, No. 22 at 2; NYSEO, No. 26 at 7; NWPPC, No. 30 at 4; AGA, No. 32 at 3). However, several other commenters argued against the inclusion of externalities in the economic analysis. (Tampa Electric Co. (TECo.), No. 3 at 3; Cleveland Electric Illuminating Co., No. 7 at 1; ARI, No. 31 at 6; Electricity Consumers Resource Council (ELCON), No. 33 at Attachment 1; EEI, No. 35 at 2; GAMA, No. 27 at 24; National Rural Electric Cooperative Association (NRECA), No. 42 at 2, 3).

The Department recognizes that the inclusion of monetized externality cost estimates in the evaluation of standards is a complex and controversial question. In a Supplemental Advance Notice of Proposed Rulemaking Regarding Energy Conservation Standards for Three Types of Consumer Products, (59 FR 51140, October 7, 1994), the Department solicited public comment on whether a sound analytical basis exists for estimating the monetary value of environmental and energy security externalities. Because the Department has yet to identify a sound analytical basis for estimating the monetary value of environmental or energy security externalities, it is not proposing to use such estimated monetary values in this rulemaking. However, as in previous efficiency standards rulemakings, the Department has estimated the likely effects of the proposed standards on certain categories of emissions and on oil use, and has considered these effects in reaching a decision about whether the benefits of the proposed standards exceed their burdens.

8. Manufacturability. General Electric Appliances believes that the Department needs to incorporate an evaluation of manufacturability as an essential aspect of the technical feasibility determination. (GEA, No. 39 at 13). Maytag proposed that the Department recognize that manufacturability and technological feasibility are inextricably

[10] See Written Comments of the AHAM to the DOE on Energy Conservation Program for Consumer Products: ANOPR on Energy Conservation Standards for Room Air Conditioners and Kitchen Ranges and Ovens, Docket No. CE–RM–90–201, dated December 12, 1990, by the AHAM, pp. 67–68; and Statement of the AHAM to the DOE on the NOPR on Energy Efficiency Standards for Dishwashers, Clothes Washers, and Clothes Dryers, CE–RM–88–101, also by AHAM, dated October 10, 1989.

linked, that a new operating definition of max tech should be developed, and that the process should consider patent restrictions, toxicity, functional viability, verifiability, and reliability. (Maytag, Transcript at 317–19).

The Department believes that the max tech level should reflect a product that is capable of being assembled, but not necessarily mass produced, by the effective date of the amended standards. (This issue is discussed in more detail in the section on Maximum Technologically Feasible Levels, II.A.2.)

B. *Product-Specific Comments*

1. Classes.

a. Compacts. The current energy efficiency standards specify standards for seven classes of refrigerators and refrigerator-freezers and three classes of freezers. The classes are based on various characteristics of the products such as type of defrost, location of the freezer and whether the unit has through-the-door features. No consideration was given to dividing the refrigerator products in different classes based on size. The Joint Comments proposed establishing separate classes for compact refrigerator products which would include all products less than 7.75 cubic feet (Federal Trade Commission (FTC)/AHAM rated volume) and 36 inches or less in height. The marketplace and industry recognize products meeting these criteria as a separate niche with special engineering and investment constraints. Much smaller, privately-held, family-owned, single-product companies are typical in this market. Economies of scale for these companies are much different from those of the full-size product manufacturers. Also, there are far fewer design options available to improve the performance of the compact refrigerator products. (Joint Comments, No. 49 at 15).

The Department has decided to adopt additional classes for compact refrigerator products because they have added consumer utility (ability to fit in small spaces), and because there are fewer energy conservation design options available for compacts. The additional compact classes are Nos. 11–18 in the ‘‘Product Classes and Effective Dates’’ Table found at the end of this NOPR.

b. HCFC-Free. The Joint Comments also proposed additional classes for HCFC-free refrigerator products, both full-size and compact. The Joint Comments stated that treatment of HCFCs becomes a significant issue in the design of these standards because implementation of the new energy standards will occur less than five years before regulations promulgated by the Environmental Protection Agency (EPA), making HCFC–141b unavailable, become effective January 1, 2003. There is also concern that the date for phaseout of HCFC–141b may be moved up. Current data from Europe, Japan, and the U.S., provided by the Joint Comments, support approximately a 10 percent energy penalty in the shift from HCFC–141b to proposed hydrofluorocarbon and hydrocarbon substitutes. New technologies may be developed to reduce or eliminate the energy penalty, but it is impossible to forecast with certainty whether they will be commercially available by 2003. The Joint Comments proposed that new classes be established for any product employing non-ozone-depleting foam blowing agent which EPA approves under the Safe Alternatives Program of the Clean Air Act, or which uses blends or mixtures of less than 10 percent HCFC. (Joint Comments, No. 49 at 21).

The Environmental Protection Agency stated that, given the lack of a technology equal or better than HCFC–141b in terms of energy and ozone-depletion, EPA does not plan to phase out HCFC–141b any earlier than 2003. (EPA, No. 34 at 9). The Environmental Protection Agency also submitted a report entitled, ‘‘Zero Ozone Depleting Blowing Agents for Use in Polyurethane-based Foam Insulations,’’ which found that the high density, molded foam produced with the fluorinated ether, E245, has a thermal conductivity similar to that of CFC–11. (EPA, No. 34, Appendix 8 at 4). The report also states that the major problem with E245 is that it is not commercially available, and toxicity tests must still be conducted. (EPA, No. 34 at Appendix 8, p. 7).

The Department has considered all the viewpoints expressed concerning the impact of HCFC–141b phaseout on this rulemaking. The thermal conductivity of HCFC–141b product substitutes that may become available in the future is difficult to project. The following summarizes what is presently known about four potential substitutes:

- HFC–356 foam has a thermal conductivity of 0.126 Btu-in/hr-ft^2-°F (18.2mW/m-K), which is about 4 percent higher than the 0.121 Btu-in/hr-ft^2-°F (17.4 mW/m-K) conductivity of foams using CFC–11 [11]. HFC–356 has the advantage of being less aggressive toward liner materials than CFC–11. Toxicity testing is incomplete.
- The fluorinated ether E245 is nonflammable and may serve as a near drop-in replacement for CFC–11 and HCFC–141b. Foams using E245 as a blowing agent have been reported to have a thermal conductivity at 32°F (0°C) of 0.126 Btu-in/hr-ft^2-°F (25mW/m-K) [12]. It is not commercially available and will need to undergo toxicity testing.
- Cyclopentane has about a 10 percent higher thermal conductivity than CFC–11 blown foam. The conductivity could be lowered by about 5 percent with the addition of small amounts of perfluoralcanes (PFAs) [13]. Although pentanes are being used in Europe, the flammability of cyclopentane concerns U.S. manufacturers.
- HFC–365 and a blend of H–365 and HFC–134a have been tested as blowing agents and found to produce foams with similar thermal conductivities to CFC–11 [14]. As has occurred for HCFC–141b, DOE expects that the thermal conductivities of these new foams will improve as more experience is gained with their use in different formulations. In the analyses for these proposed standards, it was assumed that the thermal conductivity remained constant at 1993 values.

Based on the uncertainty of the availability of HCFC–141b replacements with equivalent thermal properties, the Department has decided to develop new product classes for products that do not use HCFC–141b or other HCFCs in the foam insulation.

2. Design Options. In the 1993 Advance Notice the Department requested comments on 30 design options it proposed evaluating for potential improvement of the refrigerator products. The comments received on each design option are discussed below. (Through the process of providing technical support for the informal negotiations of the Joint Comments parties, the Department was able to gain a better understanding of the issues relating to use of each of the design options considered. This has greatly improved the Department's ability to estimate the efficiency

[11] E. Ball and W. Lamberts. ‘‘HFC–356, a Zero Ozone Depletion Potential (ODP) Blowing Agent Candidate for North American Appliance Foam Formulations,’’ Proceedings of Polyurethanes World Congress 1993, Vancouver, Canada, October 1993, pp. 10–13.

[12] E. Blevins et al., ‘‘Zero Ozone Depleting Blowing Agents for Use in Polyurethane Based Foam Insulations.’’ EPA, No. 34, Appendix 8.

[13] U. Wenning. ‘‘Hydrocarbons as PU Blowing Agents in Domestic Appliances’’, Proceedings of 1993 International CFC and Halon Alternatives Conference,’’ Washington, DC, 1993, pp 317–325.

[14] J. Murphy et al., ‘‘HFC–365 as a Zero ODP Blowing Agent for Foams,’’ Proceedings of 1993 International CFC and Halon Conference, Washington, DC, October, 1993, pp 346–355.

improvements that will result from incorporation of the design options.)

Increased Cabinet Insulation Thickness. Increasing the wall thickness has been identified as the option providing the greatest energy savings. According to the industry participants as stated in the Joint Comments, an increase in external dimensions on refrigerator-freezers of as little as a ½ inch can eliminate as much as 20 to 30 percent of a marketplace available for that particular product. If the external dimensions are maintained and the wall thickness increase is made to the inside of a cabinet, the interior volume of the cabinet is reduced. Smaller capacity products carry a lower price with less margin. The smaller volume cabinet will also have to meet a more restrictive energy standard. Finally, this design may sacrifice important utility of the product in violation of the mandates of NAECA. (Joint Comments, No. 49 at 7).

The non-industry participants in the Joint Comments agreed with industry position that the max tech level based on increasing both wall and door thickness by 1 inch—a 2-044h increase in side-to-side dimensions of the refrigerator—would have a significant impact on some products, because there are not sufficient alternative design options available to manufacturers should they find it necessary not to produce products with larger exterior dimensions (products that could not fit through doors in existing buildings if enlarged). (Joint Comments, No. 49 at 10).

The Joint Comments state that increased wall and door thickness has a more severe impact on compact refrigerators than it does on full-size products. Marketing of compacts does not allow for an increase in wall thickness since most products are designed for niche applications with no room for expansion of the cabinet size. Any increase in wall thickness would compromise the utility of the product by decreasing the usable interior volume for a product that already has limited applications in the marketplace. A similar problem applies to insulation increases in top and bottom panels; this space constraint is recognized in the new definition of the compact class as limited to models below 36 inches in height. (Joint Comments, No. 49 at 16).

Sub-Zero stated pursuant to its definition of built-in compact refrigerators, the available depth is restricted to 24 inches and the width to 24, 30, 36 or 48 inches. (Sub-Zero, No. 37 at 2). U-Line stated that the consumer uses of undercounter refrigerators and freezers will not permit increased exterior cabinet dimensions; exterior cabinet dimensions cannot exceed 24 inches in depth and width and 34 inches in height. Shipping costs would increase $3 per unit for a 1 inch increase in cabinet width. Decreasing internal volume would reduce consumer utility and require retooling. (U-Line, No. 11 at 1, 2).

The Joint Comments also state that the impact of increased wall thickness is as much a concern for household freezers as it is for household refrigerator-freezers. One basic problem is getting the larger, thicker-walled unit through doorways and stairwells. Another problem is that because the freezer market is declining, introduction of designs which are unacceptable to some consumers is even more troublesome. The Joint Comments state that increased wall and door thicknesses are not options that can be used to increase energy performance for household freezers. One freezer manufacturer presented information regarding how it had been forced to reduce its wall thickness by one-half inch to improve the marketability of the product. (Joint Comments, No. 49 at 18).

The Environmental Protection Agency has conducted a market survey that indicated consumers strongly preferred the double-insulated, or thick-walled, refrigerator when they are presented with economic information and labeling which highlights the environmental benefits. (EPA, No.34 at 9–10).

The Department agrees that there are problems associated with increasing the wall thickness for some classes of refrigerator products. If the increase is external, some of the larger models will not be able to pass through doorways or fit into the space found in many kitchens. The Department also recognizes that if the external dimensions are not changed, an increase of only one-half inch in wall thickness will decrease the internal volume of a typical refrigerator by about 10 percent. The Department has considered these factors in determining the proposed standards. However, the Department has determined that in some cases increases of less than one inch in the insulation thickness is acceptable.

Improved Foam Insulation for Cabinet or Door. Whirlpool stated that the CFC–11 blown foam that it has used typically has had a k-factor of approximately 0.125 Btu-in/hr-ft² °F, and it generally has been made with about 12 percent CFC–11 in the foam. The company said it was possible to improve the k-factor by increasing the amount of CFC–11, reducing cell size and increasing density, which required an increase in cost and in investment in some new equipment. However, none of the available replacements for CFC–11 has characteristics that match those of CFC–11. (Whirlpool, No. 36 at 4).

Sub-Zero stated it uses a froth-foam system that typically has higher k-values than high-pressure systems, but it would require a very large capital expenditure for the company to switch to a high-pressure system. Sub-Zero also commented that there is a lesser chance of incorporating micro-cell insulation with a froth system. (Sub-Zero, No. 37 at 4). U-Line stated that most exotic foam technologies (such as micro-cell) require high-pressure impingement foaming equipment; it uses froth-foaming equipment which would be expensive to replace with high-pressure systems. (U-Line, No. 11 at 2). General Electric Appliances stated that insulation efficiency suffers from replacement of CFC–11 foam by HCFC–141b foam, and that for it to switch from HCFC-blown foams is feasible, but such a transition would result in foams with poorer insulation value. (GEA, No. 39 at 4).

The Department did not find any experimental data to support this option. The Department does not believe that any technology that would improve the insulation properties of HCFC–141b blown foams beyond that of the present CFC–11 blown foam would be available in time to be considered in this rulemaking. Therefore, improvements in foam insulation were not considered in this analysis.

Evacuated Insulation Panels. The Joint Comments, commenting on vacuum panels, stated: ''Vacuum panel technologies have progressed since the last refrigerator rulemaking. The appliance industry probably will introduce limited vacuum panel designs over the next five to ten years. Issues of concern are manufacturability, availability, reliability and in-product performance. It is still too early in the development of this technology to apply it as a reliable design option in the production of a 1998 compliant product. Several major issues remain unresolved.

''• Vacuum panels must be used in concert with foam insulation (polyurethane foam is the mechanical support for the cabinet).

''• Wire harnesses, drain tubes, shelf anchors, etc., are [placed] between the cabinet shell and inner liner making 100 percent coverage of vacuum panels impossible. Fifty to sixty percent is about maximum and for freezers would be even less.

''• Vacuum panels are 6 to 10 times heavier than foam. Panels in doors may compromise Underwriters Laboratories (UL) tip-over requirements. The shipping weight of a typical cabinet with vacuum panels would increase by about 50 pounds.

''• Polyurethane foam averages about 15 cents per board foot. Powder-filled panels are $2.50 to $3.50 per board foot and fiber-filled panels range from $5.00 to $7.50 per board foot. An average refrigerator-freezer has about 114 board feet of surface area, of which approximately 35 board feet would be vacuum panels.

''• Worldwide production capability for all types of vacuum panels is between 3 to 5 million board feet per year. Full implementation of vacuum panels in the U.S. alone would require more than 400 million board feet of panels.

''• Product-life performance characteristics (15 to 20 years) are being observed, but industry continues to work toward a vacuum panel product that maintains reliability over the life of the refrigerator.'' (Joint Comments, No. 49 at 7–8).

The Environmental Protection Agency sponsored a study to estimate the cost of producing vacuum panels at a new plant designed to produce enough vacuum insulation panels for 300,000 refrigerator-freezers per year. It determined that the variable cost for a 21 cubic foot refrigerator-freezer is about $1.40 per board foot, and the investment cost is about $0.55 per board foot. (EPA, No. 34, Appendix 5 at 54–58). After feasibility is established and funding is obtained, it would take about 2 ½ years to begin production. (EPA, No. 34, Appendix 5 at 56–59). The energy savings estimated by simulation analyses averaged about 16 percent for top-mounted refrigerator-freezers. (EPA, No. 34, Appendix 5 at 73).

Based on the information cited above, the Department has concluded that production capability will be insufficient in 1998 for vacuum panel insulation to be considered as a design option for all classes of refrigerator products. However, the Department believes that for some classes of refrigerator products, vacuum panels may be the most attractive option available to meet the proposed standards.

Gas-Filled Panels. Whirlpool stated there is a low probability that this technology will be viable for use on products built in 1998. It is not aware of any situation in which gas-filled panels have been successfully demonstrated in a refrigerator. A major problem with application in a refrigerator is the lack of sufficient structural integrity of the resulting product. Whirlpool recommended that this option not be considered. (Whirlpool, No. 36 at 5). U-Line commented that gas-filled panels are not a feasible technology. (U-Line, No. 11 at 3).

General Electric Appliances stated that the gas-filled panels developed at the LBL are even less promising than vacuum insulation panels. Insulation values are only about R13/inch even with the most insulating gas, krypton. This is only about 60 percent of the value of powder vacuum panels. At the same time, gas panels are projected to exceed vacuum panels in cost. Even if gas panels had comparable performance and cost characteristics, they would require enormous investment expenditures to be incorporated into current refrigerator designs. At present, virtually all mass-produced refrigerators are designed using the liner, foam insulation, and exterior metal case as integrated elements of the cabinet structure. General Electric Appliances also stated that gas panels have absolutely no structural capability and would require the development of a fundamentally different cabinet design concept to achieve adequate structural integrity. Unlike other design options, where the option is designed to fit the refrigerator, gas panels would require the refrigerator to be completely redesigned to accommodate this option. Finally, the cost to the industry would be enormous and, given the comparatively unattractive efficiencies offered, unjustified. (GEA, No. 39 at 6).

The Department concurs that gas-filled panels lack structural integrity and have low resistivity compared to evacuated panels and therefore has not considered them in this NOPR.

Improved Gaskets. Whirlpool stated that much work has been done in attempting to improve the performance characteristics of refrigerator door gaskets. However, there is a tradeoff between the thermal performance of a gasket and the forces required to open or close the door. This makes it extremely difficult to improve on current designs. While savings on the order of 1 percent may be achieved on some models, Whirlpool stated this design option may not be available for all products, and, therefore, should not be recommended as a viable design option. (Whirlpool, No. 36 at 5). U-Line stated that because many manufacturers redesigned gaskets prior to 1993, any additional enhancements would provide diminished returns. (U-Line, No. 11 at 3).

The Environmental Protection Agency submitted a report, ''Finite Element Analysis of Heat Transfer Through the Gasket Region of Refrigerators-Freezers,'' evaluating means of improving a 1991 model refrigerator, that described theoretical modeling and experimental research on gasket heat loads. (EPA, No. 34, Appendix 6). The report concluded that replacing about half of either the metal door flange or cabinet flange with plastic can reduce the heat flow through the gasket region by 25 percent. (EPA, No.34, Appendix 6 at 28). The report concluded that for one refrigerator-freezer, a 30 percent heat flux reduction for the gasket region led to a measured 7 to 8 percent energy use reduction, whereas for a second refrigerator-freezer, a 22 percent heat flux reduction led to a measured 4 to 5 percent energy use reduction. (EPA, No. 34, Appendix 6 at 26–28).

AHAM provided the Department with estimates of energy savings and the costs of improved gaskets from a number of its member manufacturers. These values ranged from less than 1 percent to nearly 3 percent energy savings depending on the size and configuration of the refrigerator product.

The Department has decided to use the industry supplied data in the engineering analysis for each class of refrigerator. (See TSD, Chapter 3.) The higher EPA energy savings estimates were based on a refrigerator that met the 1990 standards whereas the Department's analysis is based on models which meet the 1991 standards.

Double Door Gaskets. Whirlpool stated that this option involves the same tradeoff between thermal performance and door opening and closing forces discussed under ''improved gaskets,'' see above. The company does not recommend this as a viable design option. (Whirlpool, No. 36 at 5). General Electric Appliances agreed with Whirlpool's comments. (GEA, No. 39 at 6–7). U-Line stated that cabinet icing and other potential field service-related issues have precluded their application to compact refrigerators and freezers. (U-Line, No 11 at 3).

The Department's analysis indicates that a significant amount of heat leakage (from the outside) into a refrigerator occurs across the door gasket. Decreasing this leakage could result in significant energy savings. This could be achieved by either improving the gaskets or using double-door gaskets. The cost of a double-door gasket is more than the cost to improve the single gasket to achieve the same amount of savings. The Department has, therefore, decided not to consider this option but instead to consider improved gaskets, as discussed, *supra.*

Reduced Heat Load for Through-the-Door Features. Whirlpool stated that there is some potential for energy savings in this area through improvements in insulation around the dispenser. However, the amount of savings is limited. It believes that an appropriate allowance for ''through-the-door features'' with improved insulation is approximately 70 kWh/year. (Whirlpool, No. 36 at 5). U-Line stated that compact refrigerator products do not employ through-the-door features. (U-Line, No. 11 at 3). General Electric Appliances stated that it had already made incremental design changes on some 1993 models to reduce the heat leakage of through-the-door features. (GEA, No. 39 at 7). These consisted of using polyurethane (vs. expanded bead polystyrene) insulation and totally redesigning the dispenser assembly. While some additional, marginal energy reductions are possible, GEA stated that if it extended these design changes to the full dispenser model line, further significant energy savings beyond this do not seem likely with current technology. No toxicity/safety or reliability problems exist with these changes. General Electric Appliances stated that these design changes could be introduced to the full line relatively quickly (i.e., from between 6 months and 2 years). (GEA, No. 39 at 7).

AHAM provided estimates of the energy savings from reducing the heat load for through-the-door features and the associated costs based on a survey of its members. These are the values that have been used in the analysis.

Reduction in Energy Used for Anti-Sweat Heaters. Whirlpool stated that most manufacturers utilize the minimum-needed energy within the cabinet for the anti-sweat heaters. Therefore, there is little opportunity to improve this option. (Whirlpool, No. 36 at 5). General Electric Appliances stated that required wattage for most anti-sweat heaters already has been reduced to save energy on 1993 models, variable-watt density heaters are already being used, and reducing the wattage further is expected to result in poor anti-sweat performance and reduced consumer satisfaction. (GEA, No. 39 at 7).

Based on the data supplied by manufacturers through AHAM, DOE decided not to use this option in its analyses because most models of refrigerator-freezers already employ condenser hot gas or liquid line to minimize the use of electric anti-sweat heat. Compacts and freezers, in general, do not use anti-sweat heat.

Substitution of Condenser Hot Gas for Electric Anti-Sweat Heat. Whirlpool stated this option already has been exercised by most manufacturers. (Whirlpool, No. 36 at 5). Sub-Zero stated the company already employs this option. (Sub-Zero, No. 37 at 5). U-Line stated that with the exception of some compact freezers, anti-sweat heaters are not employed in the designs of compact/undercounter refrigerator-freezers. (U-Line, No. 11 at 3). General Electric Appliances stated that it already uses condenser gas loops everywhere practicable. (GEA, No. 39 at 7).

After reviewing the data received from the manufacturers, the Department has concluded that this option already has been exercised by most of the manufacturers of refrigerator products and, therefore, this design option was not included in the engineering analysis for this rulemaking.

Reduction in Energy Used for Auto-Defrost Heater. Whirlpool stated that there are no significant savings available in this area because this energy is required to remove frost and prevent buildup of ice. Also, any savings would be redundant with savings from the use of adaptive defrost. The company, therefore, does not recommend this option. (Whirlpool, No. 36 at 5). U-Line stated that with the exception of some compact freezers, this design does not apply to the compact/undercounter refrigerator products. (U-Line, No. 11 at 4). General Electric Appliances stated that little significant energy savings are possible using this option; solenoid actuated dampers that attempt to retain heat in the evaporator compartment do not significantly reduce heater ''on'' times. (GEA, No. 39 at 7). Designs which attempt to transfer heat more directly to the evaporator, and thus less to the air are theoretically attractive but have achieved only minimal savings in practice while increasing the likelihood of evaporator ice-balling. Further reducing the temperature at which the thermostat turns the heater off would result in poor defrost performance and increased service calls. General Electric Appliances stated the basic defrost heater system must be very robust or severe reliability problems can occur. (GEA, No. 39 at 7).

The Department, after reviewing available data, concluded that most manufacturers already have reduced significantly the electric heat for automatic defrost in order to comply with the 1993 Standards, and there is little opportunity to save additional energy by exercising this option. The only exception is the side-by-side refrigerator-freezer without through-the-door features, where the baseline model has a higher defrost energy use than other models, and the Department included this option in the engineering analyses for that class.

Substitution of Condenser Hot Gas for Electric Auto Defrost Heat. Whirlpool stated it had explored this option in some depth in the 1970s. It was not successful in developing a system that would perform well and be reliable. Also, any savings that might be achieved would be redundant with savings from the use of adaptive defrost. The company believes adaptive defrost is the preferred alternative for saving defrost energy. Thus, it does not recommend substitution of condenser hot gas for electric auto defrost heat. (Whirlpool, No. 36 at 6). U-Line stated it is not aware of any compact/undercounter refrigerator-freezers that employ electric auto-defrost heaters. (U-Line, No. 11 at 4). General Electric Appliances believes this method of defrost is more complicated, more expensive and less reliable than its current designs. (GEA, No. 39 at 8).

The defrost system increases the energy usage of a system in two ways: the electric heater directly affects the electricity use and the heat of defrost increases the heat load inside the refrigerator, which to be rejected requires compressor work. One method of saving energy would be to do away with the electric heaters by substituting condenser hot gas in its place. The other method would be to better control the time and amount of defrost heat by using adaptive defrost. The Department did not find any data to demonstrate the condenser hot gas method to be more cost-effective than adaptive defrost, which is a well-developed and accepted technology. Thus, the condenser hot gas method of defrost was not considered in the engineering analysis for this rulemaking.

Adaptive Defrost Systems. Whirlpool stated this is a viable option for most of its products and produces energy savings on the order of 3 percent. (Whirlpool, No. 36 at 6). U-Line stated that it employs timers to initiate defrost, and it is unlikely that adaptive and demand defrost systems would significantly reduce energy consumption. (U-Line, No. 11 at 4).

The energy savings and associated costs of replacing the present defrost system with the adaptive defrost system have been provided to the Department by AHAM and its members. (See design option comments, supra). These are the values that have been used in the analysis. Compacts, in general, do not use electric heaters for initiation of auto defrost.

Improved Compressor Efficiency. Whirlpool expects to see further improvements in compressor efficiency prior to 1998. (Whirlpool, No. 36 at 6). However, the degree of improvement is uncertain at this time. Although compressor efficiencies as high as 5.8 EER have been projected, Whirlpool stated that any design changes made to improve efficiency often have negative impacts on reliability. It believes the risk of failure has increased with the introduction of a new refrigerant and a new lubricant. Therefore, it believes a conservative estimate should be used for future compressor efficiencies. (Whirlpool, No. 36 at 6). Sub-Zero is concerned that efficiencies of small-capacity compressors may not improve in time for future standards. (Sub-Zero, Transcript at 427). It is concerned particularly with the changeover to HFC–134a and the timing of compressor efficiency improvements for small-capacity compressors. (Sub-Zero, Transcript at 426). U-Line stated that compressor EERs of 5.5 are not realistic at low capacities. It expects 3.6 EER for HFC–134a at 200 Btu/hr. Furthermore, due to their low production volumes, manufacturing units with low capacities is a low priority for compressor manufacturers. (U-Line, No. 11 at 4). Maytag stated there are patent restrictions on linear motors that protect their use. (Maytag, No. 20 at 6). Additionally, Maytag said there is not enough time for proper reliability testing and implementation of linear motor compressors for the January 1998 standards date. (Maytag, No. 20 at 5). The Environmental Protection Agency submitted a report that found efficiency levels of 5.0 EER can be obtained at the low end of the capacity range of 200–600 Btu/hr with an increased cost to refrigerator manufacturers of $10–20. (EPA, No. 34 at Appendix 4, ''State of the Art Survey of Hermetic Compressor Technology Applicable to Domestic Refrigerator-Freezers,'' at 7–1). The Environmental Protection Agency also stated that for compressor capacity of 750 Btu/hr and above, an EER level of 6.5 is technically feasible with an incremental increase in manufacturer costs of about $15. (EPA, No. 34, at Appendix 3, ''State of the Art Survey of Motor Technology Applicable to Hermetic Compressors for Domestic Refrigerator-Freezers,'' at i).

The Joint Comments stated that with improvements in foam insulation and gaskets in freezers, the compressor size needed to maintain freezer food quality is smaller than used in previous years. These smaller compressors have lower EERs than used in DOE's max tech analysis. Freezer manufacturers and compressor suppliers indicated that an improvement of approximately 7 percent in EER can be expected between 1994 and 1998. (Joint Comments, No. 49 at 19).

The Department has obtained data on efficiency and costs of HFC–134a compressors from three compressor manufacturers, from AHAM and its members, and from other sources (e.g., company literature from Sunpower, Inc. and EPA reports, referenced above). The Department expects future efficiencies of small-capacity compressors will continue to be lower than those of larger-capacity compressors and has reflected that in its analyses of refrigerator products. (See TSD, Chapter 3).

Two-compressor system. Whirlpool stated a two-compressor system requires the use of two smaller capacity compressors, thus inherently it will be less efficient than the one larger capacity compressor used in current refrigerators. One of these smaller compressors would be operating under more efficient conditions due to the raised evaporator temperature for the circuit cooling the refrigerator compartment. Whirlpool stated all indications are that the decrease in compressor EER from two smaller compressors offsets the increased efficiency in one portion of the sealed system due to increased evaporator temperature. In addition, any increase in refrigerator efficiency inherently involves several other negative factors. They are significant increases in product cost, increases in service incidence rates due to the use of more components, reduction of useful volume of the refrigerator due to a larger machine compartment for two compressors, and potential for increased sound level when both compressors are running. Whirlpool does not recommend this option. (Whirlpool, No. 36 at 6).

Sub-Zero stated that although it presently uses a two-compressor system, the efficiency gain from the higher evaporator temperature in the fresh-food section is offset by the lower compressor efficiency for the smaller capacity compressor. (Sub-Zero, No. 37 at 6). U-Line stated that two-compressor systems are not practicable for compact/undercounter refrigerator-freezers. (U-Line, No. 11 at 4).

The Department agrees that a two-compressor system requires a larger, more efficient compressor to be replaced by two smaller, less efficient compressors. Some of the gain from improving the thermodynamics of the system will be offset by the decrease in the compressor efficiencies. While it has been shown that the two-compressor system could save some energy in the older less efficient refrigerators, the Department is not aware of any experimental data that demonstrate energy savings from this option for refrigerators in the efficiency ranges being considered in this rulemaking. For this reason, this option has not been included in the engineering analysis.

Variable-Speed Compressor. Whirlpool stated that the key to the effectiveness of this type of compressor is the development of highly efficient, cost-effective, and reliable drive systems (motor plus power electronics) for the compressor. It said development to date for drive systems sized for refrigerators has not been able to achieve the efficiency levels required to make this concept viable. Once these drive systems are available, there are then several other issues to be addressed. For example, design changes will have to be made to the compressor valves and bearings for good performance at a range of speeds; compressor reliability will have to be ensured through extensive life testing at a variety of speeds; sound tests will have to be performed on the finished refrigerator under all speeds foreseen to make sure that no resonances (which cause sound problems) are present; and, there will have to be an understanding of the relationship between any projected energy savings from this feature and the amount of savings found in actual field usage conditions. Whirlpool stated that the availability of this option in 1998 should not be assumed. (Whirlpool, No. 36 at 7). U-Line stated that this option is not feasible for compacts. (U-Line, No. 11 at 5). General Electric Appliances stated its experiments indicate the energy savings are small and the costs are large; it halted development when they found there would be an unfavorable cost-performance ratio coupled with significant noise problems. (GEA, No. 39 at 8).

The Department concurs that this technology has not been developed to the point where it will be ready for incorporation into refrigerators by the effective date of this rulemaking. This option is not included in the analysis.

Improved Fan Motor Efficiency. Whirlpool commented that there is significant uncertainty concerning the newer ''permanent magnet'' motors. They have not yet been produced in adequate volume in the design required for refrigerators. The bearing systems must be made quieter and must be tested for reliability. Whirlpool stated there is a significant risk that these very high efficiency motors will not be available by 1998. If they are not, then savings would be less, because permanent split capacitor (PSC) motors would be the best available. Whirlpool argued that the DOE should ''count on'' the PSC fan motors and not count on permanent magnet motors as a viable design option. (Whirlpool, No. 36 at 7). The Association of Home Appliances

Manufacturers stated the cost estimated by LBL for electronically commutated motors is about 40 to 60 percent less than estimates provided to it by suppliers. (AHAM, No. 17, Attachment 17 at 2).

Sub-Zero stated that it expects efficiencies of evaporator and condenser fan motors to improve. (Sub-Zero, Transcript at 427). U-Line stated that some improvement in the fan motor still may exist. (U-Line, No. 11 at 5). General Electric Appliances said it is pursuing various options with both evaporator and condenser fan motors and that reliability and testing of these components are fairly well understood. (GEA, No. 39 at 8).

The Department obtained cost and efficiency data from three manufacturers of evaporator and condenser fan motors. Averages of these data were used in the analyses performed by the Department. The cost estimates obtained by the Department are for quantities equal to the present volumes of fan motors being purchased by refrigerator-freezer manufacturers. The Technical Support Document (Chapter 3) provides details on these data for the various product classes.

Improved Fan Efficiency. Whirlpool stated that potential savings through this option are very limited. Fan motor size is governed not only by the operating load on the fan, but also by the need to ensure starting under all anticipated voltage and temperature conditions. Whirlpool said that most of the potential for fan energy savings lies in the fan motors themselves. (Whirlpool, No. 36 at 7). U-Line stated that where fan motors and blades are employed, optimization does provide opportunity for energy improvement. (U-Line, No. 11 at 5). General Electric Appliances stated it found energy savings benefits for condenser fans are marginal and that an energy savings of approximately 4 kWh/yr are available from evaporator fan redesign. (GEA, No. 39 at 8).

The energy savings from improved condenser and evaporator fans and the associated costs have been provided to the Department by AHAM and its members. These figures have been used in the analysis for the full-sized refrigerator products. Because most of the compacts employ natural convection and do not use fans, this option is not included in the analysis for compacts.

Variable-Speed Fans. Whirlpool stated that with a single-speed compressor, the rate of heat transfer for either the evaporator or condenser does not vary appreciably with changes in either ambient temperature or control setting because the compressor operates at only one speed. The compressor has a longer duty-cycle as either the ambient temperature goes up or the control setting is lowered. In order for the variable-speed fan feature to reduce energy consumption, it must allow the refrigerator to attain a more optimal air flow condition for a particular set of circumstances. The optimal air-flow condition is a trade off—reduced heat transfer versus reduced fan use. Because the heat transfer rate with single-speed compressors does not vary appreciably, Whirlpool stated there is little potential for energy reduction due to variable fan speed with a single-speed compressor. In addition, it stated there are concerns about excessive costs for the motors and required electronic controls, and the reliability of both the mechanical (bearing) and electrical (windings and controls) systems. Whirlpool argued that variable-speed fans should not be counted on to save energy. (Whirlpool, No. 36 at 7). U-Line stated this option is considered infeasible by the compact/undercounter AHAM subcommittee. (U-Line, No. 11 at 5).

General Electric Appliances said fan energy consumption reductions achieve false savings to the extent that a change in fan speed and airflow adversely affects energy performance elsewhere within the refrigerator system. General Electric Appliances found from a recent internal study that a 25 percent reduction in evaporator fan power input for its 24 cubic foot side-by-side product (with an ECM fan motor) lowered the evaporator saturation temperature, lowered system capacity, increased compressor run-time, and increased overall energy consumption. General Electric Appliances also said that while increasing fan speed enhances heat exchanger performance, it also increases gasket heat leakage which, in turn, requires more fan motor input power. Additionally, GEA said noise from higher fan speeds is becoming such a significant issue with consumers that noise attenuation costs must be factored into this cost-performance assessment. (GEA, No. 39 at 8–9).

Based on the comments provided, the Department has decided this option should not be included in the analysis.

Hybrid Evaporator. Whirlpool commented that it has no experience with ''hybrid evaporators.'' (Whirlpool, No. 36 at 8). U-Line stated the evaporator may offer potential for energy improvement by enhancing air to refrigerant heat exchange. (U-Line, No. 11 at 5). General Electric Appliances understands this option to be a two-stage dual evaporator system. (GEA, No. 39 at 9).

A hybrid evaporator employs two evaporators, one for the freezer and the other for the fresh-food section.The Department did not include this option in the analysis because the data available showed little energy savings using this technology.

Other Refrigeration Cycles. Whirlpool commented that it worked cooperatively with a major university in a development program for the Lorenz cycle for more than 2 years. During that period, a number of prototype systems were built and tested in its labs. While some energy savings were measured, it was unable to consistently demonstrate substantial savings using this technology. For products tested, the maximum savings achieved was about 8 percent. Because the second evaporator required for such systems reduces the storage volume by approximately ½ cubic foot, the net savings were something less than 8 percent. Because of the difficulty in obtaining reproducible results and the relatively small savings achieved, Whirlpool found this not to be a viable technology. (Whirlpool, No. 36 at 8). U-Line stated that other refrigeration cycles do not offer a feasible alternate technology. (U-Line, No. 11 at 6). Maytag stated thermo-acoustic refrigeration system prototypes are not available. (Maytag, No. 20 at 6). General Electric Appliances stated it has undertaken studies of various refrigeration cycles (Brayton, gas absorption, thermoelectric, magneto-caloric, and thermoacoustic) to compare their energy savings potentials against enhanced Rankine cycle designs. Of the alternative cycles studied, only the Stirling presented a credible opportunity for competitive efficiencies. (GEA, No. 39 at 9–11). The company undertook development of Stirling cycles in concert with Sunpower, Inc. General Electric Appliances confirmed that the Stirling cycle could perform on a par with the Rankine cycle currently being used, but it did not present any material improvement. In addition, GEA said the problems and costs associated with developing a completely new cycle design, versus upgrading existing cycle technology, argued against pursuing the Stirling cycle. (GEA, No. 39 at 9).

Except for the Lorenz cycle, the Department is not aware of any prototypes using alternative refrigeration cycles. In the case of the Lorenz cycle, the reports of energy savings vary considerably. Although this option has a significant potential for future energy savings, this technology is not developed well enough at this time to be considered an option for 1998 refrigerator-freezers.

Two-Stage Two-Evaporator System. Whirlpool commented it understands this concept to be one whereby there is an evaporator in each compartment with refrigerant passing through both evaporators simultaneously. The two different temperature (and thus pressure) levels for the two evaporators require two compressors in order to attain any efficiency improvements. Therefore, the negative effects highlighted under two-compressor systems apply: Lower EER, service incidence rate increases, very significant increases in product cost, space concerns, and increased sound level. In addition, Whirlpool is concerned about the ability of the two-compartment control scheme in this concept to handle changes in relative heat loads between the two compartments. These changes can occur when the door is opened in one compartment only, or when warm food is added to one compartment only. Whirlpool also is concerned about the loss of the ability to provide independent temperature adjustment in each compartment. Whirlpool recommends against the use of this option. (Whirlpool, No. 36 at 8). U-Line stated that two-evaporator systems are not practicable for compact/undercounter refrigerator-freezers. (U-Line, No. 11 at 5).

Due to the inability of the Department to find usable performance data for this type of system, this option has not been included in the engineering analysis.

Improved Heat Exchangers. Whirlpool believes there may be some savings yet available with improved heat exchangers. Adding surface area is generally difficult. For the condenser, space is limited and densely finned surfaces do not have good lint-handling characteristics. For the evaporator, simply making it larger detracts from product volume, and increasing fin density can negatively impact frost handling characteristics, causing poor performance in humid climates. (Whirlpool, No. 36 at 8). U-Line stated that effectiveness improvements are expected to be in the range of only 1 to 2 percent. (U-Line, No. 11 at 6). General Electric Appliances stated evaporator improvements have reached the point of diminishing returns, and condenser improvement benefits can be achieved but cost/performance tradeoffs will limit opportunities to less than that which theory predicts. (GEA, No. 39 at 11). AHAM stated LBL should account for the fact that increasing the evaporator size results in a loss of internal volume; this results in a decrease in both the energy standard and the marketing utility of the refrigerator. (AHAM, No. 17, Attachment 17 at 2).

The energy savings from improving the heat exchange in the evaporator and condenser and the associated costs have been agreed upon by AHAM and its members and provided to the Department. These are the values that have been used in the engineering analysis. (*See* TSD, Chapter 3). Increasing the evaporator heat exchange effectiveness might increase evaporator area (although not necessarily) and therefore, decrease internal volume very slightly. This slight decrease, a maximum of ~0.15 cubic feet (~4.25L), would not be large enough to noticeably impact consumer utility.

Alternative Refrigerants. Whirlpool stated there are no pure refrigerants that demonstrate an efficiency improvement over HFC–134a and are ready for application development work on refrigerators. If such a candidate does appear, there is a long testing process before production. This testing includes toxicity testing, chemical compatibility testing, reliability testing and safety. Whirlpool believes this option should not be considered. (Whirlpool, No. 36 at 8). U-Line stated it is unlikely that refrigerants not yet identified could be commercially available in time to become a realistic part of the solution. (U-Line, No. 11 at 6). General Electric Appliances said HFC–134a is the refrigerant of choice and the flammability of HFC–152a makes it undesirable. (GEA, No. 39 at 11). It also said that hydrocarbon refrigerants are being used in Europe in cold wall evaporators only and use of those designs in the U.S. would require a total redesign of the refrigerator and would reduce consumer utility. (GEA, No. 39 at 12).

With the phaseout of CFC–12, HFC–134a appears to be the accepted refrigerant replacement in the U.S. There are other promising refrigerants under development but none of the replacements that are without problems such as toxicity or flammability have been proven to perform better than HFC–134a . Therefore, the Department has assumed that HFC–134a will be used as the refrigerant for 1998 refrigerators.

Improved Expansion Valve. Whirlpool stated expansion valves are not generally used in refrigerators because capillary tubes yield better performance. The company's studies show no savings from expansion valves. It does not recommend this option. (Whirlpool, No. 36 at 9). U-Line stated improved expansion valves offer no improvement over properly balanced refrigeration systems using conventional capillary tubes. (U-Line, No. 11 at 6). General Electric Appliances stated this is a viable option but will require considerable time (3–5 years) to optimize. It said reliability will be lower than that of the current capillary design, and the cost will be higher. It believes improvement may be limited to electronic units. (GEA, No. 39 at 12). AHAM stated the improved expansion valve should be eliminated if its savings are reflected in the fluid control valve option. (AHAM, No. 17, Attachment 17 at 3).

Because the Department was not able to find any data demonstrating that thermostatic or electronic expansion valves will save energy in refrigerators, this option has not been included in the analysis.

Fluid Control Valves. Whirlpool stated these devices provide significant savings when used with rotary compressors, which are designed with the compressor shell maintained at the condensing pressure. Whirlpool said they do not yield significant savings when used with reciprocating compressors, which operate with the compressor shell at the evaporator pressure. To Whirlpool's knowledge, no rotary compressors have passed reliability tests using HFC–134a and new lubricants. The company believes this design option should be dropped. (Whirlpool, No. 36 at 9). U-Line stated the application of fluid control valves in reciprocating compressors requires use of a high starting torque compressor (capacitor start motor) and that the energy savings, although potentially significant, may not be economically justified. (U-Line, No. 11 at 6). General Electric Appliances said this option carries the greatest benefit for high-side compressors, but they are no longer used in the U.S. This option has extremely limited value (2 to 3 percent energy reduction) when applied to the high-efficiency low-side compressors currently in use. The value of this option will continue to decrease as cycling losses are further reduced through other means. This type of design change could be put into production relatively quickly (1 to 2 years) once the reliability of the valve is confirmed. However, confidence in the valve must be high as its failure can result in a total loss of refrigeration. (GEA, No. 39 at 12).

Based upon the comments above and research data received from Oak Ridge National Laboratory [15] that fluid control valves do not save energy when used with reciprocating compressors, and since most of the manufacturers use reciprocating compressors, the

[15] Letter from J.R. Sand of Oak Ridge National Laboratory dated March 16, 1994.

Department has decided not to include this option in the analysis.

Location of Compressors. Whirlpool stated that for refrigerators with ''forced air hi-side'' design (which is the most common design used in the industry), there is no thermodynamic reason to expect energy savings from a change in location of the compressor and condenser. Such a change is also likely to decrease utility of the product by reducing the storage volume available at a convenient height off the floor. Whirlpool does not recommend this option. (Whirlpool, No. 36 at 9). Sub-Zero stated that it already mounts the compressors at the top of the unit; this allows easier servicing and theoretically should reduce the temperature differential. (Sub-Zero, No. 37 at 6). U-Line stated there are not many opportunities to relocate compressors and condensers for compact/under counter products. (U-Line, No. 11 at 7).

General Electric Appliances stated that the benefit of removing the evaporator fan from the refrigerated space diminishes as fan efficiencies improve. The feasibility of this option in large-scale production is questionable due to the need to seal the shaft without significantly increasing the frictional losses. Moisture migration, ice formation, and noise transfer to the cabinet are additional concerns. Moving the high-side components to the top of the refrigerator has marginal cabinet heat leakage benefits, but would require a fundamental redesign of the cabinet structure. Moving the high-side components would require the refrigerator to be completely redesigned to accommodate the option. It likely would require enhanced structural rigidity and deliberate means, such as low-placed weights, to prevent tip-overs. General Electric Appliances concluded that, absent a total restructuring of the production line, or creation of new production capacity, the cost of introducing this design option is prohibitive. (GEA, No. 39 at 12–13).

The Department could find no data that showed that relocation of the compressor would save energy. After consideration of the comments discussed above, the Department has decided that even if there are small energy savings from this option, these savings would be insignificant compared to the costs of redesigning and manufacturing a refrigerator with the compressor on top. Therefore, this option has not been included in the engineering analysis.

Use of Natural Convection. Whirlpool stated this option is counterproductive for larger products (above about 14 cubic feet) since the wattage of condenser fan motors has been reduced substantially in recent years. It does not recommend this option. (Whirlpool, No. 36 at 9). U-Line stated that except for frost-free models, all compact/undercounter refrigerator-freezers use natural convection evaporators. Those units using forced air condenser systems are designed for built-in or recessed installations. (U-Line, No. 11 at 7).

Based on the comments discussed above, the Department has concluded that the industry is already using this option where it is practical and so has not included it in the engineering analysis.

Electrohydrodynamic Enhancement of Heat Exchangers. Whirlpool considers this to be a technology that is impractical, unsafe, and expensive to implement in products. It does not recommend this option. (Whirlpool, No. 36 at 9). U-Line stated that the compact/undercounter AHAM subcommittee does not consider this option feasible. (U-Line, No. 11 at 7). Maytag stated that prototypes are not available for electrohydrodynamically enhanced evaporators or condensers. (Maytag, No. 20 at 6). General Electric Appliances stated this may be an inexpensive approach to obtaining marginal energy savings; however, the continuous use of an extremely high voltage field presents safety risks that simply are not acceptable, even if they could be addressed to some degree at a reasonable cost. (GEA, No. 39 at 13).

This concept has only been demonstrated in a laboratory, and no prototypes using this technology have been built. Since there is no cost or performance data for this design option in refrigerators, the Department has decided that this option is not well enough developed for consideration in this rulemaking.

Voltage Control Device. Whirlpool stated it has conducted tests on these devices and found that they save no energy on products which are designed to meet existing energy standards. It does not recommend this option. (Whirlpool, No. 36 at 9). U-Line stated these devices have not demonstrated measurable reductions in energy use when applied to refrigerators and freezers. (U-Line, No. 11 at 7). General Electric Appliances stated its testing indicates current high-efficiency compressors do not exhibit energy savings when used with devices that reduce line voltage and/or change phase angles. (GEA, No. 39 at 13).

Based upon data supplied to the Department,[16] the Department believes this option does not offer any potential for energy savings for new refrigerators and freezers.

(3) Other Comments.

a. Uncertainty Inherent in Data. The Joint Comments formulated a number of different approaches for quantifying the uncertainty and variance inherent in estimated energy savings and costs for individual design options. It said the basis for quantifying uncertainty lies not only in the estimates of energy savings and costs reasonable in the 1998 time frame, but also in the different economies of scales available to companies in the refrigerator-freezer industry. The impact of design options and associated costs affect these companies' products differently. (Joint Comments, No. 49 at 8).

An example from one of the uncertainty analyses demonstrates the variance in unit cost impacts on top-mounted nondispenser automatic-defrost refrigerators. In this example, for a trial standard energy consumption 30 percent below the 1993 level, the increase in manufacturing unit costs runs from approximately $65 up to $145, depending on the specific energy saving options used. (Joint Comments, No. 49 at 8).

The Department is aware there are uncertainties in the estimated costs and energy savings of the various design options. Additionally, the Department recognizes other uncertainties that affect the feasibility of design options, including reliability, performance, and safety. The Department has asked manufacturers to supply the data needed to address the issue of the impact of uncertainties on life-cycle cost and payback periods. The Department has considered the uncertainties in costs and energy savings in developing the proposed standards for this rulemaking. The Department has also considered design feasibility and marketing utility uncertainties.

b. Simulation Model. The Joint Comments were critical of the accuracy of the ERA model, which calculates refrigerator energy use. The industry members of the Joint Comments assessed the accuracy of the ERA model in two phases. The first phase was to use current technology and currently available products to determine the accuracy of the ERA estimates versus actual energy data from refrigerator-freezers. The second phase of this assessment was to determine how the ERA model handles nonconventional technologies, e.g., those technologies

[16] Admiral Refrigerator Test Report for the Admiral Company; Izagulrre, F. L., Senior Engineer, International Technical Services, Inc., August 25, 1993.

not currently in production. (Joint Comments, No. 49 at 5)

The industry members of the Joint Comments constructed 100 ERA input files on products ranging from compact refrigerator-freezers and freezers to full-size automatic defrost refrigerator-freezers. The standard uncertainty of the ERA model using this input data was approximately 19 percent. The Joint Comments argued this accuracy level makes the ERA useful to examine engineering assessments of energy savings options, but not a sufficient tool to determine multi-million dollar rulemaking impacts. (Joint Comments, No. 49 at 5)

AHAM also had Dr. Clark Bullard at the Air Conditioning and Refrigeration Center of the University of Illinois conduct an evaluation of the ERA model. (AHAM, Transcript at 296). This analysis of the ERA model focused on the ability of the model to properly evaluate nonconventional technologies which have yet to be built into full-size refrigerator-freezers and tested or are not yet currently in production. Dr. Bullard's final report noted that many of these design options as modeled by the ERA had errors between 50–75 percent compared to laboratory measurements of these technologies. (Joint Comments, 49 at 6).

The Environmental Protection Agency submitted the *User's Manual for the EPA Refrigerator Analysis Program*. (EPA, No. 34, Appendix 2). The EPA also submitted a rebuttal statement, ''Response to Report by Clark Bullard Associates Accuracy Analysis of the ADL/EPA Refrigerator Analysis (ERA) Model.'' (EPA, No. 34, Appendix 7). One of the EPA comments is that Dr. Bullard's analysis was based on an older version of ERA, which preceded the ''official'' release of Version 1.0. Version 1.0, which DOE used for its analysis, addressed the concerns about the model raised by Dr. Bullard. (EPA, No. 34, Appendix 7, cover letter).

The Department has reviewed the reports by Dr. Bullard and by the EPA concerning the ERA model. In performing the engineering analyses, the Department selected actual refrigerator models to use for each baseline case. The measured energy use for each of these baseline models (supplied by AHAM and its members) was used to calibrate the model for each class of refrigerator product evaluated. To account for changes in performance due to the use of HFC–134a, the Department used HFC–134a compressor maps in modeling each refrigerator class. For those design options included in the cost-efficiency analyses but not directly modeled with ERA, such as gasket improvements and vacuum panel insulation, DOE energy-efficiency improvement estimates were based on measured data or other methods of calculating the energy savings. (See discussions of individual design options.) In summary, the Department has utilized measured data rather than theoretical predictions whenever data has been available.

c. CFC Phaseout. AHAM stated the costs of CFC elimination are not included in the analysis. The effect of CFC elimination must first be taken into account before proceeding with implementing options to meet various standard levels above the 1993 energy standard. (AHAM, No. 17, Attachment 17 at 3).

The Department has accounted for the costs of CFC phaseout by increasing the cost of the baseline units. The manufacturer's costs associated with the phaseout of CFC are accounted for in the manufacturer impact analysis. (See discussion under ''baselines,'' below.)

4. Standards Proposed in the Joint Comments. The standards shown in Table 1, with accompanying discussions, were proposed in the Joint Comments. (Joint Comments, No. 49 at 14–27).

TABLE 1.—STANDARDS PROPOSED IN THE JOINT COMMENTS

Product class	HCFC-containing product	HCFC-free product
i. Automatic Defrost Refrigerator-Freezers (excludes compact refrigerator-freezers):		
1. Top-mounted freezer without through-the-door ice service	9.80AV+276.0	10.78AV+303.6
2. Top-mounted freezer with through-the-door ice service	10.20AV+356.0	11.22AV+391.6
3. Side-mounted freezer without through-the-door ice service	4.91AV+507.5	5.40AV+558.3
4. Side-mounted freezer with through-the-door ice service	10.10AV+406.0	11.11AV+446.6
5. Bottom-mounted freezer without through-the-door ice service	4.60AV+459.0	5.06AV+504.9
ii. Compact Refrigerator-Freezers (AHAM/FTC volume less than 7.75 cubic feet and less than 36 inches in height):		
1. Manual defrost refrigerator-freezer	10.70AV+299.0	11.77AV+328.9
2. Partial automatic defrost refrigerator-freezer	7.00AV+398.0	7.70AV+437.8
3. Top-mounted freezer automatic defrost refrigerator-freezer	12.70AV+355.0	13.97AV+390.5
4. Side-mounted freezer automatic defrost refrigerator-freezer	7.60AV+501.0	8.36AV+551.1
5. Bottom-mounted freezer automatic defrost refrigerator-freezer	13.10AV+367.0	14.41AV+403.7
6. Upright freezer automatic defrost	11.40AV+391.0	12.54AV+430.1
7. Upright freezer manual defrost	9.78AV+250.8	10.76AV+275.9
8. Chest freezer manual defrost	10.45AV+152.0	11.50AV+167.2
iii. Freezers (excludes compact freezers):		
1. Upright automatic defrost	12.43AV+326.1	13.67AV+358.7
2. Upright manual defrost	7.55AV+258.3	8.31AV+284.1
3. Chest freezer manual defrost	9.88AV+143.7	10.87AV+158.1
iv. Manual and partial defrost refrigerator-freezers (excludes compact refrigerator-freezers):		
1. Manual defrost	8.82AV+248.4	9.70AV+273.2
2. Partial automatic defrost	8.82AV+248.4	9.70AV+273.2

AV=Total adjusted volume, expressed in ft^3.

a. Full Sized Refrigerator-Freezers. The proposed standards ''are based on a negotiated approach to identifying the maximum level of efficiency that is technologically feasible and economically justified. A negotiated approach may provide slightly different results from those achieved by conventional rulemaking because this NAECA criterion can be satisfied in a more flexible way, providing greater overall energy savings for a given level of impacts.'' (Joint Comments, No. 49 at 14). That flexibility permitted the participants, for the first time, to address both the cumulative economic impact of individual design options, and the varying severity of that impact upon different product classes and manufacturers. The negotiation process allowed for a cumulative assessment of impact, adjustments among various product standard levels, and better balance of the economic impact among manufacturers. The Joint Comments stated that * * *

''Impacts on manufacturers are different for different product classes. For product classes representing discretionary purchases, such as some compact refrigerators and most freezers, cost increases due to standards may result in much greater reductions in sales compared to the refrigerator-freezer classes, whose purchase is essentially necessary when a new house is constructed or when an existing product fails. Some design options with perceived consumer or marketing disadvantages, such as increasing wall thickness, are more troublesome for these more discretionary classes of products.

''The consumer cost-effectiveness of increasing levels of energy efficiency, as well as the impact of these levels on manufacturers, also depends on the scale on which the product is produced. For those products with the highest production volumes, capital cost increases can be amortized over a larger number of units, resulting in fewer impacts. In contrast, for products with smallest sales volumes capital cost increases will be spread over fewer models and will have a larger impact on product cost. These effects will operate differently for different manufacturers, depending on the mix of their sales.'' (Joint Comments, No. 49 at 14).

As a result, the Joint Comments final agreement ''concentrates the largest energy savings on the five automatic defrost categories (refrigerator-freezers with: top-mounted freezer non-dispenser, top-mounted freezer dispenser (ice and/or water), side-mounted freezer non-dispenser, side-mounted freezer dispenser, and bottom-mounted freezer) with the very largest percentage reduction in the two classes with the highest sales volumes. These five classes represent more than two-thirds of the total energy consumed by all refrigerators/freezers. These five product classes represent 85 percent of the total energy savings generated from the (proposed) standards.

''The parties agreed that in the interest of conserving engineering and capital resources while maximizing energy savings, the greatest changes in design should be concentrated on the largest two product classes of the five automatic defrost refrigerator-freezer classes—top mounted, non-dispenser, and side by side with dispensers—and not other refrigerator-freezers, freezers or compacts.'' (Joint Comments, No. 49 at 14).

''Dispensers for ice and/or water through the door affect the performance of top-mounted freezer models in which the dispenser is normally in the fresh food door and side-mounted freezer models in which the dispenser is normally in the freezer door, in significantly different ways. Because of this difference, the energy consumption of a side-mounted freezer dispenser can be higher than a top-mounted freezer dispenser. This is due to the greater amount of heat transferred through a freezer door dispenser.'' (Joint Comments, No. 49 at 15).

''Most manufacturers do not build all product classes or all sizes within a product class. This fact emphasizes the need to maximize the total energy savings while considering the resultant economic impacts to each company.'' (Joint Comments, No. 49 at 15).

The Department estimated both the long term and short term return on investment (ROI) for a typical small and a typical large company for each energy efficiency trial standard level considered and found that this evaluation tends to support the Joint Comments position that requiring the largest improvement in energy savings for the largest selling classes of products will maximize the energy savings.

b. Compact Refrigerators, Refrigerator-Freezers, and Freezers. This new set of classes (Nos. 11–18) includes all refrigerator products less than 7.75 cubic feet and 36 inches or less in height. The total energy consumption of all compact refrigerator products in the U.S. is less than 2.6 percent of the total energy consumed by all sizes of refrigerator products.

The only design options for compact refrigerator-freezers that were identified by industry as feasible from a design and marketing aspect were: improved gaskets, improved compressor efficiency and improved fan motor efficiency. Compact refrigerator manufacturers indicated that the other design options have extremely low design feasibility or marketing utility when applied to their products (not buildable or not saleable).

The Joint Comments stated ''The five compact refrigerator/freezer manufacturers supplying data for life cycle cost and payback analysis identified a ''max tech'' limitation to their products of approximately 15 percent below 1993 levels. This level did not take into account economic justification (consumer and manufacturer) or safe harbor issues.'' (Joint Comments, No. 49 at 16). This assessment took into account the following:

''• High efficiency compressors of 5.5 Energy Efficiency Ratio (EER) are not realistic for compact refrigerator/freezers. Low capacity compressors available for compact refrigerator/freezers in the 1998 time frame are expected to have efficiencies of approximately 3.6 EER.

''• Most compact refrigerator-freezer manufacturers are small companies with limited research and development funding and capital resources.

''• High efficiency foams require high pressure impingement systems that are only economically viable for very large manufacturers. Most compact manufacturers use what is known as an auto froth foaming system (low pressure) that cannot produce high efficiency foam insulation. Non-CFC auto froth formulations are also limited to moderately energy efficient replacements.

''• In most cases, compact refrigerator/freezers and freezers do not employ fan motors, mullions, auto-defrost or through-the-door features. As a result, design strategies which relate to these components or technologies are not available for improvement.

''• The need for high efficiency components by compact refrigerator/freezer and freezer manufacturers carries a low priority with component suppliers. Motor and compressor manufacturers apply their engineering resources to larger volume manufacturers leaving the low volume niche type compact products to the tail end of their design cycles. For example, there are compact manufacturers that still have not been provided with sample non-CFC–12 compressors that provide acceptable energy efficiency for household appliance applications.'' (Joint Comments, No. 49 at 16, 17).

''Because of the special design constraints and limited number of options applicable to compact refrigerator-freezers and freezers, it was difficult to develop life-cycle cost analyses that reflected the real marketing situation for these products. An LBL assessment using inputs from AHAM compact manufacturers showed that an energy savings level of 2 to 3 percent below the 1993 standards would result in a minimum five-year payback for consumers. This assessment did not take into consideration unique marketing restrictions of individual compact refrigerator-freezer and freezer manufacturers.'' (Joint Comments, No. 49 at 17).

In an effort to balance the economic impact on the compact product manufacturers and the consumers benefit from improvements in energy efficiency in these products, the Joint Comments proposed an energy level approximately 5 percent below the 1993 standards for all eight compact type refrigerator-freezers and freezers. (Joint Comments, No. 49 at 17).

The Department agrees with the Joint Comments statement that there are fewer design options available for improving the energy efficiency of compact refrigerator products. The Department also recognizes that there is relatively little opportunity for energy savings from the compact classes, given that they consume only 2.6 percent of total energy used by residential refrigerator products. Therefore, the Department has analyzed compact refrigerators, freezers, and refrigerator-freezers separately and is proposing separate energy efficiency standards for the compact refrigerator products.

c. Household Freezers. The Joint Comments stated ''The category of household freezers includes three product classes defined as: chest freezers with manual defrost; vertical freezers with manual defrost; and vertical freezers with automatic defrost. As a group, the freezer product classes have technical and marketing constraints unique to their individual markets. These design constraints are amplified by the fact that the 1993 NAECA energy efficiency standards imposed an additional 14% stricter target on household freezers than refrigerator/freezers. Energy efficiency gains on household freezers out pace those for any other appliance standard in the U.S. Some parties believe that as a direct partial consequence of the 1993 NAECA standards, three companies terminated production of these products.'' (Joint Comments, No. 49 at 18).

''The number of energy saving options applicable to household freezers is almost as limited as those for compact refrigerator/freezers. The options applied by LBL in its ''max tech'' analysis included increased wall and door thicknesses, higher EER compressors, improved gaskets, and enhanced performance of evaporator and condenser coils. In the automatic defrost vertical freezer product class, adaptive defrost and more efficient motors are applied. These latter options are not used on manual models.'' (Joint Comments, No. 49 at 18).

The Joint Comments stated the CFC replacement issue has been especially difficult to resolve on freezer products. The preferred refrigerant replacement, HFC–134a, ''has an additional 3 to 4 percent energy penalty inherent in its performance at temperatures necessary for household freezer products as compared to refrigerator-freezers.'' (Joint Comments, No. 49 at 19). ''The most common replacement for CFC–11 in the blowing agent for foam insulation is hydrochlorofluorocarbon (HCFC)-141b. Since this chemical is basically in a liquid phase while exposed to temperatures produced in household freezers, the liquid thermal conductivity is especially important in its performance as an energy efficient CFC–11 replacement. As applied to household freezers, however, this particular CFC–11 replacement carries an approximate 5 to 6 percent energy penalty when applied to household freezers.'' (Joint Comments, No. 49 at 19).

''Freezers are an optional commodity in a typical U.S. household. They are basically sold in the replacement market, and due to the price sensitivity of this market, there is a reduced opportunity to pass through costs of energy improvements to the consumers. Thus, if regulatory induced costs cannot be passed on, the product line becomes relatively unprofitable.'' (Joint Comments, No. 49 at 19)

After carefully reviewing the feasibility and energy efficiency options in the max tech analysis, and considering inputs from refrigerator manufacturers and compressor manufacturers, the Joint Comments proposed standards levels for freezer products. The proposal is based on most of the design options identified by DOE in the 1993 Advance Notice, but with the more conservative industry estimates of energy savings. (Joint Comments, No. 49 at 20).

The statements made by the Joint Comments concerning freezers support the Department's analysis.

d. Manual and Partial Defrost Refrigerators and Refrigerator-Freezers. The Joint Comments stated: ''There are only a few models with a small market niche in this declining product category. The percentage of U.S. sales in these product classes is 1.7 percent and falling. Data and analysis on elementary engineering and economic issues are difficult to obtain. However, non-industry participants felt that it is important to recommend a relatively stringent U.S. standard on this product class because of the potential impact on similar products produced in or for less-developed countries.'' (Joint Comments, No. 49 at 20). The Joint Comments believe it is likely these less-developed countries will adopt similar standards. Because of the limited availability of data and the small market, the Joint Comments proposed an energy consumption standard for manual and partial defrost refrigerator-freezers that is 10 percent lower than they proposed for Class 3 refrigerator-freezers (automatic defrost with top-mounted refrigerator-freezer without through-the-door ice service). (Joint Comments, No 49 at 20).

''The energy consumption differential between automatic defrost and non-automatic defrost units has been declining over time, and is expected to decline further as adaptive defrost options become incorporated into the automatic defrosting systems. The standards proposal is based on a judgment of all the participants that a 10% energy consumption difference for a given adjusted volume accounts for the relatively irreducible minimum change in energy consumption relating to a member's decision not to use automatic defrost.'' (Joint Comments, No. 49 at 20).

An analysis of the energy savings options available for the manual and partial defrost refrigerators and refrigerator-freezers by the Department supports the level of standards proposed by the Joint Comments parties. However, the concern raised by Joint Comments parties regarding the potential impact on similar products produced in or for less-developed countries was not considered by DOE.

e. Non-HCFC Products. The Joint Comments propose establishing separate classes for refrigerator products which do not use HCFCs. ''These non-HCFC classes would permit 10% greater energy use than the comparable HCFC-using classes to provide industry with a known, feasible way of meeting the standards before 2003.'' (Joint Comments, No. 49 at 21). The Joint Comments parties recommended that less stringent standards, which would expire 6 years after their effective date, be established for the HCFC-free refrigerator classes. It is anticipated that alternative design options will be available by this time. (Joint Comments, No. 49 at 21).

The Joint Comments recommended that the following conditions apply to the standards for the HCFC-free classes:

''(1) 18 months prior to the total phaseout by EPA of HCFC–141b in January 1, 2003, to wit, July 1, 2001;

''(2) 18 months prior to any earlier phaseout date or restriction on use of HCFC's in refrigerator-freezer foam set by EPA; or

''(3) After the granting of a petition by DOE which demonstrates that HCFC–141b is in very short supply or economically infeasible to use due to, for example, chemical supplier announcements or other actions affecting supply or use.

''After the 1998 effective date of the basic standards and before the effective date of the non-HCFC standard as stated in (1)–(3) above, each manufacturer may annually produce non-HCFC units subject to the alternative standard for up to 5% of its total production or for 10,000 units, whichever is less. This allowance to apply the non-HCFC standard to a small number of units allows manufacturers the ability for field testing with real consumers under actual commercial conditions which will be necessary in the case of the advanced technology which will be required to meet the 1998 standards.'' (Joint Comments, No. 49 at 21).

As discussed earlier, because of the uncertainty of the availability of HCFC–141b replacements with equivalent thermal properties, the Department has decided to develop new product classes for products that do not use HCFC–141b or other HCFCs in the foam insulation. However, the timetable for adoption of HCFC-free standards proposed by the Joint Comments differs from that proposed by DOE in this NOPR.

IV. Analysis

A. Engineering—Technical Issues

1. Efficiency Levels Analyzed

The Department conducted engineering analysis of those classes of refrigerator products for which performance and cost data could be obtained. The classes analyzed were: Top-mounted refrigerator-freezer with auto defrost, top-mounted refrigerator-freezer with auto defrost and through-the-door features, side-by-side refrigerator-freezer with auto defrost, side-by-side refrigerator-freezer with auto defrost and through-the-door features, bottom-mounted refrigerator-freezer with auto defrost, upright freezer with auto defrost, upright freezer manual defrost, chest freezer manual defrost and compact refrigerator-freezer manual defrost. Data was collected by surveys of the industry, extensive literature review and discussions with experts. This information was used as the basis for determining the improvement in performance and the manufacturer cost for each design option added to the baseline unit. The engineering analysis determined the annual energy use, life cycle costs and pay back periods for each combination of design options. Proposed standards for classes which could not be analyzed, due to the lack of data, have been based on the percentage in performance improvement over current standards determined for a similar class that was analyzed. (See TSD, Chapter 3).

The combination of design options which results in the most performance improvement technologically feasible is call the ''max tech'' design level. Table 2 presents the max tech performance levels expressed as annual energy use for all analyzed classes of refrigerator products.

TABLE 2.—ANNUAL ENERGY USAGE FOR REFRIGERATORS, REFRIGERATOR-FREEZERS, AND FREEZERS AT MAXIMUM TECHNOLOGICALLY FEASIBLE LEVELS

Product class	Annual energy use (kWh/yr)
Refrigerator-Freezers:	
Top Mounted Auto Defrost	422
Top Mounted Auto Defrost with Through-the-Door Feature	517
Side-by-Side Auto Defrost	502
Side-by-Side Auto Defrost with Through-the-Door Feature	516
Bottom Mounted Auto Defrost	444
Freezers:	
Upright Auto Defrost	484
Upright Manual Defrost	278
Chest Manual Defrost	284
Compacts: Manual Defrost Refrigerator-Freezer	260

The Department selected the max tech level and three other levels from the engineering analysis for further examination. Table 3 presents the four efficiency levels selected for analysis for the nine classes of refrigerator products analyzed Level 4 corresponds to the highest efficiency level, max tech, considered in the engineering analysis.

TABLE 3.—STANDARD LEVELS ANALYZED FOR REFRIGERATORS, REFRIGERATOR-FREEZERS, AND FREEZERS—ANNUAL ENERGY USE (KWH/YR)

Product class	Baseline	Level 1	Level 2	Level 3	Level 4
Refrigerator-Freezers:					
Top Mounted Auto Defrost	397 + 14.2 AV (397 + 0.50 av)	275 + 9.8 AV (275 + 0.35 av)	270 + 9.7 AV (270 + 0.34 av)	260 + 9.3 AV (260 + 0.33 av)	239 + 8.5 AV (239 + 0.30 av)
Top Mounted Auto Defrost with Through the Door Feature	462 + 13.0 AV (462 + 0.46 av)	362 + 10.2 AV (362 + 0.36 av)	330 + 9.3 AV (330 + 0.32 av)	321 + 9.03 AV (321 + 0.32 av)	300 + 8.5 AV (300 + 0.30 av)
Side-by-Side Auto Defrost	609 + 5.8 AV (609 + 0.20 av)	514 + 4.9 AV (514 + 0.17 av)	429 + 4.1 AV (429 + 0.14 av)	415 + 4.0 AV (415 + 0.14 av)	402 + 3.8 AV (402 + 0.14 av)
Side-by-Side Auto Defrost with Through the Door Feature	484 + 12.1 AV (484 + 0.43 av)	405 + 10.1 AV (405 + 0.36 av)	353 + 8.8 AV (353 + 0.31 av)	336 + 8.4 AV (336 + 0.30 av)	312 + 7.8 AV (312 + 0.27 av)
Bottom Mounted Auto Defrost	579 + 5.6 AV (579 + 0.29 av)	476 + 4.6 AV (476 + 0.16 av)	419 + 4.1 AV (419 + 0.14 av)	393 + 3.8 AV (393 + 0.13 av)	359 + 3.5 AV (359 + 0.12 av)
Freezers:					
Upright Auto Defrost	399 + 14.2 AV (399 + 0.50 av)	349 + 12.4 AV (349 + 0.44 av)	321 + 11.4 AV (321 + 0.40 av)	288 + 10.3 AV (288 + 0.36 av)	254 + 9.1 AV (254 + 0.32 av)
Upright Manual Defrost	275 + 8.6 AV (275 + 0.30 av)	241 + 7.6 AV (241 + 0.27 av)	187 + 5.8 AV (187 + 0.21 av)	172 + 5.4 AV (172 + 0.19 av)	158 + 5.0 AV (158 + 0.17 av)
Chest Manual Defrost	170 + 11.8 AV (170 + 0.42 av)	142 + 9.9 AV (142 + 0.35 av)	117 + 8.1 AV (117 + 0.29 av)	111 + 7.7 AV (111 + 0.27 av)	102 + 7.1 AV (102 + 0.25 av)
Compacts:					
Manual Defrost Refrigerator-Freezer	292 + 13.8 AV (292 + 0.48 av)	286 + 13.5 AV (286 + 0.48 av)	280 + 13.2 AV (280 + 0.47 av)	274 + 13.0 AV (274 + 0.46 av)	274 + 13.0 AV (274 + 0.46 av)

AV = Total adjusted volume, expressed in ft^3
(av = Total adjusted volume, expressed in Liters)

Rather than presenting the results for all classes of refrigerator products in today's NOPR, the Department selected a representative class of refrigerator-freezer, and is presenting the results only for that class. The results for the other classes can be found in the TSD in the same sections as those referenced for the representative class. The representative class for refrigerator products is a top mounted automatic defrost refrigerator-freezer, which accounts for more than 50 percent of the sales of all refrigerator-freezer products. For this representative class, trial standard level 1 accomplishes its efficiency improvements from the baseline by increased insulation, improved compressor efficiency, reduced condenser and evaporator motor power, reduced gasket heat leak, and improvements in evaporator fan efficiency; level 2 adds additional insulation and increased evaporator area; level 3 adds increased condenser area and adaptive defrost, and level 4 adds vacuum panels on the walls and doors. Similar design options are used to achieve the above efficiencies for the other classes and are found tabulated in Section 3.3 of the TSD.

2. *Payback Period.* Table 4 presents the payback periods for the efficiency levels analyzed for the representative class of the product. Payback for all classes of refrigerator products may be found in Tables 4.12 to 4.36 of the TSD.

TABLE 4.—PAYBACK PERIODS OF DESIGN OPTIONS (YEARS) FOR REPRESENTATIVE CLASS OF REFRIGERATOR-FREEZERS

Standard level	Payback period
1	3.7
2	3.9
3	4.5
4	6.2

3. Significance of Energy Savings. To estimate the energy savings by the year 2030 due to revised standards, the energy consumption of refrigerator products under the base case is compared to the energy consumption of products complying with the candidate standard levels. For the candidate energy conservation standards, the REM projects that over the period 1998–2030, the following energy savings would result for all classes of the product:

Level 1—7.12 Quads (7.51 EJ)
Level 2—9.05 Quads (9.55 EJ)
Level 3—10.26 Quads (10.82 EJ)
Level 4—12.05 Quads (12.71 EJ)

The Department finds that each of the increased standards levels considered above would result in a significant conservation of energy.

B. Economic Justification

1. Economic Impact on Manufacturers and Consumers. The manufacturers' cost increase per unit over the base case to meet the efficiency of level 1 is $40.81; to meet level 2, 3, and 4, the manufacturers' cost increases are $43.92, $54.33, and $86.15, respectively. (See TSD, Table 3.5.)

At those levels of efficiency, the projected consumer price increases are $69.22 for level 1 and $74.32, $92.56, and $146.02 for standard levels 2 through 4, respectively. (See TSD, Table 4.1.)

The per-unit reduction in annual cost of operation (energy expense) at level 1 is $19.06 for the representative class; standard level 2 would reduce energy expenses by $19.70; standard level 3 by $21.32; and standard level 4 by $24.55. (See TSD, Table 4.1.)

The Lawrence Berkeley Laboratory Manufacturer Impact Model results for all classes of refrigerator products show that revised standards would cause a prototypical manufacturer to have fairly large reductions in short-run return on equity (ROE) from the 7.3 percent return in the base case. Standard levels 1 through 4 for refrigerator-freezers are projected to produce short-run ROEs of 7.0 percent, 6.2 percent, 5.8 percent, and 7.1 percent, respectively. Similarly, revised standards have only a small effect on the prototypical manufacturer's long run ROE of 7.3 in the base case. Standard levels 1 through 4 for refrigerator-freezers are projected to produce long-run ROEs of 7.4 percent, 7.2 percent, 7.2 percent, and 7.7 percent, respectively. (See TSD, Tables 6.4 and 6.8.)

Most financial data of the type needed to characterize the prototypical manufacturer are generally not available because most manufacturing firms are subsidiaries or divisions of larger parent companies. Hence, DOE assumes that the prototypical firm has largely the same financial characteristics (e.g., debt-equity ratio, interest rate on debt, etc.) as parent firms. Financial data for the parent firms are based on publicly available sources such as Securities and Exchange Commission 10K reports and company annual reports.

2. Life-Cycle Cost and Net Present Value (NPV). A life-cycle cost is calculated for a unit meeting each of the candidate standard levels. For the representative class, life-cycle costs at all standard levels are less than the baseline unit. Of the four candidate standard levels, a unit meeting level 2 has the lowest consumer life-cycle cost. (See TSD, Figure 4.1.)

At each candidate standard level, the Department determines the average change in life-cycle costs by considering only those consumers who are being forced by the standard to move from a lower efficiency unit to one which just meets the standard level being considered and assuming that consumers who would purchase units at or above this level, even without a standard, would not be affected. This is done by assuming in the base case a distribution of purchases of units meeting the respective efficiencies of each standard level. The base case distribution is based on the distribution of current sales as a function of efficiency. As each standard level is examined, the change in life-cycle cost reported is the average change only for affected consumers. Under this scenario, standard level 1 would cause reductions in life-cycle cost for the average affected consumer of $143.36 for the representative class of refrigerator products; standard level 2 would reduce average life-cycle costs by $145.46; standard level 3, by $145.24; and standard level 4, by $127.81. These life-cycle cost reductions indicate that no standard level would cause any economic burden on the average consumer. (See TSD, Table 4.1.) The Department notes that standard levels 3 and 4 are beyond the minimum life-cycle point which, if adopted, could require some consumers, who would have otherwise purchased refrigerators having the characteristics of standard level 2, to experience higher life cycle costs.

The net present value analysis, a measure of the net savings to society, indicates that for all classes of refrigerator products, standard level 1 would produce a NPV of $7.66 billion to consumers. The corresponding net present values for standard levels 2–4 are $8.19 billion, $8.26 billion, and $7.78 billion, respectively. (See TSD, Table 5.20.)

Even though the life cycle cost and net present value analyses indicate that the proposed standards would result in substantial net benefits for consumers, as well as the nation as a whole, the Department is concerned about whether there might be adverse effects of the proposed standards on identifiable groups of consumers. Because the proposed standard level is below the level that is estimated to result in minimum life-cycle cost (level 2), it would not preclude manufacturers from producing refrigerators (or consumers from purchasing) refrigerators with even lower life-cycle costs. This assumes that the affected consumers experienced discount rates, energy prices and usage patterns similar to those assumed in the DOE analysis. However, because DOE believes that significant numbers of refrigerator users are likely to experience discount rates and energy prices that differ from the average rates and prices used in DOE's basic analysis, DOE performed additional sensitivity analyses using lower and higher consumer discount rates (2 and 15 percent), and lower and higher energy prices. These sensitivity analyses indicated that these variations in discount rates and energy prices did not change the Department's conclusion that the proposed standards would result in significant net benefits and had little or no impact on the relative merits of the different standard levels analyzed. DOE believes that there is little variation in the usage patterns of refrigerators, and therefore did not perform sensitivity analyses on this factor. The Department invites comments on whether the proposed standard would have any significant adverse effect on any identifiable group of consumers.

3. Energy Savings. As indicated above, DOE concludes that standards, at each candidate standard level, will result in significant savings of electricity consumption by refrigerator products.

4. Lessening of Utility or Performance of Products. As indicated above, DOE established classes of products in order to assure that the standards analyzed would not lessen the existing utility or performance of refrigerator products.

5. Impact of Lessening of Competition. The determination of this factor must be made by the Attorney General.

6. Need of the Nation to Save Energy. In addition to the reasons for saving energy recognized when Congress established the appliance standards program, there is an extraordinary need to save energy to reduce damage to the environment. Refrigerator products use electricity directly. In 1993, 1.74 quads (1.84 EJ) were used by refrigerator products nationally. Improving the energy efficiency of these products will reduce future electricity demands and thereby decrease air pollution. (See TSD, Environmental Assessment.)

As a result of the national cap on emissions of sulfur dioxide, together with a credit and trading system, established by the Clean Air Act Amendments of 1990, the proposed refrigerator standards are unlikely to have any significant effect on actual emissions of sulfur dioxide. However, because the proposed standards will reduce overall electricity demand, they will also enable electric utilities and other covered sources of sulfur dioxide to spend less on sulfur dioxide emission controls. This savings will be reflected in the marginal costs experienced by utilities, but may not be fully reflected in the average rates charged consumers. Because there may be some marginal benefit associated with the avoidance of sulfur dioxide emission control costs, DOE has continued to estimate the tons of sulfur dioxide emissions represented by the reductions in electricity demand likely to result from the standards. For all classes of refrigerator products at standard level 1, over the years 1998 to 2030, the total estimated sulfur oxide emissions (listed in equivalent weight of sulfur dioxide (SO_2)) affected would be 1017 kt (1120 thousand short tons). During this time period, the peak annual SO_2 emissions affected would be 0.7 percent of the U.S. total. For standard levels 2–4, the emissions affected are estimated to be 1292 kt (1424 thousand short tons); 1465 kt (1615 thousand short tons); and 1720 kt (1896 thousand short tons), respectively. The highest peak annual amount of emissions affected at these levels is estimated to be 1.20 percent.

Standards are expected to result in some decreases in nitrogen dioxide (NO_2) emissions, although here too the Clean Air Act Amendments established new requirements that may lead to regional caps (and floors) on emissions of NO_2 in certain nonattainment areas. These new requirements could, in turn, reduce or eliminate the impact of the proposed refrigerator standards on NO_2 emissions in these areas. It should also be noted that while the proposed refrigerator standards are likely to result in significant reductions of NO_2 emissions in areas of the country that are already in compliance with national ambient air quality standards for NO_2, the benefits of such reductions are likely to be very small or insignificant compared to those resulting from reductions in nonattainment areas. For standard level 1, over the years 1998 to 2030, the total estimated NO_2 reduction would be 966 kt (1065 thousand short tons), assuming that there are no regional caps/floors on NO_2 emissions. During this time period, the peak annual reduction of NO_2 emissions that are expected to be emitted by power plants in the U.S. is 0.70 percent. For standard levels 2–4, the reductions are 1228 kt (1353 thousand short tons); 1393 kt (1535 thousand short tons); and 1635 kt (1802 thousand short tons), respectively. The highest peak annual reduction of these levels is 1.20 percent.

Another consequence of the standards will be the reduction of carbon dioxide (CO_2) emissions. For standard level 1, over the years 1998 to 2030, the total estimated CO_2 reduction would be 540 Mt (595 million short tons). During this time period, the peak annual reduction of CO_2 emissions that are expected to be emitted by power plants in the U.S. is 0.70 percent. For standard levels 2–4, the reductions are 686 Mt (756 million short tons); 778 Mt (858 million short tons); and 914 Mt (1007 million short tons), respectively. The highest peak annual reduction of these levels is 1.20 percent.

C. Conclusion

The Joint Comments made a valuable contribution to the development of the energy conservation standards proposed in this NOPR. The Department found the recommendations in the Joint Comments to be reasonable and based on reliable data. The Department reached its conclusions after carefully considering the Joint Comments and all other comments received.

With this NOPR the Department is proposing new product classes for compact refrigerator products and for HCFC-free refrigerator products. Based on an analysis of the alternatives, the Department concludes that standard level 1 for classes of refrigerator products achieves the maximum improvement in energy efficiency that is both technologically feasible and economically justified.

1. Product Classes. The Department proposes to add new product classes in two categories.

a. Compact Refrigerators, Refrigerators-Freezers and Freezers. The Department proposes that new product classes be established for compact refrigerator products. The Department recommends a new set of product classes which includes all products less than 7.75 cubic feet (FTC/AHAM rated volume) and 36 inches or less in height. The total energy consumption of all compact refrigerator products in the U.S. is less than 2.6 percent of the total energy consumed by all refrigerator products. There are only three or four energy savings options expected to be available for these products by 1998. Because of small production volumes, the impact on these manufacturers is also relatively severe. Furthermore, a 5-year payback is required to recoup the cost of improvement in efficiency at levels only 2 to 3 percent below the 1993 levels.

b. HCFC-Free Refrigerators, Refrigerator-Freezers, and Freezers. The Department proposes the addition of classes for HCFC-free refrigerator products. For the purposes of this rulemaking, a HCFC-free refrigerator product is defined as a product which contains 10 percent or less by mass hydrochlorofluorocarbon in the blowing agent portion of the foam insulation. According to section 325(o)(2)(B) of the Act, the Department must consider a number of concerns when determining whether the benefits of a standard exceed its burdens. The Department believes that by establishing separate classes for HCFC-free products, industry will be encouraged to develop products which are environmentally benign.

For the HCFC-free full sized refrigerator products, the Department recommends standards which would permit 10 percent greater energy use than the comparable HCFC-using classes. The 10 percent relaxation for HCFC-free classes, however, does not apply to the compact classes, because this would result in standards that are less stringent than those standards now in effect. This is prohibited by section 325(o)(1) of the Act. Instead, for the compact classes, the HCFC-free standards are proposed to be identical to the 1993 standards.

2. Standards. Section 325(o)(2)(A) of the Act specifies that the Department must consider, for amended standards, those standards that ''achieve the maximum improvement in energy efficiency * * * which the Secretary determines is technologically feasible and economically justified.''

a. Standard Level 4. The Department first considered the max tech level of efficiency, i.e., standard level 4 for amended refrigerator, refrigerator-freezer, and freezer standards. Standard level 4, max tech, would save the most energy: 10.0 quads (10.55 EJ) for refrigerators (including refrigerator-freezers) and 2.0 quads (2.11 EJ) for freezers between 1998 and 2030. In order to meet this standard, the Department assumes that all refrigerator products would incorporate vacuum panel insulation. The use of vacuum panel insulation accounts for 30 percent of total energy savings, with increasing wall thickness as the only alternative. Vacuum panel technology has progressed, but it is not ready to be applied as a reliable design option in the production of a 1998 compliant product. There are concerns about manufacturability, availability, reliability, and performance. Vacuum panels are 6 to 10 times heavier than foam. The increase in door weight may cause the appliance to tip over when the door is opened. Also, current production capability for vacuum panels is far too small for the projected demand. A 1-inch increase in wall and door thickness (a 2-inch increase in the side-to-side dimension) is not a viable option. Too many products are already constrained by the need to fit into existing spaces and through doors and passages. Decreasing interior volume would sacrifice product utility. In addition, because standard level 4 is beyond the minimum life cycle point, there are likely to be some consumers who would experience net life-cycle cost increases compared to the units they would have otherwise purchased. Based upon a consideration of the above, the Department therefore concludes that the burdens of standard level 4 for refrigerators, refrigerator-freezers and freezers outweigh the benefits, and rejects the standard level.

b. Standards Level 3. This standard level is projected to save 8.6 quads (9.1 EJ) of energy for refrigerators and refrigerator-freezers and 1.7 quads (1.8 EJ) for freezers. While this level does not use vacuum panels, for most of the classes about 40 percent of the energy savings, compared to the base case, is obtained by increasing the insulation values. As indicated in the comments, there is general agreement that an increase in the wall thickness is not acceptable for many of the larger models in each class. This level has a payback periods as high as 25.5 years (much longer than the product life) and reduces refrigerator manufacturer short-run ROE from 7.3 percent to 5.8 percent, a reduction of 20 percent. For freezer manufacturers, short-run ROE drops from 7.3 percent to 4.7 percent, a reduction of more than 35 percent. Based on a consideration of the above, the Department concludes that the burdens of standard level 3 for refrigerators, refrigerator-freezers and freezers outweigh the benefits, and rejects the standard level.

c. Standard Level 2. This standard level is projected to save 7.8 quads (8.2 EJ) of energy for refrigerators and refrigerator-freezers, and 1.3 quads (1.4 EJ) for freezers. The payback at this level may be as long as 19.0 years, the expected life of the product. The initial burden on the manufacturers is also unacceptably high; short-run ROE for both refrigerators and freezers decreases from 7.3 percent to 6.2 percent, a reduction of 16 percent. Based on a consideration of the above, the Department concludes that the burdens of standard level 2 for refrigerators, refrigerator-freezers and freezers outweigh the benefits, and rejects the standard level.

d. Standard Level 1. During the period 1998–2030, the savings at this level are calculated to be 7.13 quads (7.5 EJ) of primary energy. In addition, the standard could have a positive effect on the environment by reducing the emissions of SO_2 by up to 1017 kt (1120 short tons) or by as much as 0.7 percent by the year 2030. Furthermore, the standard will reduce emissions of CO_2 by 540 Mt (595 million tons), or as much as 0.7 percent, over the forecast period.

The technologies that are necessary to meet this standard level 1 are presently available. The Department finds the level to be economically justified. The consumer payback of this standard level is 3.7 years for the representative class and no more than 9.2 years for any class. This standard is at or near the lowest life-cycle cost for all classes and is expected to result in a reduction in life-cycle cost of approximately $143 for the representative class. The proposed standard is also unlikely to affect adversely any identifiable group of consumers. Additionally, the standard is expected to have essentially no impact on the prototypical manufacturer's ROE of 7.3 percent.

The Department concludes that standard level 1 for refrigerator products saves a significant amount of energy and is technologically feasible and economically justified. The level 1 standards correspond closely to the standards proposed by the Joint Comments. (The Joint Comments standards will result in slightly more energy savings.) The Department proposes to amend the existing standards for refrigerator products to correspond to the standards agreed to by the Joint Comment parties. As discussed in the previous section, the Department agrees with the Joint Comment recommendation to relax the standards for full-sized HCFC-free classes of refrigerator products by 10 percent for a period of 9 years after publication of the final rule, but is proposing that the standards for the HCFC-free compact classes during the same period be the equivalent to the 1993 standards.

3. Effective Dates. The effective date of standards for the full-size refrigerator products (Classes 1–10 in the ''Product Classes and Effective Date Table'') is 3 years after publication of the final rule. The compact refrigerator product classes, Nos. 11–18, would also have an effective date of 3 years after publication of the final rule.

The HCFC-free refrigerators, listed in Product Classes 19–36, have more complex effective dates. The effective date for the HCFC-free standards will be the same date as for the other classes of products—3 years after the publication of the final rule. The effective date proposed for the HCFC-free classes is 3 years earlier than the suggestion in the Joint Comments, because section 325(o)(1) of the Act specifically prohibits the Secretary from specifying standards which would permit an increase in the energy used by a covered product. The impact on energy savings of the earlier effective date for HCFC-free product standards is not large: compared to introducing HCFC-free classes in 2001, the 1998 introduction carries an energy penalty of less than 0.1 quad over the period 1998–2030. The earlier effective date may have a countervailing environmental benefit by encouraging earlier use of HCFC substitutes.

The standards for the HCFC-free classes of products will be raised to a standard level equal to that for comparable HCFC-using classes effective 9 years after publication of the final rule for this rulemaking. At this time it is anticipated that alternative design options without HCFCs will permit efficiency improvements. The Department is seeking comments concerning requirements for HCFC-free products.

V. Environmental, Regulatory Impact, Takings Assessment, Federalism, and Regulatory Flexibility Reviews

A. Environmental Review

The Draft Environmental Assessment for Proposed Energy Conservation Standards for Refrigerators, Refrigerator-Freezers, and Freezers was prepared pursuant to the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.), regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), the Department regulations for compliance with NEPA (10 CFR part 1021) and the Secretarial Policy on the National Environmental Policy Act (June 1994). Section V.B.2. of the Secretarial Policy requires that the Department provide an opportunity for interested parties to review environmental assessments prior to the Department's formal approval of such assessments.

In accordance with the Secretarial Policy, the Department seeks comments on the Draft Environmental Assessment, which is printed within the TSD accompanying this proposed rulemaking.

B. 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).

There were no substantive changes between the draft submitted to OIRA and today's action. The draft 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 Freedom of Information Reading Room, 1000 Independence Avenue, SW, Washington, DC 20585, between the hours of 9 a.m. and 4 p.m., Monday through Friday, telephone (202) 586–6020.

The following summary of the Regulatory Analysis focuses on the major alternatives considered in arriving at the proposed approach to improving the energy efficiency of consumer products. The reader is referred to the complete draft ''Regulatory Impact Analysis,'' which is contained in the TSD, available as indicated at the beginning of this NOPR. 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 economic impact of the proposed standard.

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

- No New Regulatory Action
- Informational Action
  —Product labeling
  —Consumer education
- Prescriptive Standards
- Financial Incentives
  —Tax credits
  —Rebates
- Voluntary Energy Efficiency Targets
- The Proposed Approach (Performance Standards)

Each alternative has been evaluated in terms of its ability to achieve significant energy savings at reasonable costs, and has been compared to the effectiveness of the proposed rule.

If no new regulatory action were taken, then no new standards would be implemented for these products. This is essentially the ''base case'' for each appliance. In this case, between the years 1998 and 2030 there would be expected energy use of 45.54 quads (48.05 EJ) of primary energy, with no energy savings and a zero net present value.

Several alternatives to the base case can be grouped under the heading of informational action. They include consumer product labeling and DOE public education and information programs. Both of these alternatives are already mandated by, and being implemented under the Act. One base case alternative would be to estimate the energy conservation potential of enhancing these programs. To model this possibility, the Department assumed that market discount rates would be lowered by 5 percent for purchasers of refrigerator products. This resulted in energy savings equal to 0.05 quads (0.05 EJ), with expected consumption equal to 45.5 quads (48 EJ). The net present value is estimated to be $0.08 billion.

Another method of setting standards would entail requiring that certain design options be used on each product, i.e., for DOE to prescribe technology standards. For these products, prescriptive standards are assumed to be implemented as standards at one level below the performance standards. The lower standards level entails slightly smaller expenditures for tooling and purchased parts. Consequently, the economic impacts that are expected before the implementation date should be slightly smaller for prescriptive standards. This resulted in energy consumption, between 1998 and 2030, of 39.27 quads (41.43 EJ), and savings of 5.76 quads (6.62 EJ). The net present value, in 1990 dollars, was $7.26 billion.

Various financial incentive alternatives were tested. These included tax credits and rebates to consumers, as well as tax credits to manufacturers. The tax credits to consumers were assumed to be 15 percent of the increased expense for higher energy-efficiency features of these appliances, while the rebates were assumed to be 15 percent of the increase in equipment prices. The tax credits to consumers showed a change from the base case, saving 0.07 quads (0.07 EJ) with a net present value of $0.19 billion. Consumer rebates showed slightly higher energy savings; they would save 0.07 quads (0.08 EJ) with a net present value of $0.23 billion.

Another financial incentive that was considered was a tax credit to manufacturers for the production of energy-efficient models of these appliances. In this scenario, an investment tax credit of 20 percent was assumed. The tax credits to manufacturers had no effect; the energy consumption estimates are 45.54 quads (48.05 EJ) with no energy savings and a zero net present value.

The impact of this scenario produces no savings because the investment tax credit was applicable only to the tooling and machinery costs of the firms. The firms' fixed costs and most of the design improvements that would likely be adopted to manufacture more efficient versions of these products would involve purchased parts. Expenses for purchased parts would not be eligible for an investment tax credit.

Two scenarios of voluntary energy-efficiency targets were examined. In the first one, the proposed energy conservation standards were assumed to be voluntarily adopted by all the relevant manufacturers in 5 years. In the second scenario, the proposed standards were assumed to be adopted in 10 years. In these scenarios, voluntary improvements having a 5-year delay, compared to implementation of mandatory standards, would result in energy consumption by these appliances of 39.78 quads (41.97 EJ), energy savings of 5.76 quads (6.08 EJ), and a net present value of $6.07 billion; voluntary improvements having a 10-year delay would result in 41.22 quads (43.40 EJ) of energy being consumed, 4.42 quads (4.56 EJ) being saved, and a net present value of $4.33 billion. These scenarios assume that there would be universal voluntary adoption of the energy conservation standards by these appliance manufacturers, an assumption for which there is no reasonable assurance.

Lastly, all of these alternatives must be gauged against the performance standards that are being proposed in this NOPR. Such performance standards would result in energy consumption of refrigerator products to total an estimated 38.42 quads (40.53 EJ) of primary energy over the 1998–2030 time period. Savings would be 7.12 quads (7.52 EJ), and the net present value would be an expected $8.19 billion. As indicated in the paragraphs above, none of the alternatives that were examined for these products saved as much energy as the proposed rule. Also, most of the alternatives would require that enabling legislation be enacted, since authority to carry out those alternatives does not presently exist.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) requires an assessment of the impact of regulations on small businesses. Small businesses are defined as those firms within an industry that are privately owned and less dominant in the market.

The refrigerator products industry is characterized by two firms accounting for nearly 60 percent of sales. The five largest manufacturers account for 97 percent of sales. Smaller businesses and firms, which make primarily compact refrigerator products, share the remaining 3 percent of the market.

In this industry, average cost has an inverse relationship to firm size. The industry has economies of scale, and large firms (to the extent that their facilities are up-to-date) have lower average costs than small firms. This fact, coupled with increasing competitiveness of the national market, probably accounts for the continuing consolidation that has been occurring for several decades. The fact that the consolidation has been producing larger firms strongly corroborates the finding that large firms have a cost advantage.

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

While some small firms have more energy efficient models than larger firms, and while some have more models of average efficiency, the impact of higher efficiency standards on small firms is likely to be mixed. If standards are technologically difficult to meet, however, they may hurt selected smaller firms the most, because smaller firms have less sophisticated research and development capabilities. The Department has taken this into consideration in this rulemaking and this is one of the reasons the Department is proposing standards for the compact refrigerator products that are less stringent than those for full size refrigerator products.

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

D. Federalism Review

Executive Order 12612 (52 FR 41685, October 30, 1987) requires that regulations or rules be reviewed for any substantial direct effects on states, on the relationship between the Federal Government and the states, or on the distribution of power among various levels of government. If there are sufficient substantial direct effects, the Executive Order requires the preparation of a Federalism assessment to be used in decisions by senior policy makers in promulgating or implementing the regulation.

The Department has identified a substantial direct effect that today's proposed rule might have on state governments. It would preempt any State regulations imposing energy efficiency standards for refrigerator products. However, DOE has concluded that such effect is not sufficient to warrant preparation of a Federalism assessment. The Department knows of no such state regulations. Moreover, if any such state regulations are adopted, the Act provides for subsequent state petitions for exemption. If DOE receives such a petition, it will then be appropriate to consider preparing a Federalism assessment.

E. ''Takings'' Assessment Review

It has been determined pursuant to Executive Order 12630 (53 FR 8859, March 18, 1988) that this regulation would not result in any takings which might require compensation under the Fifth Amendment to the U.S. Constitution.

F. Paperwork Reduction Act Review

No new information or record keeping requirements are imposed by this rulemaking. Accordingly, no OMB clearance is required under the Paperwork Reduction Act (44 U.S.C. 3501 *et seq.*).

VI. Public Comment Procedures

A. Participation in Rulemaking

DOE encourages the maximum level of public participation possible in this rulemaking. Individual consumers, representatives of consumer groups, associations, states or other governmental entities, utilities, retailers, distributors, manufacturers, and others are urged to submit written comments on the proposal. The Department also encourages interested persons to participate in the public hearing to be held in Washington, D.C., at the time and place indicated at the beginning of this NOPR.

The DOE has established a comment period of 75 days following publication of this NOPR for persons to comment on this proposal. All public comments received and the transcript of the public hearing will be available for review in the DOE Freedom of Information Reading Room.

B. Written Comment Procedures

Interested persons are invited to participate in this proceeding by submitting written data, views or arguments with respect to the subjects set forth in this NOPR. Instructions for submitting written comments are set forth at the beginning of this NOPR and below.

Comments should be labeled both on the envelope and on the documents, *''Refrigerator Rulemaking (Docket No. EE-RM–93–801),''* and must be received by the date specified at the beginning of this NOPR. Ten copies are requested to be submitted. Additionally, the Department would appreciate an electronic copy of the comments to the extent possible. The Department is currently using WordPerfect™ 5.1. All comments received by the date specified at the beginning of this NOPR and other relevant information will be considered by DOE before final action is taken on the proposed regulation.

All written comments received on the proposed rule will be available for public inspection at the Freedom of Information Reading Room, as provided at the beginning of this NOPR.

Pursuant to the provisions of 10 CFR 1004.11, any person submitting information or data that is believed to be confidential and exempt by law from public disclosure should submit 1 complete copy of the document and 10 copies, if possible, from which the information believed to be confidential has been deleted. DOE will make its own determination with regard to the confidential status of the information or data and treat it according to its determination.

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

C. Public Hearing

1. Procedure for Submitting Requests to Speak. The time and place of the public hearing are indicated at the beginning of this NOPR. DOE invites any person who has an interest in these proceedings, or who is a representative of a group or class of persons having an interest, to make a written request for an opportunity to make an oral presentation at the public hearing. Such requests should be labeled both on the letter and the envelope, ''Refrigerator Rulemaking *(Docket No. EE-RM–93–801),*'' and should be sent to the address, and must be received by the time specified, at the beginning of this NOPR. Requests may be hand-delivered or telephoned into such addresses between the hours of 8:30 a.m. and 4:30 p.m., Monday through Friday, except Federal holidays.

The person making the request should briefly describe the interest group or class of persons that has such an interest, and give a telephone number where he or she may be contacted. Each person selected to be heard will be notified by DOE as to the time they will be speaking.

Each person selected to be heard is requested to submit an advance copy of his or her statement prior to the hearing as indicated at the beginning of this NOPR. In the event any person wishing to testify cannot meet this requirement, that person may make alternative arrangements with the Office of Hearings and Dockets in advance by so indicating in the letter requesting to make an oral presentation.

2. *Conduct of Hearing.* DOE reserves the right to select the persons to be heard at the hearing, to schedule the respective presentations, and to establish the procedures governing the conduct of the hearing. The length of each presentation is limited to 20 minutes.

A DOE official will be designated to preside at the hearing. The hearing will not be a judicial or an evidentiary-type hearing, but will be conducted in accordance with 5 U.S.C. 533 and section 336 of the Act. At the conclusion of all initial oral statements at each day of the hearing, each person who has made an oral statement will be given the opportunity to make a rebuttal statement, subject to time limitations. The rebuttal statement will be given in the order in which the initial statements were made. The official conducting the hearing will accept additional comments or questions from those attending, as time permits. Any questions to be asked of a person making a statement at the hearing must be submitted to the presiding official in writing. The presiding official will determine whether the question is relevant, and whether time limitations permit it to be presented for an answer.

Further questioning will be permitted by the presiding official. The presiding official will afford any interested person an opportunity to question, other interested persons who made oral presentations, as well as employees of the U.S. Government who have made written or oral presentations with respect to disputed issues of material fact, relating to the proposed rule. This opportunity will be afforded after any rebuttal statements, to the extent that the presiding official determines that such questioning is likely to result in a more timely and effective resolution of disputed issues of material fact. If the time provided is insufficient or inconvenient, DOE will consider affording an additional opportunity for questioning at a mutually convenient time. Persons interested in making use of this opportunity must submit their request to the presiding official no later than shortly after the completion of any rebuttal statements and be prepared to state specific justification, including why the issue is one of disputed fact and how the proposed questions would expedite their resolution.

Any further procedural rules regarding proper conduct of the hearing will be announced by the presiding official.

A transcript of the hearing will be made, and the entire record of this rulemaking, including the transcript, will be retained by DOE and made available for inspection at the DOE Freedom of Information Reading Room as provided at the beginning of this NOPR. Any person may purchase a copy of the transcript from the transcribing reporter.

D. Issues for Comment

Comments may address any issue related to this proposed rule. As discussed above in today's NOPR, DOE has identified a number of issues where comments are specifically requested. These issues include, but are not limited to, the following:

- The baseline units and the base cases;
- Any likely adverse affects of the standards on identifiable groups of consumers;
- Market share elasticities;
- Usage elasticities;
- The characterization of prototypical firms for the manufacturer impact analysis;
- Efficiency forecasts for these products;
- Any lessening of product utility resulting from the incorporation of the design options identified, including but not limited to the addition of insulation;
- The effects of standards on manufacturers' incentives to develop innovative products and product features;
- Any uncertainties in modeling, especially with regard to product usage (e.g., changes in usage rates as shown by survey data or changes in usage of features);
- Lifetimes of appliances; and
- Maintenance costs and failure rates of appliances and components.

Appendices

I. Acronyms and Abbreviations

As a convenience to the reader, the following list of acronyms and abbreviations is provided. Their application is limited to the preamble of this NOPR on Energy Conservation Standards for Refrigerators.

ACEEE American Council for an Energy Efficient Economy
ADL Arthur D. Little, Inc.
AHAM Association of Home Appliance Manufacturers
Amana Amana Corporation
ANOPR Advance Notice of Proposed Rulemaking
ARI Air-Conditioning and Refrigeration Institute
CEC California Energy Commission
CFC chlorofluorocarbon
EEI Edison Electric Institute
EER Energy Efficiency Ratio
ELCON Electricity Consumers Resource Council
EPA Environmental Protection Agency
EPCA Energy Policy and Conservation Act
ERA EPA Refrigerator Analysis
FTC Federal Trade Commission
GAMA Gas Appliance Manufacturers Association
GEA General Electric Appliances
GRI Gas Research Institute
GRIM Government Regulatory Impact Model
HCFC hydrochlorofluorocarbon
LBL Lawrence Berkeley Laboratory
LBL/MAM Lawrence Berkeley Laboratory Manufacturer Analysis Model
LBL/MIM Lawrence Berkeley Laboratory Manufacturer Impact Model
LBL/REM Lawrence Berkeley Laboratory Residential Energy Model
max tech maximum technologically feasible
NAECA National Appliance Energy Conservation
NECPA National Energy Conservation Policy Act
NEPA National Energy Policy Act
NOPR Notice of Proposed Rulemaking
NRDC National Resources Defense Council
NRECA National Rural Electric Cooperative Association
NWPPC Northwest Power Planning Commission
NYSEO New York State Energy Office
OMB Office of Management and Budget
ORNL Oak Ridge National Laboratory
OIRA Office of Information and Regulatory Affairs
PG&E Pacific Gas and Electric
SoCal Southern California Edison
TECo. Tampa Electric Co.
UL Underwriters Laboratories

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy conservation, Household appliances.

Issued in Washington, DC, July 12, 1995.

Christine A. Ervin,

Assistant Secretary, Energy Efficiency and Renewable Energy.

In consideration of the foregoing, it is proposed to amend part 430 of chapter II of title 10, Code of Federal Regulations, 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.

2. Section 430.2 Definitions is amended by adding the following definitions:

*   *   *   *   *

Compact refrigerator/refrigerator-freezer/freezer means any refrigerator, refrigerator-freezer or freezer with total volume less than 7.75 cubic feet (220 liters) (rated volume as determined in Appendix A1 and B1 of subpart B of this part) and 36 inches (0.91 meters) or less in height.

*   *   *   *   *

HCFC-free means any product which contains 10 percent or less by mass hydrochlorofluorocarbon in the blowing agent portion of the foam insulation used in the product.

*   *   *   *   *

3. Section 430.32 is amended by revising paragraph (a) to read as follows:

§ 430.32 Energy conservation standards and effective dates.

The energy conservation standards for the covered product classes are:

(a) *Refrigerators/refrigerator-freezers/freezers.* These standards do not apply to refrigerators and refrigerator-freezers with total refrigerated volume exceeding 39 cubic feet (1104 liters) or freezers with total refrigerated volume exceeding 30 cubic feet (850 liters).

(1) Refrigerators/refrigerator-freezers/freezers which contain HCFCs

Product class	Energy standards equations (Kwh/yr) effective dates	
	Jan. 1, 1993	3 years after publication of final rule
1. Refrigerators and Refrigerator-freezers with manual defrost	13.5AV + 299 0.48av + 299	8.82AV + 248.4 0.31av + 248.4
2. Refrigerator-Freezer—partial automatic defrost	10.4AV + 398 0.37av + 398	8.82AV + 248.4 0.31av + 248.4
3. Refrigerator-Freezers—automatic defrost with top-mounted freezer without through-the-door ice service and all Refrigerators—automatic defrost and: All-refrigerators with automatic defrost	16.0AV + 355 0.57av + 355	9.80AV + 276.0 0.35av + 276.0
4. Refrigerator-Freezers—automatic defrost with side-mounted freezer without through-the-door ice service	11.8AV + 501 0.42av + 501	4.91AV + 507.5 0.17av + 507.5
5. Refrigerator-Freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service	16.5AV + 367 0.58av + 367	4.60AV + 459.0 0.16av + 459.0
6. Refrigerator-Freezers—automatic defrost with top-mounted freezer with through-the-door ice service	17.6AV + 391 0.62av + 391	10.20AV + 356.0 0.36av + 356.0
7. Refrigerator-Freezers—automatic defrost with side-mounted freezer with through-the-door ice service	16.3AV + 527 0.58av + 527	10.10AV + 406.0 0.36av + 406.0

Product class	Energy standards equations (Kwh/yr) effective dates	
	Jan. 1, 1993	3 years after publication of final rule
8. Upright Freezers with Manual Defrost	10.3AV + 264 0.36av + 264	7.55AV + 258.3 0.27av + 258.3
9. Upright Freezers with Automatic Defrost	14.9AV + 391 0.53av + 391	12.43AV + 326.1 0.44av + 326.1
10. Chest Freezers and all other Freezers except Compact Freezers	11.0AV + 160 0.39av + 160	9.88AV + 143.7 0.35av + 143.7
11. Compact Refrigerators and Refrigerator-Freezers with Manual Defrost	13.5AV + 299 0.48av + 299	10.70AV + 299.0 0.38av + 299.0
12. Compact Refrigerator-Freezer—partial automatic defrost	10.4AV + 398 0.37av + 398	7.00AV + 38.0 0.25av + 398.0
13. Compact Refrigerator-Freezers—automatic defrost with top-mounted freezer and compact all-refrigerators—automatic defrost	16.0AV + 355 0.57av + 355	12.70AV + 355.0 0.45av + 355.0
14. Compact Refrigerator-Freezers—automatic defrost with side-mounted freezer	11.8AV + 501 0.42av + 501	7.60AV + 501.0 0.27av + 501.0
15. Compact Refrigerator-Freezers—automatic defrost with bottom-mounted freezer	16.5AV + 367 0.58av + 367	13.10AV + 367.0 0.46av + 367.0
16. Compact Upright Freezers with Manual Defrost	10.3AV + 264 0.36av + 264	9.78AV + 250.8 0.35av + 250.8
17. Compact Upright Freezers with Automatic Defrost	14.9AV + 391 0.53av + 391	11.40AV + 391.0 0.40av + 391.0
18. Compact Chest Freezers	11.0AV + 160 0.39av + 160	10.45AV + 152.0 0.37av + 152.0

(2) HCFC-free refrigerators/refrigerator-freezers/freezers

Product class	Energy standards equations (Kwh/yr) effective dates		
	Jan. 1, 1993	3 years after publication of final rule	9 years after publication of final rule
19. HCFC-Free Refrigerators and Refrigerator-Freezers with Manual Defrost	13.5AV + 299 0.48av + 299	9.70AV + 273.2 0.34av + 273.2	8.82AV + 248.4 0.31av + 248.4
20. HCFC-Free Refrigerator-Freezer—partial automatic defrost	10.4AV + 398 0.37av + 398	9.70AV + 273.2 0.34av + 273.2	8.82AV + 248.4 0.31av + 248.4
21. HCFC-Free Refrigerator-Freezers—automatic defrost with top-mounted freezer without through-the-door ice service and: HCFC-Free all-refrigerators—automatic defrost	16.0AV + 355 0.57av + 355	10.78AV + 303.6 0.38av + 303.6	9.80AV + 276.0 0.35av + 276.0
22. HCFC-Free Refrigerator-Freezers—automatic defrost with side-mounted freezer without through-the-door ice service	11.8AV + 501 0.42av + 501	5.40AV + 558.3 0.19av + 558.3	4.91AV + 507.5 0.17av + 507.5
23. HCFC-Free Refrigerator-Freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service	16.5AV + 367 0.58av + 367	5.06AV + 504.9 0.18av + 504.9	4.60AV + 459.0 0.16av + 459.0
24. HCFC-Free Refrigerator-Freezers—automatic defrost with top-mounted freezer with through-the-door ice service	17.6AV + 391 0.62av + 391	11.22AV + 391.6 0.40av + 391.6	10.20AV + 356.0 0.36av + 356.0
25. HCFC-Free Refrigerator-Freezers—automatic defrost with side-mounted freezer with through-the-door ice service	16.3AV + 527 0.58av + 527	11.11AV + 446.6 0.39av + 446.6	10.10AV + 406.0 0.36av + 406.0
26. HCFC-Free Upright Freezers with Manual Defrost	10.3AV + 264 0.36av + 264	8.31AV + 284.1 0.29av + 284.1	7.55AV + 258.3 0.27av + 258.3
27. HCFC-Free Upright Freezers with Automatic Defrost	14.9AV + 391 0.53av + 391	13.67AV + 358.7 0.48av + 358.7	12.43AV + 326.1 0.44av + 326.1
28. HCFC-Free Chest Freezers and All Other Freezers Except Compact Freezers	11.0AV + 160 0.39av + 160	10.87AV + 158.1 0.38av + 158.1	9.88AV + 143.7 0.35av + 143.7
29. HCFC-Free Compact Refrigerators and Refrigerator-Freezers with Manual Defrost	13.5AV + 299 0.48av + 299	13.5AV + 299.0 0.48av + 299.0	10.70AV + 299.0 0.38av + 299.0
30. HCFC-Free Compact Refrigerator-Freezer—partial automatic defrost	10.4AV + 398 0.37av + 398	10.4AV + 398.0 0.37av + 398.0	7.00AV + 398.0 0.25av + 398.0

Product class	Energy standards equations (Kwh/yr) effective dates		
	Jan. 1, 1993	3 years after publication of final rule	9 years after publication of final rule
31. HCFC-Free Compact Refrigerator-Freezers—automatic defrost with top-mounted freezer and: HCFC-free compact all-refrigerators—automatic defrost	16.0AV + 355 0.57av + 355	16.0AV + 355.0 0.57av + 355.0	12.70AV + 355.0 0.45av + 355.0
32. HCFC-Free Compact Refrigerator-Freezers—automatic defrost with side-mounted freezer	11.8AV + 501 0.42av + 501	11.8AV + 501.0 0.42av + 501.0	7.60AV + 501.0 0.27av + 501.0
33. HCFC-Free Compact Refrigerator-Freezers—automatic defrost with bottom-mounted freezer	16.5AV + 367 0.58av + 367	16.5AV + 367.0 0.58av + 367.0	13.10AV + 367.0 0.46av + 367.0
34. HCFC-Free Compact Upright Freezers with: Manual defrost	10.3AV + 264 0.36av + 264	10.3AV + 264.0 0.36av + 264	9.780AV + 250.8 0.350av + 250.8
35. HCFC-Free Compact Upright Freezers with: Automatic defrost	14.9AV + 391 0.53av + 391	14.9AV + 391.0 0.53av + 391.0	11.40AV + 391.0 0.40av + 391.0
36. HCFC-Free Compact Chest Freezers	11.0AV + 160.0 0.39av + 160	011.0AV + 160.0 0.39av + 160.0	10.45AV + 152.0 0.37av + 152.0

AV = Total adjusted volume, expressed in ft^3 as determined in Appendices A1 and B1 of Subpart B of this Part.
av = Total adjusted volume, expressed in Liters.

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DEPARTMENT OF THE INTERIOR

Office of the Secretary

25 CFR Chapter VI

Joint Tribal and Federal Self-Governance Negotiated Rulemaking Committee

AGENCY: Office of the Secretary, Interior.

ACTION: Notice of Membership in and Meetings of the Joint Tribal and Federal Self-Governance Negotiated Rulemaking Committee.

SUMMARY: This notice is to inform the public regarding the membership and meeting dates and places of the Joint Tribal and Federal Self-Governance Negotiated Rulemaking Committee. This notice also announces that, pursuant to the Tribal Self-Governance Act of 1994 (Title II of P.L. 103–413) and the Unfunded Mandate Reform Act of 1995 (P.L. 104–4), the Joint Tribal and Federal Self-Governance Negotiated Rulemaking Committee is not subject to, and will not be following, the procedures stipulated in the Federal Advisory Committee Act.

DATES: The following work sessions of the Joint Tribal and Federal Self-Governance Negotiated Rulemaking Committee are currently planned.

7/18–7/20/95 Sequim, Washington (Jamestown S'Klallam)
8/14–8/16/95 Hinckley, Minnesota (Mille Lacs Band)
9/12–9/14/95 San Diego, California
10/10–10/12/95 Washington, DC

FOR FURTHER INFORMATION CONTACT: William A. Sinclair, U.S. Department of the Interior, Office of Self-Governance, 1849 C Street NW., Mail Stop 2548–MIB, Washington, DC 20240, 202–219–0240.

SUPPLEMENTARY INFORMATION:

Committee Membership

The Tribal Self-Governance Act of 1994 requires that the committee be comprised only of federal and tribal government representatives and that a majority of the tribal committee members be representatives from self-governance tribes. In a letter to the Secretary of the Interior on November 1, 1994, the self-governance tribes nominated their representatives and these names were listed in a February 15, 1995 **Federal Register** announcement. Representatives of the non-self-governance tribes were selected by the Assistant Secretary—Indian Affairs following an opportunity for non-self-governance tribes to submit names as requested by the February 15, 1995, **Federal Register** announcement.

Committee membership consists of:

Representatives From Self-Governance Tribes:

Rhonda Swaney (The Confederated Tribes of Salish & Kootenai)
W. Ron Allen (Jamestown S'Klallam Tribe)
Loretta Bullard (Kawerak Inc.—Alaska)
Dale Risling (Hoopa Valley Tribe)
Bernida Churchill (Mille Lacs Band of Ojibwe Chippewa)
Lindsey Manning (Shoshone-Piaute Tribes—Duck Valley)
Merle Boyd (Sac & Fox Nation of Oklahoma)

Representatives From Non-Self-Governance Tribes:

Thomas Atcitty (Navajo Nation)
Brian Wallace (Washoe Tribe of Nevada and California)
Francis Shaw (Manzanita Tribe)
Janice Hawley (Fort Belknap)

Representatives of the Federal Government

Glynn Key (Special Assistant to the Secretary of the Interior)
Michael J. Anderson (Deputy Assistant Secretary—Indian Affairs)

The tribal co-chair person is W. Ron Allen and the tribal designated alternate is Bernida Churchill. The federal co-chair person is Glynn Key and the designated alternate is Michael Anderson.

Negotiation Procedures

The Joint Tribal and Federal Self-Governance Negotiated Rulemaking Committee adopted organizational protocols that indicated the following:

1. The Federal Advisory Committee Act does not apply pursuant to the Unfunded Mandate Reform Act of 1995 (P.L. 104–4) and Tribal Self-Governance Act of 1994 (P.L. 103–413, Title II, Sec. 407).

2. The negotiation sessions and the working group meetings will be open to federal representatives, tribal representatives, tribal organizations, and their designated representatives. At the discretion of the committee, meetings may be open to the public, who may also be given the opportunity to make comments.