made to the system notice. The following category should be revised:

* * * * *

SYSTEM MANAGER(S) AND ADDRESS:

Policy-Coordinating Official: Associate Administrator for Operations and Management, Health Resources and Services Administration, Room 14A-03, Parklawn Building, 5600 Fishers Lane, Rockville, MD 20857.

Office of the Administrator: Chief, Debt Management Branch, Division of Fiscal Services, Health Resources and Services Administration, Room 16A-09, Parklawn Building, 5600 Fishers Lane, Rockville, MD 20857.

Indian Health Service: Chief, Financial Management Branch, Indian Health Service, Room 5A-38, Parklawn Building, 5600 Fishers Lane, Rockville, MD 20857.

Bureau of Health Professions; Director, Office of Debt Management, Bureau of Health Professions, Room 8A-43, Parklawn Building, 5600 Fishers Lane, Rockville, MD 20857.

* * * * *

09-15-0052

SYSTEM NAME:

Nurse Practitioner and Midwifery Traineeship Programs, HHS/HRSA/BHPr. Minor alterations have been made to this system notice. The following category should be revised:

* * * * *

SYSTEM NAME:

Nurse Practitioner and Nurse Midwifery Traineeship Programs, HHS/HRSA/BHPr.

* * * * *

[FR Doc. 89-25150 Filed 11-16-89; 8:45 am]

BILLING CODE 4160-15-M

Food and Drug Administration

Privacy Act of 1974; Annual Publication of Systems of Records

AGENCY: Public Health Service (PHS), Department of Health and Human Services (HHS).

ACTION: Publication of minor changes to systems of records notices.

SUMMARY: In accordance with Office of Management and Budget Circular No. A-130, Appendix I, "Federal Agency Responsibilities for Maintaining Records About Individuals," the Food and Drug Administration (FDA) is publishing minor changes to its notices of systems of records.

SUPPLEMENTARY INFORMATION: FDA has completed the annual review of its systems of records and is publishing below (1) a table of contents which lists all active systems of records in FDA, and (2) those minor changes which affect the public's right or need to know, such as title changes, and changes in the systems location or the address of system managers.

Dated: October 19, 1989.

Jeffrey A. Nesbit,

Associate Commissioner for Public Affairs.

Table of Contents

Minor alterations have been made to the following system notices:

9-10-0002

SYSTEM NAME:

Regulated Industry Employee Enforcement Records, HHS/FDA/OC. The organizational symbols for this system notice have been revised to reflect organizational changes.

SYSTEM LOCATION:

Appendixes A and B, location of Field/District Offices and location of Federal Record Centers are being republished in their entirety to reflect current addresses.

Appendix A: Addresses and working hours of the Food and Drug Administration Field Offices

The following is a list of the Food and Drug Administration Field Offices, their addresses and working hours where individuals may have access to records in Food and Drug Administration Privacy Act Record Systems:

NORTHEAST REGION

Regional Office

830 Third Avenue, Brooklyn, NY 11232, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

District Offices

One Montvale Avenue, 3rd Floor, Stoneham, MA 02180, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
850 Third Avenue, 4th Floor, Brooklyn, NY 11232-1593, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
599 Delaware Avenue, Buffalo, NY 14202, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

Regional Laboratory

850 Third Avenue, 4th Floor, Brooklyn, NY 11232-1593, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
Winchester Engineering and Analytical Center (WEAC), 109 Holton Street, Winchester, MA 01890.

MID-ATLANTIC REGION

Regional Office

2nd and Chestnut Streets, Room 900, Philadelphia, PA 19106, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

District Offices

2nd and Chestnut Streets, Room 900, Philadelphia, PA 19106, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
61 Main Street, West Orange, NJ 07052, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
900 Madison Avenue, Baltimore, MD 21201, Office hours: 7:45 a.m. to 4:15 p.m. (e.s.t.).
1141 Central Parkway, Cincinnati, OH 45202-1097, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

SOUTHEAST REGION

Regional Office

60 Eighth Street, NE., Atlanta, GA 30309, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

District Offices

60 Eighth Street, NE., Atlanta, GA 30309, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
297 Plus Park Boulevard, Nashville, TN 37217, Office hours: 8:00 a.m. to 4:30 p.m. (c.t.).
7200 Lake Ellenor Drive, Suite 120, Orlando, FL 32809, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
4298 Elysian Fields Avenue, New Orleans, LA 70122, Office hours: 8:00 a.m. to 4:30 p.m. (c.t.).
Fernandez Juncos Avenue, Puerta de Tierra, San Juan, PR 00906-5719, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

Regional Laboratory

60 Eighth Street, NE., Atlanta, GA 30309, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

MIDWEST REGION

Regional Office

20 N. Michigan Avenue, Room 550, Chicago, IL 60602, Working hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).

District Offices

433 W. Van Buren Street, Room 1222, Chicago, IL 60607, Working hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
1560 East Jefferson Avenue, Detroit, MI 48207, Office hours: 8:00 a.m. to 4:30 p.m. (e.s.t.).
240 Hennepin Avenue, Minneapolis, MN 55401, Office hours: 8:00 a.m. to 4:30 p.m. (c.t.).

SOUTHWEST REGION

Regional Office

3032 Bryan Street, Dallas, TX 75204, Office hours: 8:00 a.m. to 4:30 (c.t.).

District Offices

3032 Bryan Street, Dallas, TX 75204, Office hours: 8:00 a.m. to 4:30 (c.t.).
1009 Cherry Street, Kansas City, MO 64106, Office hours: 8:00 a.m. to 4:30 p.m. (c.t.).
Denver Federal Center, Building 20, P.O. Box 25087, Denver, CO 80225–0087, Working hours: 8:00 a.m. to 4:30 p.m. (m.t.).

PACIFIC REGION

Regional Office

Federal Office Building, Room 526, 50 U.N. Plaza, San Francisco, CA 94102, Working hours: 8:00 a.m. to 4:30 p.m. (p.t.).

District Offices

Federal Office Building, Room 526, 50 U.N. Plaza, San Francisco, CA 94102, Working hours: 8:00 a.m. to 4:30 p.m. (p.t.).
1521 W. Pico Boulevard, Los Angeles, CA 90015–2486, Office hours: 8:00 a.m. to 4:30 p.m. (p.t.).
22201 23rd Drive, S.E., Bothell, WA 98021–4421, Office hours: 8:00 a.m. to 4:30 p.m. (c.t.).

Appendix B—General Services Administration, Federal Archives, and Records Centers

National Centers:

District of Columbia, Maryland, Virginia, and West Virginia except for U.S. Court records for Maryland, Virginia, and West Virginia: Washington National Records Center, Washington, DC 20409.
National Personnel Records Center (Civilian Personnel Records), 111 Winnebago Street, St. Louis, MO 63118.
National Personnel Records Center (Military Personnel Records), 9700 Page Boulevard, St. Louis, MO 63132.

Regional Centers

Maine, Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island, Federal Archives and Records Center, 380 Trapelo Road, Waltham, MA 02154.
New York, New Jersey, Puerto Rico, the Virgin Islands, and the Panama Canal Zone, Federal Records Center, Military Ocean Terminal, Building 22, Bayonne, NJ 07002–5388.
Delaware, Pennsylvania, and U.S. Court records for Maryland, Virginia, and West Virginia, Federal Records Center, 5000 Wissahickon Avenue, Philadelphia, PA 19144.
North Carolina, South Carolina, Tennessee, Mississipi, Alabama, Georgia, Florida and Kentucky, Federal Records Center, 1557 St. Joseph Avenue, East Point, GA 30344.
Illinois, Wisconsin, Minnesota, and U.S. Court records for Indiana, Michigan, and Ohio, Federal Records Center, 7358 South Pulaski Road, Chicago, IL 60629.
Indiana, Michigan, and Ohio except for U.S. Court records, Federal Records Center, 3150 Springboro Road, Dayton, OH 45439.
Kansas, Iowa, Nebraska, and Missouri, Federal Records Center, 2306 East Bannister Road, Kansas City, MO 64131.
Texas, Oklahoma, Arkansas, Louisiana, and New Mexico, Federal Records Center, P.O. Box 6216, Fort Worth, TX 76115.
Shipping address only (do not use for mail), 4900 Hemphill Street, Building 1, Dock 1, Fort Worth, TX.
Colorado, Wyoming, Utah, Montana, North Dakota, and South Dakota, Federal Records Center, P.O. Box 25307, Denver, CO 80225.
American Samoa, California, except Southern California, and Nevada, except Clark County, Federal Records Center, 1000 Commodore Drive, San Bruno, CA 94066.
Arizona; Clark County, Nevada; and Southern California (counties of San Luis Obispo, Kern, San Bernardino, Santa Barbara, Ventura, Los Angeles, Riverside, Orange, Imperial, Inyo, and San Diego). Federal Records Center, 24000 Avila Road, 1st Floor, P.O. Box 6719, Laguna Niguel, CA 92677.
Washington, Oregon, Idaho, Alaska, Hawaii, and Pacific Ocean areas (except American Samoa), Federal Records Center, 6125 Sand Point Way NE., Seattle, WA 98115.

09–10–0003

SYSTEM NAME:

FDA Credential Holder File, HHS/FDA/OC. The organizational symbols for this system notice have been revised to reflect organizational changes.

09–10–0004

SYSTEM NAME:

Communications (Oral and Written) With the Public, HHS/FDA/OC. The organizational symbols for this system notice have been revised to reflect organizational changes.

09–10–0010

SYSTEM NAME:

Bioresearch Monitoring Information System, HHS/FDA. The system location and system manager(s) portion of this notice have been revised to reflect current addresses and titles.

SYSTEM LOCATION:

Center for Drug Evaluation and Research, Office of Compliance, Division of Scientific Investigations (HFD–340), 7520 Standish Place, Rockville, MD 20855.

Center for Biologics Evaluation and Research, Office of Compliance, Bioresearch Monitoring Staff (HFB–130), 8800 Rockville Pike, Rockville, MD 20892.

Center for Devices and Radiological Health, Office of Compliance and Surveillance, Bioresearch Monitoring Staff (HFZ–341), 1390 Piccard Drive, Rockville, MD 20850.

SYSTEM MANAGER(S) AND ADDRESSES:

Deputy Director, Division of Scientific Investigations (HFD–341), Center for Drug Evaluation and Research, Office of Compliance, 7520 Standish Place, Rockville, MD 20855.

Director, Division of Regulations and Bioresearch Monitoring (HFB–130), Center for Biologics Evaluation and Research, Office of Compliance, 8800 Rockville Pike, Bethesda, MD 20892.

Director, Bioresearch Monitoring Staff (HFZ–341), Center for Devices and Radiological Health, Division of Compliance Operations, 1390 Piccard Drive, Rockville, MD 20850.

09–10–0015

SYSTEM NAME:

Blood Donors for Tissue Typing Sera and Cell Analysis and Related Research, HHS/FDA/CBER. The organizational symbols for this system notice have been revised to reflect organizational changes, the location and system managers portions of this notice have been revised to reflect current address and title.

SYSTEM LOCATION:

Center for Biologics Evaluation and Research, Division of Blood and Blood Products (HFB–400), 8800 Rockville Pike, Bethesda, MD 20892.

SYSTEM MANAGER(S) AND ADDRESSES:

Director, Division of Blood and Blood Products (HFD–830), Center for Biologics Evaluation and Research, 8800 Rockville Pike, Bethesda, MD 20892.

[FR Doc. 89–25152 Filed 11–16–89; 8:45 am]
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federal register

Friday
November 17, 1989

Part III

Department of Energy

Office of Conservation and Renewable Energy

10 CFR Part 430

Energy Conservation Program for Consumer Products: Energy Conservation Standards for Two Types of Consumer Products; Final Rule and Determinations and Analyses of Competitive Impacts

DEPARTMENT OF ENERGY

Office of Conservation and Renewable Energy

10 CFR Part 430

[Docket No. CE-RM-87-102]

Energy Conservation Program for Consumer Products: Energy Conservation Standards for Two Types of Consumer Products

AGENCY: Office of Conservation and Renewable Energy, DOE.

ACTION: Final rule.

SUMMARY: The Energy Policy and Conservation Act (EPCA), as amended by the National Energy Conservation Policy Act (NECPA), the National Appliance Energy Conservation Act (NAECA), and the National Appliance Energy Conservation Amendments of 1988 (NAECA 1988), prescribes energy conservation standards for certain major household appliances, and requires the Department of Energy (DOE or Department) to administer an energy conservation program for these products. Among other things, NAECA requires DOE to consider amending the energy conservation standards for refrigerators, refrigerator-freezers, and freezers; and to establish standards for small gas furnaces, and to consider prescribing standards for television sets.

The Department of Energy has determined that revised energy conservation standards for refrigerators, refrigerator-freezers and freezers would result in significant conservation of energy and be economically justified. Therefore, the Department is today amending title 10, part 430 of the Code of Federal Regulations (part 430) to add new standards for this product. More stringent standards, including the maximum technologically feasible level, were considered by the Department, but rejected based upon consideration of the economic analysis.

For small gas furnaces, the Department has determined that standards would result in a significant conservation of energy and be economically justified. Therefore, the Department is today amending part 430 to add standards for this product which are the maximum allowable by law.

For television sets, DOE has determined a new analysis is necessary and is not now making a determination on the need for standards on televisions.

EFFECTIVE DATES: This action amending § 430.32(a), the standards for refrigerators, refrigerator-freezers and freezers, is effective as of January 1, 1993.

This action amending § 430.32(e), setting the standards for small gas furnaces (input rate less than 45,000 Btu/hr), is effective as of January 1, 1992.

ADDRESSES: A copy of the Technical Support Document 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. Copies of the Technical Support Document may be obtained from: U.S. Department of Energy, Office of Conservation and Renewable Energy, Forrestal Building, Mail Station CE-132, 1000 Independence Avenue SW., Washington, DC 20585, (202) 586-9127.

FOR FURTHER INFORMATION CONTACT:

Michael J. McCabe, U.S. Department of Energy, Office of Conservation and Renewable Energy, Forrestal Building, Mail Station CE-132, 1000 Independence Avenue SW., Washington, DC 20585, (202) 586-9127

Eugene Margolis, Esq., U.S. Department of Energy, Office of General Counsel, Forrestal Building, Mail Station GC-12, 1000 Independence Avenue SW., Washington, DC 20585, (202) 586-9507

U.S. Department of Energy, CE-43.1, Docket No. CE-RM-87-102, Forrestal Building, Room 6B-025, 1000 Independence Avenue SW., Washington, DC 20585, (202) 586-9320

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, the National Appliance Energy Conservation Act (NAECA), Pub. L. 100-12, and the National Appliance Energy Conservation Amendments of 1988 (NAECA 1988), Pub. L. 100-357,[1] created the Energy Conservation Program for Consumer Products other than Automobiles. The consumer products subject to this program (often referred to hereafter as "covered products") are: Refrigerators, refrigerator-freezers and freezers; dishwashers; clothes dryers;

[1] Part B of title III of EPCA, as amended by NECPA, NAECA, and NAECA 1988, 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 EPCA, as amended by NECPA only, is referred to in this notice as NECPA.

water heaters; central air conditioners and central air conditioning heat pumps; furnaces; direct heating equipment; television sets; kitchen ranges and ovens; clothes washers; room air conditioners; fluorescent lamp ballasts; and pool heaters; as well as any other consumer product classified by the Secretary of Energy. Section 322. To date, the Secretary has not so classified any additional products.

Under the Act, the program consists essentially of three parts: testing, labeling, and mandatory energy conservation standards. The Department of Energy, in consultation with the National Institute of Standards and Technology (NIST), is required to amend or establish new test procedures as appropriate for each of the covered products. Section 323. The purpose of the test procedures is to provide for test results that reflect the energy efficiency, energy use, or estimated annual operating costs of each of the covered products. Section 323(b)(3). The test procedures are an integral part of the energy conservation standards. The energy performance standards, i.e., efficiency and consumption, are based on the test procedures found in subpart B to 10 CFR part 430. The test procedures are used by manufacturers to certify compliance with the standards and will be used by the Department to determine compliance with the standards.

The Federal Trade Commission (FTC) is required by the Act to prescribe rules governing the labeling of covered products for which test procedures have been prescribed by DOE. Section 324(a). These rules generally require that each particular model of a covered product bear a label that indicates its annual operating cost and the range of estimated annual operating costs for other models of that product. Section 324(c)(1). At the present time there are FTC rules requiring labels for the following products: Room air conditioners, furnaces, clothes washers, dishwashers, water heaters, freezers, refrigerators and refrigerator-freezers, central air conditioners and central air conditioning heat pumps, and fluorescent lamp ballasts. 44 FR 66475, November 19, 1979, 52 FR 46888, December 10, 1987, and 54 FR 28031, July 5, 1989.

For each of the 12 covered products, the Act prescribes an initial Federal energy conservation standard. Section 325(b)–(h). The Act establishes effective dates for the standards in 1988, 1990, 1992 or 1993, depending on the product, and specifies that the standards are to be reviewed by the Department within 3 to 10 years, also depending on the product. Section 325(b)–(h). After the specified period, DOE may promulgate new standards for each product; however, the Secretary may not prescribe any amended standard that increases the maximum allowable energy use, or decreases the minimum required energy efficiency, of a covered product. Section 325(l)(1). The Department's first review of standards is for refrigerators, refrigerator-freezers and freezers.

The Act also directs DOE to prescribe an energy conservation standard for small gas furnaces, i.e., gas furnaces having an input of less than 45,000 Btu per hour and manufactured on or after January 1, 1992. Section 325(f)(1)(B).

With regard to another covered product, television sets, the Act allows the Department to prescribe an applicable standard; however, such standard may not become effective before January 1, 1992. Section 325(i)(3).

Two products (refrigerators, refrigerator-freezers, and freezers; and small gas furnaces) are the subject of this rulemaking. As noted below in the product-specific discussion, the Department is postponing a final decision on standards for television sets and will conduct a new analysis for television sets and publish a proposed rule based on that analysis.

Any new or amended standard is required to be designed so as to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. Section 325(l)(2)(A).

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

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

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

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

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

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

(6) The need for national energy conservation; and

(7) Other factors the Secretary considers relevant.

In addition, section 325(1)(2)(B)(ii) establishes a rebuttable presumption of economic justification in instances where the Secretary determines that "the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure * * *"

Section 327 of the Act addresses the effect of Federal rules concerning testing, labeling, and standards on State laws or regulations concerning such matters. Generally, all such State laws or regulations are superseded by the Act. Section 327(a)–(c). Exceptions to this general rule include: (1) State standards prescribed or enacted before January 3, 1987, and applicable to appliances produced before January 3, 1988, may remain in effect until the applicable standard begins (section 327(b)(1)); (2) State procurement standards which are more stringent than the applicable Federal standard (section 327 (b)(2) and (e)) and certain building code requirements for new construction, if certain criteria are met, are exempt from Federal preemption (section 327 (b)(3) and (f) (1)–(4)); (3) State regulations banning constant burning pilot lights in pool heaters; and (4) State standards for television sets effective on or after January 1, 1992, may remain in effect in the absence of a Federal standard for such product (section 327(b)(6) and 327(c)).

Another exception to Federal preemption concerns standards for refrigerators, refrigerator-freezers and freezers. The Act specifies that if DOE does not publish a final rule before January 1, 1990, relating to the revision of Federal standards for this product category, the State of California's December 14, 1984, standards (effective January 1, 1992) for these products, would become effective in California beginning January 1, 1993, and may not be preempted by any Federal standard. This exemption from preemption by a Federal standard would exist as long as the California standard was not made more stringent. Section 325(b)(3)(A)(ii)(I) and section 327(c).

In addition, if DOE does not publish a final rule before January 1, 1992, relating to the revision of standards for refrigerators, refrigerator-freezers, and freezers, any State regulation which applies to such products manufactured on or after January 1, 1995, is exempt from Federal preemption until the effective date of a Federal standard. Section 325(b)(A)(ii)(II).

b. Background

The purpose of this rulemaking is two-fold: (1) To review the energy conservation standards for refrigerators, refrigerator-freezers, and freezers (hereafter referred to as refrigerators) that have been established by the Act; and, (2) to propose energy efficiency standards which are not less than 71 percent and not more than 78 percent AFUE (annual fuel utilization efficiency)[2] for small gas furnaces, i.e., those having an input rate less than 45,000 Btu per hour.

As directed by the Act, DOE published an advance notice of proposed rulemaking, with a 60-day comment period that ended February 5, 1988. (Hereafter referred to as the advance notice.) 52 FR 46367, December 7, 1987. The advance notice presented the product classes that DOE planned to analyze, and provided a detailed discussion of the analytical methodology and analytical models that the Department expected to use in performing 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 DOE's approach. In addition, on January 28, 1988, a public hearing was held on the advance notice.

On December 2, 1988, DOE published a Notice of Proposed Rulemaking concerning refrigerators, refrigerator-freezers, and freezers; small gas furnaces and television sets. (Hereafter referred to as the proposed rule.) 53 FR 48798, December 2, 1988. The Department proposed to establish an energy conservation standard of 78 percent AFUE for small gas furnaces which was the highest level within the range (71 to 78 percent AFUE) for DOE to consider as set by the Act. For television sets, the Department proposed that an energy conservation standard would not be economically justified. For refrigerators, DOE did not propose a specific standard level; rather, DOE solicited comments and information within a range of standard levels. This range of standard levels considered is shown in Table 1-1 below. The standards prescribed by the Act, effective January 1, 1990, and those prescribed today, effective January 1, 1993, are shown in Table 1-2 below. During the 60-day comment period ending January 31, 1989, DOE received 120 written comments and testimony from 33 participants at the public hearing held in Washington, DC, on January 12 and 13, 1989. The issues raised are addressed in section III of this notice.

TABLE 1-1.—PROPOSED RANGE OF ENERGY STANDARDS EQUATIONS FOR REFRIGERATORS, REFRIGERATOR-FREEZERS, AND FREEZERS

Product class	Energy standards equations (Kwh/yr)
1. Refrigerators and refrigerator-freezers with manual defrost	(16.3AV+316) to (11.9AV+258)
2. Refrigerator-freezer—partial automatic defrost	(21.8AV+429) to (14.1AV+305)
3. Refrigerator-freezers—automatic defrost with: Top-mounted freezer without through-the-door ice service	(23.5AV+471) to (16.8AV+363)
4. Refrigerator-freezers—automatic defrost with: Side-mounted freezer without through-the-door ice service	(27.7AV+488) to (13.1AV+540)
5. Refrigerator-freezers—automatic defrost with: Bottom-mounted freezer without through-the-door ice service	(27.7AV+488) to (17.9AV+386)
6. Refrigerator-freezers—automatic defrost with: Top-mounted freezer with through-the-door ice service	(26.4AV+535) to (17.6AV+380)
7 Refrigerator-freezers—automatic defrost with: Side-mounted freezer with through-the-door ice service	(30.9AV+547) to (15.2AV+652)
8. Upright freezers with: manual defrost	(10.9AV+422) to (12.3AV+181)
9. Upright freezers with: automatic defrost	(16.0AV+623) to (18.0AV+264)
10. Chest freezers and all other freezers	(14.8AV+223) to (11.2AV+163)

AV=Total adjusted volume, expressed in Ft.[3] as determined in Appendices A1 and B1 of Subpart B.

TABLE 1-2.—JANUARY 1, 1990, AND JANUARY 1, 1993, ENERGY STANDARDS EQUATIONS FOR REFRIGERATORS, REFRIGERATOR-FREEZERS, AND FREEZERS

Product class	Energy standards equations (Kwh/yr)	
	Effective Jan. 1, 1990	Effective Jan. 1, 1993
1. Refrigerators and refrigerator-freezers with manual defrost	(16.3AV+316)	(19.9AV+98)
2. Refrigerator-freezer—partial automatic defrost	(21.8AV+429)	(10.4AV+398)
3. Refrigerator-freezers—automatic defrost with: Top-mounted freezer without through-the-door ice service [1]	(23.5AV+471)	(16.0AV+355)
4. Refrigerator-freezers—automatic defrost with: Side-mounted freezer without through-the-door ice service	(27.7AV+488)	(11.8AV+501)
5. Refrigerator-freezers—automatic defrost with: Bottom-mounted freezer without through-the-door ice service	(27.7AV+488)	(14.2AV+364)
6. Refrigerator-freezers—automatic defrost with: Top-mounted freezer with through-the-door ice service	(26.4AV+535)	(17.6AV+391)
7 Refrigerator-freezers—automatic defrost with: Side-mounted freezer with through-the-door ice service	(30.4AV+547)	(16.3AV+527)
8. Upright freezers with: manual defrost	(10.9AV+422)	(10.3AV+264)
9. Upright freezers with: automatic defrost	(16.0AV+623)	(14.9AV+391)
10. Chest freezers and all other freezers	(14.8AV+223)	(12.0AV+124)

[1] Including all refrigerators with automatic defrost
AV=Total adjusted volume, expressed in Ft.[3], as determined in appendices A1 and B1 of Subpart B of this Part.

[2] AFUE is the ratio of annual fuel output energy to annual fuel input energy, expressed as a percent.

II. General Discussion

a. Maximum Technological Feasible Levels

The Act requires that, in considering any new or amended standards, the Department must consider those that "shall be designed to achieve the maximum improvement in energy efficiency which the Secretary determines is technologically feasible and economically justified." (Section 325 (1)(2)(A)). Accordingly, for each class of product that was under consideration in this rulemaking, a maximum technologically feasible level was identified. The maximum technologically feasible level is one that can be carried out by the addition of design options, both commercially feasible and prototypes, to the baseline units without affecting the product's utility. DOE believes that the maximum technologically feasible level must be capable of being assembled, but not necessarily manufactured, by the effective date of a standard.

The maximum technologically feasible levels were derived by adding energy-conserving engineering design options to the respective classes in order of decreasing consumer paybacks. Accordingly, the maximum technologically feasible level for refrigerator-freezers includes dual compressors and evacuated panels. A complete discussion of each maximum technologically feasible level, and the design options included in each, is found in the Engineering Analysis. *See* Technical Support Document, chapter 3.

The "max tech" levels presented in this notice are predicated on the assumption that CFC-11 and -12 will not be available for refrigerator production. In the Engineering Analysis the Department applied a five percent efficiency penalty for the CFC-11 substitute. *See* Technical Support Document, chapter 3. If CFC-11 and -12 were available for these designs, then the "max tech" levels could be even more efficient. A complete set of engineering cost-efficiency curves are presented in the Engineering Analysis for refrigerators, including those with CFC-11 and -12.

Table 2-1 presents the Department's maximum technologically feasible levels for the 10 refrigerator classes and 2 small gas furnace classes:

TABLE 2-1.—MAXIMUM TECHNOLOGICALLY FEASIBLE LEVELS

Products & product classes	Unit energy consumption [1]
Refrigerators:	
Manual defrost (17.0 cu. ft.) [2]	325 kWh/yr.
Partial automatic defrost (16.8 cu. ft.)	502 kWh/yr.
Automatic defrost top mount (20.8 cu. ft.)	490 kWh/yr.
Automatic defrost side-by-side (24.1 cu. ft.)	564 kWh/yr.
Automatic defrost side-by-side with through-the-door service features (31.9 cu. ft.)	746 kWh/yr.
Automatic defrost top mount with through-the-door service features (20.8 cu. ft.)	540 kWh/yr.
Automatic defrost bottom mount (22.8 cu. ft.)	498 kWh/yr.
Freezers:	
Chest, manual defrost (22.5 cu. ft.)	250 kWh/yr.
Upright, manual defrost (26.1 cu. ft.)	423 kWh/yr.
Upright, automatic defrost (25.3 cu. ft.)	588 kWh/yr.
Small Gas Furnaces:	
Non-weatherized (indoor)	97% AFUE [3].
Weatherized (outdoor)	97% AFUE [3].

[1] These maximum technologically feasible energy consumption levels for refrigerators/refrigerator-freezers/freezers are based on design options that use substitutes for CFC-11 and -12.
[2] Adjusted volume.
[3] 78 percent AFUE is the maximum standard level that is allowed by the Act for small gas furnaces.

The Department believes that these are the maximum technologically feasible energy conservation levels from an engineering standpoint; with the exception of small gas furnaces, each of these levels was evaluated in accordance with the economic justification factors specified in the Act to determine if the levels were economically justified. The maximum technologically feasible levels for small gas furnaces were excluded from the analysis, since these levels are beyond the legislated range in which the Department has to establish standards.

The Department evaluated each maximum technologically feasible level to determine if it would be economically justified at the time of the effective date of the standard. DOE rejected energy conservation standards that have unacceptable impacts on consumers or manufacturers, e.g., unusually long payback periods and negative impacts on manufacturers' returns-on-equity, or result in the changing of the utility of the product.

b. Energy Savings

1. *Determination of Savings.* The Department forecasts energy consumption through the use of the Lawrence Berkeley Laboratory Residential Energy Model (LBL-REM). The LBL-REM forecasts energy consumption over the period of analysis (1993-2015) for candidate standards and the base case.[3] The Department quantified the energy savings that would be attributable to a standard as the difference in energy consumption between the candidate standard's case and the base case.

The LBL-REM is fully explained in the Technical Support Document. Appendix B to that document addresses the LBL-REM in detail. The LBL-REM contains algorithms to project average efficiencies, usage behavior, and market shares for each product.

The LBL-REM is used to project residential energy use over the relevant time periods. By comparing the energy consumption projection at alternative standards or no standards (for small furnaces), and at alternative standard levels or the Act's 1990 standards (for refrigerators), the Department estimated the amount of energy projected to be saved during the period 1993-2015.[4] The

[3] For refrigerators, the base case represents no standards beyond the Act's 1990 standards; for small gas furnaces, the base case represents no standards.

[4] LBL-REM analyzed a single standard level or alternative 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

Continued

energy saved is expressed in Quads, i.e., quadrillion Btu's. With respect to electricity, the savings are quads of source or primary energy, which includes the energy necessary to generate and transmit electricity. The Act defines "energy use" as the quantity of energy directly consumed by a consumer product at point of use. This is generally called "site" energy, as opposed to "source" energy. There are major differences between these types of energy. In 1987, the amount of electrical energy consumed at the site was less than one-third of the amount of source energy that was required to generate and transmit the site electrical energy.[5] Therefore, it is important to identify whether the electricity involved is site or source energy.

The LBL-REM projections are dependent on many assumptions. Among the most important are responsiveness of household appliance purchases to changes in energy prices and consumer income, future energy prices, future levels of housing construction, and options that exist for improving the energy efficiency of appliances. As is the case with any complicated computer model simulation, the validity of the outputs is critically dependent on the inputs.

Under section 325(l)(3)(B) of the Act, the Department is prohibited from adopting a standard for a product if that standard would not result in "significant" energy savings. While the term "significant" has never been defined in the Act, the Department believes that a standard level option need not meet a threshold level of energy savings to be considered a "significant" saver of energy. The U.S. Court of Appeals, *NRDC* v. *Herrington,* 768 F.2d 1355 (D.C. Cir. 1985), concluded that Congressional intent in using the word "significant" was to mean "non-trivial." *Id.* at 1373. Thus, for this rulemaking, DOE believes that each candidate standard considered results in significant energy savings.

c. Rebuttable Presumption

NAECA established new criteria for determining whether a standard level is economically justified. Section 325(l)(2)(B)(iii) states:

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

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

d. Economic Justification

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

1. *Economic Impact on Manufacturers and Consumers.* The engineering analysis identified improvements 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 simulated hypothetical firms in the industries under consideration. This model, the Lawrence Berkeley Laboratory Manufacturer Impact Model (LBL-MIM), is explained fully in the Technical Support Document. *See* Technical Support Document, Appendix C. LBL-MIM provides a broad array of outputs. The outputs are shipments, price, revenue, net income, and return-on-equity (ROE). An "Output Table" lists values for all these in the base case and in each of the standards cases under consideration. It also gives a range for each of these estimates. A "Sensitivity Chart" shows how ROE would be affected by a change in any one of the model's nine control variables.

For consumers, measures of economic impact are the changes in purchase price and annual energy expense. The purchase price and annual energy expense of each standard level are presented in Chapter 6 of the Technical Support Document.

2. *Life-Cycle Costs (LCC).* One measure of the effect of proposed standards on consumers is the change in life-cycle costs resulting from standards. This is quantified by the difference in life-cycle cost (LCC) between the base and standards case for the appliance classes analyzed. The LCC is the sum of the purchase price and the operating expense, incuding maintenance expenditures, discounted over the lifetime of the appliance.

The LCC was calculated for the range of efficiencies in the Engineering Analysis for each class of product in the year standards are imposed. 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 inputs that are taken from the 1989 *Annual Energy Outlook* of the Energy Information Administration. Appliance usage inputs for refrigerators are taken from the refrigerator test procedure and for small gas furnaces are taken from the furnace test procedure and modified to adjust from laboratory to field usage.

The differences in life-cycle costs between the base case and various levels of standards for refrigerators and small gas furnaces are presented in Tables 6.1-6.3 of the Technical Support Document. These LCC's are calculated at a seven percent discount rate; a higher rate, e.g., ten percent, gives a smaller difference between standards cases and the base case, while a lower rate, e.g., five percent, produces a greater difference. This results because the consumer benefits, i.e., reduced operating expenses accrue over the life of the appliance and are discounted back to some base year. Therefore, the lower the discount rate, the greater the resulting consumer benefits after discounting. In addition, as can be seen in the various LCC curves, the use of a higher discount rate results in a flatter curve.

When the LCC numbers are plotted graphically (on the Y axis) against unit energy consumption (on the X axis), the data generally produce a curve that is concave from above in shape. This means that at first the LCC curve will decline as efficiency improvements are made, will reach a minimum (which may or may not be discrete), and then rise. This indicates that the first efficiency

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 2015.

[5] Energy Information Administration, *Electric Power Annual 1987,* Tables 25 and 82, DOE/EIA-0348(87), 1988.

[6] For this calculation, cost-of-operation, i.e., energy saving, is derived from the DOE test procedures. See §§ 430.22 (a) and (n). Consumers who use the products less than the test procedure assumes will experience a longer payback while those who use them more than the test procedure assumes will have a shorter payback.

improvements will produce energy savings, the value of which will more than pay for the design change. As additional efficiency improvements are made, it becomes increasingly costly to save more energy, and, eventually, the value of the energy savings will not cover the expenditures for the design improvements. *See* Technical Support Document, Figures 6.1–6.12.

The minimum of the LCC curve was of particular interest in the analysis. The minimum of the curve represents that level of efficiency improvements that maximizes the difference between the value of energy saved and the additional consumer expenditures for the relevant efficiency improvements. Therefore, design options that corresponded to the minimum point were of special consideration in establishing standard levels.

The Department conducted a net present value (NPV) analysis to assess the differential economic impacts on consumers that would occur from the adoption of standards (for small gas furnaces) and amended standards (for refrigerators) compared to a base case with no-standards (for small gas furnaces) and the Act's 1990 standards (for refrigerators). *See* Technical Support Document, Chapter 5. The LBL–REM calculates the total expenditure for each product (discounted total value of energy consumption from 1992 through the last year of use for those products purchased through the year 2015, plus the total discounted expenses for equipment purchased from 1992 through 2015), with and without standards (for small furnaces), and with more stringent standards and with the Act's 1990 standards (for refrigerators). The NPV analysis is similar to the LCC analysis, in that the greatest NPV should occur at the standard level that corresponds to the LCC minimum for the product.[7] The NPV for each product at the different standard levels is identified in section IV of this notice.

3. *Energy Savings.* While the significant conservation of energy is a separate statutory requirement for imposing an energy conservation standard, the Act requires DOE, in determining the economic justification of a standard, to consider the total projected savings that are expected to result directly from new or revised standards. DOE used the LBL–REM results, discussed earlier, in its consideration of total projected savings. The savings are provided in section IV of this notice.

4. *Lessening of Utility or Performance of Products.* This factor cannot be quantified. In establishing classes of products and design options, the Department tried to eliminate any degradation of utility or performance in the two products under consideration in this rulemaking. That is, to the extent that comments, or DOE's own research, indicated 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 this product. In this way the Department attempted to minimize the impact of this factor as a result of the standards that were analyzed. However, other factors, in conjunction with standards, could affect the utility or performance of products subject to standards. For example, the EPA limitations on chlorofluorocarbon (CFC) production could cause refrigerator manufacturers to adopt alternatives to the regulated CFCs which could affect the referigerator's utility or performance. If this occurs, DOE is not able to assure that utility and performance would not be affected by standards.

5. *Impact of Lessening of Competition.* The determination of this factor is to be made by the Attorney General. This determination is presented for each product in section IV of today's notice. In addition, a copy of the Attorney General's letter containing the findings is published in today's **Federal Register.**

6. *Need of the Nation to Conserve Energy.* With increasing concern about the prospects of polluted air, acid rain and global warming, some have argued that energy conservation, including more stringent energy conservation standards, is necessary to help alleviate those prospects. Accordingly, results from the environmental assessment for each product will be reported concerning this factor in the product specific discussion (section IV) of this notice.

7. *Other Factors.* This provision allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that he deems to be relevant. The only such factor that has been identified is the EPA regulation to restrict the production of certain CFCs. This factor, too, is discussed in section IV of this notice.

III. Discussion of Comments

The Department received 120 written comments in response to the December 1988 proposed rule, and received testimony from 33 persons at the January 12–13, 1989, public hearing. These comments addressed all aspects of the analysis. In this section, the Department will discuss the general analytical issues raised by the comments; and then, the product-specific issues.

a. General Analytical Comments

1. Energy Projections

In the analysis for the proposed rule, the Department used energy price forecasts from the 1986 Annual Energy Outlook of the Energy Information Administration. The American Gas Association (AGA) contended that these price forecasts should be updated. (AGA, No. 128, at 16–17).[8]

The Department agrees with AGA and has updated the energy price projections by incorporating the forecasts from the 1989 Annual Energy Outlook (DOE/EIA-0383(89)).

2. Discount Rate Selection

In the Department's analysis for the proposed rulemaking, a seven percent discount rate was used to calculate consumer life-cycle costs and net present values.

The Department received numerous comments on the choice of an appropriate discount rate.[9] Among those supporting a lower rate, generally either three or four percent, were the Rocky Mountain Institute (RMI) (RMI, No. 49, at 1), the Natural Resources Defense Council (NRDC) (NRDC, No. 81, at 8–9), the Northwest Conservation Act Coalition (NCAC) (NCAC, No. 91, at 1), Massachusetts Executive Office of Energy Resources (Mass) (Mass, No. 107, at 5), the California Energy Commission (CEC) (CEC, No. 108, at 17), Edison Electric Institute (EEI) (EEI, No. 127, at 10), Ohio Office of the Consumer's Counsel (Ohio) (Ohio, No. 138, at 7), and Representative Edward J. Markey (Markey, No. 151, at 3).

The principal argument offered in support of a lower rate is that appliance energy conservation standards have

[7] The net present value (NPV) of a standard, per appliance, is calculated for all affected appliances that are purchased in the projection period, while the life-cycle cost (LCC) is calculated only for the lifetime of an appliance that is purchased in the first year of the relevant standard. Therefore, NPV and LCC estimates, per appliance, may not correlate exactly

[8] Comments on the proposed rule have been assigned docket numbers and have been numbered consecutively. Statements that were presented at the January 12 and 13, 1989, public hearing are identified as Testimony.

[9] Since the benefits of improved efficiency and the expenses of obtaining and maintaining the more efficient equipment accrue at different rates over time, the values must be stated in terms of a common point in time. Usually this common time is the present, and the expense and benefit flows are discounted to present values through the application of an appropriate discount rate. This rate is typically independent of price changes and tax considerations; as such, it is a real, after-tax rate.

benefits that accrue to all of society, and these positive benefits should be accounted for by a reduction in the discount rate for the individual purchasers of the energy saving appliances.

The Department agrees that all of society benefits from energy-conserving appliances, e.g., more energy-efficient appliances can help reduce the need to build additional electrical generating plants, and thereby have positive economic and environmental effects that can be enjoyed by all members of society. It is also true, however, that most of the benefits from more efficient appliances are realized by the individual purchasers of those appliances, while those benefits that are collective in nature and benefit all members of society, e.g., the environmental benefits mentioned above, are properly tallied in the environmental assessment that the Department must conduct for the rulemaking, and are considered under the economic justification factors. Such external benefits from the purchase of energy conserving appliances should not be used to support a lower discount rate for calculating the benefits to the individual purchasers.

Social discount rates can be appropriate in situations where there are significant societal benefits that cannot be estimated. However, even in those circumstances, there is a practical problem in determining what that rate should be, that is, by what amount the private discount rate should be lowered in order to account for the benefits that accrue to all of society. Most of the comments that argue for a social discount rate suggested, as noted above, lowering the individual purchaser's rate to three or four percent. None of these comments, however, offers any theoretical or empirical basis to support such a reduction, and the Department, therefore, rejects such calls for lowering the individual purchaser's discount rate. Furthermore, as noted above, many of the benefits that accrue to all of society from more energy-efficient appliances are, the Department believes, environmental benefits, which are calculated in the Environmental Assessment (DOE/EA-0386). Any additional social benefits that might exist from an individual's purchase of more energy-efficient appliances are, DOE believes, not sufficiently large or inestimable to warrant reducing the consumer's discount rate.

The use of a three percent discount rate has no reasoned theoretical basis. It is not related to the opportunity cost of money for purchasing consumer durables. It represents the extreme of the calculations of the social discount rate in a more general context, and is thus suspect on these grounds. Finally, the use of a three percent discount rate does not change the results qualitatively. For refrigerators, as seen in the Technical Support Document, standard level 3 has certain positive benefits, greater in magnitude than results calculated at a higher discount rate. Level 4 has even higher benefits, but is rejected for reasons not related to the discount rate and the calculated life-cycle-cost and net present value.

The principal exception to those who argued for a lower discount rate was a comment offerd by Battelle (Battelle) on behalf of the Association of Home Appliance Manufacturers (AHAM). (Battelle, No. 110, at 8-18 and 32-34). Battelle stated that consumers' past implicit discount rates [10] for appliances have been calculated to be in the 40 to 100 percent range. These rates are implicit discount rates, developed from data on past consumer purchases. Based on these data, Battelle contends that the discount rate, to be used in the analysis, should be no lower than 20 percent.

DOE reviewed these comments and found several problems with Battelle's recommendation. First, the implicit discount rate is a value, initially calculated from historical data, that is used by LBL-REM in the projection of efficiency choices. LBL-REM uses implicit (market) discount rates that characterize the market-place's trade-off of purchase price against operating expense. For refrigerators, these values are calculated from purchase data, including the shipment weighted energy factor for 1987, which was obtained from AHAM. The implicit discount rates used in the proposed rule were reported for each class in table B.2 of the Technical Support Document, and range from 78 to 279 percent. Implicit discount rates for the small gas furnace classes were calculated to be 16 and 20 percent; these were used in the proposed rule and are also reported in Table B.2 of the Technical Support Document.

Secondly, household appliances are considered to be consumer durable goods, not investment goods. This definition has been accepted elsewhere in the Federal government; for example, the U.S. Department of Commerce's *Survey of Current Business* reports expenditures on appliances in this way. A consumer durable good is one that is expected to last more than one year. All of the appliances that are covered by the Act fall into this category.

The return to a consumer of an appliance is the utility that is derived from having and using the product. The consumer will spend on appliances up to the point that the marginal utility that he derives is equal to the purchase price.

The idea of a monetary payback from consuming an appliance is contrary to economic thought. Only investment goods are expected to yield a monetary return. Furthermore, to calculate a rate of return to consumers from consuming an appliance, one would need some cardinal measure of their individual utility schedules, and would need to make interpersonal comparisons of them. Both of these concepts are contrary to economic theory and application.[11]

Although the concept of paybacks from the consumption of a consumer durable is contrary to economics, such is the approach that has been taken by those who argue that the "correct" discount rates to use in consumer life-cycle cost and net present value calculations for the appliance standards program are the implicit discount rates derived from past consumer appliance purchase data.

It has been suggested by some that, since many of the appliances under this program are "necessities," the average model should be considered a consumer durable, but that any additional price paid for a more energy-efficient model could be considered a consumer investment, against which monetary returns can be calculated. It is then suggested that the rate of these returns should be used as discount rates in the life-cycle-cost and net present value calculations.

This approach has some conceptual appeal; however, there would be problems with its implementation. Such a calculation would be appropriate where the more energy-efficient model differed from the average model only in its improved energy-efficiency. If there were other differences in features between the two appliances, the extra price for the more energy-conserving model could be at least partly related to those different features; therefore, the extra price would not be solely for the energy conserving aspect of the more efficient machine, and calculating rates of return based on that extra price

[10] The implicit discount rate is a measure of marketplace behavior where, using historical data, a discount rate is calculated that would result in the shipment weighted energy factor (SWEF) coinciding with the minimum LCC point.

[11] See, for example, Donald Stevenson Watson, *Price Theory and Its Uses*, Boston: Houghton Mifflin Company, 1963, Chs. 4 and 5, esp. pages 59-61 and 68-71. For an additional critique of the practicality of cardinal measurement of utility, see William S. Vickrey, *Microstatics*, New York: Harcourt Bruce & World, Incorporated, 1964, pp. 38-51.

would not produce a rate of return from the aspect of investing in energy-efficiency.

Finally, the proposal to use a discount rate of 20 percent is counter to the practice of government agencies that are evaluating either regulatory program or government investments. In the evaluation of regulations, regulatory agencies often use (real) discount rates of three to seven percent. For example, the Environmental Protection Agency (EPA) in performing its regulatory impact assessment of the Montreal Protocol, used a 3 percent real discount rate. DOE, in evaluating Voluntary Energy Conservation Performance Standards for Commercial and Multi-family High Rise Residential Buildings used a seven percent real discount rate.

Even if the arguments for the use of a higher discount rate were accepted, they would not change the results of the analysis qualitatively. For refrigerators, at a ten percent discount rate, the level 3 standards would have some positive benefits (although reduced from the benefits calculated at seven percent. The net benefits of the level 3 standards would be higher than level 2 or level 4.

In deriving the seven percent discount rate that was used in the proposed rule, DOE was guided by the Court decision. *NRDC* v. *Herrington, supra* at 110. In the December 22, 1982, and August 1983 final rules concerning appliance energy efficiency standards, DOE used a ten percent discount rate. In dismissing the ten percent discount rate, the Court presented, without comment, a methodology for calculating a discount rate for consumer life-cycle cost and net present value calculations.

The methodology was a calculation of the interest charged on consumer loans, minus the tax deductibility of such interest, minus the rate of inflation; this yields a real, after-tax, rate of interest.

The applicability of that methodology changed considerably with passage of the Tax Reform Act of 1986 (Pub. L. 99-514). The Tax Reform Act phases out the tax deductibility of interest paid on consumer loans (the phase-out will be complete at the end of 1990). DOE used that methodology in calculating a discount rate for the December 1988 proposed rule. The Department examined interest rates on consumer loans (then about 12 percent) and deducted the expected annual rate of price increases (often used as a measure of the inflation rate) in the early 1990's (then forecasted to be around 5 percent).

With the passage of the Tax Reform Act, the issue became more complex. To the extent that purchases of more efficient appliances occur along with the sale of new homes, then the purchase prices of those appliances are often being financed by the interest rate on the mortgage, which is typically lower than interest on consumer installment loans, and is also fully tax deductible. Therefore, in order to derive an appropriate discount rate for these purchasers, it is necessary to estimate the expected mortgage interest rates, as well as the percentage of shipments of refrigerators and small furnaces that are expected to be installed in new homes. When this rule is effective in 1993, there are projections that the fixed contract mortgage rate for conventional commitments will be 10.78 percent.[12] For a purchaser in a marginal tax rate of, say, 28 percent, the after tax rate of interest paid would be 7.76 percent (10.78 x .72). Furthermore, it is estimated that the annual rate of price increases in 1993 will be 4.7 percent.[13] Therefore, the net, after tax, real rate of interest to these consumers would be 3.06 percent (7.76-4.70).

However, only a fraction of the units are expected to be installed in new homes and, thus, qualify for such a favorable interest rate. According to projections in the LBL-REM, around 60 percent of the small furnace shipments, and more than 30 percent of refrigerator shipments in 1993 are expected to be installed in new homes.

Presumably, then, 40 percent of small furnace shipments and 70 percent of refrigerator shipments in 1993 will be purchased as replacements and installed in existing homes. How these units are purchased would indicate an appropriate discount rate. For example, some replacement purchases could be made through home equity loans, the interest for which would be fully tax deductible. Many other replacements will be bought with cash that is withdrawn from savings or by an unsecured, personal loan.

For cash purchases, the relevant interest expense is the foregone interest that those savings could have earned. In 1993, time deposits, i.e., savings accounts, are expected to be earning between 7.72 and 7.79 percent interest.[14] Since such interest, if earned, would be fully taxable, the net, after tax earnings that are foregone are between 5.55 and 5.61 percent for an individual in a 28 percent marginal tax bracket. Subtracting the expected rate of price increases (4.7 percent), one obtains a resulting discount rate of 0.85 to 0.91 percent.

[12] DRI/McGraw-Hill, *U.S. Long-Term Review; Winter 1988-89, Table 6.*

[13] *Idid.*, Table 1.

[14] *Ibid.*, Table 23.

Many consumers, however, will purchase their appliances by taking out unsecured, personal loans, which are likely to carry interest rates of 18 to 20 percent; these interest payments would not be tax deductible. The discount rate for this group of purchasers would be as high as 13.3 to 15.3 percent.

As the foregoing discussion indicates, there is a wide range of possible discount rates to be used in calculating life-cycle costs and net present values. The range is from approximately 1 percent to slightly more than 15 percent.

Although many of the purchasers of these appliances should have real, after tax interest payments below 7 percent, many will have payments in excess of 15 percent; thus it would appear that the use of a seven percent rate in the consumer life-cycle cost and net present value calculations is justified. Since one discount rate is to apply in all the calculations, the Department used a rate approximately at the mid-point of the potential consumer discount rates.

This approach has several advantages. First, it has a reasoned theoretical justification in that it is related to the opportunity cost of money for purchasing consumer durables; as such, it is justified in terms of the alternate consumer investment opportunities that are forgone in order to finance the purchases of the appliances. Secondly, use of a higher rate would arbitrarily bias the LCC results upward, while a lower rate would create biases in the opposite direction.

3. Selection of Candidate Standard Levels

In the proposed rule, the Department indicated that its selection of candidate standard levels was dependent on the consumer life-cycle cost curves that were developed in the analysis. These curves were calculated by estimating the expected initial price increase that such additional design options would cause, adding the discounted value of maintenance and operating expenses, and comparing them to the discounted value of energy savings that would result from those design options. The selection criteria were to consider as possible standard levels as many points from the curves as would be practical. Two levels that were considered as standards were the maximum technologically feasible levels, as required by the Act, and the LCC minima which, at least theoretically, should maximize the benefits to the consumer. In addition, in the case of classes of refrigerators, the Department considered, as candidate standard levels, up to three points less efficient than the LCC minima.

NCAC and Ohio suggested that LCC points occurring between the LCC minima and the maximum technologically feasible should be considered as viable candidate levels. (NCAC, No. 91, at 2; Ohio, No. 138, at 3).

DOE disagrees with the comment. The Department analyzed the LCC minima and maximum technologically feasible levels for refrigerators, and found both levels not to be economically justified. While there is an engineering design that falls between the LCC minima and the maximum technologically feasible, the Department believes that if two standard levels are found not to be economically justified, the levels between them are also not economically justified.

The CEC said that the establishment of a revised standard that is less efficient than the lowest LCC point is not economically justified. (CEC, No. 108, at 30).

The Department disagrees with the CEC's statement; the standards decision is based on a review of the analytical results, after taking all seven factors of economic justification into consideration. The LCC results are just one of the factors that is considered.

Jon Leber (Leber), a professional engineer, noted that DOE incorrectly stated that "at efficiency levels beyond the LCC minima, the incremental first cost of the product exceeds the value of the energy savings such that the average consumer does not realize a benefit from the investment." DOE agrees; Mr. Leber correctly notes that, in such a situation, "The consumers will still realize a benefit from the investment but the ratio of the benefit to the cost will now be less than one." (Leber, No. 155, at 1).

Ohio maintained that Congress clearly did not intend for DOE to exclude considering the benefits of energy efficiency that go beyond those that are represented in a life-cycle cost comparison. (Ohio, No. 138, at 7).

The Department agrees with Ohio, and notes that the LCC comparison was just one of the seven factors of economic justification that was consider.

4. Calculation of Energy Savings

Some comments questioned the Department's calculations of energy savings. The CEC contended that historically the average efficiency resulting from a new standard has overshot the theoretical market minimum by five to ten percent, and that DOE has underestimated the actual energy savings and economic benefits that will accrue from standards by at least that amount. (CEC, Testimony, January 12, 1989).

The Department notes overshoot means the positive difference between maximum unit energy consumption standard levels, and the average unit energy consumption actually attained by models sold after standards are implemented. For example, actual unit energy consumption may be five percent or more lower than standard levels.

DOE did not assume an overshoot, but adhered to its methodology, that, in the base case, the market will demand a range of efficiencies such that the SWEF exceeds the 1990 standard (in the case of refrigerators). In the standards cases, designs which met or went beyond the standard were considered to be available for purchase and were used to calculate a new SWEF. While no arbitrary overshoot was assumed, the average efficiency projected after standards by this method is allowed to go beyond the standard by an amount depending upon the base case distribution of efficiencies. In looking at the SWEF under each standard level, the Department is confident that it has captured all of the energy savings that each candidate standard level could generate.

It should be noted that the more stringent the standard level, the closer that the SWEF will be to the standard level, and the lower that the overshoot will be. LBL-REM SWEF projections are found in Tables 5.6, 5.7, and 5.16 of the Technical Support Document.

5. Reporting of the Environmental Benefits of Standards

In reporting the results of the analysis in the proposed rule, the Department presented the environmental effects of standards only in the Environmental Assessment (DOE/EA-0372, November 1988). The Solar Energy Association of Oregon (SEAO) commented that, in determining the economic justification of candidate standards, the Department should consider the environmental benefits that it calculates would result from candidate standards. (SEAO, No. 44, at 2). In addition, Representative Markey commented that mitigating global warming and pollution are important for our national security. (Markey, No. 151, at 2).

Under the economic justification factor, Need of the Nation to Conserve Energy, as discussed above, the Department considered the environmental effects that are expected to result from standards. These effects are reported for each product in section IV of this notice.

6. Choice of Proposed Standard Levels

In the proposed rule, the Department proposed a range of refrigerator standards, from not amending the 1990 standards through standard level 3. All of these possible standards were found to save a significant amount of energy, be technologically feasible, and be economically justified.

RMI commented that although the Department found that standard levels 4 and 5 also satisfied those requirements, it did not propose either, thereby "violating the law." (RMI, No. 49, at 2).

The Department notes that RMI is mistaken; in fact, in the proposed rule, the Department said that both standard levels 4 and 5 would be technologically feasible and would result in a significant conservation of energy, but that the Department found that they were not economically justified.

GE and AHAM commented that the Department should not adopt refrigerator standards that are based on the scenario used for the proposed rule (in which it was assumed that CFC-11 and -12 would be available for refrigerator production), since that analysis did not consider the phase-out of CFCs. (GE, No. 125, at 7; and AHAM, No. 137, at 2).

While there is much speculation and many proposals concerning the phase-out of CFC-11 and -12, the Montreal Protocol calls for an immediate rollback of production to 1986 levels with a 50 percent cut of those levels by 1998. As a result, various chemical companies and laboratories are doing research on finding replacement chemicals. However, the record is fairly clear that replacement chemicals will not be available by 1993 when these standards go into effect.

DOE believes that CFC-11 and -12 will be available to refrigeration manufacturers in 1993 and probably will still be available in 1997, although at higher prices. The Department believes that, short of some new treaty or legislation, any transition from CFC-11 and -12 over the 1993 to 1998 time span will occur voluntarily. However, DOE believes that such a transition would likely occur; therefore, the analysis was modified to include the possibility that it occurs before 1998. To accomplish this, the analysis was divided into two parts. For the period 1993 through 1995, it was assumed that CFC-11 and -12 are available, and for the period 1996 and beyond, it was assumed they are replaced.

For this later time period, the engineering analysis was modified as discussed, *supra*, in the "Product-

Specific Analytical Comments for Refrigerators" to include features such as enhanced heat transfer for evaporators and dual compressors. Other features, such as the 5.3 EER compressor and enhanced performance foam insulation (k=.10), were deleted, since such designs are not likely to be achievable without CFCs. A 5.3 EER compressor needs CFC-12 as a working fluid to achieve its maximum efficiency. Based on announcements from Dupont, it was assumed that a replacement for CFC-12 becomes available with no performance penalty. In addition, based on results of tests conducted by the Mobay Corporation [15], it was assumed that the replacement for CFC-11 will have a five percent penalty in insulation performance. The thermal conductivity of 0.1275 Btu-in/hr°F ft ^{2} was used in the analysis for today's final rule.

In addition to a performance penalty for the CFC-11 substitute, the Department also assumed a price penalty for both CFC-11 and CFC-12 substitutes. This penalty was to assume a three-fold increase in price.

The engineering analysis presented in the proposed rule is still used for the earlier time period; the Department chose to modify the engineering analysis only slightly, because the Department believes it still is generally representative of the possibilities with CFC-11 and -12 being available. The slight modifications included increasing the estimates of evacuated panel costs, and, as baseline volumes were adsjusted, recomputing the baseline cost estimates.

All impacts of the refrigerator standards presented today are a result of the original engineering analysis being used for 1993 through 1995 and the modified engineering analysis, with its different costs and features, being used from 1996 and beyond. The Department believes that this represents a conservative but plausible scenario for the possibility of a transition away from the CFC-11 and -12.

Both the with- and without CFC-11 and -12 scenarios were used in the LBL-REM, LBL-MIM, and in the environmental analyses. As the scenarios changed inputs to LBL-REM, the LBL-REM fed into LBL-MIM and the environmental analyses and affected their results, also.

The Department notes that in the above scenario the consumer paybacks presented are based on the earlier CFC case, since the Department believes that the Act requires those estimates to be presented for the year in which the standards are to be effective. The trial standard levels, however, were based on costs and efficiencies achievable with alternatives to CFC-11 and -12, i.e., the post-1995 scenario.

b. Product-Specific Analytical Comments

1. Refrigerators

A. *Engineering Analysis:* The comments on the engineering analysis of refrigerators dealt with a variety of issues, ranging from the Department's methodological approach and assumptions to its estimates and calculations.

Evacuated Panel Costs and Energy Efficiency

One comment contended that, in the analysis for the proposed rule, the Department had underestimated the costs and overestimated the associated K value for evacuated panel insulation. (Admiral, No. 135, at 2). General Electric's (GE's) comment, however, supported the K value (of 0.05 for a composite of evacuated panel and foam insulation) used by the Department. (GE, No. 125, in Appendices 6 and 7).

With regard to the underestimation of cost, for the analysis for the final rule, the Department agrees that an increase in its estimate of evacuated panel costs is justified after receiving comments from Admiral, who has performed research on the development of vacuum panels.

DOE agrees with GE that the K value for a composite wall of foam insulation ands an evacuated panel is correctly represented by 0.05. The Department realizes that Admiral's original estimate of K value was speculative. However, DOE is relying more on GE's comment, since that company has actually manufactured powder filled panels in refrigerator-freezers, and, therefore, has actual knowledge of what the K factor can be.

Evacuated panel availability

Amana Refrigeration, Inc., (Amana, No. 87, at 1-3) believes that the arguments concerning the future availability of evacuated panels for industry wide use are ill-considered. The statement identified a single, but all-important facet of this emerging technology; namely, the supply of ultra-fine silica powders which have thus far been the best candidates for filler material for two types of panels.

Amana stated that based upon the several patents issued and other literature covering this subject area, fumed silica and precipitated silica are the premier candidates for filler material in evacuated panels. When utilized in a plastic pouch and evacuated to an absolute pressure of approximately 0.1 Torr, the densified silica weighs approximately 8.0 to 9.8 lbs per ft^3. (This is the powder-filled panel produced by GE). Fumed silica tends to have a smaller particle size (0.8 um) than the fine precipitated silicas (1.3 to 2.0 um), thus tending to be a more consistent insulator.

With this information, Amana provided a "what if" scenario, for a hypothetical use of evacuated panels in the industry's refrigerator and refrigerator/freezer products. First, Amana made several assumptions:

(1) The industry's annual production of 6.9 million refrigerators and refrigerator/freezers in 1988 will continue at that level.

(2) The 18 cu. ft. top freezer model described in the Technical Support Document represents an "average" model for the purpose of calculating material requirements.

(3) That a composite insulation structure consisting of ½" thick panels (R=10) and foamed-in-place polyurethane represents a viable structure for consideration.

(4) That the evacuated panels should substantially cover the entire inner surface (5 sides) of the refrigerator outer case to achieve the benefits of enhanced insulation. For the assumed model described in the Technical Support Document engineering analysis, this could require as much as 45 ft^2 of evacuated panel. The silica material required then ranges from 15.5 to 18.6 lbs. per unit. (The lower number refers to fumed silica fillers; the higher to precipitated silica.)

DOE believes that these four assumptions are reasonable for this analysis. Amana's fifth and all important assumption is that the entire Industry has to install evacuated panels in all its products by 1993—a purely hypothetical scenario.

Amana, using the assumptions above, demonstrates that industry requirements for fumed and precipitated silica for evacuated panel use are in the range of from 107 to 128 million pounds, annually. Since the entire United States' production capability for manufacturing these materials is estimated to be approximately 200 million pounds annually, the refrigeration industry's requirements could consume over 60 percent of the entire national supply. This would be an untenable situation, and the suppliers of silica powders

[15] Dietrich, K. W. and H. P. Doerge, "Performance of Alternative Chlorofluorocarbons in Rigid Urethane Appliance Foams," in *Proceedings of SPI; 31st Annual Technical/Marketing Conference*, October 18-21, 1988, pp. 141-147.

would need to enhance their productive capability significantly.

A fumed silica manufacturing plant with an annual capacity of 11 million pounds represents a $40 million investment, not including the siting and environmental protection costs. To meet the hypothetical demand noted above, ten such plants would be needed. Erection and prove-out time requirements would range from 3 to 4 years after site selection, zoning approvals, environmental impact statements, and other preliminary procedures were completed.

Quantum Optics testified that "Aerogels are now available only in limited quantities, but several projects are underway that could lead to production for the entire refrigerator industry by 1993 if adequate investment capital is committed." (Quantum Optics, Testimony, January 12, 1989).

DOE has reviewed the comments, and believes that the chemical industry will not be able to make sufficient quantities of silica commercially available by 1993; and, therefore rejects this technology as being economically justified.

Additivity of Energy Impacts of Design Options

White Consolidated Industries (WCI) stated that the analysis was "not adequate for standard setting. Often various design changes interact with each other or with existing systems. The results are rarely additive as simplistically assumed by (the Department's) analysis." (WCI, No. 78, at 5).

The Department agrees that because designs can interact, the energy impacts are not necessarily additive. That is why the Department computed independently the energy impacts of each combination of designs. Simulations were run for each combination of design options as shown in the Technical Support Document. Interactions among design options were accounted for as part of the simulation model.

Estimates of Improved Thermal Conductivity Values

WCI stated that the Department's analysis of improved insulations goes "far beyond anything we believe will be available." (WCI, No. 78, at 6). Specifically, WCI argued that the assumption that .11 and .10 K values can be achieved with MDI foam is not valid.

In response, the Department notes that GE testified that it presently achieves a K value equal to 0.11. (GE, Testimony, January 12, 1989). Since a K value equal to 0.11 is available now, the Department has no reason to believe that it will not still be available in 1993, when this rule will be in effect. On the other hand, because of the expected product development, e.g., drying, rigidity, and other implementation issues, that the Department expects will be needed to achieve the availability of .10 foam, DOE agrees with WCI that such foam is not likely to be available, in necessary quantities, in 1993. Therefore, in its analysis for this final rule, the Department limited its consideration of a maximum improvement in thermal conductivity value to 0.11.

Substitution of Foam Insulation for Fiberglass

In the proposed rule, the Department reported that it had estimated a 12 percent reduction in energy-use as a result of substituting foam for fiberglass under the lid of a chest freezer. WCI argued, however, that when it made a similar substitution, there were zero energy savings. (WCI, No. 78, at 5).

The Department's estimate of energy savings from foaming the lid of a chest freezer was obtained from an analysis of K factors for fiberglass and foam insulation. With the area and temperature difference being equal, the Department believes that the superior K factor of foam should provide a noticeable savings.

Furthermore, even assuming a penalty for the replacement of CFC-11, the Department estimated that foaming the lid of a chest freezer would still result in an 8.6 percent reduction in energy-use for this design option.

In addition, the substitution of foam for fiberglass should provide superior insulating qualities, at least theoretically, and, therefore, provide some energy savings. Empirically, such substitutions have produced energy savings in other refrigeration applications. The Department, therefore, does not understand why WCI's substitution of foam for fiberglass in a chest freezer lid produced no energy savings.

Energy Savings With the 5.0 EER Compressor

In the proposed rule, the Department reported that its energy model predicted an 11.2 percent energy reduction when a 5.0 EER compressor was substituted for a 4.5 EER compressor in the case of an 18 cubic foot, top-mount, automatic defrost refrigerator-freezer. Admiral, however, commented that its simulation model "predicts a 7.1 percent energy reduction for the same change." (Admiral, No. 123, at 7).

The Department's simulations modeled actual compressors with data supplied by compressor manufacturers. The 5.0 EER compressor that was modeled was actually a 5.05 EER compressor at the standard rating conditions (130°F condensing temperature and −10°F evaporator temperature). The Department has changed its designation of the 5.0 EER compressor to a 5.05 EER compressor in the substitute CFC analysis. The 4.5 EER compressor is actually a 4.3 EER compressor at the rating point. If both compressors operated at the same standard conditions, the efficiency improvement for the refrigeration system would be $(5.05-4.3)/4.3=17.4$ percent. The energy reduction, (assuming no auxiliary electric energy use) would be 14.8 percent. However, since only about 75 percent of the total energy use for the top-mount automatic defrost refrigerator-freezer is for the compressor, the efficiency improvement would be only 11.1 percent (.75 (14.8 percent)). Therefore, if the evaporator and condenser temperatures were at −10°F and 130°F, respectively, 11.1 percent would be the expected energy savings. The Department had an 11.2 percent energy savings. It should be noted that the simulation model solves iteratively for the condenser and evaporator temperatures. Therefore, the actual compressor EER is rarely equal to the nominal value.

Baseline Model

A number of comments claimed that the baseline models are inaccurate; that is, they do not properly represent the features of average models to be sold in 1990. These comments also stated that the average unit represented by the shipment-weighted energy factor (SWEF) would be substantially higher, i.e., more efficient, than the 1990 standard. (AHAM, No. 137, at 3 and 16; GE, No. 125, at 22–24. Battelle, No. 110, at 1, and Testimony, January 13, 1989; and Admiral, No. 123, at 7).

In response, the Department notes that the purpose of the baseline models is to provide a basis for estimating changes in unit energy consumption and production costs associated with implementing engineering design changes. The baseline models in the analysis for today's final rule are generally representative of units that marginally comply with the 1990 standard. In the proposed rule, DOE stated that the baseline models for refrigerators, refrigerator-freezers, and freezers "represent a typical model within an appliance class that will be sold during 1990, the year NAECA standards first take effect."

The Department's baseline unit contained designs that were meant to represent only one combination that can be used to meet the 1990 standard. The baseline description should not be interpreted as being unique. Indeed, there are many ways to achieve a particular energy-use. The baselines that were chosen represent one set of descriptions for units close to the 1990 standards. Where the baseline consumption was greater than the expected 1993 SWEF, an adjusted baseline (from the cost-efficiency curve) was established with which to calculate economic quantities such as payback periods. The Department believes that it is reasonable to expect that the baseline unit should have characteristics that are similar to marginally compliant units that will be produced in 1990. The Department believes that recent manufacturer data submitted to the Department by Battelle show that objective was accomplished. (Battelle, No. 110).

The Department has responded to Battelle's comment by adding a point in the engineering analysis' cost-efficiency curves that reflects the BEM, and has used that information in the LBL-REM. This point was used as the 1990 SWEF, from which calculations of energy savings were made. In addition, its use in the LBL-REM influenced the other parts of the analysis that use LBL-REM output as input, e.g., the LBL-MIM, environmental analysis payback calculations.

In selecting a baseline unit, the Department chose units that had adjusted volumes that are representative of the different models sold. Comments that the baselines chosen had adjusted volumes that differed from the industry averages, which were provided by Battelle, are not relevant. That is because energy standards are not in terms of a single maximum allowable energy consumption regardless of size, but, rather, the standards are equations that relate energy-use to adjusted volume. Therefore, differently sized units of the same class have different maximum allowable levels of energy consumption.

According to data submitted by Battelle, in many cases, the industry has planned design changes to meet the 1990 standards which differ from those characterized by the DOE baseline model. DOE recognizes the diverse methods by which industry can meet the 1990 standards, and is not implying that a specific design will be adopted by all manufacturers. For some classes, the DOE baseline units do not meet the 1990 standards. In those classes, a design option is identifiable which will meet the 1990 standard. DOE assumes that the most cost-effective designs will be incorporated first.

Compressor Efficiencies for Smaller Capacity Units

WCI contended that the proposed rule failed "to take into account the very important difference that size makes in compressor efficiency." (WCI, No. 78, at 5).

Specifically, WCI pointed out that in smaller refrigerators, the correspondingly smaller compressors are less energy-efficient.

This point was also raised at the hearing in testimony offered by Mr. Hardt of the Embraco Corporation. (Hardt, Testimony, January 12, 1989).

After extensive review of the subject, the Department agrees with WCI's and Embraco's contention. As a result, the analysis for this rulemaking limited its evaluation of the maximum feasible compressor efficiency to 4.0 EER for the very small refrigerator-freezers. This consideration was applied only to the manual defrost refrigerator class, since that is the class in which virtually all of the relevant smaller units fall.

Accuracy of the Simulation Model

GE stated that "using the simulation program that GE normally uses for design guidance, the results showed the baseline model would use 1016 kWh/yr., compared with 947 kWh/yr. as shown in the TSD." (GE, No. 125, at 21).

In response, the Department notes that it is difficult to compare two simulation programs without knowing all the details about them. However, there is a very important difference between GE's baseline unit and DOE's. The Department's description of the schematic drawing of its baseline in Appendix A of the proposed rule's Technical Support Document was in error. It describes a 20 ft^3, rather than an 18.0 ft^3, top-mount automatic defrost refrigerator-freezer. The simulations were done for an 18.0 ft^3 unit as described in the proposed rule. The Department, however, placed the wrong schematic in the appendix. Therefore, GE would be expected to obtain a higher energy consumption for its baseline than the Department did. The adjusted volume for the unit pictured in Appendix A is actually 23.4 ft^3 rather than 20.8, a 2.6 ft^3 increase over the baseline adjusted volume. DOE believes that the difference in adjusted volume accounts for the higher energy use of GE's baseline unit.

Analysis of Several Refrigerator Design Options

Several comments contended that the Department had failed to analyze properly several significant design options. These included dual compressor units; two-stage, two-evaporator systems; hybrid evaporators; variable-speed compressors; and, silica aerogel insulation. (American Council for an Energy-Efficiency Economy (ACEEE), ACEEE, No. 77, at 1–4; NRDC, No. 81, at 38–55; NYSEO, No. 156, at 125; CEC, No. 108, at 10; and RMI, No. 49, at 3–5). Each of these will be discussed.

There are at least three variants of two-evaporator systems. These are the two-stage, two-evaporator system, e.g., the LaBrecque cycle; the two-compressor, two-evaporator system; and the hybrid evaporator system. The energy savings arise by having the refrigerator evaporator operate at a higher (about 20 °F) temperature than the freezer evaporator (about −13 °F). A reduction in defrost energy is also possible since there is less condensation of moisture from food in the refrigerator at the higher evaporator temperature. Food will also keep longer because it will not get as dehydrated.

The two-stage, two-evaporator LaBrecque cycle refrigerator-freezer is being developed. Theoretical estimates are that this design can save 20–25 percent of compressor energy currently consumed.

The hybrid evaporator is a two-evaporator system with one compressor. A valve controls the flow of refrigerant to the two evaporators. Two companies have commented that it did not perform well. Amana stated that "variations in the temperatures had a marked effect on the compressor cycling pattern and on thermal performance of the unit." (Amana, Testimony, January 13, 1989).

The two-compressor, two-evaporator system received much attention in the comments (ACEEE, No. 77, at 3; RMI, No. 49, at 4; NRDC, No. 81, at 49–53). These comments identified the Norgard prototype as a low energy prototype that uses this technology. It must be noted that the Norgard prototype also uses thicker insulation than is normal for similarly sized U.S. refrigerator-freezers. There are no anti-sweat heaters and no condenser fan. The Norgard paper [16]

[16] Per Henrik Pedersen, Jorgen Schjaer-Jacobsen, and Jorgen S. Norgard, *Reducing Electricity Consumption in American Type Combined Refrigerator/freezer*, paper presented at 37th Annual International Appliance Technical Conference, Purdue University, May 6–7, 1986.

estimates about 20 percent energy savings for the refrigeration system. Using the Norgard equations and the Department's data results in a 17 percent energy savings for the compressor. Norgard does not provide data on the compressor EERs or additional cost for the refrigeration system. One comment stated that the Norgard prototype can be built for $150–$200 more than conventional models, and the price premium would fall with increased production. (RMI, No. 49, at 4). This price increase is supposed to cover all changes in the prototype relative to the conventional model. Two-compressor, two-evaporator system models are built by Sub-Zero in the U.S. and by Bosch in Germany.

After analyzing the three different two-evaporator systems, the Department has added such a design option to the analysis. DOE selected the two-evaporator, two-compressor system for the analysis.

The Department attempted to obtain data on variable-speed compressors from refrigerator and compressor manufacturers, but was unable to. In the future, manufacturers may go to this technology to match loads better to compressor capacity. This will reduce cycling losses and allow for higher evaporator temperatures in the refrigerator compartment. The cost of such a system and the performance are not yet known. This design could eventually be considered as another alternative for the two-evaporator system; that is, a variable-speed compressor could operate with an electronically controlled valve and two evaporators to supply refrigerant to the cabinet that requires it.

Since the Department's original analysis, aerogel insulation has been more seriously considered as a replacement for foam insulation in refrigerators and freezers. A prototype is being constructed by a manufacturer in concert with Quantum Optics, Inc. (Quantum) (Quantum, Testimony, January 12, 1989). DOE performed some analysis of this design option, e.g., the development of cost-efficiency data, but chose instead to let powder-filled panels be the representative for evacuated panel insulation. Powder-filled evacuated panels have been used in some refrigerators marketed in the United States, and the Department believes that the data on their cost and performance characteristics are more reliable for use in modeling the energy-conserving possibilities of evacuated panels.

Two comments argued that the Department's analysis was insufficient in treating alternative refrigerants, condenser gas heating, and improved gaskets. (NRDC, No. 81, at 44–55; and CEC, No. 108, at 10).

Improved gaskets reduce heat leakage and thus reduce compressor energy use. This can be done by improving single gasket designs or changing to a double gasket design. NRDC commented that improved single gaskets should be considered. (NRDC, No. 81, at 57). The Department's proposed rule assumed a 10 percent improvement in gasket heat leakage for its baseline models. The Department does not see that further improvements can be made. Therefore, for the final rule, the Department continued to assume a 10 percent improvement in gasket heat leakage for the baseline models.

Since the proposed rule was prepared, new research has been performed on alternative refrigerants. Alternatives, such as HFC–134a and HCFC–22, and mixtures have been considered. The former will not provide an efficiency as high as that of CFC–12, although both HFC–134a has the advantage of no ozone depleting potential (ODP) and HCFC–22 a much lower ODP than that of CFC–12. For mixtures, such as CFC–12 and DME, preliminary Oak Ridge National Laboratory (ORNL) data show an improvement in efficiency relative to that of CFC–12 alone. However, the work at ORNL is only preliminary and more testing is necessary. The Dupont mixture, consisting of HCFCs–22 and –124, and HFC–152a, is reported to be approximately equal to CFC–12 in efficiency. The new blend is reported to be a drop-in, and oil compatibility is not reported to be a problem. The ODP is very low (0.03) relative to CFC–12 (1.0). Toxicity testing is needed for HCFC–124. Only limited commercial quantities could be provided before 1993–94 (Dupont, No. 113, at 2).

Two comments contended that substitution of condenser gas heating for anti-sweat heaters around the doors of refrigerators and freezers will save energy because the electric energy use of the heaters is saved. (NRDC, No. 81, at 56; and RMI; No. 49, at 5). This is a controversial issue. It is not clear if the heat flowing into the cabinets due to the increased wall temperature would be greater than that provided by the electric heaters. Since any additional internal heat would have to be removed by the refrigeration system, condenser gas heating may not be more energy efficient than electric anti-sweat heating. One participant at the hearing stated that it is unclear whether using condenser gas heating saves energy. (Sub-Zero Freezer Company, Inc. (Sub-Zero), Testimony, January 12, 1989).

NRDC assumes that condenser gas heating will save energy because most of the heat energy will flow outwards (due to the higher R-value of the walls). However, DOE believes this may not occur since the wall temperature may still be higher than without condenser gas heating. Therefore, DOE rejects condenser gas heating as an energy saving design.

Natural Convection in Lieu of Fans

RMI commented that the Department should have included the use of natural convection currents instead of fans in some situations. (RMI, No. 49, at 5).

The Department notes that it may be possible to remove fans in a two-evaporator design where air need not be circulated from the freezer to the refrigerator compartment. The Norgard design uses one fan in the freezer compartment, and none in the refrigerator cabinet. Sub-Zero's design, on the other hand, uses fans in each cabinet.

Where two-evaporator systems were studied, the Department's analysis included a four watt evaporator fan in the freezer compartment, and no fan in the refrigerator compartment. By modeling this design, which is similar to the Norgard one, the Department's analysis does address the savings potential of natural convection currents.

Inclusion of Enhanced Heat Transfer for Evaporators

Two comments stated that DOE should have included in its analysis enhanced heat transfer for evaporators. Heat exchanger heat transfer can be improved by increased area, increased air flow over the refrigerant tubes or other heat transfer enhancement. (ACEEE, No. 77, at 4; and CEC, at 10). All of these approaches allow the evaporator temperature to be increased, which results in less compressor energy use. Heat exchanger area can be increased by increasing face area or adding more rows of refrigerant tubes. Increased area will result in increased evaporator heat transfer effectiveness. Increasing the volume occupied by the heat exchanger will reduce the internal volume since evaporators are located inside the cabinets. Simulations with the top-mount, automatic defrost refrigerator-freezer indicate that an increase in evaporator "heat transfer-area product" of 10 percent will result in a 1.1 percent energy use decrease.

DOE added this design option to the analysis.

Another alternative is to add fins or redesign the fins so as to increase the rate of heat transfer. For example, the amount of material used in the fins could be kept constant while changing the shape of the fins, and possibly increasing their density. Alternate materials could be used that have higher rates of heat transfer to the surrounding air. The heat transfer on the interior of the heat exchanger tubes can also be enhanced by adding grooves or other modifications. Data provided by coil manufacturers to the Department indicate that an energy savings of 1.5–2.0 percent is possible for enhanced evaporator heat transfer for an additional cost of $1.225 million (all tooling and expenses, covering all applicable refrigerator and freezer classes). Although there is no confirmation of this cost estimate, DOE has converted this tooling cost into a per unit cost.

The ACEEE further stated that a paper by Mr. Bohman of Amana discusses the potential savings with improved evaporator heat transfer. In that paper, an example was given where the uA value [17] for the evaporator is increased from 65 to 113, and the compressor can operate at −10 °F rather than −15 °F. This results in an energy savings of 7.5 percent for a 74 percent increase in heat transfer effectiveness. This is similar to the simulation results cited above. The analysis is over-simplified since space limitations and other factors must still be considered. Costs of such an improvement were not provided in any comments received. Therefore, DOE is using the data that was used previously to estimate energy savings and costs for enhanced evaporator heat transfer.

Improved Expansion Valves and Fluid Control Valves

One comment states that data should be gathered on improved expansion valves and fluid control valves, since fluid control valves could be used to reduce off-cycle refrigerant movement. (CEC, No. 108, at 10). Fluid control valves would cause a compressor to start against an unequalized pressure condition. This has been accomplished for rotary, but not for reciprocating compressors. Fluid control valves have not been effective with reciprocating compressors; and, it was reciprocating compressors that the Department simulated in its analysis. Therefore, the Department has not modeled any energy savings from the use of fluid control valves with reciprocating compressors.

Although DOE has comments requesting an evaluation of improved expansion valves, no new data have been forthcoming. As stated in the proposed rule, it is expected that some energy savings would be possible from this design option in the non steady-state mode. Another complication is that the test procedure may not be suitable to demonstrate the savings from this design option. Additional information from the laboratory as well as in-use data are needed to evaluate this design accurately.

There were no new data submitted on either of these design options.

B. *Consumer Analysis:* The comments on the consumer analysis of refrigerators dealt with a number of issues including the baseline models and efficiencies for 1990 and the Department's projections of no improvement in energy use and efficiency levels for refrigerators.

Energy Use Projections

Battelle submitted data that support the energy consumption estimates that had been attributed to specific designs by the Department. These data indicate that manufacturers plan to exceed the 1990 standards. Battelle did not criticize the costs associated with the design options.

DOE continues to calculate energy savings and net present value of proposed standards by comparing the trial standards cases to the base case, which includes the 1990 standards. DOE welcomes the AHAM data submitted by Battelle, since it is useful for calibrating the base case in 1990, as noted above.

Based on revisions to the engineering data and modeling inputs, e.g., energy price projections and heat pump shipments, the Department has calculated a new projection of efficiencies for refrigerators. These revised projections are reported in the Technical Support Document accompanying today's final rule. *See* Technical Support Document, Appendices A and B.

NYSEO criticized the Department's questioning of its own projection that, in the absence of more stringent refrigerator standards, no improvement in refrigerator efficiency would be likely. NYSEO characterized the Department's statement as a "turnaround" for which DOE had provided no justification. (NYSEO, No. 156, at 20).

While the Department believes that conservation improvements in refrigerators will occur, nevertheless, the analysis for the final rule continues to project that in the absence of more stringent standards, there would be no improvement in refrigerator energy efficiency. The Department continues to question the LBL-REM's forecast of no improvement in SWEF over the analysis period (1993–2015). The Department finds that the improvement in efficiency which has occurred and the improvements that are possible, as shown in the engineering analysis, make it highly unlikely that, on average, there will be no improvement in refrigerator efficiency over the next 25 years.

Shipments

One comment on the proposed rule suggested that the Department's projections of refrigerator shipments under the different standards cases were too high. (Battelle, No. 110, at 2, 23). Battelle not only does not expect shipments to increase in the standards cases, as DOE had projected in the proposed rule, but expects instead that shipments would decline under standards, at least in the short term. (Battelle, No. 110, at 21).

DOE agrees with comments raised by Battelle.

DOE obtained the results of increasing shipments in the standards' cases primarily because of the operating expense elasticities in the LBL-REM, which were based on a cross-sectional analysis that was done in 1976. In response to Battelle's comments, the Department has revised, but not eliminated, operating expense elasticities, in order to prevent refrigerator sales from increasing in the standards' cases. Values of the operating cost elasticities for refrigerators and for freezers are presented in the Technical Support Document.

Battelle also contended that "consumers switching to efficient models only steal sales from inefficient models." (Battelle, No. 110, at 22).

The Department believes that this view is unsupported. Although effectively all households in the U.S. now own a refrigerator, the saturation did not stop at 100 percent. In fact, many households now own two, and in some cases three, refrigerators. If the operating expense of an appliance decreases, it could become more attractive to a larger population.

Maintenance Expenses

Another critique of the consumer analysis of refrigerators was that the Department did not include additional maintenance expenses that would be associated with more efficient refrigerator designs. Battelle suggested, in fact, that more efficient designs impose an incremental maintenance expense equal to five percent of the incremental price. (Battelle, No. 110, at 16). In addition, while not suggesting a specific amount, GE also complained

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[17] uA is the engineering factor for heat transfer-area usually given in units of Btus/hr/°F.

that the economic analysis that was reported in the proposed rule did not consider maintenance expenses. (GE, No. 125, at 34).

In the proposed rule, DOE assumed that there would be no incremental maintenance expenses for the refrigerator, refrigerator-freezer, and freezer design options considered. The Department does not believe that incremental maintenance expenses are accurately represented by simply taking five percent of the incremental price as proposed by Battelle. The information presented is insufficient to justify including such expenses as proportional to equipment prices. In addition, the Department does not believe that the designs under consideration, e.g., more efficient compressors and improved gaskets, would be sufficiently different in design from their less energy-conserving counterparts that their estimated reliability should be lower. The Department, therefore, continued to assume no incremental maintenance expenses in its analysis for the final rule.

C. *Manufacturer Analysis:* The comments on the proposed rule's analysis of impacts on refrigerator manufacturers dealt with four areas: the markups used in the analysis; profitability questions; the discount rate from the manufacturers' perspective; and, the "worst case" refrigerator sensitivity scenario. Each of these are discussed, below:

Markup

CEC and NRDC argued that the constant markup assumption in the manufacturers' impact model (LBL–MIM) was unrealistically high, and they requested documentation of its origin. (CEC, No. 108, at 14–16; and NRDC, No. 81, at 111–113).

The Department notes that the Manufacturer Analysis uses a manufacturer markup, which varies with the product class, and a retail markup which is constant. To arrive at the retail price, the manufacturer's cost is multiplied by the manufacturer markup and the retail markup.

The LBL–MIM computes a set of manufacturer markups based on estimates of the average markup and the ratio of the highest to the lowest markup, and on the assumption that markup is linearly related to the price of the appliance class, that is, the greater the price, the greater the markup that is contained within that price. These three pieces of information completely define the manufacturer markup for each appliance class.

The first use of these markups is to estimate the unit variable cost in the calibration, or present-day, case. This is done by taking the retail prices for calibration-case appliance models, and dividing, first, by a constant retail markup, and then by the manufacturer markup for the appropriate class.

The central economic calculations of the LBL–MIM (found in the long-run module) divides the cost of a baseline (calibration) unit into fixed and variable components. It is assumed that fixed costs cannot be marked up, but that variable costs are. From this assumption, a markup for variable cost is computed; this markup reproduces the estimate of the industry's average ROE. This markup is then applied to the long-run variable cost component of all cost increases, and is constant over all design options. At this stage of the model, classes are not considered.

The manufacturer analysis is based on manufacturer price, which is calculated as just described. In addition, one final calculation using markups is made for the benefit of other parts of the analysis. That is the calculation of retail prices for the individual classes. This begins with the manufacturing price in the calibration case, and adds to this the change in long-run variable cost times the manufacturer markup for the particular class under consideration. (This is the markup described above; it varies from class to class.) These new prices are then all multiplied by a factor (near one in value) which is designed to ensure that the average price, when computed by weighing all classes by their shipments, is the same as the price that is computed by the long-run module, and is used in the LBL–MIM analysis.

The comments requested documentation to validate these markups. There are no "real market data" on markups at either the manufacturer or retail level, since these data are highly confidential. The manufacturer markups used in the analysis were developed for the proposed rule from data and information collected from refrigerator manufacturers.

The retail markup is an average retail markup that covers a range of actual markups and it is not meant to represent any one type of retail distribution channel. NRDC asserts that the retail markup will decrease rather than stay constant as standards impose a higher first cost of refrigerators. (NRDC, No. 81, at 111). However, NRDC does not provide any data to support its claim or to show how much the markup should decrease. There is no reason to believe that retailers will not mark up cost increases induced by standards. The Department did not use any data to arrive at the constantness of the retail markup assumption, because no data exist, but believes that assumption is more plausible than any alternative.

Profitability

The questions about refrigerator manufacturers' profitability involved projections about profitability in the short- and long-run, as well as the projected differences in forecasted profitability under five standards cases.

In commenting on the likely short-run profitability results, Battelle stated, "the cost increases that will accompany more stringent standards will not be fully recovered or immediately reflected in higher prices, resulting in lower profits and returns in the short run." (Battelle, No. 110, at 22).

In response, it must be noted that if standards lead to a decrease in shipments, the LBL–MIM does predict a short-run fall in profits. LBL–MIM predicts, however, that there will not be a decline in shipments or profits in the short run for refrigerator manufacturers. Nevertheless, the dynamic process of adapting to a new situation—the process of reaching a new equilibrium of demand and supply—is difficult to model. It is difficult to predict what production, marketing, and pricing strategies different manufacturers would choose in adapting to more stringent standards, and it is possible that some manufacturers would make choices that would result in lower profits in the short run until they learn how to operate in the new environment.

On the issue of long-run profitability, Battelle contends that, under revised standards, refrigerator and freezer shipments will decrease rather than increase (as the Department had projected in the proposed rule), and, therefore, profits will decrease. In addition, for any chance for profits to increase, shipments would need to increase. (Battelle, No. 110, at 22). The Department of Justice (DOJ) also questions the conclusion that the proposed refrigerator standards could increase profits. (DOJ, No. 162, at 4).

The Department notes that for improved profitability, it is not necessary for shipments to increase under revised standards. If a manufacturer sells fewer units that are higher priced or that have higher profit margins, it is possible that profits would increase.

Battelle does state that "because cost increases cannot be passed on, immediately or completely in this price competitive market, profits and ROE (return-on-equity) cannot increase." (Battelle, No. 110, at 22).

In response, the Department questions the inevitability of this result, since Battelle gives no data to support the assertion that costs cannot be passed on completely, nor to what extent they can be passed on. Observation of the marketplace strongly supports the view that increases in variable costs generally are passed on, often with a markup. No single manufacturer could independently make substantially more efficient machines and expect an increase in his profitability, because his product's purchase price would be higher to the consumer than would his competitor's less-efficient product. Because of that manufacturer's higher prices, and the fact that the average consumer does not consider life-cycle expenses, that manufacturer, by acting alone to produce a more energy-efficient appliance, would likely experience declines in profitability and ROE. However, standards are likely to raise the production costs of major refrigerator manufacturers similarly, thereby increasing the likelihood that costs can be passed on in the form of higher consumer prices for refrigerators. Furthermore, the extent to which costs are passed on is determined by the proportion that is variable as opposed to fixed, as discussed under markup above.

In urging support for standard level 4, the Oregon Department of Energy (ODE) contended that "level 4 results in a more positive economic impact on manufacturers than level 3." (ODE, No. 83, at 2).

The Department notes that the ODE did not describe what criteria it was using for "positive economic impact;" from the analytical results in support of the proposed rule, however, the Department consistently used ROE as the normal measure of impact, and ROE was reported to be 0.03 percentage point lower at standard level 4 than at standard level 3.

Manufacturers' discount rate

Battelle asserts that "From the manufacturers' perspective, use of a 7 percent real discount rate is also unsupportable" for a manufacturer analysis. (Battelle, No. 110, at 33). Battelle's concern appears to be that the correct discount rate be used in estimating the economic impacts of energy conservation standards on manufacturers.

In response, the Department notes that the LBL–MIM used a real interest rate of six percent in modeling the interest rate paid for debt incurred by the firm. This figure was reported on pages C–45 and C–59 of the proposed rule's Technical Support Document. Battelle concurs with using this interest rate for this part of a manufacturer's operations. (Battelle, No. 110, at 33).

LBL–MIM uses the firm's weighted average cost of capital (WACC) (which includes both return-on-equity and return on debt) in analyzing the impacts of additional investments induced by standards, and LBL–MIM uses a WACC rate of 12.1 percent for refrigerator manufacturers (See proposed rule TSD, p. C–59). Battelle uses ROE for the manufacturers discount rate. Although WACC is a different measure from ROE, the rate that is used is similar to what Battelle suggests the analysis should use: "Based on our knowledge and experience, an industry like the refrigerator/freezer industry would likely require a return-on-equity between 10 and 20 percent, though probably in the mid to lower half of this range * * * *" (Battelle, No. 110, at 33).

Thus, it seems that Battelle's disagreement with the discount rate used in the Manufacturers Analysis is a result of misunderstanding what numbers are used in what portions of LBL–MIM.

Sensitivity Analysis

The NRDC commented that the refrigerator sensitivity analysis that was used in a "worst case" scenario, which consisted of a low consumer operating expense elasticity, was implausible and should not be used. (NRDC, No. 81, at 113–117).

In response, the Department notes that the NRDC correctly states that if the operating cost elasticity is zero, "consumers pay no attention whatever to operating costs," but then incorrectly concludes that "market forces will never save a single kilowatt-hour of energy consumption in refrigerators, but instead that standards will be and have been responsible for 100 percent of the efficiency improvement that can ever take place." (NRDC, No. 81, at 113–114). In fact, increased efficiency is often the by-product of technological change driven by very different market forces. DOE does not believe that all scenarios are possible. This one is offered as a way of providing a firm bound on the estimated values. The Department agrees with NRDC that a zero operating cost elasticity is highly improbable, but lacks the data to estimate that probability.

NRDC also states that even if consumers are totally unresponsive to savings in operating costs, there will still be an operating cost elasticity, because consumers are saving money on operating expenses, and thus will buy more refrigerators. This is referred to as the "income effect," which, the Department believes, would be small in this case because: (1) The operating cost savings in any one year are extremely small relative to a consumer's income; and, (2) the consumer is not restricted to buying appliances with the money saved—he or she can spend it in any way desired.

Regarding the industry price elasticity, the Department agrees with NRDC's analysis that the data showing a price elasticity of −1 are improbable. That price elasticity was used, however, only in the sensitivity analysis. Sensitivity analyses are meant to help set upper and lower bounds on the results of an analysis, and as such are supposed to be unlikely. Thus, the Department believes that its choices of industry price elasticity and operating cost elasticity for the sensitivity analysis are good choices.

2. Comments on Small Furnace Analysis

A. Engineering Analysis

The engineering comments related to the energy use of an induced draft fan, the space required for induced draft fans in narrow units, low maintenance costs, and low installation costs. Each of these will be addressed.

Energy Use

Lone Star Gas (LSG) correctly states that DOE did not include the cost of electricity to operate the induced draft fan motor in a 78 percent AFUE small gas furnace. (LSG, No. 130, at 9).

The Department has not included electrical consumption in the determination of AFUE for any gas or oil furnaces. However, as furnaces have become more sophisticated with items such as induced draft fans, to include electricity consumption in the determination of AFUE has become a growing concern. While the AFUE calculation for small gas furnaces does not include any fan energy consumption, the Department did include, in the analysis for the final rule, an operating cost for a 50W electric power demand for the induced draft fan in the 78 percent AFUE small gas furnace.

Size

Energen and Alabama Gas Corporation (E&AGC) state that induced draft fan designs are currently not available in the narrow sizes (10.5"–12.25") that are often used in multifamily housing. (E&AGC, No. 82, at 4).

Presently designed induced draft units may not fit some of the narrowest spaces now being used. DOE believes that there are no technical reasons, however, to preclude the design of narrower induced draft fan units. It is difficult for DOE to predict exactly what new models will look like but the Department does not believe that the compact, narrow furnace market will be abandoned. Additionally, some of the relatively new gas units that combine water and space heating in one unit may be appropriate where compactness is required.

Maintenance Costs

LSG and Southern Gas Association (SGA) state that DOE maintenance costs are too low and that DOE should include the cost of replacing a circuit board which, they claim, is likely to fail during the life of a small gas furnace. (LSG, No. 130, at 7; and SGA, No. 51, at 6).

DOE does not consider the control electronics for the induced draft unit to be basically any more complex than for the IID design required for the 71 percent AFUE furnace. There are only simple controls such as thermostats, sensors and switches to test for air flow. The Department does not expect any increased circuit board maintenance costs for the induced draft furnace relative to the 71 percent AFUE design and, therefore, the maintenace costs have not been changed.

Installation Costs

A number of gas supply companies stated that increased installation costs would result from the replacement of old furnaces with 78 percent AFUE induced draft furnaces, because of venting modifications to accommodate atmospheric gas water heaters. LSG estimated an increase of $60–$150. (LSG, No. 30, at 6). SGA estimated an increase of $0–$400 with an average of $175. (SGA, No. 51, at 5). Florida Natural Gas Association (FNG) estimated an increase of $200. (FNG, No. 115, at 3). AGA projected an unspecified increased cost. (AGA, No. 128, at 13).

Common venting of induced draft gas furnaces and atmospheric water heaters is a complex issue. Building codes vary throughout the nation and most localities may require some modifications to common venting systems, including prohibiting them. Such modifications would be expected to cause some increase in installation cost. The costs would fall most heavily on replacement furnaces in multifamily buildings, since changes from current venting practices can be accounted for in designs for new construction and single family units, where venting can often be done directly through the sidewall. DOE does not have any data that provides an estimate of how frequently additional installation costs would be incurred. To account for these increased costs, the final rule included a $200 estimated extra installation cost for all replacement furnaces in multifamily units.

B. Consumer Analysis

There were comments on many consumer issues dealing with small gas furnaces. These included end-use specific gas prices, conversion expenses, fuel-switching, oversizing factors, rebound effects, maintenance expenses, heat pump shipments, fan energy consumption, calculations of AFUE, and the furnace-water heating fuel linkage. Each of these will be addressed.

End-Use Gas Price

Enserch Corporation (Enserch) commented that for the Department to employ end-use specific electricity prices for the analysis of those appliances that consume electricity, and not to employ end-use specific natural gas prices for the small furnace analysis is both "illogical and erroneous." (Enserch, No. 51, at 8).

In response, the Department notes that while it agrees in principle with using end-use specific energy prices for natural gas in the small furnace analysis, neither the Energy Information Administration, nor the AGA (in its Home Househeating Survey) collects direct information on natural gas prices by end-use consumption.

The Department does not believe, therefore, that the price of natural gas that is utilized by small gas furnaces can be determined from any existing data base. Therefore, DOE continued to assume that the price of natural gas for small gas furnaces was the average residential price of natural gas.

Shift to Electric Resistance Heating

The Act required that the Department analyze the extent to which the prices associated with conservation standards on small gas furnaces could cause consumers to switch from natural gas to electric resistance heat. In the analysis for the proposed rule, the Department did not account for any additional consumer expense in undertaking such a switch. This assumption was criticized by the Edison Electric Institute (EEI) and by the American Electric Power System and Southern Company (AEPSSC). (EEI, No. 127, at 6–7; and AEPSSC, No. 136, at 10). EEI stated that this expense would not be insignificant. According to the 1988 edition of "Means Electrical Cost Data," EEI reported that to upgrade a home with electrical service capacity of 60 amperes to 200 amperes would cost the consumer $860. Even to upgrade to 150 ampere service, EEI reported, would cost the consumer $715. (EEI, No. 127, at 6).

In response, the Department included, in the LBL–REM modeling runs for this final rule, expenses that could be involved in the replacement market to convert from gas heat to electric heat.

A number of comments were received concerning the Department's belief that a 78 percent AFUE standard on small gas furnaces would not result in a significant shift to electric resistance heating. The Department proposed this conclusion as a result of its estimation of expected market shares from LBL–REM. In Table 5.20 of the proposed rule's Technical Support Document, the Department had estimated that a 78 percent AFUE standard or small gas furnaces would not lead to a shift to electric resistance heat. The analysis projects that standards would lead to an increase in small gas furnace shipments, compared to the base case, over the 1992–2015 time period. This increase was expected to come at the expense of larger gas furnaces and electric heat pumps. A similar shift is found in this final rule.

The small gas furnace methodology is based on historical data on space heating choices in new homes from 1976–79. In addition, the method effectively assumes that the elasticities are a function of climate, energy prices, and other variables, and are not constant.

As a result, the Department is confident in its analysis of market shares.

Nevertheless, numerous comments suggested that a 78 percent AFUE standard on small gas furnace would lead to initial price increases, the result of which would be a significant shift to electric resistance heat, especially in new construction where, it is argued, builders, who are concerned primarily with the initial purchase price, make the purchase decision. Among those presenting these conclusions were Southern Gas Company (SGC) (SGC, No. 51, at 3 and 9); Atlantic Gas Light Company (AGLC) (AGLC, No. 70, at 1); Mobile Gas Service Company (MGSC) (MGSC, No. 72, at 2); Hope Gas, Inc. (HGI, No. 112, at 2); Florida Natural Gas Association (FNGA) (FNGA, No. 115, at 3); Laclede Gas Company (LGC) (LGC, No. 121, at 2–5); AGA (AGA, No. 128, at 6 and 12); Southern California Gas Company (SCGC, No. 134, at 2 and 6); and ENTEX and Arkansas Louisiana Gas (ENTEX) (ENTEX, No. 161, at 3).

A number of comments, on the other hand, supported the Department's conclusion that a 78 percent AFUE standard on small gas furnaces would not result in a significant shift from natural gas to electric resistance heat.

Bard Manufacturing Company (Bard) and GAMA concluded that a 78 percent AFUE small furnace standard should not result in a loss of market share by gas utilities because: (1) The price differential between a 71 percent AFUE and a 78 percent AFUE furnace in today's marketplace would not apply in 1992 when NAECA standards go into effect; (2) the cost to upgrade older homes to the 200 amp service needed for electric heating makes it unlikely that gas furnaces would lose market share to electric resistance heating in replacement markets; (3) in the new construction market in the South, gas furnaces compete against heat pumps, not against electric resistance heating; and, (4) in new construction, the cost of venting a 78 percent AFUE fan-assisted combustion system gas furnace through the wall is, in most cases, less than the cost of venting a 71 percent AFUE atmospheric combustion gas furnace, which would require construction of a chimney for venting. (Bard, No. 90, at 1–2; and GAMA, No. 129, at 3–6).

Market Share

In response to comments received, DOE revised several assumptions that have an impact on the market shares of gas furnaces, including: Energy price projections, maintenance costs of efficient gas furnaces, conversion costs from gas to electric heat, and retrofit costs for replacing small gas furnaces. These changes are reported in the Technical Support Document.

GAMA data indicate that 40 percent of 1985 shipments of all gas warm air central furnaces were at or above 71 percent AFUE, and that 61 percent of small gas furnaces sold in 1985 were at or above 71 percent AFUE. (1985 is the most recent year for which data on small gas furnace shipments are available). In 1988, 52 percent of all gas furnaces shipped were at or above 71 percent AFUE. DOE believes that the more efficient furnaces are being bought both for replacement and for use in new housing. AGA data show increasing market shares for gas heating, and a substantial number of conversions from electric heat to gas heat. (AGA, No. 128, Attachment 1, at 4 and 11). In light of the current market for gas furnaces, DOE does not believe that purchasers, including builders, are sensitive only to equipment costs. Therefore, DOE has modeled the market decisions based upon observed market behavior. *See* Technical Support Document, Appendix B.

Fuel Switching

In a related comment, ENTEX charged that the Department had not adequately addressed fuel-switching because LBL–REM "does not emulate the marketplace for furnaces in new residential construction, where builders decide on which type of heating equipment is installed, and are extremely sensitive to the initial cost of the equipment." (ENTEX, No. 161, at 3).

As described in the proposed rule, LBL–REM had been modified for the purpose of analyzing small gas furnaces, to take account of the sensitivity to initial equipment cost and other sensitivities that have been reflected in actual market purchases in new homes. In addition, LBL–REM models the sensitivity to first cost as a function of climate, with purchasers in milder climates more sensitive to first cost (relative to operating cost) than purchasers in more severe climates. This information was reported on pages B–10 and B–11 of the proposed rule's Technical Support Document. These modifications were maintained in the analysis for this final rule.

Oversizing Factor

In the analysis of small gas furnaces, the Department assumed that furnaces would be oversized for the expected heating loads by a factor of 2.3. This assumption was derived from AGA data for existing furnaces.

Several comments suggested that, with the trend toward less oversizing, the Department was using an unrealistic assumption about the future, wherein, it is argued, smaller equipment, more suited to actual heating loads, will be installed. These comments contend, therefore, that by using an unrealistically high oversizing factor, the Department has underestimated the size of the future market for small gas furnaces. (LGC, No. 121, at 4; EEI, No. 127, at 8; and NRDC, No. 81, at 92).

In response, the Department analyzed a small gas furnace sensitivity case with an oversizing factor of 1.3. This resulted in much higher shipments and a correspondingly higher net present value. In addition, the impacts of standards remained small. *See* Technical Support Document, Tables 5.28 and 5.31.

Rebound Effect

In the analysis for the proposed rule, the Department assumed that purchasers of more efficient furnaces, with a 78 percent AFUE standard, could utilize them more intensively than expected, and thereby reduce the energy savings below what the engineering estimates would otherwise project. This so-called "rebound effect" was assumed to be 30 percent, so that only 70 percent of the engineering estimates of expected savings would actually be expected to result.

This estimate of a 30 percent rebound effect was criticized in several comments, which argued that the rebound should be lower, and perhaps equal to zero. (AEPSSC, No. 136, at 13; EEI, No. 127, at 9; NRDC, No. 81, at 93; and NYSEO, No. 156, at 2 and 28–30).

In response, in a sensitivity analysis for the final rule, the Department removed the rebound effect with respect to operating expense for all small heating systems. Usage behavior, however, was still assumed to be a function of income.

Setting the usage elasticity with respect to operating cost at zero was expected to increase the energy savings attributed to standards. Since the rebound effect was eliminated for all small heating systems, the impacts were observed among other fuels, as well as natural gas.

Other Issues

EEI commented that in the proposed rule, the Department underestimated heat pump shipments. (EEI, No. 127, at 9).

In the final rule, the Department revised the heat pumps shipments to agree with reported shipments from 1980–1987. These results are presented in the Technical Support Document. *See* Technical Support Document, Table 5.18.

Lastly, LGC commented that since the choice of space heating fuel usually determines the choice of water heating, the relevant comparison is not between a small gas furnace and electric resistance heat, but, rather, it is between a small gas furnace with a gas water heater and electric resistance heat with an electric water heater. (LGC, No. 121, at 5).

While the Department agrees that water heating fuel choice is usually linked to space heating fuel in new construction, LBL-REM treats these end-uses separately. The model cannot handle these two appliance choices jointly, but, by modeling the results for small furnaces *vis a vis* electric heat, the Department believes that water heater sales are not an issue that affects the analysis.

C. Manufacturer Analysis

There were three areas of the manufacturer analysis for the proposed rule that drew comments. Comments were submitted dealing with the markup and prices that were used, the pricing and production of 71 percent AFUE furnaces after 1992, and the impacts of standards on gas furnace manufacturers.

Markup

The Energen Corporation (Energen) asserted that the manufacturer analysis "was based on manufacturing cost estimates instead of actual contractor pricing," and it did not take into account that higher efficiency furnaces receive higher markups. (Energen, No. 82, at 5–6).

In response, the Department notes that the manufacturer analysis takes into account, in a limited way, the fact that higher efficiency furnaces receive higher markups. Small gas furnaces of 90 percent AFUE, and higher, receive a manufacturer markup of 1.3, while lower efficiency furnaces receive a markup of 1.15. These markups are based on data gathered from contractors by DOE for the proposed rule. All large furnaces receive a markup of 1.3. After 1992, furnaces with lower than 80 percent AFUE rating will be the least efficient furnaces on the market, and thus will receive the lowest manufacturer markup. Most comments that provided data used current price and markup lists, but manufacturers testified that their costs, markups, and pricing will change when the Act's standards go into effect. (Rheem, No. 67, at 2; and GAMA, No. 129, at 3–4).

With regard to the analysis considering only "manufacturing cost estimates instead of actual contractor pricing," the Department has learned through discussions with contractors that "actual contractor pricing" is highly variable, and that the Department's estimates of price differences are fairly reasonable.

The Department had estimated that the current price difference between a 71 percent AFUE small gas furnace and a 78 percent AFUE one to be $137. Several gas utilities, e.g., Enserch (No. 51), Energen (#82), Laclede (No. 121), and PSCNC (No. 144), criticized that price difference as being too low. The submissions of those companies had price differences ranging from $200 (Laclede) to $467 (PSCNC).

On the other hand, one gas furnace manufacturer, Carrier Corporation (Carrier), supported the Department's estimate of the current price difference between a 71 percent AFUE and 78 percent AFUE furnace:

> We believe that the DOE estimate of $87 (sic) installed cost differential between atmospheric and induced draft furnaces of less than 45,000 BTU/H is reasonable. Carrier's estimate of installed cost differential is approximately $100. In no event would we expect the differential to exceed $150. (Carrier, No. 143, at 1).

While the Department does not doubt that the price differences submitted by the gas utilities have occurred, Carrier's support of DOE's estimate of the price difference between a 71 percent AFUE and 78 percent AFUE small furnace gives the Department confidence that its estimate is reasonable. In all likelihood there is a range of price differentials. In addition, because Carrier is a manufacturer of these appliances, the Department believes that its numbers are representative. Furthermore, gas furnace manufacturers stated in their comments that the price difference between 78 percent and 71 percent furnaces would certainly decrease in 1992 when NAECA standards go into effect. (Rheem, No. 67, at 2; Snyder General Corporation (Snyder), No. 73, at 3; and GAMA, No. 129, at 2–4).

The proposed rule had indicated that using current prices of those furnaces would overstate the retail price difference that would prevail after standards on larger gas furnaces went into effect 1992 because:

(1) Seventy-one percent AFUE furnaces would become more expensive in 1992 because they no longer would be the standard type of furnace, but instead would be a specialty product which would be produced in short production runs about twice a year, or be purchased from another manufacturer (thus incurring an extra level of markup).

(2) Seventy-eight percent AFUE furnaces will become less expensive in 1992 because they will be produced in even larger quantities then.

(3) Seventy-eight percent AFUE furnaces will become less expensive under a 78 percent standard because they will then be the "bottom of the line" furnace and receive the lowest markup, whereas they now receive a higher markup.

Impact on Manufacturers

Last, SCGC questions the Department's conclusion that a 78 percent AFUE minimum energy conservation standard on small gas furnaces would have a minimum impact on manufacturers. (SCGC, No. 134, at 4).

In response, the Department notes that SCGC has reservations about the assertion that manufacturers will be better off manufacturing like products, i.e., after 1992 all furnaces would be 78 percent AFUE or more, and that the overall impact is a high return on investment.

However, SCGC's assertion is in error. First, the proposed rule does not conclude that the overall impact of gas furnace standards is a high return on investment for manufacturers. In fact, LBL–MIM estimates that standards will cause a decrease in ROE of less than 0.01 percent. Second, the SCGC doubts that manufacturers can manufacture high efficiency furnaces and be better off, and then rebuts its own statement by citing Lennox as a company that produces high-efficiency furnaces and does well. In addition, manufacturers have stated that they are better off not having to maintain a separate production line for lower-efficiency small gas furnaces. (Rheem, No. 67, at 2; and GAMA, No. 129, at 2–4). Last, no gas furnace manufacturer has commented on the estimate that standards will have a minimum impact on such manufacturers.

As a result, the Department continues to believe that a 78 percent AFUE standard on small gas furnaces will have a minimum impact on manufacturers.

3. Utility Analysis

SCGC commented that the utility analysis should have included estimates of the lost revenues to gas utilities that would result from a 78 percent AFUE small gas furnace standard. (SCGC, No. 134, at 5).

In response the Department notes that a separate analysis of impacts on the gas utilities was not performed. The Department notes that an electric utility impacts analysis was performed to address significant economic impacts from appliance efficiency standards, based on calculations specific to the electric utility industry. The utility analysis also provides inputs to the environmental analysis.

Furthermore, the Act requires that the Department examine any possible shift to electric resistance heating. This is accomplished through the LBL–REM.

The electric utility analysis was originally undertaken because: (1) The expected economic impacts of standards on electric utilities were expected to be large; (2) it was important to estimate the peak demand and capacity savings from any standards, since electricity cannot be stored. In addition, power plant capacity has been increasing in cost, and has been more difficult to site and build in recent years; and (3) the environmental impact analysis required information about which generating plants would be curtailed in response to the changes in load brought about by any standards.

The Department's utility analysis did not include gas utilities because: (1) The expected economic impacts of small gas furnace standards on gas utilities are small on a national scale; (2) natural gas can be stored, so capacity savings, fixed costs, and the consequent potential revenue losses are not as large a problem for gas utilities as for electric ones. Gas utilities typically have 20–40 percent of their costs attributable to fixed costs, while electric utilities typically have upwards of 50 percent of their costs attributable to fixed costs. In addition, the costs of laying natural gas transmission and distribution pipelines, which represent the major share of the fixed costs in the natural gas industry, have not been increasing substantially over time (unlike power plant capital costs); and, (3) the environmental analysis calculates these impacts directly from the amount of natural gas consumed, without the need for an intervening utility analysis.

IV. Product Specific Discussion

a. Refrigerators

1. Efficiency Levels Analyzed

DOE examined a range of standard levels, including the 1990 NAECA standards. As discussed above, the impacts of any revised standards were compared to the 1990 NAECA standards; therefore, the impacts of the base case are generally not presented because they are calculated to be zero.

Table 4–1 presents the efficiency levels, other than the base case, selected for analysis for 1993. Alternate levels were selected to generate a range of impacts for analysis. Initially, the levels were selected for the class of top-mount, automatic defrost refrigerator-freezer without through-the-door ice service. Level 5 corresponds to the highest efficiency level considered in the engineering analysis. This is the maximum technologically feasible level. It was felt that manufacturers can assemble appliances at this efficiency. Level 4 generally corresponds to the minimum life-cycle cost point. Levels 1 through 3 correspond to efficiencies lower than that of level 4. Each level was analyzed discretely in the engineering analysis. Standard levels for each of the other classes of refrigerators were based on the combination of design options for the top-mount, automatic defrost refrigerator-freezer without through-the-door ice service. The top-mount automatic defrost refrigerator-freezer was used as the analytical model for the analysis because that class represents nearly 73 percent of new refrigerator and refrigerator-freezer sales.

TABLE 4.1.—ALTERNATIVE EFFICIENCY LEVELS FOR 1993 REFRIGERATORS, REFRIGERATOR-FREEZERS AND FREEZERS

[Energy Consumption KWh/Yr.]

Product class	Level analyzed				
	1	2	3	4	5
Refrigerators and refrigerator-freezers with manual defrost	105+25.2×AV	104+23.9×AV	98+19.9×AV	70+14.7×AV	70+14.7×AV
Refrigerator-freezer—partial automatic defrost	423+11.9×AV	420+11.2×AV	398+10.4×AV	383+7.1×AV	383+7.1×AV
Refrigerator-freezers—automatic defrost with:					
Top-mounted freezer without through-the-door ice service.[1]	391+18.9×AV	376+17.1×AV	355+16.0×AV	329+11.8×AV	290+10.4×AV
Side-mounted freezer without through-the-door ice service.	574+15.0×AV	539+13.7×AV	501+11.8×AV	444+8.8×AV	377+7.5×AV
Bottom-mounted freezer without through-the-door ice service.	397+18.0×AV	371+16.3×AV	364+14.2×AV	290+12.7×AV	248+10.9×AV
Top-mounted freezer with through-the-door ice service	431+20.8×AV	414+18.8×AV	391+17.6×AV	363+13.0×AV	310+11.0×AV
Side-mounted freezer with through-the-door ice service	594+20.6×AV	571+18.0×AV	527+16.3×AV	408+14.7×AV	347+12.5×AV
Upright freezers with:					
Manual defrost	286+13.1×AV	276+12.5×AV	264+10.3×AV	211+7.8×AV	211+7.8×AV
Automatic defrost	449+19.0×AV	425+17.6×AV	391+14.9×AV	322+10.7×AV	311+10.3×AV
Chest freezers and all other freezers	140+14.2×AV	139+13.8×AV	124+12.0×AV	85+7.3×AV	85+7.3×AV

[1] Including all refrigerators with automatic defrost.
AV = Total adjusted volume, expressed in Ft. 3.

2. Payback Period

Table 4–2 presents the payback period for the efficiency levels analyzed for the most prevalent size (20.8 cubic foot adjusted volume) automatic defrost refrigerator-freezer. As noted earlier, under "Selection of Candidate Standard Levels," paybacks are calculated for the 1993 time period which includes the assumption that CFC–11 and –12 are available.

For most classes, standard level 3 corresponds to the most stringent energy conservation standard level at which the additional expense of purchasing a product at this efficiency level will be less than three times the value of the energy savings that the consumer will receive during the first year. The payback period for refrigerators that meet standard level 1 efficiency ranges from a low of 0.10 year for a manual defrost refrigerator to a high of 1.62 years for a partial automatic defrost refrigerator-freezer; the payback period for refrigerators that meet standard level 2 efficiency ranges from a low of 0.90 year for a side by side automatic defrost refrigerator-freezer with through-the-door service to a high of 1.73 years for a partial automatic defrost refrigerator-freezer; at standard level 3, the paybacks range from a low of 1.27 years for an upright, manual defrost freezer to a high of 3.65 years for a manual defrost refrigerator; the payback period for units that meet level 4 efficiency ranges from 3.24 years for a partial automatic defrost refrigerator-freezer to 7.91 years for a manual defrost chest freezer; and, the standard level 5 paybacks range from allow of 3.24 years for a partial automatic defrost refrigerator-freezer to a high of 7.91 years for a manual defrost chest freezer. *See* Technical Support Document Tables 6.3 and 6.4.

TABLE 4.2.—PAYBACK PERIOD (YEARS) TOP MOUNT AUTO DEFROST REFRIGERATOR-FREEZER, WITHOUT THROUGH-THE-DOOR FEATURES

[Adjusted Volume=20.8 Cu. Ft.]

Standard level	Payback period
1	0.76
2	1.40
3	2.46
4	5.99
5	6.93

The Department has also calculated paybacks for the later time period when, it is assumed, CFC–11 and –12 will not be available for refrigerator production. These paybacks are reported in Tables

6.24 and 6.25 of the Technical Support Document.

3. Significance of Energy Savings

To estimate the base case energy savings by the year 2015, the weighted average energy consumption of new refrigerators sold in the absence of revised standards is compared to 1990 when the legislated standards become effective. When revised energy conservation standards are imposed, the LBL–REM projects that over the period 1993–2015, the following savings would be attributable to the increased standards:

Level 1—2.4 Quads
Level 2—3.7 Quads
Level 3—5.2 Quads
Level 4—8.6 Quads
Level 5—10.8 Quads

(*See* Technical Support Document, Table 5.8)

On the basis of the above, DOE believes that each of the increased standard levels considered for refrigerators would result in a significant conservation of energy.

4. Economic Justification

A. *Economic Impact on Manufacturers and Consumers.* The per unit increased cost to manufacturers to meet the level 5 efficiency ranges from $65.30 for a 25.3 cubic foot AV upright automatic defrost freezer to $141.25 for a 31.9 cubic foot AV automatic defrost refrigerator-freezer with side freezer and through-the-door services. The cost for the most prevalent class of product (automatic-defrost refrigerator-freezer with top-mounted freezer) would increase $129.65. For level 4 efficiency, the per unit increased cost to manufacturers to meet that efficiency ranges from $47.30 for a 22.5 cubic foot chest freezer to $75.25 for a 31.9 cubic foot automatic defrost refrigerator-freezer with side freezer and through-the-door services. The cost for the most prevalent class of product (automatic-defrost refrigerator-freezer with top-mounted freezer) would increase $63.65. The per unit increased cost to manufacturers to meet the level 3 efficiency ranges from $25.20 to $50.85, while level 2 cost increases range from $8.10 to $20.25. For level 1, the cost increases are from $3.60 to $7.30. *See* Technical Support Document, Tables 3.14–3.23.

In the base case, the LBL–MIM, projects manufacturers' long-run ROE to be 9.73 percent for refrigerators and refrigerator-freezers and 8.60 percent for freezers. At level 5, the LBL–MIM predicts that a prototypical refrigerator and refrigerator-freezer manufacturer would have a gain in its ROE to 13.20 percent, a gain of 35.7 percent. The projected ROE's at levels 3 and 4, respectively, would be to 10.27 percent, a gain of 5.5 percent, and to 11.85 percent, a gain of 21.8 percent. At levels 1 and 2, the refrigerator and refrigerator-freezer manufacturers' ROE are expected to improve respectively, to 9.95 percent (an improvement of 2.3 percent) and to 10.24 percent (an improvement of 5.2 percent). For freezer manufacturers, the ROE is expected to improve to 8.97 percent (an improvement of 4.3 percent) and to 8.96 percent (an increase of 4.2 percent) for levels 1 and 2, respectively. *See* Technical Support Document, Tables 7.9 and 7.10.

The Department's characterization of the prototypical manufacturer in the base case assumes that manufacturers' typical refrigerator, refrigerator-freezer and freezer designs are based on the combination of options presented in the Engineering Analysis. As discussed above, DOE revised the base case based on the comments received. However, manufacturers that use a different combination of design options to comply with the 1990 NAECA standard, may have a different financial position than the prototypical manufacturer in the LBL–MIM.

The sensitivity analysis indicates the refrigerator, refrigerator-freezer and freezer industry is sensitive to price and operating expense elasticities. For example, the high price and low operating cost scenario indicates that the effects of standards would be to decrease ROE for refrigerator, refrigerator-freezer manufacturers by nearly 3.3 percent, and 10.7 percent for freezer manufacturers, in the base case. *See* Technical Document, Tables 7.17 and 7.18.

For consumers, standard level 5 would cause price increases that would range from a low of $151.20 for an automatic defrost, upright freezer, to a high of $353.14 for an automatic defrost, side-by-side refrigerator-freezer with through-the-door services. The price would increase for the most prevalent class of product (automatic-defrost refrigerator-freezer with top-mounted freezer) by $172.34. The corresponding range of price increases at standard level 4 would be a low of $98.00 for a chest freezer and a high of $189.12 for an automatic defrost, side-by-side refrigerator-freezer. The price for the most prevalent class of product would increase $134.48. The price increase to consumers at standard level 3 ranges from $59.23 to $16.99, while level 2 price increases range from $19.00 to $46.36. For level 1, the price increases range from $8.40 to $112.10. *See* Technical Support Document, Tables 3.31–3.40.

B. *Life Cycle Cost and Net Present Value.* The LCC analysis indicates that, for each possible standard level, the increase in purchase price would be offset by savings in operating expenses. Standard level 4 generally corresponds to the minimum for each of the life-cycle cost curves. *See* Technical Support Document, Figures 3.13–3.22. This indicates that the standard level would not cause any economic burden on the average consumer. DOE examined the effect of different discount rates, 5, 7 and 10 percent, on the LCC curves and generally found little impact.

The LBL–REM employs national average energy prices and usage rates. The appropriateness of this approach depends on the relationship between energy prices and consumer choice of efficiency levels and the relationship between consumers' expected usage and choice of energy efficiency level.

The NPV analysis indicates that if a standard were adopted at level 5, there would be an NPV of $9.3 billion from energy savings over the period 1993–2015. At level 4, the corresponding NPV would be $11.8 billion; at level 3, $9.1 billion; at level 2, $7.7 billion; and, at level 1, the corresponding NPV would be $6.0 billion. *See* Technical Support Document, Table 5.14.

C. *Energy Savings.* As discussed above, DOE concludes that standards, at each candidate standard level, would result in a significant saving of energy.

D. *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 or refrigerators.

One of the design options, increased foam thickness on the refrigerator walls, could serve to reduce interior volume slightly. It has been argued that if manufacturers used this design option to achieve a level of refrigerator energy-efficiency, the impact on consumers could be some small loss of utility. DOE, however, does not believe that the small reduction in interior volume that may be caused by this standard will cause any utility losses among consumers. Furthermore, the Department notes that manufacturers need not use this design option, as they would be free to use other energy-conserving design options, e.g., dual compressors, to achieve a standard level, even if that level had been based on thicker sidewalls in the analysis.

E. *Impact of Lessening of Competition.* In accordance with the requirements of the Act, the Department of Justice (DOJ) evaluated the impacts on competition of the proposed rule. Based on its analysis and review of the proposed rule, DOJ concluded that the proposed standards (levels 1–3) would not lessen competition in the refrigerator, refrigerator-freezers and freezer markets. *See* DOJ, No. 162.

DOJ states that for standards to affect competition adversely, standards-induced cost increases would have to be sufficiently severe and asymmetrical that they would force from the market one or more significant competitors. In addition, levels of concentration would have to rise substantially because of such exits. Also other market conditions would have to be conducive to oligopolistic pricing or price fixing. DOJ concludes, based on available evidence, that such a lessening of competition would not likely occur if DOE adopts any of the proposed standards for refrigerators, refrigerator-freezers and freezers. DOJ did not examine the more efficient standard levels 4 and 5. Also, DOJ rejects the Department's assertion, in the proposed rule, that the proposed standards will increase profits. As discussed above, one reason LBL–MIM predicted an increase in ROE and profitability, was the LBL–REM's forecast of increased refrigerator, refrigerator-freezer, and freezer sales. This had been changed in the LBL-REM in the analysis for the final rule.

The Department notes, further, that the changes to the analysis that were done for the final rule should not affect the conclusions derived from the DOJ review on the proposed rule.

Therefore, based upon its review of the DOJ analysis, DOE concludes that standard levels 1, 2 and 3 would not adversely affect competition. However, the Department believes that standard levels 4 and 5, which would require the use of evacuated panels, could affect competition. No U.S. manufacturer has manufactured refrigerators with evacuated panels on a high volume basis. GE manufactured a limited number, 1,000 units, by hand, and subsequently discontinued the unit. The Department believes that the technological problems that exist in mass producing evacuated panel refrigerators are such that it is likely that major manufacturers would consider leaving the market. This industry has experienced numerous mergers.

DOE believes that one likely result of standards at level 5 could be to increase the rate of industry consolidation by merger of two significant competitors, which could result in a substantially larger firm. DOE believes that standards at level 5 could lessen competition by increasing levels of concentration. The Department further believes that standards at level 4, which involves efficiencies attained with evacuated panels, could lead to some firms leaving the industry, because of an inability to produce or purchase sufficient numbers of panels.

F. *Need of the Nation to Save Energy.* Refrigerators use electricity as their energy source. Nearly seven percent of the nation's total electricity (which required source energy of 29.5 Quads in 1988) powers refrigerators, and nearly 13 percent of that seven percent would be saved by standards for this product at level 3, while 21 percent of that seven percent would be saved at level 4, and over 26 percent of that amount would be saved at level 5. Levels 1 and 2 would save 6 and 9 percent, respectively. In addition, decreasing future electricity demand as a result of standards will decrease air pollution. The greatest decreases in air pollution will occur for sulfur oxides (listed in equivalent weight of sulfur dioxide, or SO_2). For standard level 5, in the year 2010, the estimated SO_2 reduction would be 256,933 tons. This reduction represents 1.5 percent of the United States SO_2 emissions that are expected to be emitted by power plants in that year.

Standard level 5 would also result in a decrease in nitrogen dioxide (NO_2) emissions for the year 2010, of 173,715 tons. This decrease represents 1.7 percent of the total NO_2 emissions expected to be emitted by power plants in that year.

Another consequence of the standards will be the reduction of carbon dioxide (CO_2) emissions. Fossil fuel burning is believed to elevate CO_2 concentrations in the atmosphere, which is believed to trap heat from the sun that has been absorbed by the Earth and would normally be re-radiated. Although there is substantial scientific uncertainty concerning the magnitude and timing of this effect, this "greenhouse effect" is thought to raise the mean global temperature. Standard level 5 is estimated to reduce United States CO_2 emissions by about 0.88 percent for the year 2010.

In 2010, standard level 4 is expected to reduce SO_2, NO_2 and CO_2 emissions by 1.2, 1.35, and 0.7 percent, respectively. Standard level 3 reductions are expected to be 0.72, 0.81, and 0.42 percent for SO_2, NO_2 and CO_2, respectively in 2010.

Standard levels 2 and 1 would reduce SO_2 power plant emissions by 0.51 and 0.33 percent, respectively. NO_2 power plant emissions would be reduced by 0.58 and 0.38 percent for standard levels 2 and 1, respectively in 2010; CO_2 emissions at standard levels 2 and 1 would be 0.3 and 0.19 percent, respectively of the total U.S. amount.

G. Other Factors.

Refrigerators typically use CFCs–11 and –12. Both of these refrigerants are subject to an EPA rulemaking that places restrictions on the manufacture of certain CFCs. Furthermore, based on comments in this rulemaking, DOE believes that these CFCs would not be available after the year 2000, either as a result of amendments to the Montreal Protocol, further EPA restrictions or marketplace forces. DuPont, for example, announced that it intends to phase out production of these CFCs by 2000.

The use of CFCs in the manufacture of refrigerators currently accounts for approximately two percent of the restricted CFCs. The 50 percent reduction in CFC manufacture prescribed by EPA, will likely result in the use of CFCs in refrigerators to exceed five percent of U.S. consumption. This increase in the percentage of CFC consumption accounted for by refrigerators would be a result of the CFC production restriction along with increased CFC use to meet the legislated 1990 standards, and increased sale of these products. Presently, DOE is unaware of any currently available alternatives to CFC–11 or CFC–12 that have been demonstrated as acceptable replacements to the affected CFCs. However, as discussed above, likely alternatives have been identified. Based upon the comments on the proposed rule, DOE assumed that suitable alternatives will be developed; however, the schedule by which these alternatives will become available in sufficient quantities is unknown at this time. As discussed above, DOE's engineering analysis is based on alternatives, and DOE has assumed that these alternatives will be adopted by refrigerator manufacturers by 1996.

5. Conclusion

Section 325(l)(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." Accordingly, the Department first considered the "max tech" level of efficiency, i.e., standard level 5, for amended refrigerator standards.

Of the standard levels analyzed, level 5 saved the most energy (10.8 quads more than the base case). In addition, it had the largest positive impact on the environment.

Two of the three technologies needed to meet this standard level, adaptive defrost and dual compressors, are available now in some refrigerators; however, the third item, evacuated panels, is not currently available on a mass produced basis. While some refrigerators with hand-built evacuated panels have been produced for sale, the Department does not believe that evacuated panels can be mass produced by the effective date of this standard, especially considering the need for additional capacity to manufacture fumed and precipitated silica, as previously discussed in the Engineering Analysis.

Furthermore, the cost of these three technologies is high, producing a relatively large increase in purchase price. While the life-cycle cost of Level 5 is lower than that of the base case, the purchase price pushes the payback to 6.9 years, and, by being beyond the minimum life-cycle cost point, would preclude consumers from buying models with the lowest life-cycle cost. The impact on manufacturers is expected to be positive, producing the highest long-run increase in net income and return-on-equity of all the standard levels analyzed. However, these results are based on the assumption that sufficient quantities of the necessary technologies will be available in 1993, and as noted above, the Department is doubtful that one of those technologies, evacuated panels, will be available in sufficient quantities by then. In addition, the Department also believes that the required use of evacuated panels could cause a lessening of competition. Overall, the Department finds the burdens, especially the technological uncertainties of level 5, to exceed the benefits, and, therefore, rejects level 5.

Standard level 4, also based on evacuated panels. saves the second greatest amount of energy, an estimated 8.7 Quads, and has the second most positive impact on the environment. However, the above discussion on evacuated panels also applies to level 4. While the purchase price is less than that of level 5, and while life-cycle cost is the lowest of any level analyzed, level 4 still produces a payback of 6.0 years. The impact on manufacturers is estimated to produce the second highest long-run increase in net income and return-on-equity of the standard levels analyzed. Overall the Department finds the burdens of level 4, especially the technological uncertainties, to exceed the benefits, and, therefore, rejects level 4, too.

Energy efficiencies approaching those of level 4 could be achieved by a reordering of the design options, e.g., by substituting dual compressors and adaptive defrost for evacuated panels. As noted above, however, design options were added on the basis of increasing time for payback, and dual compressors and adaptive defrost were added last because of their relatively long paybacks. Therefore, while a combination of the design options in standard level 3 with dual compressors and adaptive defrost designs could produce energy savings and environmental benefits approaching those of level 4, such a combination of designs would also probably have much higher consumer burdens than level 4, in the form of higher prices and longer paybacks. This would result because dual compressors and adaptive defrost have a higher initial price than evacuated panels, and produce similar energy savings. On balance, then, the Department finds that the burdens of this version of level 4 also exceed the benefits, and, therefore, rejects all combinations of level 4.

The next most energy-conserving standard level is standard level 3. After carefully considering all parts of the analysis, the Department is amending the NAECA-imposed 1990 standard for refrigerators with standard level 3 for refrigerators. The Department concludes that level 3 standards for refrigerators save a significant amount of energy, are technically feasible, and are economically justified.

As discussed above, there would be significant energy savings at this level of efficiency. During the period 1993–2015, these savings are calculated to be 5.2 Quads of primary electricity compared to the base case. Such savings would total nearly 13 percent of base case electricity use. In addition, the standards will have a positive impact on the environment by reducing the emissions of CO_2, SO_2, and NO_2 by an estimated .42, .72, and .81 percent, respectively, by the year 2010.

The technologies that are necessary to meet this standard are presently available. This standard level may initially involve the use of additional amounts of ozone-depleting CFCs; however, these additional amounts will come at the expense of other products that presently use the restricted CFCs. The amounts needed for refrigeration manufacturing are relatively small and the Department believes they will be available, albeit at a higher price.

The Department finds the level to be economically justified. The standard level meets the rebuttable presumption test for economic justification by having a payback of 2.5 years. Furthermore, the standard level substantially reduces consumer life-cycle costs and only moderately increases initial price. Additionally, the standard is also expected to have a positive impact on manufacturers by producing long-run increases in their net income and return-on-equity of 21.8 and 5.4 percent, respectively.

b. Small Gas Furnaces

1. Efficiency Levels Analyzed.

Table 4–3 presents the efficiency levels selected for analysis for 1992. These levels are the same as those analyzed in the proposed rule. Level 3 corresponds to the highest efficiency level provided for in the Act, while levels 1 and 2 correspond to efficiencies lower than level 3, with level 1 being the lowest level provided for in the Act. The engineering analysis considered design options that would result in furnace efficiencies as great as 92 percent AFUE. As discussed in the proposed rule, more efficient designs were not considered for potential standards, but rather were used as input to the LBL–REM in order that the energy forecasting analysis would have a complete set of data upon which to make projections.

TABLE 4–3—STANDARD LEVELS ANALYZED FOR SMALL GAS FURNACES

Standard level	AFUE (Percent)
1	71
2	74
3	78

2. Payback Period

Table 4.4 presents the payback period for the efficiency levels analyzed. The payback period for units that meet level 1 efficiency ranges from 3.01 years for a warm air indoor gas furnace to 3.21 years for a warm air outdoor gas furnace. The payback period for units that meet level 3 efficiency ranges from 5.78 to 6.58 years. *See* Technical Support Document, Table 6.6.

TABLE 4.4.—PAYBACK PERIODS (YEARS) OF DESIGN OPTIONS FOR GAS FURNACES (LESS THAN 45,000 BTU/HR.)

Standard level	Payback periods	
	Warm air indoor	Warm air outdoor
1	3.01	3.21
2	4.15	4.66

TABLE 4.4.—PAYBACK PERIODS (YEARS) OF DESIGN OPTIONS FOR GAS FURNACES (LESS THAN 45,000 BTU/HR.)—Continued

Standard level	Payback periods	
	Warm air indoor	Warm air outdoor
3	5.78	6.58

3. Significance of Energy Savings

By the year 2015, the weighted average energy efficiency of new small gas furnaces sold in the absence of standards is projected to be 79.9 percent AFUE. Standards, at standard levels 1 and 3, are expected to increase the average shipment weighted efficiency of small gas furnaces to between 81.0 and 83.4 percent AFUE, respectively. *See* Technical Support Document, Table 5.16. However, the aggregate annual energy consumption of small gas furnaces is projected to increase slightly. This is due to the increase in the market for small gas furnaces which comes at the expense of larger gas furnaces, heat pumps, and central electric furnaces. *See* Technical Support Document, Table 5.18. When energy conservation standards are imposed on small gas furnaces, the LBL–REM projects that, over the period 1992–2015, the following changes in energy consumption would occur:

TABLE 4.5.—CUMULATIVE RESIDENTIAL ENERGY CONSUMPTION OF GAS AND ELECTRICITY FOR SPACE HEATING, 1992-2015 (QUADRILLION BTU, PRIMARY)

	Base	Standard level		
		1	2	3
Gas heating systems:				
Small gas furnaces	1.05	1.06	1.08	1.09
All gas heating	91.7	91.7	91.6	91.6
Electric heating systems:				
Central electric furnaces	30.4	30.3	30.3	30.3
Electric heat pumps	14.9	14.8	14.8	14.8
Electric baseboard heat	14.2	14.2	14.2	14.2
All electric heating	59.5	59.3	59.3	59.3
Total gas and electric	151.2	151.0	150.9	150.9

Source: Technical Support Document, Table 5.18.

As Table 4.5 shows, standard level 1 would lead to an increase in small gas furnace energy consumption of .01 Quadrillion Btu (Quads), but would result in a net energy savings of .02 Quads. At standard levels 2 and 3, the net energy savings would total .03 Quads.

The Department finds these net energy savings to be significant.

4. Economic Justification

A. *Economic Impact on Manufacturers and Consumers.* The per unit increased cost to manufacturers to meet the level 3 efficiency ranges from $64 for an indoor gas furnace to $88 for an outdoor gas furnace. The per unit increased manufacturer cost to meet levels 1 and 2 are $21 and $96, respectively, for an indoor unit; for an outdoor unit, the per unit cost increases are $25 and $97 for levels 1 and 2, respectively. *See* Technical Support Document, Tables 3.24 and 3.25.

At standard level 3 of efficiency, the price to the consumer increases $217 for indoor gas furnaces and $247.90 for outdoor gas furnaces. The per unit increased consumer price at levels 1 and 2 are $77.91 and $208.39, respectively, for an indoor unit; for an outdoor unit, the per unit price increases are $84.83 and $226.94 for levels 1 and 2, respectively. *See* Technical Support Document, Tables 3.41 and 3.42.

The LBL–REM results indicate that standards at level 3 will result in nearly a four percent improvement in average shipment weighted efficiency when compared to standard level 1. This would result in a $178 drop in life-cycle costs for an indoor, warm air, small gas furnace; for an outdoor one, the LCC savings would be $154.

In the LBL–MIM results for small gas furnaces, it was found that standards would cause manufacturers to lose even more money on these furnaces than they are projected to lose in the base or no-standards case. In the base case, manufacturers' ROE are expected to be −2.02 percent for small furnaces, compared to an ROE of a −2.13 percent under standard level 3 and −2.03 percent under standard level 1. *See* Technical Support Document, Table 7.16.

Small gas furnaces tend to have very low profit margins and thus they contribute little or nothing to a gas furnace manufacturer's profitability. DOE believes this is because of marketing considerations, in that manufacturers find it important for marketing purposes to carry a complete line of furnace capacities. Thus, manufacturers tend to carry small gas furnaces in their product lines, although many of these firms carry only one or two models.

LBL–MIM projects that a standard of either 71, 74, or 78 percent AFUE for small gas furnaces would result in lower net income and ROE than would occur in the absence of standards.

The LBL–MIM predicts at level 3 that a prototypical furnace manufacturer would experience a .001 percent decrease in ROE. *See* Technical Support Document, Table 7.23. The sensitivity analysis, however, indicates the gas furnace industry results are sensitive to consumer price elasticities and unit variable cost increases. For example, the sensitivity analysis indicates that the effects of standards could be to decrease return-on-equity for small gas furnace manufacturers by nearly 1.2 percent or to raise it by nearly the same amount. However, there is only a one percent chance of either of these sensitivity results occurring.

B. *Life Cycle Cost and Net Present Value.* The LCC analysis indicates that at each possible standard level, the increase in purchase price would be offset by savings in operating expenses. *See* Technical Support Document, Table 6.7. Also, of the three candidate standard levels, level 3 had the lowest consumer life-cycle cost. The decreasing life-cycle-costs indicate that the standard level would have the greatest benefit to consumers.

The NPV analysis indicates that if a standard were adopted at level 3, there would be a net present value of $21 million to consumers. At levels 1 and 2, the respective NPV's would be $13 million and $16 million. *See* Technical Support Document, Table 5.23.

C. *Energy Savings.* As indicated above, standards will result in an increase of gas consumption for small gas furnaces, but, also, in an overall savings of natural gas. If, however, the marketplace continues to demand changes in efficiency at the same rate as historically, the LBL-REM projects that there would be no savings from standards over the 1992–2015 period. This result occurs because in the base case, the efficiency, or SWEF, of all new small gas furnaces is projected to exceed the 78 percent AFUE standard by the time it would come into effect. *See* Technical Support Document, Table 5.30, Reference 10.

D. *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 small gas furnaces. In addition, DOE believes that none of the design options considered will affect utility.

E. *Impact of Lessening of Competition.* The Department of Justice concluded that for small gas furnaces, the available evidence affirmatively suggests that no significant adverse competitive impact is likely. DOE, therefore, concludes that none of the candidate standard levels would lessen competition.

F. *Need of the Nation to Save Energy.* Small gas furnaces use natural gas as their energy source. Nearly 0.16 percent of the nation's natural gas consumption is used to operate small gas furnaces, and nearly four percent of that 0.16 percent would be saved by standards for this product at level 3. However, the sensitivity analysis on the LBL-REM indicates that if consumer awareness of and concern with appliance efficiency continues the projected savings would be the same as with level 3 standards.

Furthermore, the natural gas saved would result in a cumulative CO_2 emission savings in 2010 for standard level 3 of 312,000 tons, and 98,000 tons for level 1. Other environmental effects from furnace standards would be savings in 2010 of 3,822 tons of SO_2 and 2,976 tons of NO_2 at standard level 3; at standard level 1, the savings would be 1,200 tons of SO_2 and 927 tons of NO_2.

5. Conclusion

As noted above, the Act requires that, in establishing standards, the Department look first at that standard that maximizes energy savings, i.e., is the "max tech" level of efficiency for small gas furnaces, the "max tech" level is at 97 percent AFUE.

It was also noted above, however, that for this rulemaking, the Department is restricted in its consideration to an efficiency level between 71 percent AFUE and 78 percent AFUE. Therefore, the Department must begin its consideration for a standard at that level that is the most stringent level allowed, i.e., 78 percent AFUE.

After careful consideration of all the factors, the Department is establishing a 78 percent AFUE standard on small gas furnaces. This standard for small gas furnaces will result in a significant conservation of energy, and it is technologically feasible and economically justified.

In addition to producing the maximum unit energy savings of the candidate standards, this standard is beneficial to consumers and manufacturers alike.

The technology that would generally be used to meet this level of efficiency, i.e., induced draft combustion, is not only presently available, but it also will be installed on all other gas furnaces when this standard is to be effective.

For consumers, the 78 percent AFUE standard produces the lowest consumer life-cycle cost of the candidate levels. Furthermore, the standard's NPV of $21 million over the 1993–2015 period is the highest of the standard levels analyzed. Also, the designs necessary to achieve that level of efficiency, i.e., induced draft combustion, should have no effect on utility to the consumer.

Also, the initial purchase price increase may be lower than that which has been estimated. This result is possible, because the 78 percent AFUE standard on small gas furnaces is the same level of efficiency that the Act imposes on larger gas furnaces, which presently comprise more than 95 percent of furnace sales. Therefore, to the extent that manufacturers can produce these small units on the same production lines, with the same design options that will be used for the larger furnaces, there may be economies of scale in the production of these units.

Small gas furnace manufacturers have strongly supported the 78 percent AFUE standard on their products. The analysis indicates that such a standard should have relatively little economic impact on them. It is estimated that a 78 percent AFUE standard on small gas furnaces would cause the prototypical gas furnace manufacturer to suffer a loss of .1 percent in its ROE. The uniformity of a 78 percent AFUE standard on small furnaces and on larger units, however, may make the production process simpler for the manufacturers. This occurs because, as mentioned above, a uniform standard for all gas furnaces could result in fewer production lines.

In addition, as noted above, the Attorney General has determined that this standard should not have a significant adverse effect on competition among furnace manufacturers.

While the effects of a 78 percent AFUE standard are only slightly better than a 71 percent AFUE standard, the Department believes that the Act requires that the Department establish the most stringent standard that saves a significant amount of energy, is technologically feasible, and is economically justified. The 78 percent AFUE standard meets these requirements.

In comments on the proposed rule, several gas utilities contended that a 78 percent AFUE standard on small gas furnaces would cause them to lose market share to electric resistance heat. The analysis for this final rule, however, indicates that such a loss of market share is not a likely result from a 78 percent AFUE standard. The LBL-REM projects that market share for small gas furnaces is likely to increase as a result of the level 3 standard. *See* Technical Support Document, Table 5.20.

One drawback to the 78 percent AFUE standard on small gas furnaces is that it would eliminate units that may, in some circumstances, be the most cost-effective for some consumers. This is a result that could possible occur in some Southern-tier States, where the most cost-effective small gas furnace could be one that is less efficient and whose first cost is less than that of the minimum LCC unit. Nevertheless, while this is a possible outcome for some purchasers in some areas, the Department believes that such effects, should they occur at all, would be limited.

Another possible drawback is that some installations, particularly of replacement furnaces in some multi-family units could be somewhat complicated because of space limitations. The Department believes that these effects, too, would be limited, if they occur at all.

Lastly, 78 percent AFUE standards, over the forecast period (1993–2015), are expected to save 4,818,000 tons of CO_2, 65,112 tons of SO_2, and 48,393 tons of NO_2 emissions.

c. Television Sets

The Department received a number of comments concerning the engineering analysis for television sets. However, none of the comments included data or sufficient information for the Department to consider. In order to respond to the comments, DOE believes an in-depth analysis of televisions would likely need to be performed. And, since the data in a new analysis would be new data that was not previously subject to comment, the Department believes a new analysis and proposed rule for television sets would have to be published.

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

The Department has reviewed today's final rule in accordance with the Department's obligations under:

- The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 *et seq.*), the Council on Environmental Quality regulations implementing the procedural provisions of NEPA (40 CFR part 1500 *et seq.*), and the Department's own NEPA guidelines (54 FR 49667, December 13, 1987);
- Executive Order 12291 (46 FR 13193, February 19, 1981) which pertains to agency review of the impact of Federal regulations;
- Executive Order 12630 (53 FR 8859, March 18, 1988) which pertains to agency consideration of Federal actions that interfere with constitutionally protected property rights;
- Executive Order 12612 (54 FR 41685, October 30, 1987) which pertains to agency consideration of Federal actions that would have a substantial direct effect on States, on the relationship between the National Government and the States, and on the distribution of power and responsibility among the various levels of government; and
- The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) which requires, in part, that an agency prepare a regulatory flexibility analysis for any final rule unless it determines that the rule will not have a "significant economic impact on a substantial number of small entities." In the event that such an analysis is not required for a particular rule, the agency must publish a certification and explanation of that determination in the **Federal Register**.

a. Environmental Review

In issuing the proposed rule, the Department prepared an Environmental Assessment (EA) (DOE/EA-0372) that was published within the Technical Support Document (DOE/CE-0239, November 1988). The environmental effects from different possible standard levels were found not to be significant, and a Finding of No Significant Impact (FONSI) was published along with the proposed rule. (53 FR 48626, December 2, 1988).

In conducting the analysis for the final rule, the Department re-ordered the refrigerator design options in order of increasing consumer payback periods, as noted above. As a result of this re-ordering, the environmental effects for the different refrigerator standard levels differ from those reported in the EA. *See* Technical Support Document, Environmental Effects.

Due to this re-ordering, and to greater efficiencies projected in the base case, standard level 3 for refrigerators will result in slightly lesser reductions in carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) than those projected in the EA for this level.

In the proposed rule, the forecast period ended in the year 2010. The emissions savings of CO_2 in that year for standard level 3 for refrigerators were estimated to be 9.18 million tons, a reduction in emissions that was determined not to be significant.

For the standard level being finalized in this rulemaking, the expected CO_2 emissions savings in 2010 are 7.691 million tons, and, in the year of the greatest savings, 2015, the emissions reductions are expected to be 8.834 million tons. Both of these reductions in emissions are lower than the amount that was estimated for the proposed rule.

For standard level 3 for refrigerators, the proposed rule's SO_2 and NO_2 emissions savings in 2010 were estimated to be 151,000 tons and 100,000 tons, respectively. These reductions in SO_2 and NO_2 emissions were determined not to be significant.

For the standard level being finalized in this rulemaking, the expected reductions in SO_2 and NO_2 emissions in 2010 are 123,282 tons and 83,352 tons, respectively. In 2015, the year of the greatest expected reductions in SO_2 and NO_2 emissions, the savings are expected to total 126,365 tons and 94,624 tons, respectively. The SO_2 and NO_2 emissions reductions expected in 2010 and in 2015 from this final rule are lower than the amounts that were estimated for the proposed rule.

The Department believes that these environmental impacts are not sufficiently large to be considered "significant." These impacts fall within the range of impacts that were analyzed in the EA that was prepared for the proposed rule, and which were determined not to be significant in the FONSI that was issued for the proposed rule. Accordingly, DOE has determined that the impacts of re-ordering the refrigerator engineering design options are bounded by the analysis in the results of the EA, and that the original FONSI is still valid.

Furthermore, if the Clean Air Act Amendments that have been introduced in Congress were to become law, the amount of allowable powerplant emissions of SO_2 and NO_2 in the year 2010 would be reduced from the amount otherwise anticipated. The Department expects that there would be a corresponding drop in emissions reductions caused by these appliance standards. Under those conditions, the Department would expect that standard level 3 for refrigerators would lead to reductions in emissions of 64,881 tons of SO_2, and 62,013 tons of NO_2. Each of these reductions is less than what would be expected without the Clean Air Act Amendments, i.e., in the Department's forecast results, presented above.

The NRDC was critical of the Department's finding in the FONSI that the environmental effects that could result from appliance standards are not signficant. The NRDC contended, in fact, that the expected environmental benefits are significant, and that the Department should have prepared an Environmental Impact Statement. (NRDC, No. 81, at 120-124). NRDC has not taken exception to DOE's forecasts of emissions reductions.

The Department has determined that the environmental effects described, totaling less than 1 percent of U.S. powerplant emissions (for SO_2 and NO_2) and less than one-half of 1 percent of U.S. emissions of CO_2 in the year 2015, are not significant, and do not require preparation of an Environmental Impact Statement. Nevertheless, as noted above, the environmental effects were considered in selecting the final standard for refrigerators.

b. Regulatory Impact Review

Executive Order 12291 (46 FR 13193, February 19, 1981) directs that, in issuing a major rule,[18] an agency perform a regulatory analysis. Such an analysis presents major alternatives to the regulation that could substantially achieve the same regulatory goal at lower cost, as well as a description of the costs and benefits (including potential net benefits) of the proposed approach.

DOE has determined that this rule is a "major rule." Accordingly, a Final Regulatory Impact Review has been prepared and submitted to the Office of Management and Budget (OMB). OMB

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[18] "Major rule" means any regulation that is likely to result in: (1) An annual effect on the economy of $100 million or more; (2) A major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions; or (3) Significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets.

has reviewed the Regulatory Analysis under Executive Order 12291.

The Regulatory Analysis is summarized below. This summary 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 final "Regulatory Impact Analysis," which is contained in the Technical Support Document, available as indicated at the beginning of this notice. It consists of: (1) A statement of the problem addressed by this regulation, and the mandate for government action; (2) a description and analysis of the feasible policy alternatives to this regulation; (3) a quantitative comparison of the impacts of the alternatives; and (4) the economic impact of the proposed approach.

It should be noted at the outset that none of the alternatives that were examined for these products saved as much energy as the rule. Also, most of the alternatives would require that enabling legislation be enacted, since authority to carry out those alternatives does not presently exist.

Alternatives for Achieving Consumer Product Energy Conservation

Six major alternatives were identified by DOE as representing feasible 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 approach.

If no new regulatory action were taken, then no new standards would be implemented for refrigerators or small gas furnaces. This is essentially the "base case" for each appliance. In this case, between the years 1992 and 2015, there would be expected energy use of 44.09 Quads 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's public education and information program. Both of these alternatives are mandated by 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 five percent for purchasers of these products. This resulted in no energy savings, with expected consumption equal to 44.09 Quads. The net present value is estimated to be $0.00.

Another method of setting standards would entail requiring that certain design options be used on each product, i.e., prescriptive standards. For refrigerators, this involved assuming a 1.5 inch foam door and 5.0 EER compressor (4.0 EER compressor for manual defrost units) and, for small gas furnaces, a power burner. This resulted in energy consumption, between 1992 and 2015, of 40.37 Quads, and savings of 3.71 Quads. The net present value, in 1987 dollars, was $7.79 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 cost of 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 almost no change from the base case, i.e., this alternative would save less than 0.01 Quad with a net present value of $80 million. Consumer rebates however, would save 0.05 Quad with a net present value of $260 million.

The consumer rebate program and the tax credit program would return to the participating consumer exactly the same amount of money. However, it is expected that there will be more participants in the rebate program. Therefore, the rebate program would result in substantially more energy savings than the tax credit program would.

The most important differences to the consumer between rebate and tax credit programs is that a rebate can be obtained quickly, whereas a tax credit is delayed until income taxes are filed or a tax refund is provided by the Internal Revenue Service. This means that middle- and low-income purchasers, who generally have little ready cash to purchase more expensive products, are not as likely to take advantage of the program as are upper income purchasers. To simulate this impact, DOE has assumed that only 60 percent of consumers would purchase more energy efficient products as a result of the tax credit program.

Another financial incentive that was considered was tax credits to manufacturers for the production of energy-efficient refrigerators and small gas furnaces. In this scenario, an investment tax credit (ITC) of 20 percent was assumed. The tax credits to manufacturers had almost no effect, since the energy consumption estimates are 44.09 Quads with no energy savings, and a net present value equal to $30 million.

The impact of this scenario is so small because the ITC was applicable only to the tooling and machinery costs of the firms, i.e., the firms' fixed cost, 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 ITC.

Two scenarios of voluntary energy efficiency targets were examined; in the first one, energy conservation standards were assumed to be adopted voluntarily by all the relevant manufacturers in five years, and, in the second scenario, the standards were assumed to be adopted in 10 years. In these scenarios, the five year delay would result in energy consumption by these appliances of 40.71 Quads, energy savings of 3.38 Quads, and a new present value of $5.69 billion; the 10 year delay would result in 42.27 Quads of energy being consumed, 1.82 Quads being saved, and a net present value of $3.43 million.

These scenarios assume that there would be universal voluntary adoption of the energy conservation standards by the refrigerator and small gas furnace 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 prescribed by this rule. Such performance standards would result in energy consumption of refrigerators and small gas furnaces to total an estimated 38.89 Quads of primary energy over the 1992–2015 time period. Savings would be 5.20 Quads, and the net present value would be an expected $9.18 billion.

As noted at the beginning of this section, none of the alternatives that were considered for refrigerators and small gas furnace would save as much energy as today's rule.

c. 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 National Government and the States, or on the distribution of power and responsibilities among various levels of government. If there are sufficient substantial direct effects, then Executive Order 12612 requires preparation of a federalism assessment to be used in all decisions involved in promulgating and implementing a regulation or a rule.

DOE has identified a substantial direct effect that today's rule would have on State governments. It would initially preempt inconsistent State regulations. However, DOE has concluded that the initially preemptive effect is not sufficient to warrant preparation of a federalism assessment for the following reason: the Act provides for subsequent State petitions for exemption, which necessarily means that the determination as to whether a State law prevails must be made on a case-by-case basis using criteria set forth in the Act. When DOE receives such a petition, it will be appropriate to consider preparing a federalism assessment consistent with the criteria in the Act.

d. Regulatory Flexibility Review

The Regulatory Flexibility Act of 1980 (Public Law 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.

In this rulemaking, two different products and, hence, industries, are being addressed. Regulatory flexibility issues are addressed for the two industries for which standards are being finalized.

First, the energy conservation standard of 78 percent AFUE on those small gas furnace manufacturers, who could be considered small businesses, is discussed. There is no indication that the impact of standards will be directly related to firm size. Although different size firms have different cost structures, industry sources indicate that, overall, neither large nor small firms have a cost advantage and that neither large nor small firms tend to have a higher proportion of fixed cost. A corollary to this observation is that profits are also not correlated to firm size. Some large firms are quite profitable, while others earn more modest profits, and the same is true for smaller firms.

The Engineering Analysis indicates that the measures necessary to meet the standards levels under consideration involve using additional purchased parts which do not require development costs of the appliance manufacturer. While larger firms may have some slight cost advantage from buying in larger quantites, the fact that the design options predominantly involve purchased parts tends to be an equalizing factor among different-sized firms.

Therefore, the fact that this energy conservation standard on small gas furnaces is not likely to "have a significant economic impact on a substantial number of small entities" suggests that the provisions of section 605.(b) of the Regulatory Flexibility Act pertain. These provisions state that neither an initial nor a final regulatory flexibility analysis need be performed for a proposed or final rule "if the head of the agency certifies that the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities."

Of the eight small refrigerator firms reviewed for this analysis, three make custom refrigerators, three make compact units (largely for mobile homes and recreational vehicles), and two make 3-in-1 units with range tops and sinks.

The analysis of combined-unit manufacturers is straightforward. Three-in-one units are not covered by the present standards, so these manufacturers will not be affected.

The custom refrigerator manufacturers seem to be fairly well protected for two reasons; they are not exposed to either direct foreign competition or direct competition from major domestic firms, and because they produce custom units they have a greater ability to make design changes compared to a large manufacturer. These two facts indicate that standards will probably not hurt the custom manufacturer's control of its market; however, its market may shrink due to price increases. This cannot be estimated without engineering data and an estimate of the elasticity of demand in this market. One thing must be remembered when analyzing this problem: standards will increase the price of standard refrigerators and this will offset (partly or more than completely) the impact of the price increase of custom refrigerators.

The three small manufacturers of compact refrigerators are probably at the greatest risk, both without standards and from standards. They face stiff foreign competition from large foreign manufacturers.

In conclusion, since neither of the standards is expected to have a "significant economic impact on a substantial number of small entities," the Department has found that it was not necessary to prepare a regulatory flexibility analysis.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Energy consideration, Household appliances.

In consideration of the foregoing, part 430 of chapter II of title 10, Code of Federal Regulations, is amended as set forth below.

Issued in Washington, DC, November 13, 1989.

J. Michael Davis, P.E.,

Assistant Secretary, Conservation and Renewable Energy.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

Authority: Energy Policy and Conservation Act, title III, part B, as amended by National Energy Conservation Policy Act, title IV, part 2, National Appliance Energy Conservation Act of 1987, and National Appliance Energy Conservation Amendments of 1988 (42 U.S.C. 6291–6309).

2. Section 430.32 is amended by revising paragraph (a) as follows:

§ 430.32 [Amended]

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

Product class	Energy standards equations (Kwh/yr) Effective dates	
	January 1, 1990	January 1, 1993
1. Refrigerators and Refrigerator-Freezers with manual defrost	(16.3AV+316)	(19.9AV+98)
2. Refrigerator-Freezer—partial automatic defrost	(21.8AV+429)	(10.4AV+398)
3. Refrigerator-Freezers—automatic defrost with: Top-mounted freezer without through-the-door ice service [1]	(23.5AV+471)	(16.0AV+355)
4. Refrigerator-Freezers—automatic defrost with: Side-mounted freezer without through-the-door ice service	(27.7AV+488)	(11.8AV+501)
5. Refrigerator-Freezers—automatic defrost with: Bottom-mounted freezer without through-the-door ice service	(27.7AV+488)	(14.2AV+364)

Product class	Energy standards equations (Kwh/yr) Effective dates	
	January 1, 1990	January 1, 1993
6. Refrigerator-Freezers—automatic defrost with: Top-mounted freezer with through-the-door ice service	(26.4AV+535)	(17.6AV+391)
7 Refrigerator-Freezers—automatic defrost with: Side-mounted freezer with through-the-door ice service	(30.9AV+547)	(16.3AV+527)
8. Upright Freezers with: Manual defrost	(10.9AV+422)	(10.3AV+264)
9. Upright Freezers with: Automatic defrost	(16.0AV+623)	(14.9AV+391)
10. Chest Freezers and all other Freezers	(14.8AV+223)	(12.0AV+124)

[1] Including all refrigerators with automatic defrost
AV=Total adjusted volume, expressed in $Ft.^3$, as determined in Appendices A1 and B1 of Subpart B of this Part.

3. Section 430.32(e) is amended by revising the Table headings and Item 3. in the table, and by adding footnote 1 to the table to read as follows.

* * * * *

(e) *Furnaces.*

Product class	AFUE [1] (percent)	Effective date
* * *	*	*
3. Small furnaces (other than furnaces designed solely for installation in mobile homes) having an input rate of less than 45,000 Btu/hr		
(A) Weatherized (outdoor).	78	January 1, 1992.
(B) Non-weatherized (indoor).	78	January 1, 1992.

[1] Annual Fuel Utilization Efficiency, as determined in § 430.22(n)(2) of this part.

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[FR Doc. 89-26965 Filed 11-13-89; 3:29 pm]

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10 CFR Part 430

[Docket No. CE-RM-87-102]

Energy Conservation Program for Consumer Products; Energy Conservation Standards for Two Types of Consumer Products

AGENCY: Office of Conservation and Renewable Energy, DOE.

ACTION: Publication of Department of Justice Determinations and Analyses of Competitive Impacts.

SUMMARY: In today's Federal Register, the preamble to the final rule on energy conservation standards for small gas furnaces, and refrigerators, refrigerator-freezers and freezers presented the Attorney General's findings on the competitive impacts of the standards in the final rule. Section 325(1)(2)(B)(ii) of the Energy Policy and Conservation Act, as amended, requires the Attorney General's determinations and analyses to be published in the **Federal Register**. This notice presents the determinations and analyses.

Issued in Washington, DC, November 15, 1989.

B. Reid Detchon,

Principal Deputy Assistant Secretary, Conservation and Renewable Energy.

Honorable Donna R. Fitzpatrick,
Acting Secretary of Energy, United States Department of Energy, Forrestal Building, 1000 Independence Ave., SW., Washington, DC 20585.

Dear Ms. Fitzpatrick: By letter dated December 9, 1988, the Department of Energy ("DOE") transmitted to the Attorney General a Notice of Proposed Rulemaking (53 FR 48798) addressing energy standards for three classes of household appliances. Section 325 of the Energy Policy and Conservation Act, as amended in 1987 (42 U.S.C. 6295), requires the Attorney General to determine the impact, if any, of any lessening of competition likely to result from the proposed standards. Competitive impact is one of seven criteria to be considered by DOE in evaluating proposed standards. This letter contains the competitive impact determination of the Department of Justice ("Department").

Summary

The evidence available to the Department does not indicate that any significant lessening of competition is likely to result from the imposition of any of the proposed standards contained in DOE's Notice of Proposed Rulemaking. For small gas furnaces and television sets, the available evidence affirmatively suggests that no significant adverse competitive impact is likely. In the case of refrigerators, refrigerator-freezers, and freezers, it is the Department's best judgment based on the available evidence that no significant adverse competitive impact is likely; but, under certain limited conditions described below, an unquantifiable adverse competitive impact would be possible.

Discussion

In appraising the competitive effect of the proposed standards in the context of this statute, the Department has examined the relevant markets within which the standards will operate. The Department has then considered whether adoption of the standards would be likely to contribute to increased levels of concentration and, if so, whether the resulting concentration levels and other relevant market conditions would facilitate either oligopolistic pricing or actual price fixing. The Department also has considered whether, independent of or in conjunction with any increase in concentration, the standards would be likely to facilitate oligopolistic pricing or price fixing by increasing product homogeneity.

In this instance, the Department has utilized the HHI computations, commonly employed in market analysis and described in the Department's merger guidelines, as an initial "screen." This screen has permitted the Department to conclude that the proposed standards are unlikely to have a significant adverse impact on competition in two classes of appliances: small gas furnaces and television sets. In both instances, the DOE technical support document provides information that permits the Department to calculate HHI figures for the tentatively defined markets in question. For each market—small gas furances, color television sets, and black and white television sets—the HHI figure is below 1,800. In other words, none of these markets is highly concentrated.

At levels of concentration below 1,800, the number of competitors is ordinarily sufficient to make competitive pricing likely and to defeat oligopolistic pricing. Even if the standards resulted in increased costs and reduced the number of competitors, or increased product homogeneity in some measure, the Department would expect that the markets in question would continue to enjoy a substantial measure of competition. Although price fixing can occur in less concentrated markets, the conditions that accompany this threat do not appear to be present in the markets in question.

The analysis of refrigerators, refrigerator-freezers, and freezers is more complex because the risk of an adverse competitive impact is not diminished by the existing market structure as reflected in the HHI figures. Based on data contained in the technical support document, refrigerators and freezers have HHI figures, respectively, of over 2,200 and over 3,000. These figures reflect high levels of concentration, albeit at the lower end of the highly concentrated range (whose maximum is 10,000). It is thus prudent to examine more closely the possibility that the standards could increase concentration within a market, increase product homogeneity, or both.

The possibility that concentration might increase depends primarily on whether compliance with the standards both (1) increases costs significantly and (2) results in