American Council for an Energy-Efficient Economy
Appliance Standards Awareness Project
California Energy Commission
Consumer Federation of America
Natural Resources Defense Council
National Consumer Law Center
National Grid, USA
Northeast Energy Efficiency Partnerships
Northwest Power and Conservation Council
Pacific Gas & Electric Company
Vermont Energy Investment Corporation

June 1, 2004

Spencer Abraham
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Dear Secretary Abraham,

We are writing to formally petition DOE to conduct a rulemaking to amend existing minimum efficiency standards for residential refrigerators, refrigerator-freezers, and freezers. As you know, these products are regulated by DOE under the National Appliance Energy Conservation Act (NAECA) of 1987. Initial standards on refrigerators, which were established by Congress and signed by President Reagan, took effect in 1990. DOE subsequently strengthened these standards by 25% effective 1993 and an additional 30% effective 2001. Currently nearly 700 products are being produced and sold that exceed the 2001 standard by 15%, including half a dozen products that exceed the 2001 standard by 30%.[1] We respectfully submit that the existence of these products, combined with the other evidence presented in this petition, more than justifies the granting of this petition and the commencement of another round of rulemaking for refrigerators to amend existing standards. We ask you to begin this rulemaking in Fiscal Year 2005.

Petitioners include energy efficiency organizations, environmental organizations, consumer organizations, states and electric utilities. The undersigned organizations have a strong interest in the establishment of strong, cost-effective appliance standards under NAECA, including new standards for residential refrigerators. Appliance energy efficiency standards are the single most effective tool for reducing energy usage while still providing consumers with reliable and affordable energy services. Increasing appliance efficiency levels reduces electricity waste and electricity demand and reduces air pollution and other environmental problems associated with electricity generation,

[1] EPA and DOE, ENERGY STAR Qualified Refrigerators, last uploaded April 19, 2004. Available at http://www.energystar.gov/index.cfm?c=refrig.pr_refrigerators .

while providing consumers with the same level of service from their appliances. As President Bush's National Energy Policy states, appliance standards "stimulate energy savings that benefit the consumer and reduce fossil fuel consumption, thus reducing air emissions."[2] Appliance energy efficiency standards also have important benefits for consumers, including low-income consumers: by reducing electricity usage, standards reduce consumer bills for those who purchase appliances and also help to reduce electricity prices overall by reducing wholesale electricity prices, particularly at times of peak demand. Appliance standards are an important tool for relieving stress on overloaded electric grids and provide a means for electric utilities to provide least cost service to their customers. Finally, appliance standards assist in ensuring energy security by helping to reduce America's dependence on imported fossil fuels and by reducing electric grid vulnerability.

Petitions for Amended Standards Under NAECA

Under NAECA, DOE is mandated to conduct two reviews of standards on each regulated product. These two reviews have been completed for refrigerators. However, section 325(n) of NAECA [42 U.S.C. § 6295(n)] also provides that:

> Petition for an Amended Standard.—(1) With respect to each covered product described in paragraphs (1) through (11), and in paragraphs (13) and (14) of section 322(a) [refrigerators are in paragraph (1)], any person may petition the Secretary to conduct a rulemaking to determine for a covered product if the standards contained either in the last final rule required under subsections (b) through (i) of this section [refrigerators are covered under subsection (b)] or in a final rule published under this section shall be amended.
>
> (2) The Secretary shall grant a petition if he finds that it contains evidence which, assuming no other evidence were considered, provides an adequate basis for amending the standards under the following criteria—
>
> (A) amended standards will result in significant conservation of energy;
>
> (B) amended standards are technologically feasible; and
>
> (C) amended standards are cost effective as described in subsection (o)(2)(B)(i)(II). [This calls for comparing "the savings in operating costs throughout the estimated average life of the covered product in the type (or class) compared to any increase in the price of, or in the initial charges for, or maintenance expenses of, the covered products which are likely to result from the imposition of the standard"].
>
> The grant of a petition by the Secretary under this subsection creates no presumption with respect to the Secretary's determination of any of the criteria in a rulemaking under this section.

In this petition, we will show how the three key criteria for a petition are met, and therefore that DOE has no choice but to grant the petition. Furthermore, DOE has just begun a process to set priorities for standards rulemakings in Fiscal Year 2005, and

[2] National Energy Policy Development Group, 2001, *National Energy Policy.* Pp. 4-5, Washington, DC: U,S. Government Printing Office.

therefore the timing is just right for adding a new rulemaking into the schedule. In addition, although budgetary issues are irrelevant to the establishment of amended standards under NAECA, we note that DOE should have funds for a new rulemaking as a substantial amount of funds for the standards program are not being spent in Fiscal Year 2004 and are therefore available for Fiscal Year 2005. Congress is likely to provide additional funds for the program in Fiscal Year 2005, including some funds beyond the budget request.

In the following sections we discuss each of the three key petition criteria in relation to residential refrigerators, refrigerator-freezers, and freezers.

Conservation of Energy

On April 27, 2004, DOE issued a set of analyses that it is using to help set rulemaking priorities for the standards program.[3] As part of this analysis DOE estimated the energy savings from possible new efficiency standards including the current ENERGY STAR® specification (energy consumption at least 15% less than the current mandatory standard) and higher tiers developed by the Consortium for Energy Efficiency, a group of utilities, states and non-profit organizations that plan and operate energy-saving programs. In this analysis, DOE found that a new standard at the ENERGY STAR level would save an average of 83 kWh per refrigerator, and that when multiplied by the more than 9 million refrigerators sold annually, would save 2.89 quads of energy on a cumulative basis over the 2010-2035 period.[4] This level of savings is similar to the recent fluorescent ballast final rule.[5]

As part of the same analysis, DOE also looked at CEE tier 3 and found that this level of performance would save an average of 166 kWh per refrigerator, resulting in cumulative savings of 5.78 quads of energy over the 2010-2035 period.[6] This level of savings is similar to DOE's recently completed clothes washer, water heater and central air conditioner rules,[7] and similar to the potential savings from the distribution transformer and residential furnace/boiler rulemakings now underway.[8]

---

[3] In particular, we refer to "Appendix A: FY2005 Technical Support Document" which can be found at http://www.eere.energy.gov/buildings/appliance_standards/2005_priority_setting.html . [Relevant excerpts are included as Attachment 1].

[4] Ibid., p. 7-7.

[5] In the Final Rule setting the new ballast standard, DOE states: "The Department concludes that an electronic ballast standard saves a significant amount of energy. The energy savings reported in the Department's analysis for an electronic ballast standard based on the Joint Comments ranged between 1.20 and 2.32 Quads of energy, not including the HVAC effects. The Department considers energy savings within this range to be significant." *Federal Register* 65(182), Sept. 19, 2000, p. 56745.

[6] Appendix A, p. 7-7. See note #3.

[7] In the Final Rule setting the clothes washer standard, DOE states: "Next, we considered the two step 1.04/1.26 MEF efficiency level, which was proposed in the Joint Comment (Joint Comment, No. 204) [This is the standard ultimately adopted]. This trial standard level, Trial Standard Level 3, has energy savings of 5.52 quads through 2030, a significant amount." *Federal Register* 66(9), Jan. 12, 2001, p. 3327.

In the Final Rule setting the new water heater standard, DOE states: "Next, we considered trial standard level three [This is the standard ultimately adopted]. This trial standard level saves about 4.6 quads of energy, a significant amount." *Federal Register* 66(11), Jan. 17, 2001, p. 4493.

In summary, with savings of this magnitude, it is clear that a new refrigerator standard will "result in significant conservation," under NAECA Section 322(n)(2)(A), 42 U.S.C. § 6295(n)(2)(A). The savings levels that DOE itself has published are similar to the levels it has found to be significant in prior DOE rulemakings.

Technical Feasibility

DOE's recent analysis also deals with the issue of technical feasibility of a new standard. DOE notes that more than 50 products meet the CEE tier 1 levels (20% savings relative to the DOE standard), 11 meet CEE tier 2 (25% savings relative to the DOE standard), and 6 meet CEE tier 3 (30% savings).[9] More recent data is available on the ENERGY STAR web site. As of April 19, 2004 this site listed 687 refrigerators and refrigerator-freezers meeting ENERGY STAR, 102 models meeting CEE tier 1, 17 meeting CEE tier 2, and 9 meeting CEE tier 3.[10] If this many existing products can meet these higher efficiency levels, then clearly higher efficiency standards are "technically feasible" under NAECA Section 322(n)(2)(B), 42 U.S.C. § 6295(n)(2)(B).

Cost-Effectiveness

Since energy savings and technical feasibility are clear cut, cost-effectiveness will be the key issue in determining whether a new refrigerator efficiency rulemaking is warranted. The petition must contain evidence "which, assuming no other evidence were considered, provides an adequate basis for amending the standards," which requires a much lower standard of evidence than that required for setting an actual new standard (42 U.S.C. § 6295(n)(2)(C)).

Again, DOE's April 2004 analysis provides the data that is needed to show that this criteria can be met. Specifically, in this analysis DOE uses decade-old estimates it developed of the incremental cost of more efficient refrigerators relative to a unit meeting the current federal standard.[11] In the case of the current ENERGY STAR levels, DOE estimates an incremental cost of $60 per unit and finds that at this cost, the cumulative net present value benefits (i.e. the "savings in operating costs throughout the estimated average life of the covered product") at this standard level are $500 million more than the costs.[12] This finding alone should satisfy the legislated criteria for granting our petition and beginning a rulemaking that will collect more recent cost data. There is no evidence

---

In the Final Rule setting the new central air conditioner and heat pump standard, DOE states: "Next, we considered Trial Standard Level 4. This level specifies 13 SEER equipment for all product classes. In considering Trial Standard Level 4 the Roll-up efficiency scenario and reverse engineering cost data are the assumptions we consider to be the most probable… Primary energy savings would likely be 4.2 quads which the Department considers significant." *Federal Register* 66(14), Jan. 22, 2001, p. 7197.

[8] "Appendix B: FY2005 Draft Priority-Setting Data Sheets" which can be found at http://www.eere.energy.gov/buildings/appliance_standards/2005_priority_setting.html .

[9] Appendix A, p. 7-3. See note #3.

[10] EPA and DOE, ENERGY STAR Qualified Refrigerators, last uploaded April 19, 2004. See note #1.

[11] These estimates were published by DOE in 1995 but developed a few years earlier.

[12] Appendix A, p. 7-7. See note #3.

that we are aware of that ENERGY STAR level refrigerators have any maintenance costs in excess of those of non-ENERGY STAR models. Therefore, maintenance costs do not affect the result of this cost-effectiveness analysis.

However, it is worth noting that more recent data indicates that the old DOE cost estimates overestimate costs by at least about a factor of two, and perhaps by a factor of nine. Specifically, a recent review by the American Council for an Energy-Efficient Economy of the Sears website found that ENERGY STAR refrigerators cost an average of about $36 more than otherwise comparable units that are not ENERGY STAR.[13] Thus, current incremental costs appear to be nearly half of what DOE estimated in the 1990s. At an incremental cost of $36, an ENERGY STAR refrigerator saving 83 kWh/year will have a simple payback to the consumer of about 5 years at current national average electricity prices. If we revise DOE's net present value analysis to change the incremental cost to $36 but leave all other assumptions the same, then the net benefits of this standard increase to $3.2 billion.[14]

Furthermore, current costs for ENERGY STAR are for a niche product and not for widespread production. In particular, as shown in Attachment 2, manufacturers are currently charging a large cost premium for ENERGY STAR side-by-side units since these are high-end units for which manufacturers can charge very profitable prices. Past experience shows that when new standards are set, costs are generally much less than what manufacturers and DOE estimate during the standard-setting process. For example, the U.S. Census Bureau, as part of its annual Census of Manufacturers, collects data on the number of refrigerators shipped and the value of the shipments. Taking value of shipments and dividing by the number shipped gives average value per unit, including manufacturer costs, markups and profit. In preparation for the 2001 standard, manufacturers made a variety of product changes, primarily in 2000 and 2001. Therefore, the incremental cost at the manufacturer level of the new standards can be estimated by comparing value per unit for 1999 (which was $424.96) and 2002 ($427.94). The difference is only $2.98.[15] If we multiply this by DOE's estimate of the markup factor between manufacturer costs and consumer cost (2.07),[16] then the real world incremental cost is approximately $6, which is only 12% of the $50 average consumer incremental cost estimated by DOE in the rulemaking.[17]

---

[13] Details are provided in Attachment 2.

[14] Net benefit calculations were done with DOE's "refrig_std_nes_20040409" spreadsheet available at http://www.eere.energy.gov/buildings/appliance_standards/2005_priority_setting.html . Only incremental costs were changed.

[15] Details of this data analysis are provided in Attachment 3.

[16] We derive this markup factor by comparing the retail price of a top mount auto defrost refrigerator-freezer at the selected standard level from Table 4.1 on p. 4-3 with the manufacturer cost of this same model from Table 3.5 on p. 3-2. DOE, 1995, *Technical Support Document: Energy Efficiency Standards for Consumer Products: Refrigerators, Refrigerator-Freezers, and Freezers*, DOE/EE-0064. Washington, DC: DOE.

[17] Ibid., Table 5.3.4, p. 5-12.

If we apply this 12% factor to DOE's 1990s estimate of a $60 incremental cost for the current ENERGY STAR level, then we get an incremental cost of only $7, a simple payback of one year, and the net benefits of such a standard increase to $5.6 billion.[18]

We can apply the same logic to DOE's 1990's estimate of the incremental cost of a unit using 30% less energy than the current standard (e.g., CEE tier 3). In the 1990s DOE estimated a $235 incremental cost, but if DOE overestimated this cost increase to the same degree it overestimated the incremental cost of a unit just meeting the new standard, then the incremental cost is only $28 ($235 * 12%), the simple payback about two years, and the net benefits of the standard $10.1 billion.[19]

In summary, even with DOE's very dated and conservative assumptions, the cost-effectiveness test is met by a standard 15% below the present one (i.e., the current ENERGY STAR). But if newer data are used, such as current incremental costs for ENERGY STAR or adjusting the earlier DOE estimates in light of actual experience implementing the 2001 standard, then new refrigerator standards are even more cost-effective (e.g. probably more cost-effective than almost any other standard DOE has set). In short, we have pointed to more than enough evidence to provide an "adequate basis" for determining that amended standards are cost effective, sufficient to require the granting of this petition (42 U.S.C. § 6295(n)(2)(C)).

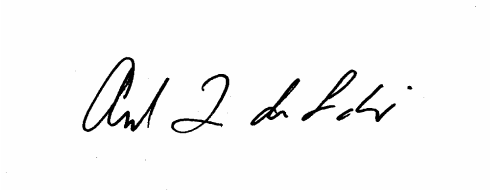
Conclusion

DOE's own analysis indicates that a new refrigerator standard will save a significant amount of energy, is technologically feasible, and is cost-effective. Thus, using DOE's own analysis, the three criteria under NAECA for granting a petition for amended standards are met. Furthermore, more recent cost data indicate that a new refrigerator standard could well be one of the most successful standards, with very large economic benefits and energy savings. Given these findings, we respectfully request that this petition be granted and that you begin a new rulemaking for refrigerators and related products in Fiscal Year 2005.

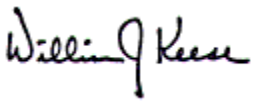
Sincerely,

Steven M. Nadel
Executive Director
American Council for an Energy-Efficient Economy
1001 Connecticut Ave. NW, Suite 801
Washington, DC 20036

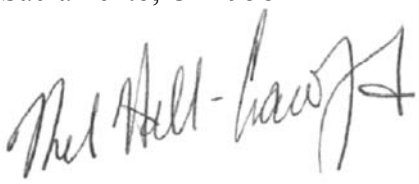
[18] See note #14.
[19] See note #14.



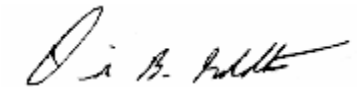
Andrew L. deLaski
Executive Director
Appliance Standards Awareness Project
20 Belgrade Ave., Suite 1
Boston, MA 02131



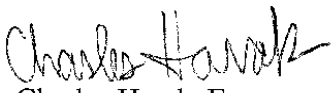
William J. Keese
Chairman
California Energy Commission
1516 Ninth St.
Sacramento, CA 95814



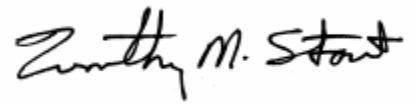
Mel Hall-Crawford
Energy Projects Manager
Consumer Federation of America
1424 16 St., Suite 604
Washington, DC 20036



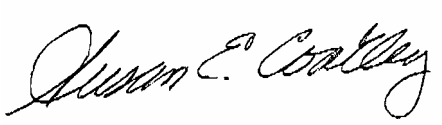
David B. Goldstein
Senior Scientist
Katherine Kennedy
Senior Attorney
Natural Resources Defense Council
71 Stevenson St., Suite 825
San Francisco, CA 94105



Charles Harak, Esq.
National Consumer Law Center
(On behalf of its low-income clients)
77 Summer Street, 10th floor
Boston, MA 02110
617 542-8010 (ph)
617 542-8028 (fax)
charak@nclc.org



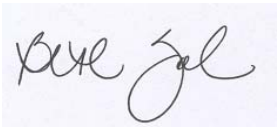
Timothy M. Stout
Vice President – Energy Efficiency
National Grid, USA
55 Bearfoot Rd.
Northborough, MA 01532



Susan E. Coakley
Executive Director
Northeast Energy Efficiency Partnerships
5 Militia Dr.
Lexington, MA 02421

Stephen L. Crow
Executive Director
Northwest Power and Conservation Council
851 S.W. Sixth Ave., Suite 1100
Portland, OR 97204

Roland J. Risser
Director, Customer Energy Efficiency
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, CA 94177



Beth Sachs
Executive Director
Vermont Energy Investment Corporation
255 S.Champlain St.
Burlington, VT 05401

Attachment 1.

Refrigerator Section from DOE FY2005 Technical Support Document

(full document available at:
http://www.eere.energy.gov/buildings/appliance_standards/2005_priority_setting.html)

A7 Refrigerators and Refrigerator-Freezers, Freezers, and Compact Refrigerators

A7.1 Background

Refrigerators, refrigerator-freezers, and freezers are major household appliances designed for the refrigerated storage of food products. A refrigerator consists of a refrigerated cabinet designed for the refrigerated storage of food at temperatures above 0°C (32°F) and below 3.9°C (39°F), configured for general refrigerated food storage, and having a source of refrigeration requiring single phase, alternating current electric energy input only. A refrigerator may include a compartment for the storage of food at temperatures below 0°C (32°F), but does not provide a separate low temperature compartment designed for freezing and storage of food at temperatures below -13.3°C (8°F). A refrigerator-freezer is a cabinet which consists of at least one compartment designed for the refrigerated storage of food at temperatures above 0°C (32°F) and at least one other compartment designed for the freezing and storage of food at temperatures below -13.3°C (8°F). A freezer consists of a cabinet for the storage and freezing of foods at -17.8°C (0°F) or below. Compact refrigerators are defined by the DOE as having less than a 7.75 cubic foot capacity and 36 inches or less in height.

In 1987, the National Appliance Energy Conservation Act (NAECA) was signed into law establishing minimum energy efficiency standards for refrigerators, refrigerator-freezers, and freezers. For twelve product classes, NAECA specified the maximum allowable energy in kilowatt-hours per year for products manufactured on or after January 1, 1990 (NAECA 1987). Subsequent to the NAECA requirements, a new set of minimum efficiency standards became effective first in 1993 then again in 2001 (DOE 1997). The new minimum efficiency standards in 1993 eliminated 99 percent of the models and increased efficiency by 25 to 30 percent relative to the NAECA requirements. The minimum efficiency standards that became effective on July 1, 2001 increase the efficiency of the most popular product class, top mount refrigerator-freezers with auto-defrost, by approximately 30 percent relative to the 1993 standards.

Table A7-1 provides background data on the installed base, annual shipments, lifetime, and national annual energy consumption for refrigerator-freezers and freezers. The background data are divided into three categories: standard size refrigerators and refrigerator-freezers, freezers, and compact refrigerators.

Table A7-1: Standard Refrigerator, Freezer, and Compact Refrigerator Background Data

Type	Data type	Value[1]	Source/Comments
Refrigerator & Refrigerator-Freezers	Installed Base, millions	142	Based on historical shipments and equipment lifetime of 19 years
	Annual Shipments, millions	9.74	(Appliance 2004)
	Equipment Lifetime, years	19	(DOE 1995)
	AEC, quad	0.86	Based on installed base and stock annual energy use
Freezers	Installed Base, millions	29	Based on historical shipments and equipment lifetime of 19 years
	Annual Shipments, millions	1.49	(Appliance 2004)
	Equipment Lifetime, years	19	(DOE 1995)
	AEC, quad	0.14	Based on installed base and stock annual energy use
Compact Refrigertors	Installed Base, millions	12	Based on historical shipments and equipment lifetime of 19 years
	Annual Shipments, millions	1.40	(Appliance 2004)
	Equipment Lifetime, years	11	(DOE 1995)
	AEC, quad	0.04	Based on installed base and stock annual energy use

Installed base, annual shipment, and AEC values are for the year 2002.

A7.2 Product Technology Description and Market Presence

Technology for improving refrigerator and freezer performance include: using more efficient compressors, reducing the power consumption of fans, using smart defrost technology to minimize the amount of defrost that is needed and adding insulation.

The saturation of refrigerators/refrigerator-freezers was 96 percent in 2001, based on the number of households with at least one refrigerator (AHAM 2003). The sales of compact refrigerators have increased appreciably in the last several years. While most seem to be sold to residential consumers, significant amounts are also prevalent in non-residential applications such as hotels, dormitories and offices.

The Federal Energy Management Program (FEMP), ENERGY STAR®, and the Consortium for Energy Efficiency (CEE) specify voluntary efficiency requirements for refrigerators, refrigerator-freezers, and freezers (FEMP 2004; ENERGY STAR® 2004; CEE 2004). FEMP provides efficiency targets only for standard size refrigerator-freezers. For example, for top-mount refrigerator-freezers with auto-defrost, the specified annual energy use reduction target is four percent lower than the current minimum standard. FEMP is in the process of revising its purchasing recommendations for refrigerators, in order to be in alignment with ENERGY STAR® specifications. The difference between FEMP and ENERGY STAR® will be that while

ENERGY STAR® specifies an efficiency curve, FEMP divides recommendations into bins based on capacity and reports their recommendations in kWh/year rather than as a percentage increase in efficiency.

ENERGY STAR® specifies annual energy use reduction targets of 15, 10, and 20 percent for standard size refrigerator-freezers, freezers, and compact refrigerators respectively. CEE targets only standard-size refrigerator-freezers. CEE specifies three tier levels specifying annual energy use reduction targets of 20, 25, and 30 percent relative to current minimum efficiency standards.

The market presence of higher efficiency refrigerators and freezers can be gauged somewhat by the number refrigerators meeting the ENERGY STAR® specifications and CEE tier levels. The AHAM 2003 Fact Book reports that 25 percent of sales of refrigerator products over 6.5 cu. ft. in capacity meet ENERGY STAR® levels (AHAM 2003). On January 1, 2004, the ENERGY STAR® criteria changed for all full size refrigerators (above 7.75 cu. ft in capacity). For top-mount refrigerator-freezers with volumes between 16.5 to 18.4 cu. ft., 33 models currently meet the ENERGY STAR® criteria. For chest freezers, twelve models currently meet the ENERGY STAR® criteria; however, none were in the 22.5 to 24.4 cu. ft. range. For single-door refrigerators, 23 models currently meet the ENERGY STAR® criteria (ENERGY STAR® 2004). All single-door refrigerator models meeting ENERGY STAR® have volumes less than 7.75 cu.ft., qualifying them as compact refrigerators. According to information compiled by ENERGY STAR®, several refrigerator-freezer models meet the CEE tier levels. Over 50 refrigerator-freezer models lie between the first two CEE tier levels (i.e., energy use of 20 to 25 percent lower than existing minimum standards), five models lie between the second and third CEE tier levels (i.e., energy use of 25 to 30 percent lower than existing minimum standards), and six models have lower energy consumption than the third CEE tier level (ENERGY STAR® 2004).

Tables A7-2 through A7-4 provide the UEC values corresponding to various efficiency levels of standard-size refrigerator-freezers, freezers, and compact refrigerators.

Table A7-2: Standard-Size Refrigerator-Freezer Technology Levels and UEC Values

Technology Level	UEC[1] (kWh/year)	Source
Typical New	552	(AHAM 2003)
Minimum Efficiency Standard	484[2]	(DOE 1997)
FEMP[3] (4% decrease)	530	(FEMP 2004)
ENERGY STAR® (15% decrease)	469	(ENERGY STAR® 2004)
CEE Tier 1 (20% decrease)	442	(CEE 2004)
CEE Tier 2 (25% decrease)	414	(CEE 2004)
CEE Tier 3 (30% decrease)	338	(CEE 2004)

[1] UEC values are a shipment-weighted average of all standard-size refrigerator-freezers.

[2] Minimum standard for top- mount refrigerator-freezer with auto defrost, 21.4 cu. ft. adjusted volume.

[3] FEMP is in the process of revising its purchasing recommendations for refrigerators, in order to be in alignment with ENERGY STAR® specifications. The difference between FEMP and ENERGY STAR® will be that while ENERGY STAR® specifies an efficiency curve, FEMP divides recommendations into bins based on capacity and reports their recommendations in kWh/year rather than as a percentage increase in efficiency.

Table A7-3: Freezer Technology Levels and UEC Values

Technology Level	UEC[1] (kWh/year)	Source
Typical New	444	(AHAM 2003)
ENERGY STAR® (10% decrease)	400	(ENERGY STAR® 2004)

[1] UEC values are a shipment-weighted average of all freezers.

Table A7-4: Compact Refrigerator Technology Levels and UEC Values

Technology Level	UEC[1] (kWh/year)	Comment/Source
Typical New	300	(AHAM 1996)
ENERGY STAR® (20% decrease)	240	(ENERGY STAR® 2004)

UEC values are a shipment-weighted average of all compact refrigerators.

Tables A7-5 through A7-7 provide retail price information corresponding to the efficiency levels specified in Tables A7-2 through A7-4. Retail price data for typical new standard-size refrigerator-freezers and freezers are provided by AHAM in their 2003 Fact Book (AHAM 2003). A representative retail price for a typical new compact refrigerator was obtained from a retailer website (WalMart 2004). Retail prices are generated for high efficiency levels from the percentage price increases indicated by the price versus efficiency relationships in DOE's 1995 refrigerator Technical Support Document (TSD) (DOE 1995).

Table A7-5: Standard-Size Refrigerator-Freezer Retail Prices

Technology Level	UEC (kWh/year)	Retail Price ($2002)	Source
Typical New	552	$788	(AHAM 2003)
FEMP (4% decrease)	530	$796	(DOE 1995)[1]
ENERGY STAR® (15% decrease)	469	$856	(DOE 1995)[1]
CEE Tier 1 (20% decrease)	442	$903	(DOE 1995)[1]
CEE Tier 2 (25% decrease)	414	$961	(DOE 1995)[1]
CEE Tier 3 (30% decrease)	338	$1031	(DOE 1995)[1]

[1] Price vs. efficiency relationship, top-mount refrigerator-freezer with auto-defrost, Table 4.1

Table A7-6 Freezer Retail Prices

Technology Level	UEC (kWh/year)	Retail Price ($2002)	Source
Typical New	444	$405	(AHAM 2003)
ENERGY STAR® (10% decrease)	400	$415	(DOE 1995)[1]

Price vs. efficiency relationship, chest manual defrost freezer, Table 4.8, baseline to design option 2 efficiency range.

Table A7-7: Compact Refrigerator Retail Prices

Technology Level	UEC (kWh/year)	Retail Price ($2002)	Source
Typical New	300	$125	(WalMart 2004)
ENERGY STAR® (20% decrease)	240	$131	(DOE 1995)[1]

[1] Price vs. efficiency relationship, compact manual defrost refrigerator, Table 4.9.

A7.3 Test Procedure Status

Standard-size refrigerators, refrigerator-freezers, freezers, and compact refrigerators are all covered under the same DOE test procedure. They are tested at an ambient temperature of 90°F while internal volume temperatures are kept within specified temperature conditions. DOE has recently taken action on a couple of issues regarding the test procedure. Also, there have been recent actions to improve AHAM's test standard. The National Institute of Standards and Technology (NIST) has investigated the possibility of harmonizing the U.S. test procedure with international test standards. All of these recent actions are described in more detail below.

Credit for a more efficient defrost system
DOE issued a direct final rule, which became effective in May 2003, amending the calculation of the test time period for "long-time" automatic defrost units (DOE 2003). This change gives credit for a control capable of detecting frost so that the defrosting occurs other than during a compressor-on cycle, thereby saving energy by taking advantage of the natural warming of the evaporator during the compressor-off cycle. This revision has no effect on the testing of refrigerators and refrigerator-freezers that do not employ a long-time automatic defrost system.

Change in electric refrigerator definition to exclude wine coolers
Several manufacturers of wine coolers requested exemptions from the refrigerator energy efficiency standards. Some wine coolers are made with glass front doors, which make them less energy efficient than standard refrigerators. As a result, the DOE amended the definition of "electric refrigerator", effective December 19, 2001, to include a maximum temperature of the fresh food storage compartment, and to exclude certain appliances whose physical configuration makes them unsuitable for general storage of perishable foods. The purpose of the revised electric refrigerator definition was to exclude wine coolers from the energy efficiency regulation (DOE 2001). This rule may also affect other compact refrigerators designed to store and cool beverages other than wine. For example, since the time of the test procedure revision, a new product has entered the market that is both a compact refrigerator and wine cooler whose performance cannot be rated by the existing test procedure.

Repeatability issues for testing compact refrigerators
Because of inconsistencies in test results for compact refrigerators, the National Institute of Standards and Technology (NIST) investigated repeatability and reproducibility issues and published a report entitled "Repeatability of Energy Consumption Test Results for Compact Refrigerators". In addition, NIST participated in a task force formed by the Association of Home Appliance Manufacturers (AHAM) to revise their AHAM HRF-1 test procedure. The latest version of AHAM's test procedure is now AHAM HRF-1, 2003. But the existing DOE test procedure still references an older version of the AHAM test procedure, AHAM HRF-1, 1979. DOE may need to amend the test procedure to reference the most recent version of AHAM HRF-1.

Harmonizing with international standards
NIST has done comparisons between ISO's international test standards and the North American test standard. The two test procedures are similar but not identical. Differences include the ambient temperature at which the refrigerators are tested and the ISO specified test load. There is some interest in harmonizing and unifying the two test procedures by manufacturers interested in international trade. Recently, the United States, Canada, and Mexico have harmonized their test procedures.

A7.4 Energy Savings Estimates and Calculations

Table A7-8 presents the energy savings potential for the FEMP, ENERGY STAR®, and CEE efficiency levels specified in Tables A7-2 through A7-4. Also provided in Table A7-8 is the economic benefit or burden to consumers for each efficiency level. Note that only the FEMP and ENERGY STAR® efficiency levels yield an economic benefit to consumers. Consumer national utility bill savings for a given year are derived by taking the national annual energy savings and multiplying it by the corresponding electricity price from the DOE-Energy Information Administration's *Annual Energy Outlook 2004* (DOE 2004). Consumer national equipment cost increases are derived by taking the per unit change in equipment cost and multiplying it by the annual shipments. Cumulative bill savings and equipment cost increases are summed over the time period 2010-2035 with the net benefit or burden being the difference between the two values.[13]

Table A7-8: Refrigerator Potential Energy and Economic Impact Estimates

Technology Level	UEC (kWh/yr)	Energy Saving Potential, 2010-2035 (quads)	Potential Economic Benefits/Burdens; Cumulative NPV 2010-2035 (billions of $2002)
Standard-Size Refrigerator-Freezers			
Base Case	552	NA	NA
FEMP	530	0.77	1.00
ENERGY STAR®	469	2.89	0.52
CEE Tier 1	442	3.85	-1.28
CEE Tier 2	414	4.82	-4.07
CEE Tier 3	386	5.78	-7.85
Freezers			
Base Case	444	NA	NA
ENERGY STAR®	400	0.38	0.61
Compact Refrigerators			
Base Case	300	NA	NA
ENERGY STAR®	240	0.48	0.87

[13] Economic calculations are performed with a spreadsheet tool which is available on the DOE Building Technologies Program, Appliances and Commercial Equipment Standards web site. <http://www.eere.energy.gov/buildings/appliance_standards/2005_priority_setting.html>

A7.5 Regulatory Actions and Cumulative Burden

For full line manufacturers of white goods, consideration needs to be given to what other regulatory actions are in effect for other products.

Also, refrigerator manufacturers had to recently comply with U.S. EPA regulations on the phase-out of HCFC-141b in 2003, the blowing agent that was used for foam insulation. Any consideration given to updated minimum efficiency requirements needs to account for the effort and cost manufacturers expended for meeting this regulation.

A7.6 Issues Impacting Potential Energy Efficiency Standards

DOE's most recent energy efficiency standards became effective on July 1, 2001. This set of standards is the third set of minimum efficiency requirements that the industry has faced since 1990. The first set of standards took effect in 1990 and the second set in 1993.

Wine cooler and beverage centers as well as combination refrigerator/beverage coolers, need definitions and possible test procedures and standards.

Compact refrigerators are a fast growing part of the overall refrigerator market. Thus, due to their increased national energy consumption, potential energy savings could become greater in the future.

References

Appliance Magazine. 2004. "Healthy Times Ahead." January, 2004.

Association of Home Appliance Manufacturers (AHAM). 1996. Data on compact refrigerators. Chicago, IL.

Association of Home Appliance Manufacturers (AHAM). 2003. "Fact Book 2003." Chicago, IL.

Consortium for Energy Efficiency (CEE). 2004. www.cee1.org

ENERGY STAR®. 2004. www.energystar.gov

Federal Energy Management Program (FEMP). 2004. http://www.eere.energy.gov/femp/technologies/eeproducts.cfm

National Appliance Energy Conservation Act (NAECA), 1987, Pub. L. 100-12

U.S. Department of Energy (DOE)-Office of Codes and Standards, 1995. "Technical Support Document: Energy Efficiency Standards for Consumer Products: Refrigerators, Refrigerator-Freezers, & Freezers ." Washington, DC. DOE/EE-0064.

U.S. Department of Energy (DOE)-Office of Energy Efficiency and Renewable Energy. 1997. "Energy Conservation Program for Consumer Products: Energy Conservation Standards for Refrigerators, Refrigerator-Freezers and Freezers; Final Rule." Federal Register 62 (81): 23102-23116.

U.S. Department of Energy (DOE)-Office of Energy Efficiency and Renewable Energy. 2001. "Energy Conservation Program for Consumer Products: Amendment to the Definition of Electric Refrigerator; Final Rule." Federal Register 66 (223): 57845-57848.

U.S. Department of Energy (DOE)-Office of Energy Efficiency and Renewable Energy. 2003. "Energy Conservation Program for Consumer Products: Test Procedure for Refrigerators and Refrigerator-Freezers; Direct Final Rule." Federal Register 68 (45): 10957-10961.

U.S. Department of Energy (DOE), Energy Information Administration. 2004. "Annual Energy Outlook 2004 with projections to 2025." Washington, DC. DOE/EIA-0383(2004). January 2004.

WalMart. 2004. Retail price for a Haier 4.2 cu.ft. compact refrigerator. March, 2004. www.walmart.com

Attachment 2

Incremental Cost of ENERGY STAR Refrigerators, May 2004

					not ENERGY STAR		ENERGY STAR				
Brand	**Color**	**Type**	**Volume (cu. Ft.)**	**Other features**	**Model**	**Price**	**Model**	**Price**	**Price Δ**	**% Δ**	**Notes**
Kenmore	White	Top freezer	20.6	icemaker	73092	$ 650.00	74172	$ 650.00		0%	
Kenmore	White	Top freezer	20.6	icemaker	74162	$ 630.00	74172	$ 650.00	$20.00	3%	ES model loses the wine/beverage rack
Kenmore	White	Top freezer	20.6		63092	$ 600.00	64172	$ 600.00		0%	
Kenmore	White	Top freezer	20.6		64152	$ 580.00	64172	$ 600.00	$20.00	3%	
Kenmore	White	Top freezer	18.3		63892	$ 550.00	64882	$ 550.00		0%	
GE	White	Top freezer	17.9		GTS18KBPWW	$ 600.00	GTH18JBRWW	$ 580.00	-20	-3%	ES model adds "NeverClean" condenser, Deluxe Quiet Design
GE	White	Top freezer	14.9		GTR15BBRWW	$ 510.00	GTH15BBRWW	$ 550.00	$40.00	8%	ES model adds"FrostGuard"
							Top freezer Average		**$8.57**		
Kenmore	White	Side by side	21.9		54242	$ 1,000.00	55582	$ 1,120.00	$120.00	12%	ES model has many trademarked names associated with it (e.g. "America's Quietest sound package", "Acceler-Ice ice production")
Kenmore	White	Side by side	25.4		54542	$ 1,050.00	54582	$ 1,170.00	$120.00	11%	ES model has many trademarked names associated with it (e.g. "America's Quietest sound package", "Acceler-Ice ice production")
GE	White	Side by side	22	thru-door ice & water	GSS22KGPWW	$ 1,150.00	GSH22KGPWW	$ 1,200.00	$50.00	4%	Identical features, except for ENERGY STAR
GE	White	Side by side	25	thru-door ice & water	GSS25JFPWW	$ 1,050.00	GSH25VGRWW	$ 1,250.00	$200.00	19%	
Frigidaire	White	Side by side	22.6	thru-door ice & water	FRS23KF5CW	$ 900.00	FRS23KF6CW	$ 1,000.00	$100.00	11%	ES model adds crisper light & water filter indicator light
							Side by side Average		**$118.00**		
Amana	White	Bottom freezer	21.9		ARB2217CW	$ 1,250.00	ABB2227DEW	$ 1,250.00		0%	ES model has many trademarked names (e.g., "Temp-Assure freshness control", "SofSound I Quiet package", "FreshNest egg storage")
							Bottom freezer Average		**$0**		

General notes for ACEEE analysis:
As the source of pricing, we used http://www.sears.com/ during the May 20-21, 2004 period. This has the advantage of being "real world" pricing, not as inflated as MSRP.
We used "Regular" prices and ignored sale prices, discounts, and coupons, mostly because the discounts were variously time dependant (so doing the research the next day would, literally, have resulted in different price points.)

The market shares used below are from DOE 1995 TSD p. B-4. We use the single-family home column and exclude compact manual defrost units in calculating market shares.

Type	**Average cost of ENERGY STAR**	**Weight**		
Top freezer	$8.57	73%	$6.26	
Side by side	$118.00	25%	$29.50	
Bottom freezer	$0	2%	$0.00	
			$35.76	***= Weighted Average***

Attachment 3

Household Refrigerator Shipments and Costs
From Census of Manufacturers -- MA335F (Major Household Appliances)

				Change relative to:	
Year	Quantity	Value	Value/unit	1997	Previous year
1997	12,092.4	$5,272.4	$436.01	$0.00	NA
1998	11,279.0	5,035.6	446.46	10.45	$10.45
1999	11,692.5	4,968.8	424.96	-11.05	-21.50
2000	12,354.7	5,395.8	436.74	0.73	11.78
2001	11,776.4	5,227.1	443.86	7.85	7.12
2002	12,067.9	5,164.3	427.94	-8.07	-15.93

Data are compiled by the Bureau of the Census and are available at:
http://www.census.gov/cir/www/335/ma335f.html .