DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket Number EE–2008–BT–STD–0012]

RIN 1904–AB79

Energy Conservation Program: Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers

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

ACTION: Final rule.

SUMMARY: The Energy Policy and Conservation Act (EPCA) prescribes energy conservation standards for various consumer products and commercial and industrial equipment, including refrigerators, refrigerator-freezers, and freezers. EPCA also requires the U.S. Department of Energy (DOE) to determine if more stringent, amended standards for these products are technologically feasible and economically justified, and would save a significant amount of energy. In this final rule, DOE is adopting more stringent energy conservation standards for refrigerators, refrigerator-freezers, and freezers. It has determined that the amended energy conservation standards for these products would result in the significant conservation of energy and are technologically feasible and economically justified.

DATES: The effective date of this rule is November 14, 2011. Compliance with the amended standards established for refrigerators, refrigerator-freezers, and freezers in today's final rule is September 15, 2014.

ADDRESSES: For access to the docket to read background documents, the technical support document, transcripts of the public meetings in this proceeding, or comments received, visit the U.S. Department of Energy, Resource Room of the Building Technologies Program, 950 L'Enfant Plaza, SW., 6th Floor, Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Please call Ms. Brenda Edwards at the above telephone number for additional information regarding visiting the Resource Room. You may also obtain copies of certain previous rulemaking documents in this proceeding (*i.e.,* framework document, notice of public meeting and announcement of a preliminary technical support document (TSD), notice of proposed rulemaking), draft analyses, public meeting materials, and related test procedure documents from the Office of Energy Efficiency and Renewable Energy's Web site at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/refrigerators_freezers.html.*

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SUPPLEMENTARY INFORMATION:

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I. Summary of the Final Rule and Its Benefits

The Energy Policy and Conservation Act (42 U.S.C. 6291, *et seq.;* EPCA or the Act), as amended, provides that any new or amended energy conservation standard DOE prescribes for certain consumer products, such as residential refrigerators, refrigerator-freezers, and freezers (collectively referred to in this document as ''refrigeration products''), shall be designed to ''achieve the maximum improvement in energy efficiency * * * which the Secretary determines is technologically feasible and economically justified.'' (42 U.S.C. 6295(o)(2)(A)) The new or amended standard must result in the significant conservation of energy. (42 U.S.C. 6295(o)(3)(B)) In accordance with these and other statutory provisions discussed in this notice, DOE is adopting amended energy conservation standards for refrigeration products. The standards in today's final rule, which are the maximum allowable energy use expressed as a function of the calculated adjusted volume of a given product, are shown in Table I.1. These standards apply to all products listed in Table I.1 and manufactured in, or imported into, the United States starting in 2014.

TABLE I.1—REFRIGERATION PRODUCT ENERGY CONSERVATION STANDARDS (EFFECTIVE STARTING 2014)

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft^3)	Based on av (L)
1. Refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost	7.99AV + 225.0	0.282av + 225.0
1A. All-refrigerators—manual defrost	6.79AV + 193.6	0.240av + 193.6
2. Refrigerator-freezers—partial automatic defrost	7.99AV + 225.0	0.282av + 225.0
3. Refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker	8.07AV + 233.7	0.285av + 233.7
3–BI. Built-in refrigerator-freezer—automatic defrost with top-mounted freezer without an automatic icemaker.	9.15AV + 264.9	0.323av + 264.9
3I. Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.	8.07AV + 317.7	0.285av + 317.7
3I–BI. Built-in refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.	9.15AV + 348.9	0.323av + 348.9
3A. All-refrigerators—automatic defrost	7.07AV + 201.6	0.250av + 201.6
3A–BI. Built-in All-refrigerators—automatic defrost	8.02AV + 228.5	0.283av + 228.5
4. Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker.	8.51AV + 297.8	0.301av + 297.8
4–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker.	10.22AV + 357.4	0.361av + 357.4
4I. Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.	8.51AV + 381.8	0.301av + 381.8
4I–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.	10.22AV + 441.4	0.361av + 441.4
5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker.	8.85AV + 317.0	0.312av + 317.0
5–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker.	9.40AV + 336.9	0.332av + 336.9
5I. Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.	8.85AV + 401.0	0.312av + 401.0
5I–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.	9.40AV + 420.9	0.332av + 420.9
5A. Refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service.	9.25AV + 475.4	0.327av + 475.4
5A–BI. Built-in refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service.	9.83AV + 499.9	0.347av + 499.9
6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service.	8.40AV + 385.4	0.297av + 385.4
7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	8.54AV + 432.8	0.302av + 432.8
7–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	10.25AV + 502.6	0.362av + 502.6
8. Upright freezers with manual defrost	5.57AV + 193.7	0.197av + 193.7

TABLE I.1—REFRIGERATION PRODUCT ENERGY CONSERVATION STANDARDS (EFFECTIVE STARTING 2014)—Continued

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft^3)	Based on av (L)
9. Upright freezers with automatic defrost without an automatic icemaker	8.62AV + 228.3	0.305av + 228.3
9I. Upright freezers with automatic defrost with an automatic icemaker	8.62AV + 312.3	0.305av + 312.3
9–BI. Built-In Upright freezers with automatic defrost without an automatic icemaker	9.86AV + 260.9	0.348av + 260.9
9I–BI. Built-in upright freezers with automatic defrost with an automatic icemaker	9.86AV + 344.9	0.348av + 344.9
10. Chest freezers and all other freezers except compact freezers	7.29AV + 107.8	0.257av + 107.8
10A. Chest freezers with automatic defrost	10.24AV + 148.1	0.362av + 148.1
11. Compact refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost	9.03AV + 252.3	0.319av + 252.3
11A. Compact all-refrigerators—manual defrost	7.84AV + 219.1	0.277av + 219.1
12. Compact refrigerator-freezers—partial automatic defrost	5.91AV + 335.8	0.209av + 335.8
13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer	11.80AV + 339.2	0.417av + 339.2
13I. Compact refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker.	11.80AV + 423.2	0.417av + 423.2
13A. Compact all-refrigerators—automatic defrost	9.17AV + 259.3	0.324av + 259.3
14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer	6.82AV + 456.9	0.241av + 456.9
14I. Compact refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker.	6.82AV + 540.9	0.241av + 540.9
15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer	11.80AV + 339.2	0.417av + 339.2
15I. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker.	11.80AV + 423.2	0.417av + 423.2
16. Compact upright freezers with manual defrost	8.65AV + 225.7	0.306av + 225.7
17. Compact upright freezers with automatic defrost	10.17AV + 351.9	0.359av + 351.9
18. Compact chest freezers	9.25AV + 136.8	0.327av + 136.8

AV = adjusted volume in cubic feet; av = adjusted volume in liters.

DOE's analyses indicate that the amended standards would save a significant amount of energy–an estimated 4.84 quads of cumulative energy over 30 years (2014 through 2043). This amount is equivalent to three times the total energy used annually for refrigeration products in U.S. homes.

The cumulative national net present value (NPV) of total consumer costs and savings of the amended standards for products shipped in 2014–2043, in 2009$, ranges from $6.4 to $10.4 billion (at a 7-percent discount rate) to $28.1 to $36.1 billion (at a 3-percent discount rate).[1] The NPV is the estimated total value of future operating-cost savings during the analysis period, minus the estimated increased product costs, discounted to 2010. The industry net present value (INPV) is the sum of the discounted cash flows to the industry from the base year through the end of the analysis period (2010 to 2043). Using a real discount rate of 7.2 percent, DOE estimates that INPV for manufacturers of all refrigeration products in the base case is $3.731 billion in 2009$. By adopting the amended standards, DOE expects that manufacturers may lose 15 to 24 percent of their INPV, or approximately $0.573 to $0.887 billion. Using a 7-percent discount rate, the NPV of consumer costs and savings from today's amended standards would amount to 4 to 16 times the total estimated industry losses. Using a 3-percent discount rate, the NPV would amount to 26 to 60 times the total estimated industry losses.

The projected economic impacts of the amended standards on individual consumers are generally positive. For example, the estimated average life-cycle cost (LCC) savings are $42 for top-mount refrigerator-freezers, $22 for bottom-mount refrigerator-freezers, $57 for side-by-side refrigerator-freezers, $195 for upright freezers, $69 for chest freezers, $14 for compact refrigerators, $12 for compact freezers, and from $2 to $71 for built-in refrigeration products, depending on the product class.[2]

In addition, the amended standards are projected to have significant environmental benefits. The energy saved is in the form of electricity and DOE expects the energy savings from the amended standards to eliminate the need for approximately 4.8 gigawatts (GW) of generating capacity by 2043. The savings would result in cumulative greenhouse gas emission reductions of 344 million metric tons (Mt)[3] of carbon dioxide (CO_2) in 2014–2043. During this period, the amended standards would result in emissions reductions[4] of 277,000 short tons (tons) of nitrogen oxides (NO_X) and 1.45 tons of mercury (Hg).

The value of the CO_2 reductions is calculated using a range of values per metric ton of CO_2 (otherwise known as the Social Cost of Carbon, or SCC) developed by a recent interagency process. The derivation of the SCC values is discussed in section IV.M. DOE estimates the present monetary value of the CO_2 emissions reduction is between $2.8 and $27.5 billion, expressed in 2009$ and discounted to 2010. DOE also estimates that the present monetary value of the NO_X emissions reduction, expressed in 2009$ and discounted to 2010, is between $35 and $360 million at a 7-percent discount

[1] DOE uses discount rates of 7 and 3 percent based on guidance from the Office of Management and Budget. See section IV.G for further information.

[2] The LCC is the total consumer expense over the life of a product, consisting of purchase and installation costs plus operating costs (expenses for energy use, maintenance and repair). To compute the operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product. The sources and methods used to derive purchase, installation and operating costs are described in section IV.F of this notice.

[3] A metric ton is equivalent to 1.1 short tons. Results for NO_X and Hg are given in short tons.

[4] DOE calculates emissions reductions relative to the most recent version of the *Annual Energy Outlook* (*AEO*) Reference case forecast. This forecast accounts for regulatory emissions reductions through 2008, including the Clean Air Interstate Rule (CAIR, 70 FR 25162 (May 12, 2005)), but not the Clean Air Mercury Rule (CAMR, 70 FR 28606 (May 18, 2005)). Subsequent regulations, including the proposed CAIR replacement rule, the Clean Air Transport Rule (75 FR 45210 (Aug. 2, 2010)), do not appear in the forecast. DOE notes that a new CAIR rule has recently been finalized. See *http://www.epa.gov/crossstaterule/*.

rate, and between $87 and $890 million at a 3-percent discount rate.[5]

Table I.2 summarizes the national economic costs and benefits expected to result from today's standards for refrigeration products.

TABLE I.2—SUMMARY OF NATIONAL ECONOMIC BENEFITS AND COSTS OF REFRIGERATION PRODUCT ENERGY CONSERVATION STANDARDS

Category	Present value *billion 2009$*	Discount rate (percent)
Benefits		
Operating Cost Savings	21.7	7
	55.4	3
CO_2 Reduction Monetized Value (at $4.9/t)*	2.8	5
CO_2 Reduction Monetized Value (at $22.1/t)*	9.0	3
CO_2 Reduction Monetized Value (at $36.3/t)*	13.5	2.5
CO_2 Reduction Monetized Value (at $67.1/t)*	27.5	3
NO_X Reduction Monetized Value (at $447/ton)*	0.035	7
	0.087	3
NO_X Reduction Monetized Value (at $4,591/ton)*	0.36	7
	0.89	3
Total Benefits†	30.9	7
	64.9	3
Costs		
Incremental Installed Costs	11.3 to 15.3	7
	19.3 to 27.3	3
Net Benefits		
Including CO_2 and NO_X†	15.6 to 19.5	7
	37.5 to 45.5	3

* The CO_2 values represent global monetized values of the SCC in 2010 under several scenarios. The values of $4.9, $22.1, and $36.3 per metric ton (t) are the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The value of $67.1/t represents the 95th percentile of the SCC distribution calculated using a 3% discount rate.

** The range of results for incremental product costs reflects the range of product price forecasts discussed in section IV.G.3.

† Total Benefits for both the 3% and 7% cases are derived using the SCC value calculated at a 3% discount rate, and the average of the low and high NO_X values used in DOE's analysis.

The benefits and costs of today's standards, for products sold in 2014–2043, can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value, expressed in 2009$, of the benefits from operating products that meet the amended standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase and installation costs, which is another way of representing consumer NPV), and (2) the annualized monetary value of the benefits of emission reductions, including CO_2 emission reductions.[6]

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating savings are domestic U.S. consumer monetary savings that occur as a result of market transactions while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and SCC are performed with different methods that use different time frames for analysis. The national operating cost savings is measured for the lifetime of refrigeration products shipped in 2014–2043. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Estimates of annualized benefits and costs of today's standards are shown in Table I.3. The results under the primary estimate, expressed in 2009$, are as follows. Using a 7-percent discount rate and the SCC series having a value of $22.1/ton in 2010, the cost of the standards in today's rule is $1,167 to $1,569 million per year in increased equipment costs, while the annualized benefits are $2,275 million per year in reduced equipment operating costs, $515 million in CO_2 reductions, and $21 million in reduced NO_X emissions. In this case, the net benefit amounts to $1,241 to $1,643 million per year. Using a 3-percent discount rate and the SCC series having a value of $22.1/ton in 2010, the cost of the standards in

[5] The range of values at each discount rate reflects use of low and high estimates of the benefits of avoiding one ton of NO_X emissions. With respect to mercury, DOE is aware of multiple agency efforts to determine the appropriate range of values used in evaluating the potential economic benefits of reduced Hg emissions. DOE has decided to await further guidance regarding consistent valuation and reporting of Hg emissions before it once again monetizes Hg in its rulemakings.

[6] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2010, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of three and seven percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.3. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2014 through 2043) that yields the same present value. This payment includes benefits to consumers which accrue after 2043 from the refrigerators purchased from 2014 to 2043. Costs incurred by manufacturers, some of which may be incurred prior to 2014 in preparation for the rule, are not directly included, but are indirectly included as part of incremental equipment costs. The extent of these costs and benefits depends on the projected price trends of refrigerators since consumer demand of refrigerators is a function of refrigerator prices. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

today's rule is $1,081 to $1,526 million per year in increased equipment costs, while the benefits are $3,160 million per year in reduced operating costs, $515 million in CO_2 reductions, and $28 million in reduced NO_X emissions. In this case, the net benefit amounts to $2,176 to $2,622 million per year.

TABLE I.3—ANNUALIZED BENEFITS AND COSTS OF AMENDED STANDARDS FOR REFRIGERATION PRODUCTS SHIPPED IN 2014–2043 *

	Discount rate	Monetized (million 2009$/year)		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits:				
Operating Cost Savings	7%	2275	1996	2560.
	3%	3160	2720	3596.
CO_2 Reduction at $4.9/t **	5%	162	162	162.
CO_2 Reduction at $22.1/t **	3%	515	515	515.
CO_2 Reduction at $36.3/t **	2.5%	772	772	772.
CO_2 Reduction at $67.1/t **	3%	1567	1567	1567.
NO_X Reduction at $2,519/ton **	7%	21	21	21.
	3%	28	28	28.
Total (Operating Cost Savings, CO_2 Reduction and NO_X Reduction) †.	7% plus CO_2 range	2457 to 3863	2178 to 3584	2742 to 4148.
	7%	2810	2531	3095.
	3%	3703	3263	4139.
	3% plus CO_2 range	3350 to 4755	2910 to 4315	3786 to 5192.
Costs:				
Incremental Product Costs	7%	1167 to 1569	1480	1232.
	3%	1081 to 1526	1430	1147.
Net Benefits:				
Total †	7% plus CO_2 range	888 to 2696	698 to 2103	1511 to 2916.
	7%	1241 to 1643	1051	1863.
	3%	2176 to 2622	1832	2993.
	3% plus CO_2 range	1823 to 3674	1479 to 2885	2640 to 4045.

*This table presents the annualized costs and benefits associated with refrigerators shipped between 2014 and 2043. These results include benefits to consumers which accrue after 2043 from the refrigerators purchased from 2014 to 2043. Costs incurred by manufacturers, some of which may be incurred prior to 2014 in preparation for the rule, are not directly included, but are indirectly included as part of incremental equipment costs. The extent of these costs and benefits depends on the projected price trends of refrigerators since consumer demand of refrigerators is a function of refrigerator prices. The extent of the costs and benefits will depend on the projected price trends of refrigerators, as the consumer demand for refrigerators is a function of refrigerator prices. The Primary, Low Benefits, and High Benefits Estimates utilize forecasts of energy prices and housing starts from the AEO2010 Reference case, Low Estimate, and High Estimate, respectively. In addition, incremental product costs reflect a medium decline rate for projected product price trends in the Primary Estimate, a low decline rate for projected product price trends using a Low Benefits Estimate, and a high decline rate for projected product price trends using a High Benefits Estimate. The different techniques used to derive projected price trends for each estimate are explained in section IV.G.3. In the Primary estimate, the range of results for incremental product costs reflects the range of projected price trends.

** The CO_2 values represent global monetized values (in 2009$) of the SCC in 2010 under several scenarios. The values of $4.9, $22.1, and $36.3 per metric ton are the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The value of $67.1/t represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The value for NO_X (in 2009$) is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3% and 7% cases are derived using the SCC value calculated at a 3% discount rate, which is $22.1/t in 2010 (in 2009$). In the rows labeled as "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

DOE has concluded that the standards in today's rule represent the maximum improvement in energy efficiency that is both technologically feasible and economically justified, and would result in the significant conservation of energy. DOE further notes that products achieving these standard levels are already commercially available for at least some, if not most, product classes covered by today's ruling. Based on the analyses described above, DOE found the benefits of today's standards to the Nation (energy savings, positive NPV of consumer benefits, consumer LCC savings, and emission reductions) outweigh the burdens (loss of INPV for manufacturers and LCC increases for some consumers).

II. Introduction

The following section briefly discusses the statutory authority underlying today's final rule as well as some of the relevant historical background related to the establishment of standards for refrigeration products.

A. Authority

Title III of EPCA sets forth a variety of provisions designed to improve energy efficiency. Part A of title III (42 U.S.C. 6291–6309) provides for the Energy Conservation Program for Consumer Products Other than Automobiles.[7] EPCA covers consumer products and certain commercial equipment (referred to collectively hereafter as ''covered products''), including the types of refrigeration products that are the subject of this rulemaking. (42 U.S.C. 6292(a)(1)) EPCA prescribed energy conservation standards for these products (42 U.S.C. 6295(b)(1)–(2)), and directed DOE to conduct three cycles of rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(b)(3)(A)(i), (b)(3)(B)–(C), and (b)(4)) As explained in further detail in section 0, this rulemaking satisfies the third round of amendments under 42 U.S.C. 6295(b). (DOE notes that under 42 U.S.C. 6295(m), the agency must periodically review its already established energy conservation standards for a covered product. Under this requirement, the

[7] This part was titled Part B in EPCA, but was subsequently codified as Part A in the U.S. Code for editorial reasons.

next review that DOE would need to conduct would occur six years from the issuance of a final rule establishing or amending a standard for a covered product.)

Under the Act, DOE's energy conservation program for covered products consists essentially of four parts: (1) Testing, (2) labeling, (3) the establishment of Federal energy conservation standards, and (4) certification and enforcement procedures. The Federal Trade Commission (FTC) is generally responsible for labeling issues for consumer products, and DOE implements the remainder of the program. Section 323 of the Act (codified at 42 U.S.C. 6293) authorizes DOE, subject to certain criteria and conditions, to develop test procedures to measure the energy efficiency, energy use, or estimated annual operating cost of each covered product. Manufacturers of covered products must use the prescribed DOE test procedure as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA and when making representations to the public regarding the energy use or efficiency of those products. (42 U.S.C. 6293(c) and 6295(s)) Similarly, DOE must use these test procedures to determine whether the products comply with standards adopted under EPCA. *Id.* The test procedures for refrigeration products currently appear at title 10, Code of Federal Regulations (CFR), part 430, subpart B, appendices A1 and B1, respectively. (These procedures have recently been amended and recodified as part of new Appendices A and B, which will, pending further comment from interested parties, be required to be used when certifying compliance with the standards detailed in today's final rule. See 75 FR 78810 (December 16, 2010)).

EPCA prescribes specific criteria for DOE to consider when amending standards for covered products. As indicated above, any amended standard for a covered product must be designed to achieve the maximum improvement in energy efficiency that is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) EPCA precludes DOE from adopting any standard that would not result in the significant conservation of energy. (42 U.S.C. 6295(o)(3)) Moreover, DOE may not prescribe a standard for certain products, including refrigeration products, (1) if no test procedure has been established for that product, or (2) if DOE determines by rule that the amended standard is not technologically feasible or economically justified. (42 U.S.C. 6295(o)(3)(A)–(B)) The Act also provides that, in deciding whether an amended standard is economically justified, DOE must determine whether the benefits of the standard exceed its burdens. (42 U.S.C. 6295(o)(2)(B)(i)) DOE must do so after receiving comments on the proposed standard, and by considering, to the greatest extent practicable, the following seven factors:

1. The economic impact of the standard on manufacturers and consumers of the products subject to the standard;
2. The savings in operating costs throughout the estimated average life of the covered products in the type (or class) compared to any increase in the price, initial charges, or maintenance expenses for the covered products that are likely to result from the imposition of the standard;
3. The total projected amount of energy savings likely to result directly from the imposition of the standard;
4. Any lessening of the utility or the performance of the covered products likely to result from the imposition of the standard;
5. The impact of any lessening of competition, as determined in writing by the Attorney General, that is likely to result from the imposition of the standard;
6. The need for national energy conservation; and
7. Other factors the Secretary of Energy (Secretary) considers relevant.

(42 U.S.C. 6295(o)(2)(B)(i)(I)–(VII))

EPCA also contains what is known as an ''anti-backsliding'' provision, which prevents DOE from prescribing any amended standard that either increases the maximum allowable energy use or decreases the minimum required energy efficiency of a covered product. (42 U.S.C. 6295(o)(1)) Also, DOE may not prescribe a new standard if interested persons have established by a preponderance of the evidence that the standard is likely to result in the unavailability in the United States of any covered product type (or class) with performance characteristics, features, sizes, capacities, and volumes that are substantially the same as those generally available in the United States. (42 U.S.C. 6295(o)(4))

Further, EPCA establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy savings during the first year that the consumer will receive as a result of the standard, as calculated under the applicable test procedure. See 42 U.S.C. 6295(o)(2)(B)(iii).[8]

Additionally, 42 U.S.C. 6295(q)(1) specifies the requirements for setting classes of a covered product. In such cases, DOE may specify a different standard level than that which applies generally to such type or class of products ''for any group of covered products which have the same function or intended use'' if one of two conditions is met: (A) The specific group of products for which a class category would apply consume a different kind of energy from that consumed by other covered products within such type (or class); or (B) that specific group of products has a capacity or other performance-related feature which other products within such type (or class) do not have and such feature justifies a higher or lower standard'' than applies or will apply to the other products within that type or class. *Id.* In determining whether a performance-related feature justifies a different standard for a group of products, DOE must ''consider such factors as the utility to the consumer of such a feature'' and other factors DOE deems appropriate. *Id.* Any rule prescribing such a standard must include an explanation of the basis on which such higher or lower level was established. (42 U.S.C. 6295(q)(2))

Federal energy conservation requirements generally supersede State laws or regulations concerning energy conservation testing, labeling, and standards. (42 U.S.C. 6297(a)–(c)) DOE can, however, grant waivers of Federal preemption for particular State laws or regulations in accordance with the procedures and other provisions of section 327(d) of the Act. (42 U.S.C. 6297(d))

Section 310(3) of the Energy Independence and Security Act of 2007 (EISA 2007; Pub. L. 110–140 (codified at 42 U.S.C. 6295(gg))) amended EPCA to require that energy conservation standards address standby mode and off mode energy use. Specifically, when DOE adopts a standard for a covered product after July 1, 2010, it must, if justified by the criteria for adoption of standards in section 325(o) of EPCA (42 U.S.C. 6295(o)), incorporate standby mode and off mode energy use into the standard, if feasible, or adopt a separate

[8] In this context, the presumption provides a legal finding that the criteria under 42 U.S.C. 6295(o)(2) have been met if the specified level of savings within the first year occur. To ensure that it has fully examined the potential costs and benefits of a given level, DOE routinely conducts a full analysis of the potential standards it considers.

standard for such energy use for that product. (42 U.S.C. 6295(gg)(3)(A)–(B)) DOE's current (and recently amended) test procedures and current standards for refrigeration products address standby and off mode energy use, as do the amended standards adopted in this final rule. Standby and off mode energy use is measured by the test procedures and integrated into the energy use metric, thus separate metrics for these quantities are not needed.

DOE has also reviewed this regulation pursuant to Executive Order 13563 (76 FR 3281, Jan. 21, 2011). EO 13563 is supplemental to, and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in, Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

DOE emphasizes as well that Executive Order 13563 requires agencies ''to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible.'' In its guidance, the Office of Information and Regulatory Affairs has emphasized that such techniques may include ''identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes.'' For the reasons stated in the preamble, DOE believes that today's final rule is consistent with these principles, including that, to the extent permitted by law, agencies adopt a regulation only upon a reasoned determination that its benefits justify its costs and select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits.

Given the range of inputs and parameters analyzed in this rulemaking, there may be multiple standards that would maximize annualized net benefits.[9] For some product classes, depending on different assumptions, the standard that maximized annualized net benefits could fall within a range of TSLs. Five different TSLs were considered for each product class grouping with high and low values for the maximum annualized net benefits estimated for each TSL. For standard-size refrigerator-freezers, the TSL with maximum annualized net benefits with the highest value was TSL 3, although certain values for maximum annualized net benefits fell within the ranges estimated for TSL 1 to TSL 3. For standard-size freezers, the maximum annualized net benefits fell within the calculated ranges for TSL 3 to TSL 4. However, DOE noted that even using the low end of this range, efficiency levels are significantly higher than the most efficient products already available on the market (see Section VI.C.2). Therefore, DOE selected TSL 2, which DOE also notes corresponds to the recommended level in the Joint Comments. For compact refrigeration products, the maximum annualized net benefits fell within the calculated ranges for TSL 1 to TSL 3, and DOE selected TSL 2. With respect to compact refrigeration products, DOE estimates an approximately 10 percent increase in total installation costs as a result of the standard. Because DOE was unable to estimate the income subgroup LCC effects due to lack of data, the agency believes choosing a TSL on the lower end of the range of estimated cost impacts (*i.e.,* TSL 2) would provide a more conservative approach to minimize any potentially negative consumer welfare impacts on lower income consumers. For built-in refrigeration products, the TSL with maximum annualized net benefits was TSL 2, and DOE selected TSL 2. Therefore, consistent with EO 13563, the energy efficiency standards adopted herein by DOE achieves maximum net benefits.

[9] The maximum annualized net benefits included monetized emissions savings.

B. Background

The following discussion provides some background information describing the events leading up to today's final rule.

1. Current Standards

In a final rule published on April 28, 1997 (1997 Final Rule), DOE prescribed energy conservation standards for refrigeration products manufactured on or after July 1, 2001. 62 FR 23102. This 1997 rule set the energy conservation standards that are currently in place and completed the second round of rulemaking to amend the standards for refrigeration products required under 42 U.S.C. 6295(b)(3)(B)–(C). The current standards consist of separate equations for each product class. Each equation provides a means to calculate the maximum levels of energy use permitted under the regulations. These levels vary based on the storage volume of the refrigeration product and on the particular characteristics and features included in a given product (*i.e.,* based on product class). 10 CFR 430.32(a). The current standards are set forth in Table II.1. DOE notes that the standard levels denoted in the additional product classes listed as 5A and 10A were established by the Office of Hearings and Appeals (OHA) through that Office's exception relief process, and are applicable to basic models of those types if their manufacturer has applied for and been granted exception relief for them by OHA.

TABLE II.1—FEDERAL ENERGY EFFICIENCY STANDARDS FOR REFRIGERATORS, REFRIGERATOR-FREEZERS, AND FREEZERS

Product class	Energy standard equations for maximum energy use (kWh/yr)
	Made Effective by the 1997 Final Rule
1. Refrigerators and refrigerator-freezers with manual defrost	8.82AV+248.4 0.31av+248.4
2. Refrigerator-freezers—partial automatic defrost	8.82AV+248.4 0.31av+248.4
3. Refrigerator-freezers—automatic defrost with top-mounted freezer without through-the-door ice service and all-refrigerator—automatic defrost.	9.80AV+276.0 0.35av+276.0
4. Refrigerator-freezers—automatic defrost with side-mounted freezer without through-the-door ice service	4.91AV+507.5 0.17av+507.5
5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service	4.60AV+459.0 0.16av+459.0
6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service	10.20AV+356.0 0.36av+356.0
7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service	10.10AV+406.0 0.36av+406.0
8. Upright freezers with manual defrost	7.55AV+258.3 0.27av+258.3
9. Upright freezers with automatic defrost	12.43AV+326.1 0.44av+326.1
10. Chest freezers and all other freezers except compact freezers	9.88AV+143.7 0.35av+143.7
11. Compact refrigerators and refrigerator-freezers with manual defrost	10.70AV+299.0 0.38av+299.0
12. Compact refrigerator-freezer—partial automatic defrost	7.00AV+398.0 0.25av+398.0
13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer and compact all-refrigerator—automatic defrost.	12.70AV+355.0 0.45av+355.0
14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer	7.60AV+501.0 0.27av+501.0
15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer	13.10AV+367.0 0.46av+367.0
16. Compact upright freezers with manual defrost	9.78AV+250.8 0.35av+250.8
17. Compact upright freezers with automatic defrost	11.40AV+391.0 0.40av+391.0
18. Compact chest freezers	10.45AV+152.0 0.37av+152.0
Product Class	Made Effective Through OHA Exception Relief
5A. Refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service	5.0AV+539.0 0.18av+539.0
10A. Chest freezers with automatic defrost	14.76AV+211.5 0.52av+211.5

AV: Adjusted Volume in ft^3; av: Adjusted Volume in liters (L).

2. History of Standards Rulemaking for Refrigerators, Refrigerator-Freezers, and Freezers

The amendments made to EPCA by the National Appliance Energy Conservation Act of 1987 (NAECA; Pub. L. 100–12) included mandatory energy conservation standards for refrigeration products and requirements that DOE conduct two cycles of rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(b)(1), (2), (3)(A)(i), and (3)(B)–(C)) DOE completed the first of these rulemaking cycles in 1989 and 1990 by adopting amended performance standards for all refrigeration products manufactured on or after January 1, 1993. 54 FR 47916 (November 17, 1989); 55 FR 42845 (October 24, 1990). As indicated above, DOE completed a second rulemaking cycle to amend the standards for refrigeration products by issuing a final rule in 1997, which adopted the current standards for these products. 62 FR 23102 (April 28, 1997).

In 2005, DOE granted a petition, submitted by a coalition of state governments, utility companies, consumer and low-income advocacy groups, and environmental and energy efficiency organizations, requesting a rulemaking to amend the standards for residential refrigerator-freezers.[10] DOE then conducted limited analyses to examine the technological and economic feasibility of amended standards at the ENERGY STAR levels that were in effect for 2005 for the two most popular product classes of refrigerator-freezers. These analyses not only identified potential energy savings, benefits and burdens from such standards, but also assessed other issues related to them. Most recently, DOE has undertaken this rulemaking to satisfy

[10] The petition, submitted June 1, 2004, can be viewed at *http://www.standardsasap.org/documents/rfdoe.pdf* (last accessed August 18, 2010) and is in the docket as item No. 117.

the statutory requirement that DOE publish a final rule to determine whether to amend the standards for refrigeration products manufactured in 2014. (42 U.S.C. 6295(b)(4)) The limited 2005 analyses served as background for the more extensive analysis conducted for this rulemaking.

DOE initiated this rulemaking by making available on its Web site a framework document for refrigeration products, a PDF copy of which is available at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/refrigerator_freezer_framework.pdf*). DOE also published a notice announcing the availability of the framework document and a public meeting to discuss the document. It also requested public comment on the document. 73 FR 54089 (September 18, 2008). The framework document described the procedural and analytical approaches that DOE anticipated using to evaluate energy conservation standards for refrigeration products and identified various issues to resolve during the rulemaking.

On September 29, 2008, DOE held the framework document public meeting and discussed the issues detailed in the framework document. DOE also described the analyses that it planned to conduct during the rulemaking. Through the public meeting, DOE sought feedback from interested parties on these subjects and provided information regarding the rulemaking process that DOE would follow. Interested parties discussed the following major issues at the public meeting: Test procedure revisions; product classes; technology options; approaches to the engineering, life-cycle cost, and payback period analyses; efficiency levels analyzed in the engineering analysis; and the approach for estimating typical energy consumption. At the meeting, and during the related comment period, DOE received many comments that helped it identify and resolve issues involved in this rulemaking.

DOE then gathered additional information and performed preliminary analyses for the purpose of developing potential amended energy conservation standards for refrigeration products. This process culminated in DOE's public announcement of the preliminary analysis public meeting. 74 FR 58915 (November 16, 2009) (the November 2009 notice) At that meeting, which was held on December 10, 2009, DOE discussed the following matters: The product classes DOE analyzed; the analytical framework, models, and tools that DOE was using to evaluate standards; the results of the preliminary analyses performed by DOE; and potential standard levels that DOE could consider. DOE also invited written and verbal comments on these subjects and announced the availability on its Web site of a preliminary technical support document (preliminary TSD) it had prepared to inform interested parties and enable them to provide comments. *Id.* (The preliminary TSD is available at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/ref_frz_prenopr_prelim_tsd.pdf*) DOE also sought views concerning other relevant issues that participants believed would affect energy conservation standards for refrigeration products, or that merited addressing in the Notice of Proposed Rulemaking (NOPR). *Id.* at 58917–18.

The preliminary TSD provided an overview of the activities DOE undertook in developing potential standards for refrigeration products, and discussed the comments DOE received in response to the framework document. It also described the analytical framework that DOE used, including a description of the methodology, the analytical tools, and the relationships among the various analyses that are part of the rulemaking. The preliminary TSD presented and described in detail each analysis DOE had performed up to that point, including descriptions of inputs, sources, methodologies, and results. These analyses included a market and technology assessment, a screening analysis, an engineering analysis, an energy use analysis, a markups analysis, a life-cycle cost analysis, a payback period (PBP) analysis, a shipments analysis, a national impact analysis, and a preliminary manufacturer impact analysis. See the NOPR for an overview of these assessments and analyses. 75 FR 59470, 59477 (September 27, 2010).

At the preliminary analysis meeting, DOE presented the methodologies and results of the analyses set forth in the preliminary TSD. Major topics discussed at the meeting included test procedure revisions, product classes (including wine coolers, all-refrigerators,[11] and built-in refrigeration products), the use of alternative foam blowing agents and refrigerants, engineering analysis tools, the use of vacuum insulated panels (VIPs), mark-ups, field energy consumption, life-cycle cost inputs, efficiency distribution forecasts, and trial standard level selection criteria. DOE also discussed plans for conducting the NOPR analyses. Comment received in response to the November 2009 notice, helped shape DOE's resolution of the issues raised in the preliminary analysis meeting.

In response to the preliminary analysis, DOE also received a comment submitted jointly by groups representing manufacturers (Association of Home Appliance Manufacturers, Whirlpool, General Electric Company (GE), Electrolux, LG Electronics, BSH, Alliance Laundry, Viking Range, Sub Zero-Wolf, Friedrich A/C, U–Line, Samsung, Sharp Electronics, Miele, Heat Controller, AGA Marvel, Brown Stove, Haier, Fagor America, Airwell Group, Arcelik, Fisher & Paykel, Scotsman Ice, Indesit, Kuppersbusch, Kelon, DeLonghi); energy and environmental advocates (American Council for an Energy Efficient Economy, Appliance Standards Awareness Project, Natural Resources Defense Council, Alliance to Save Energy, Alliance for Water Efficiency, Northwest Power and Conservation Council, Northeast Energy Efficiency Partnerships); and consumer groups (Consumer Federation of America, National Consumer Law Center). This collective set of comments, which DOE refers to in this notice as the "Joint Comments," [12] recommended specific energy conservation standards for refrigeration products that, in the commenters' view, would satisfy the requirements under EPCA. According to this submission, negotiations between these various groups commenced in the spring of 2010, resulting in a finalized agreement with recommended standards on July 30, 2010. (Joint Comments, No. 52 at p. 8) Those recommended standards were reported in percentages of energy use reductions and in annual energy use based on the test procedure then in place but after DOE had published its NOPR proposing to amend that procedure. (Id. See also 75 FR 29824 (May 27, 2010)) DOE neither organized nor was a member of the group but made its contractors available to perform data processing. Consistent with its legal obligations when developing an energy conservation standard, DOE provided the public with the opportunity to comment on the proposed levels that DOE considered adopting for refrigeration products in

[11] An "all-refrigerator" is defined as "an electric refrigerator which does not include a compartment for the freezing and long time storage of food at temperatures below 32 °F (0.0 °C). It may include a compartment of 0.50 cubic feet capacity (14.2 liters) or less for the freezing and storage of ice." (10 CFR part 430, subpart B, appendix A1, section 1.4).

[12] DOE Docket No. EERE–2008–BT–STD–0012, Comment 49. DOE considered the Joint Comments to supersede earlier comments by the listed parties regarding issues subsequently discussed in the Joint Comments.

the NOPR, which mirror those recommended in the Joint Comments.

DOE published the NOPR on September 27, 2010. 75 FR 59470. The NOPR and its accompanying NOPR TSD described the analyses that DOE conducted after the preliminary analyses, including revisions of analyses to address stakeholder comments. The additional analyses performed during the NOPR phase included the consumer subgroup analysis, manufacturer impact analysis, employment impact analysis, utility impact analysis, environmental analysis, and regulatory impact analysis. The NOPR discussed all of the NOPR analyses in depth, including the revision of analyses initially conducted in the preliminary analysis phase. (see 75 FR at 59485–59530 (September 27, 2010)) DOE held a public meeting to discuss the NOPR on October 14, 2010. At the meeting, DOE presented its analyses and raised issues for comment. The issues discussed at the meeting included the measurement changes associated with the new test procedures under consideration, product classes, product class definitions, status of specific technologies (*e.g.* high-efficiency compressors, VIPs, and isobutane refrigerant), max-tech levels, energy use equation slope changes, adjustments to the methodology for field energy use estimates, maintenance costs, efficiency distributions, energy standard round-off, impacts on small manufacturers, setting built-in standards at levels determined to have negative consumer impacts, and DOE's treatment of emissions reductions. DOE considered comments received at the public meeting and during the NOPR comment period in finalizing the standards.

As discussed in greater detail in section IV.F.1 below, after publishing the NOPR, DOE more carefully examined trends in product prices and the possible impact of such trends on its analyses. On February 22, 2011, DOE published a notice of data availability (NODA) that discussed the approach it was considering to use in its forecasts of product prices. 76 FR 9696. DOE requested comments on the information provided in the NODA, and several stakeholders responded, including some that had not commented on the NOPR.

Table II.2 below lists the stakeholders that provided comments on the NOPR and the NODA.

TABLE II.2—STAKEHOLDERS PROVIDING COMMENTS ON THE NOPR AND NODA

Name	Acronym	Type *	NOPR oral comments	Written comments
Air-Conditioning, Heating, and Refrigeration Institute	AHRI	IR		NODA
American Council for an Energy Efficient Economy	ACEEE	EA		NODA
American Gas Association	AGA	UA		NODA
American Public Power Association	APPA	UA		NOPR
Appliance Standards Awareness Project (ASAP)	ASAP	EA	✓	NODA
Appliance Standards Awareness Project (ASAP) and Others [13]	Joint Advocates' Comment (JAC).	EA, CA		NOPR
Association of Home Appliance Manufacturers	AHAM	IR	✓	NOPR, NODA
California Investor-Owned Utilities	IOUs	U		NOPR, NODA
Consumer Federation of America	CFA	CA		NODA
Earthjustice	Earthjustice	EA	✓	NOPR
Edison Electric Institute	EEI	UA		NOPR, NODA
Electrolux Home Products	Electrolux	M	✓	
General Electric Consumer and Industrial	GE	M	✓	NOPR
Ingersoll Rand Residential Solutions	Ingersoll Rand	M		NODA
National Consumer Law Center	NCLC	CA		NODA
Natural Resources Defense Council	NRDC	EA		NODA
Northeast Energy Efficiency Partnerships	NEEP	EA		NODA
Northwest Energy Efficiency Alliance	NEEA	EA		NODA
Northwest Power and Conservation Council	NPCC	UA	✓	
People's Republic of China WTO/TBT National Notification & Enquiry Center.	PRC	FG		NOPR
Portland General Electric Company	PGEC	U		NOPR
Sacramento Municipal Utility District	SMUD	U		NOPR
Southern Company	SC	U		NOPR, NODA
Sub Zero-Wolf, Inc	Sub Zero	M		NOPR
Traulsen	Traulsen	M		NODA
Whirlpool Corporation	Whirlpool	M	✓	NOPR

* IR: Industry Representative; M: Manufacturer; EA: Efficiency/Environmental Advocate; CA: Consumer Advocate; CS: Component Supplier: TE: Technical Expert: I: Individual; U: Utility; UA: Utility Advocate; FG: Foreign Government Agency.

DOE notes that comments from the PRC indicated that it received notice of the September 27th NOPR on October 27, 2010, which permitted the Chinese government less than 60 days to provide comment on the proposed regulation. In DOE's view, the publication of the September 2010 proposal, along with its immediate availability on the Government Printing Office's Web site (*http://www.gpoaccess.gov*), provided any interested party with the specified 60 days of comment period. In future, however, to accommodate the PRC's concerns, and to the extent feasible, DOE may examine possible steps to ensure the availability of its proposals to interested foreign parties.

III. General Discussion

The following section discusses various technical aspects related to this rulemaking. In particular, it addresses aspects involving the test procedures for refrigeration products, the technological feasibility of potential standards to assign to these products, and the potential energy savings and economic justification for prescribing the

[13] Appliance Standards Awareness Project (ASAP), Alliance to Save Energy (ASE), American Council for an Energy-Efficient Economy (ACEEE), Consumer Federation of America (CFA), National Consumer Law Center (NCLC), Natural Resources Defense Council (NRDC), Northeast Energy Efficiency Partnerships (NEEP), and Northwest Energy Efficiency Alliance (NEEA).

amended standards for refrigeration products.

A. Test Procedures

As noted above, DOE's current test procedures for refrigeration products appear at 10 CFR part 430, subpart B, appendices A1 (for refrigerators and refrigerator-freezers) and B1 (for freezers). DOE recently published a notice containing both the test procedure final rule (affecting products manufactured prior to 2014) and an interim final rule (for products manufactured starting in 2014). The final/interim final rule notice amended Appendices A1 and B1 (which affect pre-2014 products) and created new Appendices A and B (which affect products starting in 2014). Appendix A applies to refrigerators and refrigerator-freezers covered by today's amended standards (*i.e.,* those manufactured or after the 2014 compliance date prescribed by today's rule) and Appendix B applies to freezers covered by today's amended standards. 75 FR 78810 (December 16, 2010) (this notice contains both the final and interim final rules that detail the test procedures for refrigeration products). The new Appendices A and B share many of the same revisions and additions made in Appendices A1 and B1, but also include additional revisions not made in Appendices A1 and B1. See *id.* at 78817–78818 DOE notes, however, that because the new Appendices A and B were issued as an interim final rule, these additional amendments may be subject to possible adjustment based on comments that DOE receives. DOE had previously provided commenters with 60 days within which to provide additional feedback regarding the interim final rule. *Id.* at 78810. DOE may reopen this comment period for a limited period of time after the publication of today's standards final rule.

EPCA requires DOE to consider during a test procedure rulemaking whether test procedure amendments alter the measured energy use of products, and, if so, to amend the energy standards. (42 U.S.C. 6293(e)(1)–(2)) In this case, DOE simultaneously considered the impacts of any measured energy changes within the context of the standards rulemaking required by statute. Section III.A.0 discusses the adjustment of the final energy conservation standard with respect to any test procedure changes. The approach used to implement this adjustment is also discussed in the Section 0 below.

1. Test Procedure Rulemaking Schedule

The NOPR analysis documents were published, and the NOPR public meeting was held, prior to publication of the final rule describing the amended test procedure on which the analysis was based. The test procedure final/interim final rule was issued and DOE made copies available to all interested parties prior to the end of the energy conservation standard NOPR comment period.

AHAM and GE both commented that, despite DOE's May 2010 publication of its proposed test procedure, it is difficult to prepare comments on an energy standard when the final test procedure is not yet known. (AHAM, Public Meeting Transcript, No. 67 at p. 18; GE, Public Meeting Transcript, No. 67 at p. 37) AHAM clarified that determination of the impact on energy use measurement of the test procedure changes cannot be done without having a final test procedure (AHAM, Public Meeting Transcript, No. 67 at p. 13–14, 35) In written comments, AHAM argued that because the test procedure final/interim final rule was not issued until November 24, 2010, manufacturers did not have a sufficient opportunity to test products to evaluate the impacts of the final test procedure changes—as a result, AHAM claimed it was not able to comment on the proposed energy standard equations (AHAM, No. 73 at pp. 1–2) [14] GE commented that the industry wanted to know the final test procedure before starting test work to determine whether the energy standard adjustments implemented by DOE in the NOPR sufficiently represent all of the test procedure changes. (GE, Public Meeting Transcript, No. 67 at p. 46–47) AHAM also asked whether any rulemaking process options allowed under EPCA could be considered to give the industry more time to assess the test procedure impacts. (AHAM, Public Meeting Transcript, No. 67 at p. 37–38)

DOE notes that the test procedure NOPR was published May 27, 2010, roughly two months prior to the completion of negotiations conducted by industry and advocates in creating the standards recommended in their joint comments. 75 FR 29824 (May 27, 2010). In developing those consensus standards, the industry and other stakeholders had knowledge of DOE's test procedure proposals and ample time to consider adjustments to the negotiated standards to address the proposals for today's final rule. DOE also notes that stakeholders have had several months since the publication of the test procedure NOPR to quantify the impacts of the proposed test procedure amendments. DOE again asked stakeholders at the energy conservation standard NOPR public meeting for information that would help quantify these impacts. None was provided and participants gave no indication that they had performed any such testing. In the absence of such information, DOE has developed its own information to finalize the energy conservation standards, as described in section III.A.0.

DOE notes that under EPCA, an amended or new energy conservation standard may not be prescribed unless a test procedure for the regulated product has been prescribed. See 42 U.S.C. 6295(o)(3). DOE has met this requirement.

In response to AHAM's request regarding additional time to evaluate the test procedure impacts, DOE has issued the test procedure amendments affecting products starting in 2014 as an interim final rule. This approach resulted in providing interested parties with an additional 60 days to comment on the interim final rule's amendments. 75 FR at 78810 (December 16, 2010). Additionally, as already indicated, DOE plans to provide interested parties with additional time to comment on the interim final rule. Notice of that limited reopening of the comment period will be provided in the **Federal Register**.

2. Adjustment of the Energy Standards for the New Test Procedure

As described above, DOE amended its test procedures for refrigeration products. These amendments will impact the measured energy use. DOE's amended standard levels incorporated adjustments (called a ''crosswalk'') to reflect these changes in energy use measurements. DOE described the crosswalk process in its September 2010 NOPR. See 75 FR at 59502–59505 (September 27, 2010). In short, DOE applied the crosswalk to the baseline (current energy standard) equations, thus developing baseline energy use equations using the new test procedure. DOE applied the percentage energy use reductions representing the new energy standards to these baseline equations to determine the new energy standards. The NOPR also indicated that DOE tentatively concluded that the only test procedure changes that would be likely to impact measured energy use are those associated with compartment temperatures and the volume measurement method. 75 FR at 59505 (September 27, 2010). The term ''NOPR crosswalk'' refers to this set of energy

[14] The rule was issued on November 23, 2010, not November 24 as indicated in AHAM's comments.

standard adjustments addressing these two test procedure changes.

Commenters addressed both (a) the NOPR crosswalk addressing test procedure changes in compartment temperatures and volume measurements and (b) the additional test procedure changes that could affect energy use measurements. The NOPR public meeting was held on October 14, 2010, before the publication of the test procedure final/interim final rule. Hence, stakeholder comments from the meeting addressed the proposed test procedure, rather than the final one that DOE ultimately adopted.

Whirlpool indicated that it could not comment on the proposed standard levels prior to publication of the test procedure and comprehensive testing to determine the impact of the test procedure changes. (Whirlpool, No. 74 at p. 7) GE echoed this comment, indicating that it is essential to have the final test procedure to allow evaluation of the impacts of the test procedure changes in order to be able to comment effectively on the proposed standard levels. (GE, No. 76 at p. 1) AHAM commented that the NOPR crosswalk is partly theoretical since it uses extrapolation and analysis to determine adjustments for some product classes. (AHAM, Public Meeting Transcript, No. 67 at p. 17) AHAM also commented that it ''is critical'' to do testing to determine the impact of the test procedure changes, and that the industry was not provided sufficient time between issuance of the final/interim final rule and the end of the comment period to conduct such testing. (AHAM, 73 at p. 2)

The IOUs supported DOE's approach for adjustment of the energy standards to address test procedure changes. In light of the limited time available to complete the rulemaking, the IOUs commented that DOE's approach was appropriate in spite of comments by parties at the public meeting calling for additional testing to perform a crosswalk. (IOUs, No. 77 at p. 2)

DOE notes that the NOPR crosswalk was based primarily on data provided by AHAM—which DOE described in detail in its TSD. See chapter 5, ''Engineering Analysis'', section 5.4.2. Because AHAM did not initially provide data for all product classes, DOE conducted additional analysis and developed estimates to supplement the gaps present in AHAM's data. These additional steps helped DOE to establish appropriate crosswalks for the remaining product classes. DOE first presented this process in its preliminary TSD, which DOE posted on its Web site in November 2009. Stakeholders have had more than twelve months to comment on the crosswalks for these remaining product classes, but have not done so.

Numerous commenters identified other test procedure changes that they believed would affect the measured energy use of refrigeration products and offered their views on how to address them in a final crosswalk. AHAM first indicated that the NOPR crosswalk does not represent all of the measurement impacts of the test procedure modifications. (AHAM, Public Meeting Transcript, No. 67 at p. 16; AHAM, No. 73 at p. 2) It asserted that there are many test procedure changes and that some of these changes, other than those changes affecting compartment temperature and volume calculation, can impact measured energy use. (AHAM asserted that the impact of these changes cannot be determined as a sum of the impacts of the individual changes, but did not provide data illustrating this assertion, nor did AHAM explain why an additive approach is not reasonable. (Id. at p. 35–36)) To this end, AHAM identified four specific proposed test procedure changes that it believed would impact measured energy use: (1) Test procedures addressing products with variable anti-sweat heater control, (2) use of the highest energy use position for special compartments, (3) modification of the long-time-defrost test procedure to capture precooling energy use, and (4) test procedures addressing products with multiple defrost cycle types. (Id. at 42–43) DOE notes that AHAM identified these same four additional test procedure changes in its comments on the test procedure rulemaking NOPR (AHAM, Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket Number EERE–2009–BT–TP–0003, No. 16 at p. 3) In its written comments, AHAM indicated that the final test procedure that DOE developed for products with variable anti-sweat heater control does not alter measured energy use, since DOE adopted the procedure provided in waivers already granted to companies who manufacture products with such features. (AHAM, No. 73 at p. 3)

Whirlpool asserted that applying the highest energy usage setting for special compartments, including procedures designed to capture precooling energy and to address products that use multiple defrost cycles, will alter measured energy use. (Whirlpool, No. 74 at p. 7)

The IOUs agreed that there were additional test procedure changes that could alter measured energy use that had not been considered in establishing the proposed standards, including test procedures for products with variable anti-sweat heater control, new procedures to capture precooling energy use, and new procedures for special compartments. The IOUs recommended that the energy standards should be adjusted to account for these test procedure changes. They noted that if the measured impacts of these test procedure changes have not been determined through testing, DOE should estimate their impact and direction of the impact (positive or negative). They added that if these impacts are small or applicable to only a small portion of the market, DOE should not adjust the baseline energy use equations [15] to avoid the risk of backsliding on the standard levels. (IOUs, No. 77 at p. 2) The IOUs indicated that they did not have any additional data regarding the impacts of the test procedure changes. (Id.)

GE generally noted the importance of conducting tests to evaluate the impacts of the test procedure changes. It also expressed concerns that a number of the test procedure changes may have significant measurement impacts. GE did not, however, specifically identify these test procedure changes. (GE, Public Meeting Transcript, No. 67 at pp. 36–37) Whirlpool commented that the test procedures addressing products with variable anti-sweat heater controls represent a significant test burden (in some cases, an additional week of test time) and could impact the measured energy use of a given product. (Whirlpool, Public Meeting Transcript, No. 67 at pp. 44–45) Whirlpool further identified electric heaters and/or fans in special compartments that may be used to prevent freezing in such compartments as a factor in the potential energy use measurement impact of the test procedure amendments for special compartments. (Id.)

When asked by DOE whether there are any manufacturer data that quantify the impacts of the cited additional test procedure amendments, AHAM indicated that they did not have such data. Instead, AHAM cited DOE's own statement from the refrigeration product test procedure rulemaking public meeting presentation discussing the NOPR that the amendments to capture defrost precooling energy use would increase energy use 2 percent for one tested product (AHAM, Public Meeting Transcript, No. 67 at pp. 44, 45–46, 43)

[15] The baseline energy use equations represent energy use for baseline products (i.e. products which are minimally compliant using the current test procedure) when tested using the new test procedure.

AHAM further stressed the importance of evaluating the entire modified test procedure rather than investigating the potential impacts from individual changes, because the measurement impacts of the changes may not be additive. (Id. at pp. 26–27) However, AHAM did not provide data illustrating or supporting this assertion, nor did AHAM explain why an additive approach is not reasonable.

Stakeholders also commented on the approach used to apply the projected energy measurement impacts to the energy conservation standards. When asked by DOE during the public meeting if the crosswalk should apply to the population average of the minimally compliant products, AHAM agreed, indicating that the Joint Agreement used the words ''average'' and ''minimally compliant'', but that the crosswalk should also be based on evaluating low-volume and high-volume products to properly reflect capacity impacts. (AHAM, Public Meeting Transcript, No. 67 at pp. 33–34) ASAP also agreed that the crosswalk should apply to the ''average''. (ASAP, Public Meeting Transcript, No. 67 at p. 34) DOE agrees that a shipment-weighted average approach for applying the energy use measurement impacts of test procedure changes is appropriate and is consistent with the requirements of EPCA. (42 U.S.C. 6293(e)(2)) Consistent with this approach, and the requirements of 42 U.S.C. 6293(e)(2), DOE applied a shipment-weighted approach, which provides the best indication across all shipped products of the magnitude of the impact.

AHAM also commented that anti-backsliding considerations would not apply because the changes in test procedures and energy standards will take effect simultaneously. (AHAM, Public Meeting Transcript, No. 67 at p. 41) DOE notes that amending a test procedure without an accompanying energy standard rulemaking that increases stringency may result in an increase in the maximum allowable energy use for some products. Such a change would not be allowed if the anti-backsliding provisions of EPCA (42 U.S.C. 6295(o)(1)) applied to any particular product rather than to the average for the product class population. However, such considerations do not apply in this case, as indicated by AHAM, because the test procedure and energy standard changes will occur simultaneously.

DOE notes that it has received no new information from stakeholders quantifying the changes in measured energy use associated with any of the test procedure changes. Hence, DOE adjusted its standards using the data discussed above that AHAM provided during the preliminary analysis phase, as well as supplemental data and analysis (*e.g.* testing DOE conducted during the rulemaking) that DOE developed on its own.

a. Products With Variable Anti-Sweat Heater Control

DOE amended its test procedures to require the use of the procedure currently being used by manufacturers under waivers that DOE granted. This procedure, along with a change to assure the consistency of compartment temperatures during testing, will be required to establish compliance with the 2014 standards for variable anti-sweat heater control-equipped products. The change involves the description of the conditions that apply to the anti-sweat heater wattages used in the calculation of the anti-sweat heater adjustment factor: the wattages will apply to a 0 °F freezer compartment temperature and a 39 °F fresh food compartment temperature, rather than the 5 °F and 45 °F, respectively, used in the waivers. 75 FR at 78828–78830 (December 16, 2010). DOE considers that the adjustments made to the energy conservation standards to account for compartment temperature changes also apply to the adjustment factor for anti-sweat heaters operating with variable control. Hence, no additional energy standard adjustment is needed to address this test procedure amendment.

b. Products With Multiple Defrost Cycle Types

DOE amended the test procedure to address products with multiple defrost cycle types. *Id.* at 78836–78838. As explained in the test procedure final rule, the previous procedure could not ensure that the entire defrost energy used for such products would be sufficiently captured. DOE received one test procedure waiver petition for such products, from Samsung, requesting waiver of the current test procedure of Appendix A1 for products manufactured before 2014. 76 FR 16760 (March 25, 2011). The waiver petition requests use of the same test procedure to address multiple defrost cycle types that was set forth in the test procedure interim final rule for Appendix A. Samsung did not provide information regarding the change in measured energy use associated with the modified test procedure. Furthermore, they indicated that the current energy efficiency standards are adequate, and they did not request adjustment of the standards for the products that are the subject of the waiver petition. *Id.* at p. 16763. DOE is unaware of any other manufacturer who employs this type of design. Accordingly, DOE is unaware of any impact on the measured energy use of these multiple defrost cycle products associated with this test procedure amendment.

c. Amendments To Capture Precooling Energy Use

DOE amended the test procedure for products with long-time or variable defrost to capture precooling and partial recovery energy use. *Id.* at 78832–78836. Testing performed during the engineering phase of this rulemaking indicates that capturing precooling energy use would yield an impact of roughly two percent of the total measured energy use. Additionally, the impact of capturing the energy from full temperature recovery (*i.e.* extending the test period until the compartment temperatures have recovered to their steady-state levels) for products exhibiting partial recovery may comprise another 0.5 percent of total measured energy use for those products that do not achieve a full temperature recovery within the test period prescribed by the current test procedure. Of the nine refrigerator-freezers tested during the engineering analysis phase, two of these units incorporated precooling. These units fell into current product classes 5 (refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service) and 7 (refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service). DOE is unaware of any significant percentage of products that currently do not fully recover temperature within the time period allotted by the current test procedure. DOE has adjusted the energy standard levels for these and related product classes using the observed measurement impact for capturing precooling energy use and applying that measured impact consistently with the frequency with which this feature has been observed in this group of tested products. The adjustment details are described in detail in section 0 below.

d. Test Procedures for Special Compartments

DOE amended the test procedures to require that products with special compartments using the addition of heat (''heat addition'') as a form of temperature control be tested twice. The energy use measurement of such products will be an average of measurements made with the special compartment temperature controls set in the warmest position for the first test and in the coldest position for the second test. *Id.* at 78825–78826. Of the eleven refrigerator-freezers purchased for reverse engineering analysis performed during the engineering analysis phase, two had special compartments with separate temperature control. Neither of these products used heat addition for controlling special compartment temperatures. In examining features of refrigeration products on manufacturer Web sites, DOE found that the prevalence of special compartments in standard-size refrigerator-freezers comprised 20 percent of the models examined. *Id.* at 78823. Because of the limited nature of these data, DOE conducted further study of products that employ heat addition.

DOE identified thirteen basic models that have heated special compartments. In this assessment, DOE concluded that special compartments use heaters for temperature control if the high end of their controllable temperature range is significantly higher than typical fresh food compartment temperatures. DOE considered typical fresh food compartment temperature to be the default settings set at the factory. These default settings are in the 37 °F to 39 °F range. (see, *e.g.,* GE Bottom Freezer Refrigerators, No. 78 at p. 4; LG Owner's Manual LFX28978**, No. 79 at p. 23) The controllable temperature range of heated special compartments typically reaches temperatures of up to 41 °F or 42 °F. By comparison, special compartments that rely on cooling air to manage temperatures do not exceed the typical fresh food compartment temperature range. (See, *e.g.,* GE Bottom Freezer Refrigerators, No. 78 at p. 18; Use and Care Guide Electrolux 242046401, No. 80 at p. 18) The thirteen products identified include products from current products classes 5 (refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service), 5A (refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service), and 7 (refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service). (Heated Special Compartments Web Pages, No. 81)

DOE does not have information on shipment weighting for these products. As a proxy for shipment weighting, DOE instead determined the percentage of available products represented by the identified products with heated special compartments for each of the represented product classes. To do this, DOE considered the number of available products listed in the California Energy Commission (CEC) database, adjusted to account for out-of-date product listings. The details of this approach are described in the TSD in chapter 5, section 5.4.2.6. The calculated percentages of products having heated special compartments are 10.6 percent for current product class 5A, 1.5 percent for current product class 5, and 0.7 percent for current product class 7. DOE used these percentages to adjust the standards for these product classes. The determination of the adjustment is discussed in greater depth in section 0 below.

DOE initially conducted analysis, described below in section IV.C.2, to estimate what the projected impact from the relevant test procedures would be on the measured energy use for a product with a heated special compartment. Initial estimates indicated that the change would increase measured energy use by 5.9 percent for this type of product. DOE also conducted testing for two of the thirteen products that were identified as having heated special compartments. These tests compared the measured energy use not including icemaking energy use when tested using the interim final test procedures set forth in the new Appendix A with a modified test procedure in which the heated special compartment is tested only in its coldest setting. For both of these tests, the Appendix A requirement to average measurements representing the coldest and warmest setting of the compartment resulted in higher energy use. The impacts were 6.5 percent for one product and 1.7 percent for the other—the average impact determined for these tests was 4.1 percent, which is somewhat lower than the estimated 5.9 percent impact.

After reviewing these results, DOE determined that, because the test data represent only two products, the uncertainty associated with the average of the measured impacts is fairly high. As a result, DOE concluded that the more conservative approach of basing its adjustment of the energy standard on the calculation rather than the limited testing data is appropriate to ensure that the final standard is not overly aggressive. Taking such an approach is consistent in this instance with EPCA's prohibition to make subsequent adjustments that would increase the permitted energy usage (or reduce the energy efficiency) of a regulated product. See 42 U.S.C. 6295(o)(1). Accordingly, as described in greater detail in section IV.C.2, the results of the more conserevative calculation were used to adjust the energy standard.

3. Standby and Off Mode Energy Use

DOE notes that EPCA, as amended by EISA 2007, requires DOE to amend its test procedures for all covered products, including those for refrigeration products, to include a measurement for standby mode and off mode energy consumption, except where current test procedures fully address such energy consumption. (42 U.S.C. 6295(gg)(2)) As indicated above, DOE's test procedures for refrigeration products, both the previous and recently amended versions, already fully address standby and off mode energy use. Whirlpool agreed with this assessment. (Whirlpool, No. 74 at p. 7) No commenters challenged this assessment. Because the test procedures address standby and off mode energy use, the energy conservation standards, which are based on the test procedures, also address this energy use.

B. Technological Feasibility

1. General

In each standards rulemaking, DOE conducts a screening analysis based on information gathered on all current technology options and prototype designs that have the potential to improve product or equipment efficiency. To conduct the analysis, DOE typically develops a list of design options for consideration in consultation with manufacturers, design engineers, and other interested parties. DOE then determines which of these options are technologically feasible. DOE considers a design option to be technologically feasible if it is currently in use by the relevant industry or if a working prototype exists. See 10 CFR part 430, subpart C, appendix A, section 4(a)(4)(i) (providing that ''[t]echnologies incorporated in commercially available products or in working prototypes will be considered technologically feasible.'')

Once DOE has determined that particular design options are technologically feasible, it evaluates each one using the following additional screening criteria: (1) Practicability to manufacture, install, or service; (2) adverse impacts on product utility or availability; and (3) adverse impacts on health or safety. (10 CFR part 430, subpart C, appendix A, section 4(a)(4)). Section IV.B of this notice discusses the results of the screening analysis for refrigeration products, namely, the designs DOE considered, those it screened out, and those that are the basis for the trial standard levels (TSLs) in this rulemaking. For further details on the screening analysis for this rulemaking, see chapter 4, Screening Analysis, of the NOPR TSD.

2. Maximum Technologically Feasible Levels

When DOE proposes to adopt (or not adopt) an amended standard for a type or class of covered product, it must ''determine the maximum improvement in energy efficiency or maximum reduction in energy use that is technologically feasible'' for such product. (42 U.S.C. 6295(p)(1)) Accordingly, DOE determined the maximum technologically feasible (''max-tech'') reductions in energy use for refrigeration products in the engineering analysis.

As described in the preliminary TSD, DOE conducted a full analysis of a set of product classes that comprise a large percentage of product shipments in the market today. DOE's approach for extending amended standard levels established for these product classes to the non-analyzed product classes is described in chapter 2, Analytical Framework, of the preliminary TSD, in section 2.15. Similarly, this section of today's rule reports the max-tech efficiency levels for the fully analyzed product classes, which include Classes 3 (refrigerator-freezer—automatic defrost with top-mounted freezer without through-the-door ice service), 5 (refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service), 7 (refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service), 9 (upright freezers with automatic defrost), 10 (chest freezers), 11 (compact refrigerators and refrigerator-freezers with manual defrost), 18 (compact chest freezers), 3A–BI (built-in all-refrigerators—automatic defrost), 5–BI (built-in Refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service), 7–BI (built-in Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service, and 9–BI (built-in upright freezers with automatic defrost). DOE considers the max-tech levels for these product classes to be representative of the max-tech levels of similar product classes. For example, product class 7 can be considered to represent product class 4 (refrigerator-freezers—automatic defrost with side-mounted freezer without through-the-door ice service) because they are both side-mount refrigerator-freezers, the only difference being the through-the-door ice feature of product class 7.

In determining the max-tech efficiency levels of the directly analyzed product classes, DOE used the amended test procedures that would apply once manufacturers are required to meet the new standard. The efficiency levels are defined as reductions in that portion of the energy use not associated with icemaking. As described in section III.A, above, the energy use associated with icemaking under the amended test procedure is a fixed quantity not correlated with an efficiency level. Separating this fixed quantity of energy use from the established efficiency level allows a more direct comparison of products, irrespective of whether a given product is equipped with an automatic icemaker. This approach also allows DOE to compare the efficiency levels based on the amended test procedure (*i.e.,* projections of possible energy use reductions) against the energy use based on the existing test procedure and current standard.[16]

DOE used the full set of design options considered applicable to these directly analyzed product classes to determine their max-tech efficiency levels. (See chapter 5 of the NOPR TSD, section 5.4.4.) Table III.1 lists the max-tech levels that DOE determined for this rulemaking. The table also presents the max-tech levels that are commercially available. The max-tech levels differ from those presented in the preliminary TSD and are generally lower (*i.e.,* the percent energy use reductions are lower for the NOPR analysis, thus, the max-tech energy use is higher). The reduction in the max-tech efficiency levels is due to the revisions DOE implemented in the NOPR engineering analysis to address new information obtained during this phase of the rulemaking (see the discussion of changes made to the engineering analysis in the NOPR, Table IV.10. 75 FR 59470, 59501–59502 (September 27, 2010)). DOE obtained the new information through NOPR phase interviews with manufacturers.

TABLE III.1—MAX-TECH EFFICIENCY LEVELS FOR THE REFRIGERATION PRODUCTS RULEMAKING

Product class	Description	Efficiency level (percent energy use reduction)	
		DOE analysis (percent)	Max tech commercially available (percent)
Standard-Size Refrigerator-Freezers			
3	Refrigerator-freezers—automatic defrost with top-mounted freezer without through-the-door ice service.	36	30
5	Refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service.	36	33
7	Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	33	32
Standard-Size Freezers			
9	Upright freezers with automatic defrost	44	27
10	Chest freezers and all other freezers except compact freezers	41	16
Compact Products			
11	Compact refrigerators and refrigerator-freezers with manual defrost	59	27
18	Compact chest freezers	42	23

[16] In other words, a product with energy usage that is a certain percentage below the current energy standard should remain the same percentage below the baseline energy use under the proposed test procedure after subtracting icemaking energy use. Hence, the max-tech levels expressed as a percentage of energy use reduction should be the same for both sets of test procedures.

TABLE III.1—MAX-TECH EFFICIENCY LEVELS FOR THE REFRIGERATION PRODUCTS RULEMAKING—Continued

Product class	Description	Efficiency level (percent energy use reduction)	
		DOE analysis (percent)	Max tech commercially available (percent)
Built-In Products			
3A–BI	Built-In All-refrigerators—automatic defrost	28	31
5–BI	Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service.	27	27
7–BI	Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	22	21
9–BI	Built-In Upright freezers with automatic defrost	27	27

The max-tech efficiency levels identified for commercially available products are, in most cases, different from the max-tech levels shown in Table III.1. The levels in Table III.1 are significantly higher than the commercially available max-tech levels for product classes 9 (upright freezers with automatic defrost), 10 (chest freezers), 11 (compact refrigerators and refrigerator-freezers with manual defrost), and 18 (compact chest freezers). DOE determined that higher max-tech levels for these products were possible because available products generally do not use all of the energy efficient design options considered in the DOE max-tech analyses. Prototypes with the DOE max-tech levels have not been identified, but the design options are all used in commercially available products.

DOE determined the max-tech levels using a program initially developed by the Environmental Protection Agency (EPA) called the Efficient Refrigerator Analysis program (known simply as the ERA) to conduct energy modeling. DOE conducted this energy modeling for specific products examined during the engineering analysis. DOE created energy models for the existing products and adjusted these models to represent modified designs using the screened-in design options. The max-tech levels represent the most efficient design option combinations applicable for the analyzed products. This process is described in Chapter 5 of the NOPR TSD. See NOPR TSD, sections 5.4.4 and 5.7. DOE considered different sets of design options for each product class, as indicated in Table III.2.

Table III.2 Design Options Considered for Max Tech

Product Class	Design Option							
	BLDC* Fan Motors	Heat Exchanger Improvement	Thicker Walls	Vacuum Insulation Panels (VIPs)	Variable Speed Compressor	Adaptive Defrost	Variable Anti-sweat Heater Control	Isobutane Refrigerant
3	✓	✓		✓	✓	✓		
5	✓	✓		✓	✓	✓	✓	
7	✓	✓		✓	✓	✓	✓	
9	✓	✓	✓	✓	✓	✓		
10		✓	✓	✓	✓			
11		✓	✓	✓	✓			✓
18		✓	✓	✓	✓			
3A-BI	✓	✓		✓	✓			
5-BI	✓	✓		✓	✓	✓		
7-BI	✓	✓		✓	✓	✓	✓	
9-BI	✓	✓		✓	✓	✓		

*Brushless-Direct-Current

DOE requested comments on its max-tech efficiency levels and on the evaluated groups of design options DOE's analyses indicated would be necessary to employ to achieve these levels. 75 FR at 59484 (September 27, 2010). Sub Zero commented that DOE's analysis leading to the max-tech feasible levels is reasonable. (Sub Zero, No. 69

at p. 1) Sub Zero also commented that many of the design options still available to improve the efficiency of freestanding products have already been used in built-in products that are available on the market.

Whirlpool commented that some of the design option combinations may not be practical, that the resulting efficiency gains may not be additive, and that the combinations may not be cost-effective. Whirlpool also commented that it does not believe that DOE has met the obligation to demonstrate the technical and economic feasibility of these combinations. (Whirlpool, No. 74 at p. 1). Whirlpool did not identify the specific combinations that it believed to be impractical. Accordingly, DOE has not adjusted its max-tech analysis. DOE adds that max-tech efficiency levels are not required to be cost-effective levels, but that DOE is required by EPCA to determine the maximum improvement that is technologically feasible, and to explain why the standard is not set at this level, if it is not. (42 U.S.C. 6295(p)(1))

C. Energy Savings

1. Determination of Savings

DOE used its National Impact Analysis (NIA) spreadsheet model to estimate the energy savings from amended standards for the refrigeration products covered by this rulemaking.[17] For each TSL, DOE forecasted energy savings beginning in 2014, the year that manufacturers would be required to comply with amended standards, and ending in 2043. DOE quantified the energy savings attributable to each TSL as the difference in energy consumption between the standards case and the base case. The base case represents the forecast of energy consumption in the absence of amended mandatory efficiency standards and considers market demand for more-efficient products.

The NIA spreadsheet model calculates the electricity savings in ''site energy'' expressed in kilowatt-hours (kWh). Site energy is the energy directly consumed by refrigeration products at the locations where they are used. DOE reports national energy savings on an annual basis in terms of the aggregated source (primary) energy savings, which is the savings in the energy that is used to generate and transmit the site energy. (See TSD chapter 10.) To convert site energy to source energy, DOE derived annual conversion factors from the model used to prepare the Energy Information Administration's (EIA) *Annual Energy Outlook 2010 (AEO2010).*

2. Significance of Savings

As noted above, DOE must adopt a standard for a covered product that results in ''significant'' energy savings. 42 U.S.C. 6295(o)(3)(B). While the term ''significant'' is not defined in the Act, the U.S. Court of Appeals, in *Natural Resources Defense Council* v. *Herrington,* 768 F.2d 1355, 1373 (D.C. Cir. 1985), indicated that Congress intended ''significant'' energy savings in this context to be savings that were not ''genuinely trivial.'' The energy savings for all of the TSLs considered in this rulemaking are nontrivial, and, therefore, DOE considers them ''significant'' within the meaning of section 325 of EPCA.

D. Economic Justification

1. Specific Criteria

As noted in section II.A, EPCA provides seven factors for DOE to consider when evaluating whether a potential energy conservation standard is economically justified. (42 U.S.C. 6295(o)(2)(B)(i)) The following sections discuss how DOE has addressed each of those seven factors in this rulemaking.

a. Economic Impact on Manufacturers and Consumers

As required by EPCA, DOE considered the economic impact of potential standards on consumers and manufacturers. (42 U.S.C. 6295(o)(2)(B)(i)(I)) For consumers, DOE measured the economic impact as the change in installed cost and life-cycle operating costs (*i.e.,* the change in LCC). (*See* section 0, section 0 and chapter 8 of the final rule TSD.) DOE investigated the impacts on manufacturers through the manufacturer impact analysis (MIA). (*See* section 0 and section 0 of today's final rule, and chapter 12 of the final rule TSD accompanying this rule.) The economic impact on consumers and manufacturers is discussed in detail in the NOPR. See 75 FR at 59484–59485, 59512–59516, 59519–59526, 59532–59537, and 59537–59549 (September 27, 2010).

For individual consumers, measures of economic impact include the changes in life-cycle cost (LCC) and payback period (PBP) associated with new or amended standards. The LCC, which is separately specified in EPCA as one of the seven factors to be considered in determining the economic justification for a new or amended standard, 42 U.S.C. 6295(o)(2)(B)(i)(II), is discussed in the following section. For consumers in the aggregate, DOE also calculates the national net present value of the economic impacts on consumers over the forecast period used in a particular rulemaking.

b. Life-Cycle Costs

The LCC is the sum of the purchase price of a product (including its installation) and the operating expense (including energy and maintenance and repair expenditures) discounted over the lifetime of the product. The LCC savings for the considered efficiency levels are calculated relative to a base case that reflects likely trends in the absence of amended standards. The LCC analysis requires a variety of inputs, such as product prices, product energy consumption, energy prices, maintenance and repair costs, product lifetime, and consumer discount rates. DOE assumed in its analysis that consumers will purchase the products affected by this rule in 2014.

To account for uncertainty and variability in specific inputs, such as product lifetime and discount rate, DOE uses a distribution of values with probabilities attached to each value. A distinct advantage of this approach is that DOE can identify the percentage of consumers estimated to receive LCC savings or experience an LCC increase, in addition to the average LCC savings associated with a particular standard level. Aside from identifying ranges of impacts, DOE evaluates the LCC impacts of potential standards on identifiable subgroups of consumers that may be disproportionately affected by a national standard, such as low-income people or the elderly.

c. Energy Savings

While the significant conservation of energy is a separate statutory requirement for imposing an energy conservation standard, in determining the economic justification of a standard, DOE must consider the total projected energy savings that are expected to result directly from the standard. 42 U.S.C. 6295(o)(2)(B)(i)(III). DOE uses the NIA spreadsheet results in its consideration of total projected energy savings.

d. Lessening of Utility or Performance of Products

In establishing product classes, and in evaluating design options and the impact of potential standard levels, DOE sought to develop standards for refrigeration products that would not lessen the utility or performance of these products. None of the TSLs presented in today's final rule would substantially reduce the utility or performance of the products under

[17] The NIA spreadsheet model is described in section IV.G of this rule.

consideration in the rulemaking. However, the cost premium for features that increase energy use, such as multiple drawers, may increase, thus shifting their availability to higher-priced products. 42 U.S.C. 6295(o)(2)(B)(i)(IV).

e. Impact of Any Lessening of Competition

EPCA requires DOE to consider any lessening of competition that is likely to result from setting new or amended standards for a covered product. Consistent with its obligations under EPCA, DOE sought the views of the United States Department of Justice (DOJ). DOE asked DOJ to provide a written determination of the impact, if any, of any lessening of competition likely to result from the amended standards, together with an analysis of the nature and extent of such impact. 42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii).

To assist DOJ in making such a determination, DOE provided DOJ with copies of both the NOPR and NOPR TSD for review. DOJ did not provide DOE with comments on this rulemaking. Accordingly, DOE concludes that today's final rule would not be likely to lead to a lessening of competition.

f. Need for National Energy Conservation

Certain benefits of the amended standards are likely to be reflected in improvements to the security and reliability of the Nation's energy system. Reductions in the demand for electricity may also result in reduced costs for maintaining the reliability of the Nation's electricity system. DOE conducts a utility impact analysis to estimate how standards may affect the Nation's needed power generation capacity.

Energy savings from the amended standards are also likely to result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production. DOE reported the environmental effects from the amended standards for refrigeration products, and from each TSL it considered, in the environmental assessment contained in chapter 15 in the NOPR TSD. DOE also reported estimates of the economic value of emissions reductions resulting from the considered TSLs.

g. Other Factors

EPCA allows the Secretary of Energy, in determining whether a standard is economically justified, to consider any other factors that the Secretary deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VII)) In developing this final rule, DOE also considered the comments of the stakeholders, including those raised in the Joint Comments, which DOE believes sets forth a statement by interested persons that are fairly representative of relevant points of view (including representatives of manufacturers of covered products, States, and efficiency advocates) and contains recommendations with respect to an energy conservation standard that are in accordance with 42 U.S.C. 6295(o).

2. Rebuttable Presumption

As set forth in 42 U.S.C. 6295(o)(2)(B)(iii), EPCA creates a rebuttable presumption that an energy conservation standard is economically justified if the additional cost to the consumer of a product that meets the standard is less than three times the value of the first-year of energy savings resulting from the standard, as calculated under the applicable DOE test procedure. DOE's LCC and PBP analyses generate values used to calculate the payback period for consumers of potential amended energy conservation standards. These analyses include, but are not limited to, the 3-year payback period contemplated under the rebuttable presumption test. However, DOE routinely conducts an economic analysis that considers the full range of impacts to the consumer, manufacturer, Nation, and environment, as required under 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification). The rebuttable presumption payback calculation is discussed in section IV.F.12 and chapter 8 of the final rule TSD.

IV. Methodology and Discussion

DOE used two spreadsheet tools to estimate the impact of today's amended standards. The first spreadsheet calculates LCCs and payback periods of new energy conservation standards. The second one provides shipments forecasts, and then calculates national energy savings and net present value impacts of new energy conservation standards. DOE also assessed manufacturer impacts, largely through use of the Government Regulatory Impact Model (GRIM). The two spreadsheets are available online at the rulemaking Web site: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/refrigerators_freezers.html.*

Additionally, DOE estimated the impacts on utilities and the environment stemming from energy efficiency standards for refrigeration products. DOE used a version of EIA's National Energy Modeling System (NEMS) for the utility and environmental analyses. The NEMS model simulates the energy sector of the U.S. economy. EIA uses NEMS to prepare its *Annual Energy Outlook,* a widely known energy forecast for the United States. The version of NEMS used for appliance standards analysis is called NEMS–BT [18], and is based on the *AEO* version with minor modifications.[19] The NEMS–BT offers a sophisticated picture of the effect of standards because it accounts for the interactions between the various energy supply and demand sectors and the economy as a whole.

A. Market and Technology Assessment

When initiating an energy conservation standards rulemaking, DOE develops information that provides an overall picture of the market for the products concerned, including the purpose of the products, the industry structure, and market characteristics. This activity includes both quantitative and qualitative assessments, based primarily on publicly available information. The subjects addressed in the market and technology assessment for this rulemaking include product classes and manufacturers; quantities, and types of products sold and offered for sale; retail market trends; regulatory and non-regulatory programs; and technologies or design options that could improve the energy efficiency of the product(s) under examination. See chapter 3, Market and Technology Assessment, of the TSD for further discussion of the market and technology assessment.

Discussion presented in this section of today's notice primarily addresses the scope of coverage of refrigeration products, the product class structure, and product class definitions. These issues were discussed during the NOPR public meeting. In response to comments raised during that meeting

[18] BT stands for DOE's Building Technologies Program.

[19] The EIA allows the use of the name ''NEMS'' to describe only an *AEO* version of the model without any modification to code or data. Because the present analysis entails some minor code modifications and runs the model under various policy scenarios that deviate from *AEO* assumptions, the name ''NEMS–BT'' refers to the model as used here. For more information on NEMS, refer to *The National Energy Modeling System: An Overview,* DOE/EIA–0581 (98) (Feb.1998), available at: *http://tonto.eia.doe.gov/FTPROOT/forecasting/058198.pdf*.

and from written comments, DOE has modified the product class structure, as discussed in section 0, below.

1. Exclusion of Wine Coolers from This Rulemaking

The NOPR explained that wine coolers are not covered products under the definition for electric refrigerator, and hence, are not covered by this rulemaking. 75 FR at 59486 (September 27, 2010). DOE explained that it would consider initiating a future rulemaking to establish coverage and energy standards for these products. *Id.* Whirlpool commented that it agrees that wine coolers do not meet the definition of electric refrigerator, but that DOE should reconsider its decision not to include these products in this rulemaking. (Whirlpool, No. 74 at p. 8) GE commented that DOE should regulate these products and should consider the proper mechanism for doing so. (GE, No. 76 at p. 2) In light of the timetable prescribed by EPCA, insufficient time and resources are available for DOE to conduct the necessary analyses for these products within the context of the current rulemaking. In response to the preliminary analysis, the California Investor Owned Utilities agreed with DOE's initial decision not to include wine coolers in this rulemaking, indicating that they operate at temperatures outside the range defined for refrigerators, and that they have been covered by California's energy standards since 2002. (IOUs, No. 39 at p. 12) The IOUs submitted no new comments on this topic in response to the NOPR. Sub Zero indicated in the preliminary analysis public meeting that the California energy standard for these products has become a de-facto national standard. (Preliminary Analysis Public Meeting Transcript, No. 30 at pp. 108–109). As previously indicated, DOE will revisit the coverage of these products in the future.

2. Product Classes

In evaluating and establishing energy conservation standards, DOE generally divides covered products into classes by the type of energy used, or by capacity or other performance-related feature that justifies a different standard for those products. (See 42 U.S.C. 6295(q)). In deciding whether a feature justifies a different standard, DOE must consider factors such as the utility of the feature to users. (*Id.*) DOE normally establishes different energy conservation standards for different product classes based on these criteria. DOE's regulations currently set forth 18 product classes for refrigerators, refrigerator-freezers, and freezers.[20] These classes are based on the following characteristics: type of unit (refrigerator, refrigerator-freezer, or freezer), size of the cabinet (standard or compact), type of defrost system (manual, partial, or automatic), presence or absence of through-the-door (TTD) ice service, and placement of the fresh food and freezer compartments for refrigerator-freezers (top, side, bottom).

DOE has created 24 new product classes to account for the increasingly wider number of variants of products. Six new product classes were discussed and proposed in the preliminary analysis phase, and an additional 13 were proposed in the NOPR. 75 FR at 59486–59487 (September 27, 2010). Table IV.1 presents the product classes established in this rulemaking, including both current and new classes. DOE changed the designation of some of the current product classes to address the division of these product classes. The subsections below provide additional details and discussion of comments relating to the product classes that have been added.

TABLE IV.1—PRODUCT CLASSES FOR REFRIGERATION PRODUCTS

Number	Product class
	Classes Currently Listed in the CFR
1	Refrigerators and refrigerator-freezers with manual defrost.
2	Refrigerator-freezers—partial automatic defrost.
3	Refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker.
4	Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker.
5	Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker.
6	Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service.
7	Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.
8	Upright freezers with manual defrost.
9	Upright freezers with automatic defrost without an automatic icemaker.
10	Chest freezers with manual defrost and all other freezers except compact freezers.
11	Compact refrigerators and refrigerator-freezers with manual defrost.
12	Compact refrigerator-freezers—partial automatic defrost.
13	Compact refrigerator-freezers—automatic defrost with top-mounted freezer.
14	Compact refrigerator-freezers—automatic defrost with side-mounted freezer.
15	Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer.
16	Compact upright freezers with manual defrost.
17	Compact upright freezers with automatic defrost.
18	Compact chest freezers.
	Product Classes Introduced in the Preliminary TSD
1A	All-refrigerators—manual defrost.
3A	All-refrigerators—automatic defrost.
5A	Refrigerator-freezers—automatic defrost with bottom-mounted freezer with through-the-door ice service.
10A	Chest freezers with automatic defrost.
11A	Compact all-refrigerators—manual defrost.
13A	Compact all-refrigerators—automatic defrost.

[20] Title 10—Energy, Chapter II—Department of Energy, Part 430—Energy Conservation Program for Consumer Products, Subpart A—General Provisions, Section 430.32—Energy and Water Conservation Standards and Effective Dates.

TABLE IV.1—PRODUCT CLASSES FOR REFRIGERATION PRODUCTS—Continued

Number	Product class
Additional Product Classes Proposed in the NOPR	
3–BI	Built-in refrigerator-freezer—automatic defrost with top-mounted freezer without an automatic icemaker.
3I	Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.
3I–BI	Built-in refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.
3A–BI	Built-in all-refrigerators—automatic defrost.
4I	Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.
4–BI	Built-in refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker.
4I–BI	Built-in refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.
5I	Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.
5–BI	Built-in refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker.
5I–BI	Built-in refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.
5A–BI	Built-in refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service.
7–BI	Built-in refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.
9–BI	Built-in upright freezers with automatic defrost without an automatic icemaker.
Additional Product Classes	
9I	Upright freezers with automatic defrost with an automatic icemaker.
9I–BI	Built-in upright freezers with automatic defrost with an automatic icemaker.
13I	Compact refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker.
14I	Compact refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker.
15I	Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker.

a. General Discussion Regarding Added Product Classes

DOE introduced six new product classes in the preliminary TSD. Two of these, product class 5A, ''automatic defrost refrigerator-freezers with bottom-mounted freezer with through-the-door ice service,'' and product class 10A, ''chest freezers with automatic defrost,'' were identified in the framework document as product classes 19 and 20. DOE modified the designation of these product classes in order to maintain consistency with the product class designations adopted by Canada and ease the overall burden on manufacturers in ascertaining which standards to apply to these products. *Id.* at 59487–59488. AHAM supported adding the new product classes 5A and 10A. (AHAM, No. 73 at p. 6)

Four additional product classes introduced in the preliminary TSD are all-refrigerators. As described in the NOPR, the new test procedure has led DOE to establish separate product classes for these products. *Id.* at 59488.

The NOPR also proposed 13 additional new product classes. These classes are based on the incorporation of icemaking energy use into the test procedure and address the different consumer utility and energy use characteristics of built-in products. *Id.* at 59489–59493.

EPCA provides that separate product classes be based on either (A) consumption of a different kind of energy from that consumed by other covered products within such type (or class); or (B) a capacity or other performance-related feature which other products within such type (or class) do not have, where such feature justifies a higher or lower standard from that which applies to other products within such type (or class). (42 U.S.C. 6295(q)). The second of these criteria applies to all of the new product classes in this rulemaking. DOE detailed the reasons for this approach in the NOPR. *Id.* at 59487–59493. DOE received no comments challenging this approach.

DOE also requested comment on whether any additional product classes should be established as built-in or automatic icemaker variants of products to address the range of commercially available products. Sub Zero recommended including additional product classes 9I and 9I–BI, freestanding and built-in versions of upright freezers with automatic defrost equipped with an automatic icemaker. The company asserted that such products currently are being sold (Sub Zero, No. 69 at p. 3) DOE's research confirms the existence of these two product classes (Upright Freezers with Automatic Icemakers, No. 86).

AHAM and Whirlpool recommended including product classes 9I, 9I–BI, 13I, 14I, and 15I as variants of proposed products without through-the-door ice service that may have automatic icemakers. (AHAM, No. 73 at pp. 6–7; Whirlpool, No. 74 at pp. 1–2, 3) AHAM also recommended including product class 9A, described as ''upright freezers with automatic defrost with an automatic icemaker with through-the-door ice service''. (AHAM, No. 73 at pp. 6–7) DOE has adopted product classes 9I, 9I–BI, 13I, 14I, and 15I. DOE's research identified at least one existing compact bottom-freezer product with an automatic icemaker (product class 15I, Compact Products with Automatic Icemakers, No. 85 at p. 3). DOE was not able to positively identify any compact side-mount products with automatic icemakers (product class 14I), nor any compact top-mount products (product class 13I), but did identify one existing product whose product class is not clearly indicated in the manufacturer's literature that is either a 13I or 14I product. (Compact Products with Automatic Icemakers, No. 85 at p. 1)

The standard levels for these classes are equal to the standards of their counterparts without an icemaker plus the addition of 84 kWh to help account for the energy consumed by the automatic icemaker. However, the suggested product class 9A is not a variant of any of the proposed product classes. Instead, it constitutes a new class that DOE had not considered within the context of this rulemaking. Accordingly, DOE is declining to incorporate this particular class as part of the final rule.

Lastly, Whirlpool asserted that the negotiated agreement intended to combine product classes 13 and 15, and Whirlpool likewise appeared to recommend combining product classes 13I and 15I, by grouping them together in its comments. (Whirlpool, No. 74 at p. 2) Whirlpool offered no support for this view and no other comments indicated that these product classes should be combined. Hence, DOE is maintaining separate classes for Classes 13, 15, 13I, and 15I.

b. Possible Combination of Product Class 2 With 1, and Class 12 With 11

DOE also indicated in the NOPR that it did not propose the combination of two pairs of product classes that had been discussed in the preliminary TSD—specifically, a potential combination of product classes 1 (refrigerators and refrigerator-freezers with manual defrost) and 2 (refrigerator-freezers—partial automatic defrost) and, separately, a potential combination of product classes 11 (compact refrigerators and refrigerator-freezers with manual defrost) and 12 (compact refrigerator-freezers—partial automatic defrost). DOE requested comment on its proposal not to combine these pairs of product classes. *Id.* at 59493. AHAM and NPCC agreed with this proposal. (AHAM, Public Meeting Transcript, No. 67 at p. 52; AHAM, No. 73 at p. 6; NPCC, Public Meeting Transcript, No. 67 at p. 52) Whirlpool presented a table suggesting that they were opposed to keeping product classes 1 and 2 separated. (Whirlpool, No. 74 at p. 2), but noted that it had nothing substantive to add on this matter because it does not manufacture these products. (Whirlpool, No. 74 at p. 3) In light of these comments, which generally favored DOE's proposed approach, DOE is not combining these product class pairs.

c. All-Refrigerators and Basic Refrigerators

All-refrigerators are refrigerators that do not have a compartment for the freezing and long-term storage of food below 32 °F, but which may have a compartment not larger than 0.5 cubic foot in size for freezing and storage of ice. (10 CFR part 430, subpart B, appendix A1, section 1.2) The definition for refrigerator appears in 10 CFR 430.2 and it includes both all-refrigerators and refrigerators that are not all-refrigerators. This latter category of refrigerator, which does include a compartment for the storage of food below 32 °F, is given the name ''basic refrigerator'' in both AHAM standards HRF–1–1979 and HRF–1–2008. Appendix A1 and Appendix A, respectively, both reference these industry-developed definitions.

AHAM supported establishing separate product classes for all-refrigerators, indicating that these new product classes were supported in the negotiated agreement described in the Joint Comments. (AHAM, No. 73 at p. 4) However, AHAM indicated that the product classes for refrigerators that are not all-refrigerators should be renamed using ''basic refrigerator'' to ensure that they exclude all-refrigerators. (Id.) Whirlpool supported this view. (Whirlpool, No. 74 at p. 2)

DOE agrees with AHAM that clarifying the product class names for certain classes will improve overall clarity. DOE notes that this change affects product classes 1 (refrigerators and refrigerator-freezers with manual defrost) and 11 (compact refrigerators and refrigerator-freezers with manual defrost). (These are the product class names as proposed—and currently used in the CFR.) DOE has also considered whether to rely on referencing the definition sections of HRF–1–1979 and HRF–1–2008, as described above, to provide the definition for basic refrigerator. The definitions for basic refrigerator are the same in these standards and they read as follows:

> 3.1.1 *Basic Refrigerator* A refrigerator which includes a low temperature compartment for the freezing and storage of ice and intended for short-term storage of food at temperatures below 32 °F (0 °C) and normally above 8 °F (−13.3 °C). It is characterized by a refrigerated surface(s) that partially encloses the low temperature compartment and cools the fresh food compartment by natural convection. It frequently has a partition (called the chiller or drip tray) which when removed or adjusted exposes an additional area of the refrigerated surface to the fresh food compartment.

HRF–1–1979, HRF–1–2008, section 3.1.1.

DOE notes two concerns regarding this definition of basic refrigerator.

First, the definition does not define a lower size limit for the low temperature compartment, nor does it specify a temperature range for it. The clause ''short-term storage of food at temperatures below 32 °F'' does not distinguish the temperature range of such a compartment from the compartment of an all-refrigerator that is ''for freezing and storage of ice'', since freezing and storage of ice also requires temperatures less than 32 °F. As a result, it is not clear whether a product with a low temperature compartment capable of reaching temperatures less than 32 °F and above 8 °F and a size no greater than 0.5 cubic foot is an all-refrigerator or a basic refrigerator under the AHAM definition.

Second, characterizing the basic refrigerator by describing the low-temperature compartment's sides and how they transfer cooling air to the fresh food compartment could exclude some types of refrigerators from AHAM's basic refrigerator definition. For instance, a product that uses a fan to provide forced convection transfer of cooling air to the fresh food compartment from the refrigerated surfaces enclosing the low-temperature compartment would not fit the definition. If the product class were renamed using ''basic refrigerators'', such products that do not fit the basic refrigerator definition would not be included within the product class. A manufacturer could claim such a product is not covered, assuming it does not meet the requirements of the all-refrigerator definition either.

To resolve these issues, DOE has decided to clarify the product class names for product classes 1 and 11, indicating that these product classes do not include all-refrigerators. The new names for these product classes are ''1. Refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost'' and ''11. Compact refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost.'' DOE has taken this approach rather than using the term ''basic refrigerator'' and modifying its definition, thus allowing the existing definition for basic refrigerator to retain its current meaning.

AHAM provided in its written comments a table (Table A) showing the suggested changes to all of the product class names. A similar table appears in Whirlpool's comments. In addition to the suggested name changes for product classes 1 and 11, AHAM and Whirlpool included the following suggestions.

- Inclusion of basic refrigerators in product class 3.
- Correction of the proposed name for product class 11A.
- Insertion of an ''s'' to pluralize ''all-refrigerators'' in the product class 13 name.

(AHAM, No. 73 at p. 5; Whirlpool, No. 74 at p. 2)

DOE notes that basic refrigerators have not previously been part of product class 3 (they instead have been part of product class 1), which makes the incorporation of this suggestion inappropriate. DOE notes that product class 3 denotes ''Refrigerator-freezers-automatic defrost with top-mounted freezer without an automatic icemaker''. Basic refrigerators do not belong in this product class because they are not refrigerator-freezers. For this reason, DOE is declining to adopt this suggestion and will retain its proposed name for this class —''refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker'' as proposed. However, DOE agrees with the other two suggestions and has implemented them in this final rule.

d. Built-In Refrigeration Products

DOE requested comment on its proposal to establish separate product classes for built-in products. 75 FR at 59492 (September 27, 2010). AHAM, Sub Zero, and Whirlpool agreed with this proposal. (AHAM, No. 73 at p. 3; Sub Zero, No. 69 at p. 2; Whirlpool, No. 74 at p. 3) DOE received no comments opposing the creation of built-in product classes.

DOE proposed to define built-in products as any refrigerator, refrigerator-freezer or freezer with 7.75 cubic feet or greater total volume and 24 inches or less depth, excluding handles and custom front panels. Such a product would also be designed to be encased on the sides and rear by cabinetry, securely fastened to adjacent cabinetry, walls or floor, and have sides that are not fully finished and not designed to be visible after installation. See 75 FR at 59492 (September 27, 2010).

AHAM and NPCC noted that the proposed definition differed from the definition developed as part of the consensus agreement and asked why it was different. (AHAM, Public Meeting Transcript, No. 67 at pp. 54–55; AHAM, No. 73 at pp. 3–4; NPCC, Public Meeting Transcript, No. 67 at pp. 53, 55) Sub Zero commented that the definition developed during the negotiations should be adopted. (Sub Zero, No. 69 at p. 3) Whirlpool also supported this view. (Whirlpool, No. 74 at p. 3) AHAM recommended that DOE adopt the consensus agreement definition. AHAM also pointed out that the most important difference between the consensus agreement definition and DOE's proposed definition is the specification in the consensus definition of what is not part of the 24-inch depth limit—specifically, the doors, panels, and/or handles. AHAM indicated that these components may extend beyond 24 inches in many built-in products. In AHAM's view, DOE's proposed definition would not account for such situations. (AHAM, No. 73 at p. 4) The JAC also commented that the proposed definition was not the same as the definition of the negotiated agreement, and suggested that DOE adopt this definition with any minor changes that DOE deems necessary. (JAC, No. 75 at p. 2)

The negotiated agreement presented to DOE included the following definition for built-in products:

> Definition of 'Built-in' product class—refrigerators, freezers and refrigerators with freezer units that are 7.75 cubic feet or greater in total volume and 24 inches or less cabinet depth not including doors, handles and custom front panels; are designed to be totally encased by cabinetry or panels attached during installation; are designed to accept a custom front panel or equipped with an integral factory-finished face; are designed to be securely fastened to adjacent cabinetry, walls or floor; and have sides which are not fully finished and are not intended to be visible after installation.

(Joint Comments, No. 52 at p. 30)

The substantive differences between this definition and the definition DOE proposed in its NOPR are as follows.

- The 24-inch depth allowed by the Joint Comments definition does not include the door depth. Technically, this removes the depth of the door edge and the gasket, a difference expected to be typically about 2 inches.
- The Joint Comments mention being ''totally encased'' by cabinetry or panels, while the proposed definition mentions being encased on the sides and rear by cabinetry. DOE did not propose to use the term ''totally encased'' as suggested in AHAM's preliminary analysis comment because the door is not always encased. 75 FR at 59492 (September 27, 2010). The Joint Comments added ''panels'' to apply to the cabinetry that may encase the product.
- The Joint Comments provide that the ''panels [are] attached during installation'' (emphasis added).
- The Joint Comments include the clause, ''are designed to accept a custom front panel or equipped with an integral factory-finished face'' whereas the proposed definition did not include this clause.
- The Joint Comments indicate that the sides ''are not intended to be visible after installation'', while the proposed definition uses ''not designed to be''.

DOE was aware when proposing the definition that, although establishing a depth limitation is entirely consistent with built-in designs and their use, the exact dimension that would be appropriate for this limit would be subject to further refinement from stakeholder discussion and comment. DOE considers the slightly less restrictive definition of the Joint Comments to embody the consideration and consensus of interested parties regarding the appropriate dimension, and will for this reason adopt the suggested change to the depth limitation.

Regarding the use of the term ''totally encased,'' DOE recognizes the limitation of its initially proposed approach and that the term does not necessarily mean fully encapsulated to the extent that absolutely no surface of the delivered product is visible after installation. Hence, DOE has reverted to the use of ''totally encased'' to indicate encased on all surfaces but the door, which clearly needs to be accessible to consumers for the product to function properly. DOE also agrees to the addition of the term ''panels'' that may also serve to encase the product, such as in the case where a product is installed at the end of a row of cabinets and one of the sides is covered with a panel. Further, DOE agrees with the inclusion of the words ''attached during installation'' in reference to panels, since this clause clearly distinguishes a built-in product from a freestanding product, for which there would be no attachment of panels during delivery and installation.

DOE is not convinced, however, that the clause ''are designed to accept a custom front panel or equipped with an integral factory-finished face'' helps distinguish built-in products from freestanding products, since freestanding products generally come with an integral factory-finished face that is part of the door assembly. Based on the language used in the Joint Comments definition, as well as the existence of built-in products that are not designed to accept custom front panels, DOE suspects that the purpose of including this clause is to ensure that built-in products that do not accept custom front panels are not excluded from the definition. Many built-in products have doors with a stainless steel finish (see, *e.g., http://products.geappliances.com/ApplProducts/Dispatcher?REQUEST=SPECPAGE&SKU=ZISP480DXSS&SITEID=MON2&TABID=2*). Such products are not designed to accept custom front panels, but otherwise have the same distinguishing design features of built-in products that do accept custom front panels. DOE has decided to use language to clarify that such products are not excluded from the built-in category.

Additionally, DOE believes that the definition proposed by the Joint Commenters in their negotiated agreement needs to be altered to mitigate the risk of manufacturers applying the built-in definition to a free-standing product. To address this risk, DOE is requiring that a built-in product be one that is designed, intended, and marketed exclusively in a manner that would be consistent with how a built-in product would be installed for consumer use. Factors that DOE would likely consider relevant in this context could include whether the product is sold in an unfinished state and how the product is advertised. DOE believes that by specifying these additional conditions, the definition clearly requires that a manufacturer take affirmative steps establishing the built-in nature of its products. In effect, DOE has taken the ''intended'' language presented in the negotiated agreement's proposal and clarified this concept by specifying the conditions that must be met for a particular model to be considered a built-in product.

Because of the problems that both DOE and the industry have faced with respect to the actions taken by certain manufacturers, DOE believes that it needs to take a stronger approach than that proposed in the negotiated agreement with respect to the delineation of these products. Adopting this stronger approach helps establish a clear distinction between built-in and free-standing products. Such a distinction is necessary in light of the considerably higher energy consumption of these built-in products, a fact that DOE views with some concern. Should DOE receive reports that manufacturers are misapplying this definition or otherwise abusing it, DOE will avail itself of all other options at its disposal to correct that situation and may re-examine this definition to assess whether additional modifications are required.

Accordingly, based on the above considerations, the final definition for built-in products will read as follows:

Built-in refrigerator/refrigerator-freezer/freezer means any refrigerator, refrigerator-freezer or freezer with 7.75 cubic feet or greater total volume and 24 inches or less depth not including doors, handles, and custom front panels; with sides which are not finished and not designed to be visible after installation; and that is designed, intended, and marketed exclusively (1) to be installed totally encased by cabinetry or panels that are attached during installation, (2) to be securely fastened to adjacent cabinetry, walls or floor, and (3) to either be equipped with an integral factory-finished face or accept a custom front panel.

e. Modification of the Definition for Compact Products

DOE proposed to eliminate the 36-inch height restriction in the definition for compact products. DOE underscored two reasons for this change. First, DOE noted that an increased height level provides no energy efficiency benefit. Second, DOE explained that the reason for this 36-inch height restriction, which applies to undercounter products, is not appropriate for the majority of compact products that are not undercounter products. DOE requested comment on this proposal. 75 FR at 59493–59494 (September 27, 2010).

ASAP and AHAM both indicated that the consensus agreement did not eliminate the 36-inch height limitation for compact products. (ASAP, Public Meeting Transcript, No. 67 at pp. 57–58; AHAM, Public Meeting Transcript, No. 67 at p. 58; AHAM, No. 73 at p. 6) (DOE notes that the consensus agreement is silent on this definition. (See, generally, Joint Comments, No. 52)) Whirlpool commented that the current 36-inch limitation should be retained to maintain consistency with the consumer's view of compact, and prevent ''gaming'', *i.e.,* circumvention. (Whirlpool, No. 74 at p. 3) The JAC agreed, noting that this limit helps to distinguish compact products from standard-size products and prevents the weakening of standards in other countries where products taller than 36'' but within the 7.75 cubic foot volume limit are more prevalent. (JAC, No. 75 at p. 2)

Whirlpool's comments do not indicate how removing the 36-inch limitation could lead to circumvention. The new test procedure includes a modified volume calculation method that was specifically developed to limit circumvention associated with false volume claims. 75 FR at 78839–78840 (December 16, 2010). Further, given the importance of volume as an attribute important to consumers,[21] DOE does not believe that consumers will consider tall, but low-volume, products to be standard-size. None of the commenters took issue with any of the analysis or any of the reasons that DOE presented in the NOPR to support the decision to propose eliminating the height restriction. DOE notes that the impact of U.S. standards in other countries, while an important concern, are factors beyond the scope of DOE's authority to control. Hence, DOE is eliminating the height restriction as proposed.

[21] See, for example the discussion of the importance of product volume in the 1995 TSD supporting the rulemaking to establish the 2001 energy conservation standard, in the discussion regarding increasing insulation thickness in Section 3, page 3–6.

f. Icemaking

DOE requested comments on its proposal to establish product classes for products with automatic icemakers, including its proposed approach to account for icemakers in the product class structure. 75 FR at 59489 (September 27, 2010). Sub Zero expressed support for AHAM's intent to work cooperatively with DOE to develop a robust repeatable laboratory-based test procedure to measure automatic icemaking energy use. Sub Zero also encouraged DOE to conduct field surveys to provide information on consumer use of ice by icemaker type (automatic or manual), product class, demographics, time of year, etc. This information, when combined with the laboratory test and accompanying results, would allow determination of the actual energy used by consumers to make ice. (Sub Zero, No. 69 at p. 2) Sub Zero did not object to DOE's proposed product class structure to address icemaking. (Id.) DOE received no comments objecting to DOE's proposed product class structure to integrate icemaking energy use.

AHAM supported the approach proposed by DOE to integrate automatic icemaking into the product class structure. However, AHAM suggested that some additional product classes, not specifically proposed by DOE, have been sold with automatic icemakers. (AHAM, No. 73 at pp. 5–6) These added product classes were previously discussed in section IV.A.2.0 above.

AHAM also commented that products equipped with the option to install an automatic icemaker (''kitable models'') should be considered to be products with icemakers, explaining that this approach is consistent with the test procedure and that lack of clarity on this point would create confusion among manufacturers. (AHAM, No. 73 at p. 6)

DOE disagrees that AHAM's suggested approach with respect to the treatment of ''kitable models'' would be consistent with the test procedure. If such a product is installed in a residence without the icemaker installed, it will not use the additional energy use allocated for automatic icemaking, which is set at 84 kWh in the test procedure. The added energy associated with manual icemaking is likely to be significantly less, as indicated by initial test results conducted by the National Institute for Standards and Technology (NIST). These initial results suggest that the energy use associated with the mechanisms that are used to eject ice in automatic icemakers is significantly greater than the energy use associated with the thermal load of freezing the ice. (NIST, Test Procedure for Residential Refrigerators, Refrigerator-Freezers, and Freezers, Docket Number EERE–2009–BT–TP–0003, Public Meeting Transcript, No. 10 at pp. 157–158) DOE agrees that some understanding of the energy use associated with manual icemaking should be developed to allow more accurate reporting of the energy use of products that do not have automatic icemakers but have freezers that allow for the freezing and storage of ice. However, prior to the development of a manual icemaking factor to account for this energy usage, better consistency with the test procedure will be maintained by certifying kitable models as two separate models (*i.e.,* with an automatic icemaker and without an automatic icemaker), since a consumer may purchase either version.

B. Screening Analysis

DOE uses the following four screening criteria to determine which design options are suitable for further consideration in a standards rulemaking:

1. *Technological feasibility.* DOE will consider technologies incorporated in commercially available products or in working prototypes to be technologically feasible.

2. *Practicability to manufacture, install, and service.* If mass production and reliable installation and servicing of a technology in commercially available products could be achieved on the scale necessary to serve the relevant market at the time the standard comes into effect, DOE would consider that technology practicable to manufacture, install, and service.

3. *Adverse impacts on product utility or product availability.* If DOE determines that a technology would significantly impact in an adverse way the utility of the product for significant subgroups of consumers or would result in the unavailability of any covered product type with performance characteristics (including reliability), features, sizes, capacities, and volumes that are substantially the same as products generally available in the United States at the time, it will not consider this technology further.

4. *Adverse impacts on health or safety.* If DOE determines that a technology will have significant adverse impacts on health or safety, it will not consider this technology further.

10 CFR part 430, subpart C, appendix A, (4)(a)(4) and (5)(b)

In the framework document [22] and accompanying public workshop held on September 29, 2008, DOE identified the energy efficient technologies under consideration for the rulemaking analyses. These technologies are listed below in Table IV.2. Please see chapter 3 of the TSD for detailed descriptions of these technology options.

TABLE IV.2—TECHNOLOGIES DOE CONSIDERED FOR RESIDENTIAL REFRIGERATION PRODUCTS

Insulation	**Expansion Valve**
Improved resistivity of insulation	Improved expansion valves
Increased insulation thickness	**Cycling Losses**
VIPs	Fluid control or solenoid valve
Gas-filled panels	**Defrost System**
Gasket and Door Design	Reduced energy for automatic defrost
Improved gaskets	Adaptive defrost
Double door gaskets	Condenser hot gas
Improved door face frame	**Control System**
Reduced heat load for TTD feature	Temperature control
Anti-Sweat Heater	Air-distribution control
Condenser hot gas	**Other Technologies**
Electric heater sizing	Alternative refrigerants
Electric heater controls	Component location
Compressor	**Alternative Refrigeration Cycles**
Improved compressor efficiency	Lorenz-Meutzner cycle
Variable-speed compressors	Dual-loop system
Linear compressors	Two-stage system
Evaporator	Control valve system
Increased surface area	Ejector refrigerator
Improved heat exchange	Tandem system
Condenser	**Alternative Refrigeration Systems**
Increased surface area	Stirling cycle
Improved heat exchange	Thermoelectric
Force convection condenser	Thermoacoustic
Fans and Fan Motor	
Evaporator fan and fan motor improvements	
Condenser fan and fan motor improvements	

DOE requested, but did not receive, any comments at either the framework workshop or during the framework comment period that identified additional technologies that DOE should consider. Likewise, DOE received no comments recommending additional technologies during the preliminary analysis or NOPR public meetings or comment periods.

As described in chapter 4 of the TSD, Screening Analysis, DOE screened out several of the technologies listed in Table IV.2 from consideration in this rulemaking based on one or more of the screening criteria described above. A summary of the screening analysis identifying technologies that were screened out and the EPCA criteria used for the screening is presented in Table IV.3. The checkmarks in the table indicate which screening criteria were used to screen out the listed technologies. For greater detail

[22] Available at: *http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/refrigerator_freezer_framework.pdf.*

regarding the screening analysis, see chapter 4 of the TSD.

Table IV.3 Summary of Screening Analysis

	EPCA Criteria for Screening			
Excluded Technology Option	Technological Feasibility	Practicability to Manufacture, Install, and service	Adverse Impacts on Product Utility	Adverse Impacts on Health and Safety
Improved Insulation Resistivity	✓			
Gas-Filled Panels	✓	✓		
Improved Gaskets, Double Gaskets, Improved Door Frame		✓	✓	
Linear Compressors	✓			
Improved Evaporator Heat Exchange	✓		✓	
Improved Condenser Heat Exchange	✓		✓	
Component Location		✓	✓	✓
Lorenz-Meutzner Cycle	✓	✓		
Two-Stage System	✓	✓		
Control Valve System and Tandem System	✓	✓		
Ejector Refrigerator	✓	✓		
Stirling Cycle	✓	✓		
Thermoelectric	✓	✓		
Thermoacoustic	✓	✓		

In addition to this screening, DOE did not analyze a number of technologies in the engineering analysis because they were judged unsuitable for improving the measured energy use of refrigeration products for one or more of the following reasons:

- Technology already used in baseline products and incapable of generating additional energy efficiency or reducing energy consumption;
- Technology does not reduce energy use; or
- Insufficient data available demonstrating benefit of the technology.

The technologies not analyzed for these reasons include Improved Expansion Valves, Off-Cycle Valves, Reduced Energy for Automatic Defrost, Condenser Hot Gas Defrost, Reduced Heat Load for TTD Feature, Warm Liquid or Hot Gas Refrigerant Anti-Sweat Heating, Electric Anti-Sweat Heater Sizing, Electronic Temperature Control, Air Distribution Control, Fan Blade Improvements, and Dual Loop System. Chapter 4 of the NOPR TSD discusses in greater detail the reasons for not analyzing these technologies.

1. Discussion of Comments

DOE discussed several screening issues in the NOPR. These issues are summarized, along with comments responding to the NOPR, in the sections below.

a. Compressors

DOE explained in the NOPR that the proprietary status of a technology is not a screening criterion. 75 FR at 59495 (September 27, 2010). However, DOE pointed out that selected technologies may be screened out if their proprietary status constrains their supply, and that DOE must consider ''the impact of any lessening of competition * * * that is likely to result from the imposition of the standard'' (42 U.S.C. 6295(o)(2)(B)(i)(V)). DOE indicated in the NOPR that it considered potential supply issues of high-efficiency single-speed and variable speed compressors, but concluded that the compressor performance levels analyzed would not likely be subject to significant supply constraints that would merit omitting the consideration of this particular design option. DOE requested comment on this position. Id.

Sub Zero commented that, as a smaller manufacturer, it may have more difficulty obtaining high-efficiency and variable speed compressors as compressor vendors ramp up to meet refrigeration product manufacturer demands in 2014. In its view, because of the proposed increased stringency of the standards, larger companies will demand many more of these compressors than they are currently using. (Sub Zero, No. 69 at p. 3) While it is difficult to predict the events that will occur up to the 2014 transition, DOE notes that it reached its tentative conclusion based on its NOPR phase investigation that indicated the compressor industry has been working to develop high efficiency and variable speed compressors for the residential refrigeration market for many years. (See, *e.g., http://www.panasonic.com/industrial/includes/pdf/invertercompressors-improvingefficiency.pdf,* a discussion of Panasonic's development of variable speed compressors, including initial introduction of variable speed compressors in refrigerators in 1996.) These efforts led DOE to believe that the refrigeration industry has had sufficient lead time to prepare for the possible increased demands for higher efficiency and variable speed compressors. Although the submitted comments reiterated the concerns of certain stakeholders, none contained information that would help justify altering the analysis DOE conducted regarding the projected supply of compressors available to manufacturers.

Whirlpool concurred with DOE's findings that availability of high-efficiency and variable-speed compressors will expand to meet demand, but indicated that prices might increase. (Whirlpool, No. 74 at p. 3) Whirlpool did not, however, provide any specific information about compressor prices that would allow DOE to accurately revise its analysis to address this comment. Accordingly, the analysis was not altered in this respect.

b. Alternative Refrigerants

Most refrigeration products sold in the U.S. currently use HFC–134a refrigerant, a hydrofluorocarbon (HFC) with a high global warming potential (GWP).

The NOPR described comments from several stakeholders made in response to the preliminary analysis. These comments indicated that the DOE analysis should acknowledge the widespread acceptance of hydrocarbon refrigerants in other parts of the world and the growing interest in their use in the U.S. *Id.* at 59496. The NOPR cited the ongoing consideration of these refrigerants for use in residential refrigerators, particularly isobutane, in Underwriters Laboratories' (UL's) ongoing revision of UL Standard 250, ''Household Refrigerators and Freezers'' (UL 250), and in the EPA's proposed rule (see 75 FR 25799 (May 10, 2010)) to add this refrigerant to its list of allowed substances under the Significant New Alternatives Policy (SNAP) program. DOE explained in the NOPR that the EPA proposal calls for a total charge limit of 57 g of isobutane. *Id.* at 25803 (May 10, 2010). Neither effort has been finalized at the time of the preparation of this notice.

The NOPR explained that DOE's consideration of isobutane refrigerant was based on the 57 g limit proposed by the EPA, and that this limit was sufficient to allow consideration of the use of isobutane refrigerant only for compact refrigerators, based on the refrigerant charge amounts of the reverse-engineered products. The preliminary analyses for compact refrigerators, which did not include isobutane refrigerant as a design option, were adjusted during the NOPR phase to include this design option. DOE acknowledged in the NOPR that multiple sealed systems could potentially be used in larger products without exceeding the charge limit per sealed system, but that it rejected this approach due to the potential reduction of consumer utility associated with the extra space that the additional sealed system would require. 75 FR at 59496–7 (September 27, 2010). DOE notes that the EPA's SNAP proposal did not clearly specify whether the 57 gram limit was intended to apply to each sealed system or each appliance. 75 FR at 25803 (May 10, 2010).

DOE requested comment on its approach in considering isobutane only for compact refrigerators.

Whirlpool commented that many compact and full-size refrigerators using hydrocarbon refrigerants are sold all over the world, but that the safety threshold in the U.S. is higher than many other countries. Whirlpool noted the possible tradeoffs of venting versus capturing and transporting flammable refrigerants—venting such refrigerants must be done with caution, but it alleviates the need for transport of flammable refrigerants, which may represent even greater risk, since many pounds of refrigerant captured from many products would be transported (as opposed to ounces that are in each individual product), and the duration of transport is much greater than the duration of the venting procedure. Capture and transport, however, avoid release of the refrigerant, thus limiting the small global warming impact of these refrigerants and avoiding concerns associated with volatile organic compound releases. Whirlpool suggested that DOE contact the Consumer Product Safety Commission and/or UL regarding the safety aspects related to the use of these refrigerants. (Whirlpool, No. 74 at p. 4) DOE's assessment of the use of isobutane did not extend to determination of the servicing approach. DOE notes that Section 608 of the Clean Air Act generally prohibits any person in the course of maintaining an appliance to knowingly vent refrigerants from that appliance. See generally, 42 U.S.C. 7671g. EPA regulations at 40 CFR part 82, subpart F, further clarify this prohibition and permit only de minimis releases where good faith attempts to recycle or recover refrigerants are made.

GE criticized DOE's approach. First, GE indicated that the UL standard and the EPA proposal are based on charge limits per sealed system, not per product, and that DOE did not fully consider the potential to use dual system designs to implement a switch to isobutane refrigerant. Second, GE commented that the lack of information regarding refrigeration product technologies using isobutane refrigerant stems to a large extent from the fact that this refrigerant currently is not allowed for use in these products. GE asserted that when the EPA SNAP approval is finalized, much more information will become available as products are commercialized. (GE, Public Meeting Transcript, No. 67 at pp. 60–61) In written comments, GE highlighted recent activities related to the introduction of isobutane products, including the EPA SNAP rulemaking and GE's own plans to start selling an isobutane product. It also mentioned that manufacturers will have to redesign products to use this new refrigerant, thus reiterating its view that assessing current products does not provide a complete picture of the potential use of isobutane. (GE, No. 76 at p. 2)

Sub Zero commented that some studies show that isobutane, when limited to a charge of 57 to 60 grams, is suitable for products up to 18 cubic feet in volume. Further, using multiple separate refrigeration systems, each limited to 57 to 60 grams, would allow the use of isobutane in many full-size products. Sub Zero also highlighted the current uncertainty about potential future regulation of HFC refrigerants and blowing agents, and suggested that the industry could potentially be compelled to use alternative substances by 2014, which would require significant additional capital investment. The company requested that DOE recognize in this rulemaking the possible impacts of new requirements for refrigerants and blowing agents on system efficiency and insulating performance when setting the standards. (Sub Zero, No. 69 at p. 4)

AHAM cited three issues with DOE's treatment of isobutane in the NOPR:

- There is a pending EPA Significant New Alternatives Policy (SNAP) decision that would approve hydrocarbons for household use and is expected to lead to sale of full-size refrigeration products in the U.S. that use isobutane refrigerant.
- DOE's review of the suitability of isobutane was based on review of existing products rather than future products.
- DOE concluded that the UL limit of 50 grams would apply to the entire product rather than to each refrigeration system of a product, thus overlooking the possibility that multiple systems could be used to produce full-size products using isobutane.

(AHAM, No. 73 at pp. 7–8)

In response, DOE agrees that a dual-system design would be an available option that could, depending on the SNAP rulemaking, permit manufacturers to use isobutane refrigerant within the limits of the UL standard and the anticipated EPA rule. DOE also acknowledges increased manufacturer interest in this approach, as exemplified by GE's stated intention to introduce such products as soon as the EPA rule is final (see, for example, GE's announcement for such a product as reported by Appliance Magazine on October 6, 2010, *http://www.appliancemagazine.com/news.php?article=1434814&zone=0&first=1,* GE Designs Isobutane Fridge for Smaller Dwellings, No. 82 at p. 1). DOE explained in the NOPR that consideration of the potential negative consumer utility impact of reduced internal volume was a key reason for not adopting isobutane refrigerant as a design option for the larger product classes. 75 FR at 59497 (September 27, 2010). Other considerations included the lack of information regarding (1) the possible emergence of new heat exchanger designs that would alleviate the need to consider dual system approaches and (2) the performance characteristics of low-charge designs using existing heater exchanger technology. As a result, although isobutane products may become available in the near future, considering the switch to isobutane refrigerant as a design option to reduce energy use could not be considered in the analysis, because of the consumer value concerns and the insufficient information regarding the energy savings characteristics and the costs of these potential new designs.

Moreover, DOE notes that because the parameters of whatever limits that EPA or UL may consider are not yet final, DOE is declining to speculate what these final limits might be. Without further information regarding the elements described above, DOE cannot ascertain the overall costs and benefits that could be reasonably ascribed to an isobutane refrigerant-based design. Accordingly, in evaluating the standards set by today's final rule, DOE is continuing to retain the basic approach laid out in its NOPR and related analyses.

c. Alternative Foam-Blowing Agents

DOE discussed in the NOPR the potential that legislation or newly enacted rules may restrict the use of HFC blowing agents in the future. DOE indicated that it was prepared to address this issue by evaluating the efficiency improvement and trial standard levels for products using alternative foam insulation materials, if such legislation or rules banning HFCs should be enacted or otherwise become effective. 75 FR at 59497 (September 27, 2010). As mentioned above, Sub Zero commented that DOE should recognize the potential impacts of restriction on HFC blowing agent usage in this rulemaking. (Sub Zero, No. 69 at p. 4) DOE recognizes that such restrictions may occur sometime in the future. However, as DOE explained in the NOPR, DOE believes that basing energy conservation standards on the uncertain prospect of passage of specific legislation would be speculative. Such restrictions have not emerged within the timeframe of the preparation of this final rule. Hence, DOE has not adjusted its analysis to account for this possibility.

d. Vacuum-Insulated Panels

The NOPR discussed DOE's assessment of the potential issues regarding VIP supply, longevity, durability, and quality that stakeholders raised during the preliminary analysis comment period. DOE concluded that potential issues surrounding this technology do not rise to a level justifying that it be screened out. DOE requested comment on this tentative conclusion in the NOPR. 75 FR at 59497–59500 (September 27, 2010). Sub Zero commented on this topic, reiterating concerns regarding availability, quality, and potential impact on warranty costs associated with the expected increase in VIP usage. (Sub Zero, No. 69 at p. 4) Whirlpool commented in a similar fashion, indicating that VIPs are not appropriate for improving efficiency in all situations, are subject to damage during shipment from the supplier and during installation, and expressing concern about the ability of VIP suppliers and the industry to ramp up demand sufficiently. However, the comments provided no new information or arguments that would impact DOE's conclusions regarding the viability of VIPs. Hence, DOE's final analysis continues to include VIPs as a design option.

2. Technologies Considered

DOE has concluded that: (1) All of the efficiency levels discussed in today's final rule are technologically feasible; (2) products at these efficiency levels could be manufactured, installed, and serviced on a scale needed to serve the relevant markets; (3) these efficiency levels would not force manufacturers to use technologies that would adversely affect product utility or availability; and (4) these efficiency levels would not adversely affect consumer health or safety. Thus, the efficiency levels that DOE analyzed and is discussing in this notice are all achievable using ''screened in'' technology options identified through the screening analysis. The technologies DOE considered for each group of products are shown in Table IV.4.

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IV.4 Technologies Considered by DOE for Residential Refrigeration Products, by Product Group

Design Option	Standard-Size Refrigerator-Freezers	Standard-Size Freezers	Compact Refrigerators	Compact Freezers
Increased Insulation Thickness		✓ (see Note 1)	✓	✓
Isobutane Refrigerant			✓	
VIPs	✓	✓	✓	✓
Improved Compressor Efficiency	✓	✓	✓	✓
Variable-Speed Compressor	✓	✓	✓	✓
Increased Evaporator Surface Area	✓	✓	✓	✓
Increased Condenser Surface Area	✓	✓	✓	✓
Forced Convection Condenser		✓		
Brushless DC Evaporator Fan	✓	✓		
Brushless DC Condenser Fan	✓	✓		
Adaptive Defrost	✓	✓		
Variable Anti-Sweat Heater Control	✓			

Note 1: Increased Insulation Thickness was not considered for built-in standard-size freezers.

Note 1: Increased Insulation Thickness was not considered for built-in standard-size freezers.

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C. Engineering Analysis

The engineering analysis uses cost-efficiency relationships to show the manufacturing cost increases associated with achieving increased efficiency. DOE has identified the following three methodologies to generate the manufacturing costs needed for the engineering analysis: (1) The design-option approach, which provides the incremental costs of adding design options to a baseline model that will improve its efficiency; (2) the efficiency-level approach, which provides the relative costs of achieving increases in energy efficiency levels, without regard to the particular design options used to achieve such increases; and (3) the cost-assessment (or reverse engineering) approach, which provides ''bottom-up'' manufacturing cost assessments for achieving various levels of increased efficiency, based on detailed data on costs for parts and material, labor, shipping/packaging, and investment for models that operate at particular efficiency levels.

DOE conducted the engineering analysis for this rulemaking using a combined efficiency level/design option/reverse engineering approach. DOE defined efficiency levels using percentages representing energy use reductions. The reductions were defined to apply to energy use (not including icemaking energy use) measured using the new test procedure. DOE's premise that efficiency levels expressed as a percentage of energy use lower than that of baseline products are equivalent when calculated based on both the current test procedure and the new test procedure (without icemaking energy use) allowed DOE to compare information developed from different sources. However, DOE's analysis is based on the efficiency improvements associated with groups of design options. DOE developed estimates for efficiency improvements for design options through energy use modeling analysis conducted for selected reverse-engineered products. The energy models were first established based on the existing product designs and the models were subsequently adjusted to reflect application of the groups of design options considered for analysis. DOE based some of the design option information on data gained through reverse-engineering analysis, but also used other sources, such as component vendor inquiries and discussions with manufacturers as appropriate. Details of the engineering analysis are provided in the NOPR TSD chapter 5.

In the NOPR, DOE addressed preliminary analysis comments regarding the engineering analysis. DOE explained the selection of product classes for detailed analysis, adjustment of the analyses based on new information collected in preparation of the NOPR, development of the baseline energy use equations representing baseline product energy use using the new energy test procedure (less automatic icemaking energy use), the approach used to adjust the slopes of some of these equations, the range of efficiency levels considered, treatment of design options in the analyses, development of cost-efficiency curves, and the development of standards for low-volume product classes. 75 FR at 59500–59508 (September 27, 2010).

1. Discussion of Comments

DOE requested comments and information on the following topics in the NOPR:

(1) The approach used to adjust the slopes of the baseline energy use equations of some product classes. Id. at 59505.

(2) The treatment of design options in the engineering analysis. Id. at 59507.

(3) Information that would help improve the ERA energy use model used for the engineering analysis. Id. at 59507.

Whirlpool commented that analyzing design options is an appropriate means of assessing technological capability, but that DOE should establish minimum efficiency standards without specifying particular design options to use. In its view, this approach would permit manufacturers the freedom to develop products in a fashion which they believe best meets the needs of consumers. (Whirlpool, No. 74 at p. 5) DOE notes that the standards are expressed in terms of maximum energy use and do not specify the use of particular design options in satisfying these standards.

DOE received no additional comments on these topics. Consequently, in the absence of any other comments, DOE has not adjusted its engineering analysis for the final rule.

2. Adjustment of the Baseline Energy Use Equations

Comments addressing adjustment of the standard to account for test procedure changes (the ''crosswalk'') are discussed in section III.A.2 above. As part of the engineering analysis, DOE adjusted the energy standard equations to address the modifications to the test procedures. DOE initially made such adjustments during the preliminary analysis based on consideration of the anticipated compartment temperature and volume calculation method changes. DOE used an approach to account for the test procedure changes that involved developing energy use equations representing baseline products based on testing under the new test procedures. Baseline products are those that are minimally compliant under the current energy standard when tested using the current test procedure. The initial baseline energy use equations are presented in the preliminary TSD in Chapter 5, ''Engineering Analysis'' in section 5.4.2. The efficiency levels examined in this rulemaking are represented as percentages of energy use reductions from the energy use of baseline products. Hence, the efficiency levels expressed in terms of the new test procedures are equal to these same percentage reductions applied to the baseline energy use equations.

Based on the comments responding to the preliminary analysis, as well as the additional information DOE obtained during the NOPR phase, DOE adjusted the baseline energy use equations for three product classes. These changes corrected the low slope of the maximum energy use equation of the current energy standards for product classes 4 (refrigerator-freezers—automatic defrost with side-mounted freezer without through-the-door ice service), 5 (refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service), and 5A (refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service). See the NOPR TSD, Chapter 5, section 5.4.2.4. The NOPR-phase adjusted baseline energy use equations are presented in the NOPR TSD in Chapter 5, in section 5.4.2.

Stakeholder comments recommending further adjustment to the baseline energy use equations to address test procedure changes are discussed in section III.A.2 above. These comments addressed both (1) extrapolating the analysis to product classes for which DOE did not have relevant test data for the crosswalk associated with compartment temperature changes and volume calculation method changes, and (2) measurement changes, including other test procedure changes that were not captured in the NOPR crosswalk. As discussed in section III.A.2, DOE has made adjustments to account for two of these additional test procedure changes—those changes that capture precooling energy use and that address the testing for products with heater-based temperature control for special compartments. The analysis to implement these changes is discussed below.

Special Compartments With Heater-Based Control

During the NOPR public meeting, DOE requested information regarding heater-based control systems used to control the temperatures of special compartments. DOE sought this information to help it better understand and evaluate the energy use impact of these features and the manner in which the new (then proposed) test procedure may change the measured energy use of products having such compartments. DOE received no information. In the absence of any information, DOE developed an analysis to help represent the energy use of these compartments, including the change in measured energy use associated with the new test procedure. The calculated energy use impact was multiplied by the percentages of products that are believed to have such features in each of the applicable product classes to develop average impacts associated with the test procedure amendments. The determination of the prevalence of products with these features is discussed in section 0 above.

The analysis describing the change in energy use for a product with a heated special compartment is described in the TSD in Chapter 5, ''Engineering Analysis,'' (Section 5.4.2.6). DOE conducted this analysis for a baseline-efficiency refrigerator-freezer with automatic defrost and a bottom-mounted freezer with a total capacity of 25 cubic feet. The baseline energy use for this product is 733 kWh per year, excluding icemaking energy use. This value was calculated using the baseline energy use equation for product class 5 as presented in Table 5.4.12 of the NOPR TSD. The special compartment was assumed to be located at the bottom of the fresh food compartment and to be 20 inches deep, 32 inches wide, and 4 inches high. (These dimensions were based on one of the reverse engineered products evaluated by DOE during the engineering analysis. This product had a special compartment (without heater-based control) at the bottom of the fresh food compartment of roughly the selected dimensions.)

The analysis determined the energy use for the product when tested both with the special compartment set for its coldest temperature and with the compartment set at its warmest temperature (selected as 28 °F and 42 °F, respectively, consistent with the widest range identified for special compartment temperature control for the product (see Use and Care Guide Electrolux 242046401, No. 80 at p. 18)), with the fresh food and freezer compartments operating at 39 °F and 0 °F, respectively. The influences on the compartment temperature that DOE considered in the analysis include (1) the 39 °F fresh food compartment air surrounding the top, sides, back, and front of this special compartment, transferring heat through the 3⁄16-inch plastic compartment wall, and the air film thermal resistances outside and inside the special compartment, (2) the air near the top of the freezer compartment, at an average temperature of −5 °F (at 0 °F when the compressor is not operating, and at −10 °F when the compressor is operating and the evaporator discharge air blows forward along the underside of the mullion, and assuming a 50 percent compressor run time), transferring heat from the special compartment through the special compartment's bottom surface, the 1.5-inch thick mullion, and through four air films surrounding the compartment bottom and the mullion, (3) −10 °F evaporator discharge air diverted to the special compartment, if needed to maintain a low temperature, and (4) electric resistive heating, if needed to maintain a high temperature. At the 28 °F setting for the special compartment, a small amount of evaporator discharge air (less than 1 cubic foot per minute) is needed to maintain the compartment temperature, while a heater input of 5.8 W is needed to maintain the 42 °F setting. DOE calculated the additional system energy use associated with removing the 5.8 W of heat input by assuming that the system efficiency is 5 Btu/h-W, which represents a system with a compressor with an Energy Efficiency Ratio (EER) rating of 5.5 and some additional evaporator and condenser fan power input. As described in the TSD, Chapter 5, section 5.84, standard-size baseline refrigerator-freezers typically use compressors with an EER in the range 5.0 to 5.5. DOE used the high end of this range for the estimate, recognizing that a shipment-weighted average EER would also include higher-efficiency compressors.

The calculated energy use impact of the test procedure change (measurement with the special compartment set at its coldest temperature, as is done under the current test procedure, as compared with an average of tests with the special compartment setting in the coldest position for one test and in the warmest position for the second test) is 43 kWh, a 5.9 percent energy use increase. As discussed above in section III.A.2, DOE has conducted testing for two products that have heated special compartments. The average measured impact of the test procedure change for these productss was 4.1 percent, suggesting that the calculated 5.9 percent impact is conservative. DOE chose to use the more conservative 5.9 percent impact in adjusting the energy conservation standards due to the uncertainty associated with the small data sample and the EPCA requirements prohibiting upward adjustment of maximum allowable energy use after such a standard has been set. See 42 U.S.C. 6295(o)(1).

As discussed in section III.A.2, DOE assumed that this energy use impact applies to the percentage of products of applicable product classes which currently have such features. Hence, applying the calculated measurement impact to the product model percentages of 10.6 percent (determination of this value was discussed in section III.A.2) for current product class 5A (refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service), 1.5 percent for current product class 5 (refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service), and 0.7 percent for current product class 7 (refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service) results in average impacts for these product classes equal to 0.62 percent for product class 5A, 0.088 percent for product class 5, and 0.041 percent for product class 7.

Precooling

DOE conducted energy tests of nine standard-size refrigerator-freezers during the engineering analysis. Two of these products exhibited precooling. The increase in measured energy use for these products when using the modified approach that includes precooling energy use was 2.3 percent for one product and 1.7 percent for the other. (See docket documents Precooling Product 1 and Precooling Product 2, Nos. 82.1 and 82.2). DOE has adopted an average impact of 2 percent based on these measurements. DOE calculated the shipment-weighted average energy use impact of precooling using this value and the observed frequency of precooling as follows: 2% × (2⁄9) = 0.44%. DOE applied this adjustment to all standard-size refrigerator-freezers with automatic defrost.

Combined Impact

To combine the impact of the two test procedure adjustments, DOE multiplied the factors representing their impact. For example, for product class 5A: 1. 0062 × 1.0044 = 1. 0106.[23] This approach addresses the need to consider the compounding of the impact inherent in multiple influences, similar to the compounding of interest in finance. DOE used similar calculations for other product classes for which one or both of the test-procedure-based adjustments to the standard apply. These adjustments are reflected in the table showing the final baseline energy use equations in the TSD, Chapter 5, Table 5.4.14. The final energy standards are based on applying the percentage energy use reductions to these adjusted baseline energy use equations.

D. Markups To Determine Product Cost

The markups analysis develops appropriate markups in the distribution chain to convert the manufacturer cost estimates derived in the engineering analysis to consumer prices. DOE determined the distribution channels for refrigeration products and the markups associated with the main parties in the distribution chain, manufacturers and retailers. DOE developed an average manufacturer markup by examining the annual Securities and Exchange Commission (SEC) 10–K reports filed by four publicly-traded manufacturers primarily engaged in appliance manufacturing and whose combined product range includes residential refrigeration products. For retailers, DOE developed separate markups for baseline products (baseline markups) and for the incremental cost of more-efficient products (incremental markups). Incremental markups are coefficients that relate the change in the manufacturer sales price of higher-efficiency models to the change in the retailer sales price.

In response to comments that were received on the preliminary analysis, DOE extensively reviewed its incremental markup approach in the NOPR. Among the tasks DOE performed included assembling and analyzing relevant data from other retail sectors. DOE found that empirical evidence is lacking with respect to appliance retailer markup practices when a product increases in cost (due to

[23] Note that multiplying a number by 1.000062 is equivalent to increasing it by 0.62%. Hence, the 1.0062 factor represents the adjustment to the energy use equation associated with the 0. 62% increase to account for the heated special compartment shipment-weighted average measurement change for product class 5A. Similarly, the 1.0044 factor represents the 0.44% adjustment for the precooling shipment-weighted average measurement change. The resulting factor, 1.0106, means that the energy use equation is increased 1.06%.

increased efficiency or other factors). DOE understands that real-world retailer markup practices vary depending on market conditions and on the magnitude of the change in cost of goods sold (CGS) associated with an increase in appliance efficiency.

Given this uncertainty with respect to actual markup practices in appliance retailing, DOE uses an approach that reflects two key concepts. First, changes in the efficiency of the appliances sold are not expected to increase economic profits. Thus, DOE calculates markups/gross margins to allow cost recovery for retailers (including changes in the cost of capital) without changes in company profits. Second, efficiency improvements only impact some distribution costs. DOE sets markups to cover only the variable costs expected to change with efficiency.

DOE's separation of operating expenses into fixed and variable components to estimate an incremental markup follows from the above concepts. DOE defines fixed expenses as including labor and occupancy expenses because these costs are not likely to increase as a result of a rise in CGS due to amended efficiency standards. All other expenses, as well as the net profit, are assumed to vary in proportion to the change in CGS. DOE acknowledges that its allocation of expenses into fixed and variable categories is based largely on limited information and sought additional information from interested parties to help refine its allocation approach during the NOPR phase. DOE's method results in an outcome in which retailers are assumed to cover their costs while maintaining their profit margins when the CGS of appliances changes.

As part of its review, DOE developed a new breakdown into fixed and variable components using the latest expense data provided by the U.S. Census for Electronics and Appliance Stores, which cover 2002. The newly-derived incremental markup, which would be applied to an incremental change in CGS, is 1.17, which is slightly higher than the value of 1.15 that DOE used in the preliminary analysis. DOE requested information regarding the likely retailer responses to incremental changes in the CGS of appliances associated with the proposed standards. Whirlpool stated that it would not expect retailers to accept reduced margins as a result of higher costing, more efficient products, and asserted that most major retailers are publicly traded companies whose stockholders demand consistent (or increasing) margins (Whirlpool, No. 74 at p. 5) No information or other comments were received addressing this issue. Given the lack of quantitative information, DOE has decided to continue to apply an incremental markup to the incremental MSP of products with higher efficiency than the baseline products. Chapter 6 of the final rule TSD provides a description of both the method and its current application.

E. Energy Use Analysis

DOE's analysis of the energy use of refrigeration products estimated the annual energy use of products in the field that would meet the considered efficiency levels, *i.e.,* as they are actually used by consumers. The energy use analysis provides the basis for other analyses DOE performs, particularly assessments of the energy-savings and the savings in consumer operating costs that could result from DOE's adoption of amended standard levels. In contrast to the DOE test procedure, which provides standardized results that can serve as the basis for comparing the performance of different appliances used under the same conditions, the energy use analysis seeks to capture the range of operating conditions for refrigeration products in U.S. homes.

To determine the field energy use of products that would meet possible amended standard levels, DOE used data from the Energy Information Administration (EIA)'s 2005 Residential Energy Consumption Survey (RECS), which was the most recent such survey available at the time of DOE's analysis.[24] RECS is a national sample survey of housing units that collects statistical information on the consumption of, and expenditures for, energy in housing units along with data on energy-related characteristics of the housing units and occupants. RECS provides sufficient information to establish the type (product class) of refrigeration product used in each household, and also provides an estimate of the household's energy consumption attributable to ''refrigerators'' or ''freezers''. As a result, DOE was able to develop household samples for the representative product classes for standard-size units. DOE did not use RECS for compact refrigerators and freezers because a large fraction of these products are used outside the residential sector. Instead, it based the energy use for these products on the DOE test procedure.

DOE believes that, in general, using RECS data in the estimation of field energy use of refrigeration products is valid. However, it acknowledges that the approach used in the preliminary analysis has limits. To compensate for these limits, DOE developed a new approach for the NOPR to estimate energy use of refrigeration products in U.S. homes. This approach involved collecting field-metered electricity use data for residential refrigeration products. Details of this approach and the engineering assumptions that DOE used to estimate energy use of refrigeration products in U.S. homes were described in chapter 7 of the NOPR TSD. DOE sought comment on its approach for developing energy use estimates using field-metered data. 75 FR at 59512 (September 27, 2010).

Commenting on the NOPR TSD, AHAM stated that DOE should rely on the test procedure, rather than RECS data, for determining energy use, but offered no reason or data. (AHAM, Public Meeting Transcript, No. 67 at p. 78).

As discussed in section IV.E of the NOPR (75 FR at 59510 (September 27, 2010)), test procedures must be reasonably designed to produce test results which measure energy efficiency, energy use or estimated annual operating cost of a covered product during a representative average use cycle or period of use. (42 U.S.C. 6293(b)(3)) Relying solely on a representative average use cycle or period of use does not provide an accurate measure of the possible energy savings since this approach inadequately evaluates the economic impact of the standard on consumers and the savings in operating costs throughout the estimated life of the product—two factors under EPCA that DOE must consider when promulgating an amended energy conservation standard. Further, the approach suggested by AHAM would not account for the variability stemming from household differences or be consistent with the above-cited guidance contained in 10 CFR part 430, subpart C, appendix A. In contrast, the approach that DOE has used in residential product rulemakings for over a decade, and continues to apply here, accounts for all of these factors.

Sub Zero and AHAM also indicated that more comprehensive field data be collected, including data on ice usage and icemaker energy consumption, for use in future rulemakings (Sub Zero, No. 69 at pp. 4–5; AHAM, No. 73 at p. 8). DOE has retained the approach detailed in the NOPR for the final rule. In future rulemakings, DOE may evaluate the appropriateness of collecting additional field data as suggested by these commenters.

In order to make the 2005 RECS sample more representative of current

[24] For information on RECS, see *http://www.eia.doe.gov/emeu/recs/.*

refrigeration products, DOE made two modifications for the NOPR analysis. First, DOE modified the RECS weights for top- vs. bottom-mount refrigerators in order to reflect current information on the relationship between income and refrigerator door style (*i.e.,* top- or bottom-mount) provided by AHAM in 2010. Second, DOE examined recent data from three sources [25] to scale the average interior volume of standard-size refrigerator-freezers from the 2005 RECS data. DOE requested comments on the weighting of the RECS sample using income relationships and volume scaling.

Whirlpool supported efforts to re-weight the RECS data to better reflect income and volume; however, it reiterated its previously stated reservations regarding the outdated nature of RECS. (Whirlpool, No. 74 at p. 5) AHAM did not view the weighting of the RECS sample as having meaningfully contributed to the proposed levels, and as a result, did not comment on these approaches. Instead, it emphasized that the lack of comment on its part did not signify agreement with the approaches. (AHAM, No. 73 at p. 8)

Given the value of continuing to apply the RECS-based approach, the analysis modifications to address the limits of the RECS data, and the analysis DOE performed using updated data from AHAM and other sources, DOE believes that this approach sufficiently accounts for the full range of estimated energy savings experienced by households. Accordingly, DOE has retained its above-described approach for the final rule. However, DOE did revise its usage adjustment factor (UAF) formulas, which raised the average UAF by 6 to 14 percent, depending on the product class. The revision is described in chapter 7 of the final rule TSD.

F. Life-Cycle Cost and Payback Period Analyses

DOE conducted LCC and PBP analyses to evaluate the economic impacts on individual consumers of potential energy conservation standards for refrigeration products. The LCC is the total consumer expense over the life of a product, consisting of purchase and installation costs plus operating costs (expenses for energy use, maintenance and repair). To compute the operating costs, DOE discounts future operating costs to the time of purchase and sums them over the lifetime of the product. The PBP is the estimated amount of time (in years) it takes consumers to recover the increased purchase cost (including installation) of a more efficient product through lower operating costs. DOE calculates the PBP by dividing the change in purchase cost (normally higher) due to a more stringent standard by the change in average annual operating cost (normally lower) that results from the standard.

For any given efficiency level, DOE measures the PBP and the change in LCC relative to an estimate of the base-case appliance efficiency levels. The base-case estimate reflects the market in the absence of amended energy conservation standards, including the market for products that exceed the current energy conservation standards.

For each considered efficiency level in each product class, DOE calculated the LCC and PBP for a nationally representative set of housing units. For both the NOPR and final rule analyses, DOE developed household samples from the 2005 RECS. For each sampled household, DOE determined the energy consumption for the refrigeration product and the electricity price. By developing a representative sample of households, the analysis captured the variability in energy consumption and energy prices associated with the use of residential refrigeration products.

Inputs to the calculation of total installed cost include the cost of the product—which includes manufacturer selling prices, retailer markups, and sales taxes—and installation costs. Inputs to the calculation of operating costs include annual energy consumption, energy prices and price projections, repair and maintenance costs, product lifetimes, discount rates, and the year that amended standards take effect. DOE determined the operating costs for each sampled household using that household's unique energy consumption and the household's energy price. DOE created distributions of values for some inputs, with probabilities attached to each value, to account for their uncertainty and variability. DOE used probability distributions to characterize product lifetime, discount rates, and sales taxes.

The computer model DOE uses to calculate the LCC and PBP, which incorporates Crystal Ball (a commercially available software program), relies on a Monte Carlo simulation to incorporate uncertainty and variability into the analysis. The Monte Carlo simulations randomly sample input values from the probability distributions and household samples. The model calculated the LCC and PBP for products at each efficiency level for 10,000 housing units per simulation run. Details of the spreadsheet model, and of all the inputs to the LCC and PBP analyses, are contained in the final rule TSD chapter 8 and its appendices.

Table IV.5 summarizes the approach and data DOE used to derive inputs to the LCC and PBP calculations. The table provides the data and approach DOE used for the NOPR TSD, as well as the changes made for today's final rule. The subsections that follow discuss the initial inputs and the changes DOE made to them. Unless otherwise specified, DOE received no comments on these inputs.

TABLE IV.5—SUMMARY OF INPUTS AND KEY ASSUMPTIONS IN THE LCC AND PBP ANALYSIS *

Inputs	NOPR	Changes for the final rule
	Installed Costs	
Product Cost	Derived by multiplying manufacturer cost by manufacturer and retailer markups and sales tax, as appropriate.	Applied a price trend to estimate equipment prices in 2014.

[25] California Energy Commission, Appliances Database—Refrigeration, 1998–2009. *http://www.energy.ca.gov/appliances/database/excel_based_files/Refrigeration/* (Last accessed April 25, 2009); The NPD Group, Inc., The NPD Group/NPD Houseworld—POS, Refrigerators, January–December 2008, 2007–2008, Port Washington, NY; and Association of Home Appliance Manufacturers, data from 2005–2008, memoranda dated January 19, 2009 and March 26, 2010, Washington, DC.

TABLE IV.5—SUMMARY OF INPUTS AND KEY ASSUMPTIONS IN THE LCC AND PBP ANALYSIS *—Continued

Inputs	NOPR	Changes for the final rule
Operating Costs		
Annual Energy Use	Based on a multiple linear regression of field-metered energy use data, adjusted using a UAF function based on 2005 RECS household characteristics.	Revised UAF function, raising average UAF values by 6 to 14 percent, depending on product class.
Energy Prices	Electricity: Based on EIA's Form 861 data for 2007. Variability: Regional energy prices determined for 13 regions.	No change.
Energy Price Trends	Forecasted using Annual Energy Outlook 2010 (*AEO2010*).	No change.
Repair and Maintenance Costs	Used repair cost estimation method that estimates the rate of failure for selected components along with the incremental cost of repair or replacement compared to the baseline product.	No change.
Present Value of Operating Cost Savings		
Product Lifetime	Estimated using survey results from RECS (1990, 1993, 1997, 2001, 2005) and the U.S. Census American Housing Survey (2005, 2007), along with historic data on appliance shipments. Variability: Characterized using Weibull probability distributions.	No change.
Discount Rates	Approach involves identifying all possible debt or asset classes that might be used to purchase the considered appliances, or might be affected indirectly. Primary data source was the Federal Reserve Board's SCF ** for 1989, 1992, 1995, 1998, 2001, 2004 and 2007.	No change.
Compliance Date of New Standard	2014	No change.

* References for the data sources mentioned in this table are provided in the sections following the table or in chapter 8 of the TSD.
** Survey of Consumer Finances.

1. Product Cost

To calculate consumer product costs, DOE multiplied the manufacturer selling prices developed in the engineering analysis by the supply-chain markups described in section IV.E (along with sales taxes). DOE used different retail markups for baseline products and higher-efficiency products because DOE applies an incremental markup to the MSP increase associated with higher-efficiency products.

In the NOPR analysis, DOE assumed that the manufacturer selling prices and retail prices of products meeting various efficiency levels remain fixed, in real terms, after 2010 (the year for which the engineering analysis estimated costs) and throughout the analysis period. Subsequently, examination of historical price data for various appliances and equipment indicates that the assumption of constant real prices and costs may, in many cases, over-estimate long-term appliance and equipment price trends. Economic literature and historical data suggest that the real costs of these products may in fact trend downward over time, partially because of ''learning'' or ''experience.''[26]

In light of the historical data and DOE's aim to improve the accuracy and robustness of its analyses, on February 22, 2011, DOE published a notice that discussed the approach it was considering to use to incorporate experience in its forecasts of product prices. 76 FR 9696. DOE requested public comment on the potential inclusion of this approach for its future rulemaking activities, as well as on the merits of adopting this approach within the context of its ongoing rulemaking to set standards for refrigeration products.

DOE received a number of comments on the merits of incorporating experience in its forecasts of product prices. Support for the inclusion of experience in appliance standards rulemakings was expressed by NEEP, NCLC, ACEEE, ASAP, NRDC, CFA, NEEA, and the IOUs.[27] (NEEP, No. 107 at p. 2; NCLC, No. 100 at pp. 1–2; ACEEE, No. 109 at p. 1; ASAP, No. 108 at p. 1; NRDC, No. 104 at p. 2; CFA, No. 105 at p. 2; NEEA, No. 101 at p. 4; IOUs, No. 111 and 112 at p. 1) The IOUs, ASAP, NRDC, and CFA specifically noted that incorporation of an experience curve would align with other analyses that contribute to analysis of appliance standards, such as the approach used in NEMS. (IOUs, No. 111 and 112 at p. 1; ASAP, No. 108 at p. 2; NRDC, No. 104 at p. 4; CFA, No. 105 at p. 4) ASAP and NRDC included as part of their comments an appendix that found that the model described in the NODA offers appropriate methodology. (ASAP, No. 108 at p. 10; NRDC, No. 104 at p. 5)

DOE also received a number of comments expressing opposition to, or

[26] A draft paper, ''Using the Experience Curve Approach for Appliance Price Forecasting,'' posted on the DOE Web site at *http://www.eere.energy.gov/buildings/appliance_standards*, provides a summary of the data and literature currently available to DOE that is relevant to price forecasts for selected appliances and equipment.

[27] Pacific Gas and Electric Company, Southern California Gas Company, and San Diego Gas and Electric submitted a joint letter, while Southern California Edison submitted an identical letter; comments from these letters are referred to as made by IOUs.

concern with, the proposed incorporation of experience into forecasts of product prices. (AHAM, No. 113 at p. 1; AHRI, No. 106 at p. 2; EEI, No. 102 at pp. 2–5; SC, No. 110 at p. 1) The American Gas Association (AGA) criticized the use of experience curves, stating that the current approach offers better opportunities to transparently assess costs. (AGA, No. 115 at p. 2) Traulsen, a manufacturer of commercial refrigerators, contended that a price decrease for technology over time only holds true if market forces prevail. (Traulsen, No. 99 at p. 3)

The comments that expressed opposition or reservation regarding application of the experience curve approach cited several factors. Ingersoll Rand noted that the experience curve is at best a heuristic model, and it urged more extensive examination of several points related to experience curves. (Ingersoll Rand, No. 103 at p. 2) AHAM and AHRI noted that experience curves apply only to specific products or companies and should not be inflated to industry wide cases. (AHAM, No. 113 at pp. 53–54; AHRI, No. 106 at p. 2) AGA noted that experience curves could be useful for some DOE regulated products at the early stages of development and commercialization, but would not be relevant to a wide range of equipment with mature designs and markets, including space heating and water heating. (AGA, No. 115 at p. 2) Similarly, AHAM stated that the experience curve came from early-stage industries, and at current cost reduction rates is not reliable enough to apply in mature industries with large cumulative production. (AHAM, No. 113 at p. 54) AHRI and SC noted that past performance does not necessarily indicate future performance, as past trends may have reached a plateau. (AHRI, No. 106 at pp. 2–3; SC, No. 110 at p. 2) DOE's proposed approach used experience curves that reflect broad industry-wide changes resulting from many factors. The historical data over lengthy periods (not only early-stage industries) suggest that experience curves are mathematically applicable to mature products as well as newer products. The historic decline in inflation-adjusted PPI of household appliances has slowed since 2000, but there is no evidence of a plateau.

AHAM and AHRI opposed DOE's analysis using prices, when experience or experience curves are actually based on cost. (AHAM, No. 113 at p. 55; AHRI, No. 106 at p. 3) Ingersoll Rand stated that while variable manufacturing costs may assume an experience curve, fixed costs and retail price do not. (Ingersoll Rand, No. 103 at p. 2) EEI stated that the primary cause of experience is outsourcing, so the domestic Producer Price Index (PPI) should not be used when a significant fraction of manufacturers are overseas. (EEI, No. 102 at pp. 3–5) In response, DOE acknowledges that the literature generally approaches these effects through the costs of production and that the price of the relevant good will not reflect learning as directly as the costs. This is because the price is a reflection of market conditions. Nevertheless, DOE notes that experience curves can be based on either cost or price, and that the historical data in the case of refrigerators show that real price declines occurred well before outsourcing became a significant factor in manufacturing. DOE does not attempt to forecast the impact of future outsourcing of production in its forecasts of appliance manufacturing costs.

SC noted that the PPI incorporates a performance correction so it would not reflect a true price change. (SC, No. 110 at p. 4) EEI stated that refrigerators and freezers have undergone significant changes over the years in terms of types and features and DOE did not explain how they accounted for this. (EEI, No. 102 at pp. 2–3) Ingersoll Rand stated that product performance has changed dramatically over many years, and therefore it is unclear what the PPI is actually measuring. (Ingersoll Rand, No. 103 at p. 4) In response, DOE notes that the PPI includes a quality adjustment, which attempts to factor out physical changes in the product that affect the price.[28] For that reason, the PPI is a better measure of the trends in prices than actual wholesale prices would be without quality adjustment.

DOE also received several comments related to forecasting error and the time period of the data used. Ingersoll Rand urged consideration of the expanding uncertainty band as the forecast period expands, and AHAM also noted that error in forecasts increases with time. (Ingersoll Rand, No. 103 at p. 1; AHAM, No. 113 at pp. 59–62) EEI stated that for refrigerators, the starting period used by DOE corresponds to a unique, post-war boom. (EEI, No. 102 at p. 2) SC stated that the choice of time period for PPI changes results. (SC, No. 110 at p. 4) In response to these comments, DOE conducted a sensitivity analysis that considers different time periods for estimating product price trends. DOE also notes that potentially growing forecast error is diminished by the discounting used in DOE's analysis.

AHRI and Ingersoll Rand expressed concern related to products that use significant quantities of commodities, as these prices have been volatile and cannot be predicted. (AHRI, No. 106 at p. 3; Ingersoll Rand, No. 103 at pp. 5–6) DOE will rely on historical data to determine whether commodity price volatility is a concern when estimating experience curves for specific products.

Some of the parties generally supporting DOE's proposed approach to incorporating experience into price forecasting for appliance standards requested specific changes to the proposed approach. ACEEE, NEEA, ASAP, NRDC, and the IOUs expressed concern with the proposal to assume no experience curve in cases with limited or no data; instead they recommended using scenarios or running sensitivity analyses to examine a range of experience rates. (ACEEE, No. 109 at p. 1; NEEA, No. 101 at p. 5; ASAP, No. 108 at p. 3; NRDC, No. 104. at p. 5; IOUs, No. 111 and 112 at p. 2) EEI expressed agreement with the IOUs with respect to running sensitivity analyses. (EEI Supplemental Comments, No. 116 at p. 2) ASAP and NRDC also requested that, where possible, DOE should attempt to analyze the more efficient models of certain products separately from the baseline models. (ASAP, No. 108 at p. 27; NRDC, No. 104 at p. 31) Similarly, the IOUs suggested that separate experience coefficients should be used for the base case and the standards case. (IOUs, No. 111 and 112 at p. 2) In cases with limited or no data, DOE is considering using data at a higher level of aggregation to estimate future product prices. DOE's approach in future rulemakings will be based on available data. At this time DOE is not aware of data sufficient to separately analyze baseline models and efficient models.

In conclusion, DOE evaluated the concerns expressed about its proposed approach for incorporating experience in its forecasts of product prices and determined that retaining an assumption-based approach of a constant real price trend was not consistent with the historical data for the products covered in this rule. In its stead, DOE developed a range of potential price trends that was consistent with the available data. For the default price trend for this final rule, DOE estimated an experience rate for residential refrigerators and freezers based on an analysis of long-term historical data. DOE derived a refrigerator/freezer price index from 1947 to 2010 by creating a hybrid index that changed proportional to PPI data

[28] See the Bureau of Labor Statistics' Handbook of Methods (Chapter 14: Producer Prices). *http://www.bls.gov/opub/hom/homch14.htm.*

for the period when PPI data were available, and changed proportional to the relevant CPI data for the period where CPI data were available. DOE then divided the results by the GDP deflator for the relevant year to produce an inflation-adjusted index. This proxy for historic price data was then regressed on the quantity of refrigerators and freezers produced: a corresponding series for total shipments of refrigerators and freezers.

To calculate an experience rate, a least-squares power-law fit was performed on the refrigerator/freezer price index versus cumulative shipments. DOE then derived an index, with 2010 equal to 1, to forecast prices (using PPI and CPI data as proxies) in 2014, the compliance date for amended energy conservation standards in the LCC and PBP analysis, and for the NIA, for each subsequent year through 2043. The index value in each year is a function of the experience rate and the cumulative production through that year. Projected shipments were obtained from the base case projections made for the NIA (see section IV.G.1 of this notice). The average annual rate of price decline in the default case is 1.87 percent. DOE applied the same index value to forecast prices for each group of refrigeration products at each considered efficiency level.

DOE notes that experience rates may decrease over time since returns from experience about a single technology may diminish over time. As part of its sensitivity analysis, DOE included models that derive an experience rate based on different time periods, which may reflect such a ''flattening'' of the experience curve across time, as well as a model with an explicit term that incorporates ''flattening.'' These models usually incorporate the decrease in learning through a variable representing time. DOE includes in the suite of modeling results for learning in this analysis models that do and do not reflect such a ''flattening'' of learning across time; however, the models near the middle range of estimates in its analysis do reflect this effect. DOE will continue to explore the basis and the appropriateness of incorporating for compounding changing learning effects for future rulemaking analyses.

For the NIA, DOE also analyzed two sensitivity cases that use a price trend based on an exponential in time extrapolation of refrigeration equipment PPI data. Because cumulative shipments for refrigerators can be fit to an exponential function of time for long time periods, the experience curve formulation and an exponential in time extrapolation of PPI data provide mathematically very similar price trend forecasts in many cases. In addition to the default price trend, the NIA considered a high price decline case and a low price decline case. See section IV.G.3 for further discussion.

In recognition of the uncertainty regarding estimation of the future product price trends, DOE will continue to review the relevant literature and seek to continually improve and refine its methodology through research, enhancements to its models and by seeking public input. DOE will also work to ensure the robustness of its data sets as a means to ensure the reliability of its projections.

For further information on the method and data sources used to develop price trends for residential refrigeration products, see appendix 8E of the final rule TSD.

2. Installation Cost

Installation cost includes labor, overhead, and any miscellaneous materials and parts needed to install the equipment. DOE did not include an installation cost for refrigeration products because it understands that this cost would be the same at all of the considered efficiency levels.

3. Annual Energy Consumption

For each sampled household, DOE determined the energy consumption for a refrigeration product at different efficiency levels using the approach described above in section IV.E.

4. Energy Prices

DOE derived average energy prices for 13 geographic areas consisting of the nine U.S. Census divisions, with four large States (New York, Florida, Texas, and California) treated separately. For Census divisions containing one of these large States, DOE calculated the regional average excluding the data for the large State.

DOE estimated average residential electricity prices for each of the 13 geographic areas based on data from EIA Form 861, ''Annual Electric Power Industry Database.'' DOE calculated an average annual regional residential electricity price by: (1) Estimating an average residential price for each utility (by dividing the residential revenues by residential sales); and (2) weighting each utility by the number of residential consumers served in that region (based on EIA Form 861). DOE calculated average commercial electricity prices in a similar manner. For both the NOPR and final rule analyses, DOE used EIA data for 2007.

5. Energy Price Projections

To estimate energy prices in future years for the NOPR, DOE multiplied the above average regional electricity prices by the forecast of annual average residential electricity price changes in the Reference Case using *AEO2010,* which has an end year of 2035.[29] To estimate the electricity price trend after 2035, DOE used the average annual rate of change in prices from 2020 to 2035. DOE used the same energy price forecasts for the final rule.

6. Maintenance and Repair Costs

Repair costs are associated with repairing or replacing components that have failed in the appliance, whereas maintenance costs are associated with maintaining the operation of the equipment. For the NOPR, DOE developed a repair cost estimation method that estimates the rate of failure for selected components (compressor, evaporator, condenser, evaporator fan, condenser fan, electronics and automatic icemaker). The estimated average annual repair cost for a given efficiency level can be expressed as the product of two elements: the average rate of repair of a component (expressed as an annual probability of failure) times the incremental cost of repair or replacement compared to the baseline product. DOE requested comment on its approach used for estimating repair costs. 75 FR at 59514 (September 27, 2010).

Sub Zero commented that VIPs could add repair and/or replacement costs that have not been adequately evaluated or estimated (Sub Zero, No. 69 at p. 5). However, they did not provide estimates that would allow DOE to modify its approach.

Whirlpool supported DOE's approach to estimate repair costs for more efficient refrigerators and freezers. However, it pointed out that the data shown in Table IV.14 of the NOPR did not appear to be consistent with the logic expressed in section IV.F.6 of the NOPR. It added that the use of commercial refrigeration failure rates, may lead to inaccuracies (Whirlpool, No. 74 at pp. 5–6).

With regard to the alleged inconsistency between Table IV.14 of the NOPR (75 FR at 59514 (September 27, 2010)) and the accompanying discussion, DOE has checked the accuracy of the table and notes that the table indicated only incremental repair costs, not total repair costs, which add between $7.66 and $21.90 depending on

[29] U.S. Energy Information Administration. *Annual Energy Outlook 2010.* Washington, DC. April 2010.

standard-size refrigerator-freezer product class. DOE also acknowledges the potential inaccuracy of using commercial failure rate data, but notes that (a) no other data were available, and (b) these data were scaled downward so that the total failure rate (sum of all component failure rates) was equal to observed rates for residential refrigeration products as reported in Consumer Reports (see chapter 8 of TSD).

Accordingly, DOE retained the approach for the final rule. Details of this approach can be found in chapter 8 of the final rule TSD.

7. Product Lifetime

Because the basis for lifetime estimates in the literature for refrigeration products is uncertain, DOE used other data sources to estimate the distribution of standard-size refrigerator and freezer lifetimes in the field for both the NOPR and today's final rule. By combining survey results from various years of RECS and the U.S. Census's *American Housing Survey* [30] with the known history of appliance shipments, DOE estimated the fraction of appliances of a given age still in operation. The survival function, which DOE assumed has the form of a cumulative Weibull distribution, provides an average and median appliance lifetime.

For compact refrigerators, DOE estimated an average lifetime of 5.6 years in the NOPR using data on shipments and the stock-in-place (*i.e.,* the number of units in use). DOE found that, given the data on historic shipments of compact refrigerators, using a longer lifetime would result in an equipment stock that is far larger than the stock given by 2005 RECS and EIA's 2003 Commercial Building Energy Consumption Survey. See chapter 8 of the final rule TSD for further details on the method and sources DOE used to develop product lifetimes for this final rule.

8. Discount Rates

To establish discount rates for the LCC analysis, DOE identified all debt or asset classes that might be used to purchase refrigeration products, including household assets that might be affected indirectly. DOE used data from the Federal Reserve Board's "Survey of Consumer Finances" (SCF) for 1989, 1992, 1995, 1998, 2001, 2004, and 2007 to estimate the average percentages of the various debt and equity classes in the average U.S. household portfolios. DOE used SCF data and other sources to develop distributions of interest or return rates associated with each type of equity and debt. The average rate across all types of household debt and equity, weighted by the shares of each class, is 5.1 percent. While this value corresponds to the average discount rate, DOE assigned each sample household a specific discount rate drawn from the distributions.

DOE derived the discount rate for commercial-sector compact refrigeration products from the cost of capital of publicly-traded firms in the sectors that purchase those products (including lodging and other commercial sectors). The firms typically finance equipment purchases through debt and/or equity capital. DOE estimated the cost of the firms' capital as the weighted average of the cost of equity financing and the cost of debt financing for recent years for which data were available (2001 through 2008). The estimated average discount rate for companies that purchase compact refrigeration products is 6.2 percent.

See chapter 8 in the final rule TSD for further details on the development of discount rates for refrigeration products.

9. Compliance Date of Amended Standards

In the context of EPCA, the compliance date is the future date when parties subject to the requirements of a new standard must begin to comply with that standard. As described in DOE's semi-annual implementation report for energy conservation standards activities submitted to Congress, a final rule for the refrigeration products that are the subject of this rulemaking is scheduled for completion. Compliance with amended standards for refrigeration products promulgated by DOE is required in 2014. DOE calculated the LCC and PBP for refrigeration products as if consumers would purchase new products in the year compliance with the standard is required.

10. Base Case Efficiency Distribution

To accurately estimate the share of consumers that would be affected by a standard at a particular efficiency level, DOE's LCC analysis considered the projected distribution of product efficiencies that consumers purchase under the base case (*i.e.,* the case without new energy efficiency standards). DOE refers to this distribution of product of efficiencies as a base-case efficiency distribution. DOE developed base-case efficiency distributions for each of the seven representative product classes. These distributions were developed from industry-supplied data for the year 2007 and were comprised of product efficiencies ranging from existing baseline levels (*i.e.,* meeting existing energy conservation standards) to levels meeting and exceeding ENERGY STAR levels. DOE then projected these distributions to the year that today's standards would become effective (2014).

DOE modified its approach for estimating base-case efficiency distributions for the NOPR analysis for certain product classes. DOE believes that, because the current ENERGY STAR efficiency level is higher than it was prior to the requirements established in 2008, the growth in market share may be slower than before due to the reduction in sales generally associated with higher cost, more efficient products. For the NOPR, DOE adopted a projected market share of ENERGY STAR models in 2014 (under current requirements) that is equal to the average of ENERGY STAR market shares in 2007 (the last year under the old requirements) and 2008 (when current requirements took effect). With this approach, the ENERGY STAR market shares for product class 3 (refrigerator-freezer—automatic defrost with top-mounted freezer without through-the-door ice service) and product class 5 (refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service) are projected to grow more slowly between 2008 and 2014 than they had under the old requirements before 2008. ENERGY STAR products reach a market share in 2014 of 8 percent for product class 3 and 68 percent for bottom-mount refrigerator-freezers.

DOE requested comment on its approach for estimating base case efficiency distributions. 75 FR at 59515 (September 27, 2010). Whirlpool stated it had no comment on the approach (Whirlpool, No. 74 at p. 6), and no other comments were received. In light of the absence of any comments on its approach, DOE maintained the same approach for the final rule as it used in the NOPR for all of the product classes. For further information on DOE's estimate of base-case efficiency distributions, see chapter 8 of the final rule TSD.

11. Inputs To Payback Period Analysis

The payback period is the amount of time it takes the consumer to recover the additional installed cost of more-efficient products, compared to baseline products, through energy cost savings.

[30] U.S. Census Bureau, American Housing Survey. Available at: *http://www.census.gov/hhes/www/housing/ahs/ahs.html.*

The simple payback period does not account for changes in operating expense over time or the time value of money. Payback periods are expressed in years. Payback periods that exceed the life of the product indicate that the increased total installed cost is not recovered in reduced operating expenses.

The inputs to the PBP calculation are the total installed cost of the equipment to the customer for each efficiency level and the average annual operating expenditures for each efficiency level. The PBP calculation uses the same inputs as the LCC analysis, except that discount rates are not needed.

12. Rebuttable-Presumption Payback Period

As noted above, EPCA, as amended, establishes a rebuttable presumption that a standard is economically justified if the Secretary finds that the additional cost to the consumer of purchasing a product complying with an energy conservation standard level will be less than three times the value of the energy (and, as applicable, water) savings during the first year that the consumer will receive as a result of the standard, as calculated under the test procedure in place for that standard. (42 U.S.C. 6295(o)(2)(B)(iii)) For each considered efficiency level, DOE determined the value of the first year's energy savings by calculating the quantity of those savings in accordance with the applicable DOE test procedure, and multiplying that amount by the average energy price forecast for the year in which compliance with the amended standard would be required.

G. National Impact Analysis—National Energy Savings and Net Present Value Analysis

The national impact analysis (NIA) assesses the national energy savings (NES) and the national net present value (NPV) of total consumer costs and savings that would be expected to result from new or amended standards at specific efficiency levels. (''Consumer'' in this context refers to consumers of the product being regulated.) DOE calculates the NES and NPV based on projections of annual appliance shipments, along with the annual energy consumption and total installed cost data from the energy use and LCC analyses. For the present analysis, DOE forecasted the energy savings, operating cost savings, product costs, and NPV of consumer benefits for products sold from 2014 through 2043.

DOE evaluates the impacts of new and amended standards by comparing base-case projections with standards-case projections. The base-case projections characterize energy use and consumer costs for each product class in the absence of new or amended energy conservation standards. DOE compares these projections with projections characterizing the market for each product class if DOE adopted new or amended standards at specific energy efficiency levels (*i.e.,* the TSLs or standards cases) for that class. For the base case forecast, DOE considers historical trends in efficiency and various forces that are likely to affect the mix of efficiencies over time. For the standards cases, DOE also considers how a given standard would likely affect the market shares of efficiencies greater than the standard.

To make the analysis more accessible and transparent to all interested parties, DOE uses an MS Excel spreadsheet model to calculate the energy savings and the national consumer costs and savings from each TSL.[31] The TSD and other documentation that DOE provides during the rulemaking help explain the models and how to use them, and interested parties can review DOE's analyses by changing various input quantities within the spreadsheet. The NIA spreadsheet model uses typical values as inputs (as opposed to probability distributions).

For the current analysis, the NIA used projections of energy prices and housing starts from the *AEO2010* Reference case. In addition, DOE analyzed scenarios that used inputs from the *AEO2010* Low Economic Growth and High Economic Growth cases. These cases have higher and lower energy price trends compared to the Reference case, as well as higher and lower housing starts, which result in higher and lower appliance shipments to new homes. NIA results based on these cases are presented in appendix 10–A of the final rule TSD.

Table IV.6 summarizes the inputs and key assumptions DOE used for the NIA analysis contained in the overall NOPR analysis and the changes to the analyses for the final rule. Discussion of these inputs and changes follows the table. See chapter 10 of the final rule TSD for further details.

TABLE IV.6—APPROACH AND DATA USED FOR NATIONAL ENERGY SAVINGS AND CONSUMER NET PRESENT VALUE ANALYSES

Inputs	NOPR	Changes for the final rule
Shipments	Annual shipments from shipments model, using 2008 data to estimate the ratio of bottom-mount share to side-by-side share.	No change.
Compliance Date of Standard	2014	No change.
Base-Case Forecasted Efficiencies	Used a ''roll-up + ENERGY STAR'' scenario to establish the distribution of efficiencies.	No change.
Standards-Case Forecasted Efficiencies	Used a ''roll-up + ENERGY STAR'' scenario to establish the distribution of efficiencies.	No change.
Annual Energy Consumption per Unit	Annual weighted-average values as a function of SWEUF*.	No change.
Total Installed Cost per Unit	Annual weighted-average values as a function of SWEUF*.	Applied a price trend to estimate future product prices.
Energy Cost per Unit	Annual weighted-average values as a function of the annual energy consumption per unit and energy prices.	No change.
Repair and Maintenance Cost per Unit	Annual values as a function of efficiency level	No change.
Escalation of Energy Prices	*AEO2010* forecasts (to 2035) and extrapolation through 2043.	No change.
Energy Site-to-Source Conversion Factor	Varies yearly and is generated by DOE/EIA's NEMS.	No change.

[31] MS Excel is the most widely used spreadsheet calculation tool in the United States and there is general familiarity with its basic features. Thus, DOE's use of MS Excel as the basis for the spreadsheet models provides interested parties with access to the models within a familiar context.

TABLE IV.6—APPROACH AND DATA USED FOR NATIONAL ENERGY SAVINGS AND CONSUMER NET PRESENT VALUE ANALYSES—Continued

Inputs	NOPR	Changes for the final rule
Discount Rate	Three and seven percent real	No change.
Present Year	Future expenses are discounted to 2010	No change.

* Shipments-Weighted Energy Use Factor.

1. Shipments

Forecasts of product shipments are needed to calculate the national impacts of standards on energy use, NPV, and future manufacturer cash flows. DOE develops shipment forecasts based on an analysis of key market drivers for each considered product. In DOE's shipments model, product shipments are driven by new construction, stock replacements, and other types of purchases. The shipments models take an accounting approach, tracking market shares of each product class and the vintage of units in the existing stock. Stock accounting uses product shipments as inputs to estimate the age distribution of in-service product stocks for all years. The age distribution of in-service product stocks is a key input to calculations of both the NES and NPV, because operating costs for any year depend on the age distribution of the stock. DOE also considers the impacts on shipments from changes in product purchase price and operating cost associated with higher energy efficiency levels.

In projecting shipments for refrigeration products, DOE accounted for installations in new homes and replacement of failed equipment. In addition, for standard-size refrigerator-freezers, DOE estimated purchases driven by the conversion of a first refrigerator to a second refrigerator. It also estimated purchases by existing household consumers who enter the market as new owners for standard-size freezers.

In conducting the analysis for today's rule, DOE examined the historical trends in the market shares of different refrigerator-freezer configurations to disaggregate the total shipments of refrigerator-freezers into the three considered refrigerator-freezer product categories (top-mount, bottom-mount and side-by-side configurations). The market share of side-by-side refrigerator-freezer models has grown significantly during the past two decades. Bottom-freezer models historically had a small market share, but that share has also grown in recent years. However, because DOE had insufficient data to forecast long-term growth of this product class, it made the assumption, based on past sales trends, that consumer behavior related to bottom-mount models in the future would mirror behavior regarding side-by-side models. DOE developed a model to forecast the combined bottom-mount and side-by-side market shares throughout the 30-year forecast period (beginning in 2014), and assumed that the ratio of bottom-mount share to side-by-side share would remain constant at the 2008 level (the last year for which DOE had disaggregated data).

To estimate the effects on product shipments from increases in product price projected to accompany amended standards at higher efficiency levels, DOE applied a price elasticity parameter. It estimated this parameter with a regression analysis that used purchase price and efficiency data specific to residential refrigerators, clothes washers, and dishwashers over the period 1980–2002. The estimated ''relative price elasticity'' incorporates the impacts from purchase price, operating cost, and household income, and it also declines over time. DOE estimated shipments in each standards case using the relative price elasticity along with the change in the relative price between a standards case and the base case. For details on the shipments analysis, see chapter 9 of the final rule TSD.

2. Forecasted Efficiency in the Base Case and Standards Cases

A key component of the NIA is the trend in energy efficiency forecasted for the base case (without new or amended standards) and each of the standards cases. Section IV.X described how DOE developed a base-case energy efficiency distribution (which yields a shipment-weighted average efficiency) for each of the considered product classes for the first year of the forecast period. Based on recent trends, DOE assumed no improvement of energy efficiency in the base case and held the base-case energy efficiency distribution constant throughout the forecast period.

To estimate efficiency trends in the standards cases, DOE used a ''roll-up'' scenario in its standards rulemakings. Under the ''roll-up'' scenario, DOE assumes: (1) Product efficiencies in the base case that do not meet the standard level under consideration would ''roll-up'' to meet the new standard level; and (2) product efficiencies above the standard level under consideration would not be affected.

For the NOPR, DOE refined its forecast for the base case and each of the standards cases using information obtained from ENERGY STAR program staff. To project the efficiency distributions after 2014 for the base case, DOE first considered the potential for changes to the ENERGY STAR qualification levels. DOE assumed that, in the absence of a new standard, the ENERGY STAR program would re-examine and possibly revise its qualification levels regardless of the market share in 2014. When setting a minimum product efficiency level to qualify for ENERGY STAR, one important metric is that the average payback period compared to the current standard level should not exceed five years. Using the payback period calculation described in section IV.F, DOE applied this criterion to all product classes to evaluate the extent to which the current ENERGY STAR efficiency levels would be increased in the future.

DOE then estimated the market shares for ENERGY STAR products in 2021 based on past experience in the market for these products. Rather than make long-term projections based on limited information, DOE assumed there would be no further change in market shares between 2021 and the end of the forecast period. DOE recognizes that some change in shares is likely to occur in reality. However, since DOE used the same assumption in the standards cases, the accuracy of the assumption makes no difference to the analysis of energy savings.

For the standards cases (also referred to as candidate standard levels, or CSLs), DOE used the same approach as for the base case and assumed that in the case of amended standards, the ENERGY STAR program would re-evaluate its qualifying levels for all product classes using the five-year payback period criterion. For each CSL, DOE identified the maximum efficiency level with a payback period of five years or less. If that level was below the current ENERGY STAR level, DOE maintained the current ENERGY STAR level. At higher CSLs, there is no efficiency level above the standard level with a payback period of less than 5 years. DOE assumed that the ENERGY STAR program would be suspended with standards at higher CSLs on a product-class specific basis. This result is projected to occur for all product classes at CSL 3 and above; for product classes 9 (upright freezers with automatic defrost) and 10 (chest freezers and all other freezers except compact freezers), it occurs at lower CSLs. The market share estimates for ENERGY STAR products in 2021 and beyond were based on a similar approach as for the base case.

DOE requested comment on its approach for forecasting base case and standards case efficiency distributions. 75 FR at 59518 (September 27, 2010). Whirlpool stated it had no comment on the approach (Whirlpool, No. 74 at p. 6), and no other comments were received. As a result, DOE retained its approach for the final rule. For further details about the forecasted efficiency distributions, see chapter 10 of the final rule TSD.

3. Installed Cost per Unit

In the NOPR analysis, DOE followed its past practice and assumed that the manufacturer costs and retail prices of products meeting various efficiency levels remain fixed, in real terms, after 2008 (the year for which the engineering analysis estimated costs) and throughout the period of the analysis. As discussed in section IV.F.1, for the final rule DOE used a price trend based on an experience curve derived using historical data on shipments and refrigeration equipment PPI. DOE applied the same price trend to forecast prices for each group of refrigeration products at each considered efficiency level. The average projected annual rate of price decline in the default case is 1.87 percent.

For the NIA, DOE also analyzed two cases that use a price trend based on an exponential in time extrapolation of refrigeration equipment PPI data. DOE selected a high projected price trend decline case and a low projected price trend decline case from among a number of price trends that it analyzed (see appendix 8E of the final rule TSD). The high projected price trend decline case is based on the upper end of the 95 percent confidence interval for an exponential fit to the PPI series in 1991–2010 divided by the relevant GDP deflator data from those years. The low projected price trend decline case is based on the lower end of the 95 percent confidence interval for an exponential fit to the PPI series in 1976–2010 before dividing it by the relevant GDP deflator data from those years. The annual rate of projected price trend decline is 3.12 percent in the high projected price trend decline case and 1.14 percent in the low projected price trend decline case.

4. Site-to-Source Energy Conversion

For each year in the forecast period, DOE calculates the NES for each standard level by multiplying the stock of equipment affected by the energy conservation standards by the per-unit annual energy savings.

To estimate the national energy savings expected from appliance standards, DOE uses a multiplicative factor to convert site energy consumption (at the home or commercial building) into primary or source energy consumption (the energy required to convert and deliver the site energy). These conversion factors account for the energy used at power plants to generate electricity and losses in transmission and distribution, as well as for natural gas losses from pipeline leakage and energy used for pumping. For electricity, the conversion factors vary over time due to projected changes in generation sources (*i.e.,* the power plant types projected to provide electricity to the country). The factors that DOE developed are marginal values, which represent the response of the system to an incremental decrease in consumption associated with appliance standards.

For the NOPR and today's final rule, DOE updated its annual site-to-source conversion factors based on the version of NEMS that corresponds to *AEO2010,* which provides energy forecasts through 2035. For 2036–2043, DOE used conversion factors that remain constant at the 2035 values.

In response to a request from DOE's Office of Energy Efficiency and Renewable Energy (EERE), the National Academy of Sciences (NAS), appointed a committee on ''Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards'' to conduct a study required by section 1802 of the Energy Policy Act of 2005 (Pub. L. 109–58 (August 8, 2005)). The fundamental task before the committee was to evaluate the methodology used for setting energy efficiency standards and to comment on whether site (point-of-use) or source (full-fuel-cycle) measures of energy savings would better support rulemaking efforts to achieve energy conservation goals. The NAS committee defined full-fuel-cycle energy consumption as including, in addition to site energy use, the following: energy consumed in the extraction, processing, and transport of primary fuels such as coal, oil, and natural gas; energy losses in thermal combustion in power generation plants; and energy losses in transmission and distribution to homes and commercial buildings.[32]

In evaluating the merits of using point-of-use and full-fuel-cycle measures, the NAS committee noted that DOE uses what the committee referred to as ''extended site'' energy consumption to assess the impact of energy use on the economy, energy security, and environmental quality. The extended site measure of energy consumption includes the energy consumed during the generation, transmission, and distribution of electricity but, unlike the full-fuel-cycle measure, does not include the energy consumed in extracting, processing, and transporting primary fuels. A majority of the NAS committee concluded that extended site energy consumption understates the total energy consumed to make an appliance operational at the site. As a result, the NAS committee recommended that DOE consider shifting its analytical approach over time to use a full-fuel-cycle measure of energy consumption when assessing national and environmental impacts, especially with respect to the calculation of greenhouse gas emissions. The NAS committee also recommended that DOE provide more comprehensive information to the public through labels and other means, such as an enhanced Web site. For those appliances that use multiple fuels (*e.g.,* water heaters), the NAS committee indicated that measuring full-fuel-cycle energy consumption would provide a more complete picture of energy consumed and permit comparisons across many different appliances, as well as an improved assessment of impacts.

In response to the NAS recommendations, DOE issued, on August 20, 2010, (75 FR 51423), a Notice of Proposed Policy proposing to incorporate a full-fuel cycle analysis into the methods it uses to estimate the likely impacts of energy conservation standards on energy use and emissions. Specifically, DOE proposed to use full-fuel-cycle (FFC) measures of energy and greenhouse gas (GHG) emissions, rather than the primary (extended site) energy measurement it currently uses. Additionally, DOE proposed to work collaboratively with the Federal Trade Commission (FTC) to make FFC energy

[32] The National Academies, Board on Energy and Environmental Systems, Letter to Dr. John Mizroch, Acting Assistant Secretary, U.S. DOE, Office of EERE from James W. Dally, Chair, Committee on Point-of-Use and Full-Fuel-Cycle Measurement Approaches to Energy Efficiency Standards, May 15, 2009.

and GHG emissions data available to the public to enable consumers to make cross-class comparisons. On October 7, 2010, DOE held an informal public meeting to discuss and receive comments on its planned approach. The materials related to this proposed policy are available at: *http://www.regulations.gov/search/Regs/home.html#docketDetail?R=EERE-2010-BT-NOA-0028*. Following the close of the public comment period, DOE intends to develop a final policy statement on these subjects and then take steps to begin implementing that policy in rulemakings and other activities that are undertaken during 2011.

5. Discount Rates

The inputs for determining the NPV of the total costs and benefits experienced by consumers of the considered appliances are: (1) Total annual installed cost, (2) total annual savings in operating costs, and (3) a discount factor. DOE calculates net savings each year as the difference between the base case and each standards case in total savings in operating costs and total increases in installed costs. DOE calculates operating cost savings over the life of each product shipped in the forecast period.

DOE multiplies the net savings in future years by a discount factor to determine their present value. For today's final rule, DOE estimated the NPV of appliance consumer benefits using both a 3-percent and a 7-percent real discount rate. DOE uses these discount rates in accordance with guidance provided by the Office of Management and Budget (OMB) to Federal agencies on the development of regulatory analysis.[33] The discount rates for the determination of NPV are in contrast to the discount rates used in the LCC analysis, which are designed to reflect a consumer's perspective. The 7-percent real value is an estimate of the average before-tax rate of return to private capital in the U.S. economy. The 3-percent real value represents the ''societal rate of time preference,'' which is the rate at which society discounts future consumption flows to their present value.

6. Benefits From Effects of Standards on Energy Prices

A decrease in electricity consumption associated with amended standards for refrigeration products could reduce the electricity prices charged to consumers in all sectors of the economy and thereby reduce their electricity expenditures. In chapter 2 of the preliminary analysis TSD, DOE explained that, because the power industry is a complex mix of fuel and equipment suppliers, electricity producers and distributors, it did not plan to estimate the value of potentially reduced electricity costs for all consumers associated with amended standards for refrigeration products. In response, the Northeast Energy Efficiency Partnerships urged DOE to quantify electricity demand reductions achieved by these updated standards in financial terms. (NEEP, No. 41 at p. 1)

For the NOPR and today's final rule, DOE used NEMS–BT to assess the impacts of the reduced need for new electric power plants and infrastructure projected to result from standards. In NEMS–BT, changes in power generation infrastructure affect utility revenue requirements, which in turn affect electricity prices. DOE estimated the impact on electricity prices associated with each considered TSL. Although the aggregate benefits for electricity users are potentially large, there may be negative effects on some of the actors involved in the supply of electricity, particularly power plant providers and fuel suppliers. Because there is uncertainty about the extent to which the benefits for electricity users from reduced electricity prices would be a transfer from actors involved in electricity supply to electricity consumers, DOE has concluded that, at present, because of this uncertainty, it should not give a heavy weight to this factor in its consideration of the economic justification of new or amended standards. DOE is continuing to investigate the extent to which electricity price changes projected to result from standards represent a net gain to society.

H. Consumer Subgroup Analysis

In analyzing the potential impact of new or amended standards on consumers, DOE evaluates the impact on identifiable sub-groups of consumers that may be disproportionately affected by a national standard. DOE evaluates impacts on particular sub-groups of consumers primarily by analyzing the LCC impacts and PBP for those particular consumers from alternative standard levels. For both the NOPR and today's final rule, DOE analyzed the impacts of the considered standard levels on low-income consumers and senior citizens. DOE did not estimate the impacts for compact refrigeration products because the household sample sizes were not large enough to yield meaningful results. For further details on DOE's consumer sub-group analysis, see Chapter 11 in the final rule TSD.

I. Manufacturer Impact Analysis

DOE conducted the MIA to estimate the financial impact of amended energy conservation standards on manufacturers of residential refrigeration products, and to assess the impacts of such standards on employment and manufacturing capacity.

The MIA is both a quantitative and qualitative analysis. The quantitative part of the MIA relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model customized for the residential refrigeration products covered in this rulemaking. The key MIA output is industry net present value (INPV). DOE used the GRIM to calculate cash flows using standard accounting principles and to compare changes in INPV between a base case and various TSLs (the standards cases). The difference in INPV between the base and standards cases represents the financial impact of the amended standard on manufacturers. Different sets of assumptions (scenarios) produce different results. DOE reports the MIA impacts of amended energy conservation standards by grouping together the impacts on manufacturers of certain product classes. DOE presents the industry impacts by the major product types (*i.e.,* standard size refrigerator-freezers, standard size freezers, compact refrigerators and freezers, and built-in refrigeration products). These product groupings represent markets that are served by the same manufacturers. By segmenting the results into these product types, DOE is able to discuss how these subgroups of manufacturers will be impacted by amended energy conservation standards.

The qualitative part of the MIA addresses factors such as product characteristics, characteristics of particular firms, and market trends. The qualitative discussion also includes an assessment of the impacts of standards on subgroups of manufacturers. DOE outlined its complete methodology for the MIA in the NOPR. 75 FR at 59519–59526 (September 27, 2010). The complete MIA is presented in chapter 12 of the NOPR and final rule TSD.

1. Comments From Interested Parties

DOE received a number of comments from interested parties in response to the NOPR. Sub Zero commented that while it is not a small business, it is a small refrigerator manufacturer

[33] OMB Circular A–4 (Sept. 17, 2003), section E, ''Identifying and Measuring Benefits and Costs. Available at: *http://www.whitehouse.gov/omb/memoranda/m03-21.html.*

compared to its competition. It argued that its smaller size places it at a disadvantage compared to larger competitors with respect to the supply chain for compressors, which could cause Sub Zero to experience supply disruptions that would seriously impact their business and ability to compete. (Sub Zero, No. 69 at p. 3) Sub Zero added that its cost and distribution structures are different from the majority of the industry, and its small scale results in higher costs per unit production, including engineering related expenses. (Sub Zero, No. 69 at p. 2) Sub Zero commented that the new standards on smaller manufacturers in any segment of the appliance industry introduce costs and personnel requirements that represent a larger percentage of resources than those required by larger competitors. (Sub Zero, No. 69 at p. 3) Whirlpool simply stated that it was not a small business and offered no comment on the proposal's impact on small manufacturers. (Whirlpool, No. 74 at p. 6)

DOE agrees that a smaller manufacturer could face all of the additional challenges raised by Sub Zero relative to a larger competitor. DOE also notes that while many larger refrigerator manufacturers also produce built-in units and could experience some benefits in the built-in market from their overall scale, built-in production volumes for any manufacturer are likely to be much lower for built-in products than free-standing products. While a smaller manufacturer could face all the challenges listed by Sub Zero, DOE believes that the separate analysis and presentation of results for built-in products adequately addresses Sub Zero's concerns about the potential impacts on built-in manufacturers. DOE continues to believe that presenting the built-in analysis results separately from other categories is the most appropriate way to analyze the lower production volumes and different cost structure for built-in manufacturing.

In the NOPR, DOE investigated whether small business manufacturers should be analyzed as a manufacturer subgroup. 75 FR at 59520, 59548 (September 27, 2010). As part of this effort, DOE identified one company that manufactures products covered by this rulemaking and qualifies as a small business under the applicable Small Business Administration (SBA) definition.[34] DOE did not analyze a separate subgroup of small business manufacturers in the NOPR because it determined this rulemaking would not have a significant economic impact on a substantial number of small entities. Id. at 59571–59572. DOE requested comment on this determination and sought any information concerning small businesses that could be impacted by this rulemaking as well as the nature and extent of those potential impacts of the proposed energy conservation standards on small residential refrigeration product manufacturers. Id. at 59572 and 59575. DOE received no information regarding these issues. DOE received comments from Whirlpool and Sub Zero that supported its initial classification of the number of small business manufacturers of residential refrigeration products. (Whirlpool No. 74, at p. 6; Sub Zero, No. 69 at p. 3) Therefore, the final rule continues to refrain from treating small business manufacturers as a manufacturer subgroup but also maintains the separate analysis and presentation of results for built-in products.

Sub Zero also commented that the proposed standards would have implications for their company. At the proposed built-in standard levels, it asserted that the company will be pressed to meet the necessary efficiency levels, remain a viable business, and achieve profitability. Sub Zero also argued that the new standards could also impact the number of products that meet high visibility programs such as ENERGY STAR and indicated that these challenges are in addition to attempting to recover from a difficult business environment. Sub Zero added that different regulations in other areas of the world, notably Canada and Europe, that involve more than energy and are not harmonized with U.S. requirements, pose significant challenges and noted that this regulatory burden is the biggest challenge for the future. (Sub Zero, No. 69 at p. 3) Sub Zero agreed that DOE's analysis presented in the NOPR confirms that new standards will impact built-in designs more stringently than conventional free-standing products to meet any given efficiency level. Sub Zero stated it was also concerned that built-ins be separated as distinct product classes with different efficiency levels from conventional product classes, in order to continue to offer consumers the utility they desire at reasonable added costs. (Sub Zero, No. 69 at pp. 1–2)

DOE agrees that manufacturers such as Sub Zero face challenges. For example, because Sub Zero holds a large market share of the premium, built-in market, DOE expects that a significant portion of the $65 million in product conversion costs and $55 million in capital conversion costs calculated for built-in product classes will be borne by Sub Zero. However, DOE believes that the INPV impacts calculated in the MIA analyze the potential impacts on built-in manufacturers due to amended energy conservation standards. This adjustment, along with providing separate product classes for built-in products to help preserve the utility that these products offer, will help mitigate the potential adverse financial impact that would result from this rule.

DOE also received a number of comments about possible refrigerant and blowing agent changes. Whirlpool, GE, and AHAM all noted possible changes to the regulatory landscape for the refrigerants available in residential refrigeration products. (Whirlpool, No. 74 at p. 4; GE, No. 76 at p. 2; AHAM, No. 73 at pp. 7–8) Sub Zero also highlighted the current uncertainty about potential future regulation of HFC refrigerants and blowing agents. It suggested that the industry could potentially be faced with enforced conversion to other substances by 2014, which would require significant additional capital investment. (Sub Zero, No. 69 at p. 4)

These comments are addressed above in section 0. Because these comments also relate to the cumulative regulatory burden, DOE reiterates that it concluded isobutane products may soon become available. However, DOE did not consider the switch to isobutane refrigerant as a design option to reduce energy use because sufficient information regarding the energy savings characteristics and the costs of the new designs was not available. DOE did not consider the possible capital investment needed by conversions to other substances by 2014 because DOE believes that basing energy conservation standards on the uncertain prospect of pending regulations or legislation would be speculative.

2. GRIM Key Inputs

The GRIM inputs are data characterizing the industry cost structure, investments, shipments, and markups. DOE updates the MIA to reflect changes in the outputs of two other key DOE analyses that feed into the GRIM: The engineering analysis and the NIA. For the final rule, DOE did not receive any relevant comments that would necessitate such changes to the engineering analysis. Similarly, DOE did not receive comments from interested parties that would change assumptions or shipments in the NIA. DOE did not request specific comment

[34] See *http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf* for a list of SBA size standards.

on the inputs to the MIA in the NOPR and is maintaining the same methodology for the final rule.

For the final rule, DOE incorporated trends in prices over time into the analysis. These prices trends in every year also impact the MIA results. DOE used the same price trends in the NIA from the base year of the analysis through the end of the analysis period. DOE also assumed that manufacturer product costs (MPCs) and MSPs were similarly impacted by the price trends in both the base case and standards cases. See section 0 for a description of how DOE implemented price trends into the analysis. The other major GRIM assumptions and inputs that are not part of the engineering analysis or NIA are outlined below.

a. Product and Capital Conversion Costs

Amended energy conservation standards will cause manufacturers to incur one-time conversion costs to bring their production facilities and product designs into compliance. For the MIA, DOE classified these one-time conversion costs into two major groups: (1) Product conversion costs and (2) capital conversion costs. Product conversion costs are one-time investments in research, development, testing, marketing, and other non-capitalized costs focused on making product designs comply with the amended energy conservation standard. Capital conversion costs are one-time investments in property, plant, and equipment to adapt or change existing production facilities so that new product designs can be fabricated and assembled.

DOE based its estimates of the product conversion costs that would be required to meet each TSL on information obtained from manufacturer interviews, the design pathways analyzed in the engineering analysis, and market information about the number of platform and product families for each manufacturer. DOE based its capital conversion cost estimates on manufacturer interviews and assumptions from the engineering analysis. 75 FR at 59521 (September 27, 2010). DOE's estimates of the product and capital conversion costs for all of the refrigeration products addressed in this rulemaking can be found in section 0, of today's final rule and in chapter 12 of the final rule TSD.

b. Markup Scenarios

For the MIA, DOE modeled two standards-case markup scenarios to represent the uncertainty regarding the potential impacts on prices and profitability for manufacturers following the implementation of amended energy conservation standards: (1) A flat markup scenario, and (2) a preservation of operation profit scenario. These scenarios lead to different markup values, which, when applied to the inputted MPCs, result in varying revenue and cash flow impacts.

The flat markup scenario assumes that the cost of goods sold for each product is marked up by a flat percentage to cover standard SG&A expenses, R&D expenses, and profit. This scenario represents the upper bound of industry profitability in the standards case because manufacturers are able to fully pass through to their customers the additional costs due to compliance with applicable standards. DOE also modeled the preservation of operating profit markup scenario. In this scenario, the manufacturer markups are lowered such that, in the standards case, manufacturers are only able to maintain the base-case total operating profit in absolute dollars, despite higher product costs and investment. DOE implemented this scenario in GRIM by lowering the manufacturer markups at each TSL to yield approximately the same earnings before interest and taxes in the standards case in the year after the compliance date of the amended standards as in the base case. This scenario represents the lower bound of industry profitability following amended energy conservation standards because higher MPCs and the investments required to comply with the amended energy conservation standard do not yield additional operating profit. 75 FR at 59522 (September 27, 2010).

3. Manufacturer Interviews

DOE interviewed manufacturers representing more than 95 percent of standard-size refrigerator-freezer sales, approximately 95 percent of standard-size freezer sales, about 75 percent of compact refrigerator and freezer sales, and more than 95 percent of built-in refrigeration products. These interviews were in addition to those DOE conducted as part of the engineering analysis. DOE outlined the key issues in the rulemaking for manufacturers in the NOPR. 75 FR at 59524–59526 (September 27, 2010).

J. Employment Impact Analysis

DOE considers employment impacts in the domestic economy as one factor in selecting an amended standard. Employment impacts consist of direct and indirect impacts. Direct employment impacts are any changes in the number of employees of manufacturers of the appliance products that are the subject of this rulemaking, their suppliers, and related service firms. Indirect employment impacts are changes in national employment that occur due to the shift in expenditures and capital investment caused by the purchase and operation of more-efficient appliances. The MIA addresses the direct employment impacts that concern manufacturers of refrigeration products. The employment impact analysis addresses the indirect employment impacts.

Indirect employment impacts from standards consist of the net jobs created or eliminated in the national economy, other than in the manufacturing sector being regulated, due to: (1) Reduced spending by end users on energy; (2) reduced spending on new energy supplies by the utility industry; (3) increased spending on new products to which the new standards apply; and (4) the effects of those three factors throughout the economy. DOE expects the net monetary savings from standards to be redirected to other forms of economic activity. DOE also expects these shifts in spending and economic activity to affect the demand for labor in the short term, as explained below.

One method for assessing the possible effects on the demand for labor of such shifts in economic activity is to compare sectoral employment statistics developed by the Labor Department's Bureau of Labor Statistics (BLS).[35] The BLS regularly publishes its estimates of the number of jobs per million dollars of economic activity in different sectors of the economy, as well as the jobs created elsewhere in the economy by this same economic activity. Data from BLS indicate that expenditures in the utility sector generally create fewer jobs (both directly and indirectly) than expenditures in other sectors of the economy. There are many reasons for these differences, including wage differences and the fact that the utility sector is more capital intensive and less labor intensive than other sectors.[36]

Energy conservation standards have the effect of reducing consumer utility bills. Because reduced consumer expenditures for energy likely lead to increased expenditures in other sectors

[35] Data on industry employment, hours, labor compensation, value of production, and the implicit price deflator for output for these industries are available upon request by calling the Division of Industry Productivity Studies (202–691–5618) or by sending a request by e-mail to *dipsweb@bls.gov*. Available at: *http://www.bls.gov/news.release/prin1.nr0.htm.*

[36] See Bureau of Economic Analysis, *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II).* Washington, DC. U.S. Department of Commerce, 1992.

of the economy, the general effect of efficiency standards is to shift economic activity from a less labor-intensive sector (*i.e.,* the utility sector) to more labor-intensive sectors (*e.g.,* the retail and service sectors). Thus, based on the BLS data alone, DOE believes net national employment will increase due to shifts in economic activity resulting from amended standards for refrigeration products.

For the standards considered in today's final rule, DOE estimated indirect national employment impacts using an input/output model of the U.S. economy called Impact of Sector Energy Technologies (ImSET). ImSET is a spreadsheet model of the U.S. economy that focuses on 187 sectors most relevant to industrial, commercial, and residential building energy use.[37] ImSET is a special purpose version of the ''U.S. Benchmark National Input-Output'' (I–O) model, which has been designed to estimate the national employment and income effects of energy-saving technologies. The ImSET software includes a computer-based I–O model with structural coefficients to characterize economic flows among the 187 sectors. ImSET's national economic I–O structure is based on a 2002 U.S. benchmark table, specially aggregated to the 187 sectors. DOE estimated changes in expenditures using the NIA spreadsheet. Using ImSET, DOE then estimated the net national, indirect employment impacts by sector of potential amended efficiency standards for refrigeration products.

For more details on the employment impact analysis, see the final rule TSD, chapter 13.

K. Utility Impact Analysis

The utility impact analysis estimates several important effects on the utility industry that would result from the adoption of new or amended standards. For both the NOPR final rule analyses, DOE used the NEMS–BT model to generate forecasts of electricity consumption, electricity generation by plant type, and electric generating capacity by plant type, that would result from each TSL. DOE obtained the energy savings inputs associated with efficiency improvements to considered products from the NIA. DOE conducts the utility impact analysis as a scenario that departs from the latest *AEO2010* Reference case. In other words, the estimated impacts of an amended standard are the differences between values forecasted by NEMS–BT and the values in the *AEO2010* Reference case.

As part of the utility impact analysis, DOE used NEMS–BT to assess the impacts on electricity prices of the reduced need for new electric power plants and infrastructure projected to result from the considered standards. In NEMS–BT, changes in power generation infrastructure affect utility revenue requirements, which in turn affect electricity prices. DOE estimated the change in electricity prices projected to result over time from each TSL.

Chapter 14 of the final rule TSD presents more information on the utility impact analysis.

L. Environmental Assessment

Pursuant to the National Environmental Policy Act and the requirements of 42 U.S.C. 6295(o)(2)(B)(i)(VI), DOE has prepared an environmental assessment (EA) of the impacts of the standards for refrigeration products in today's final rule, which it has included as chapter 15 of the TSD. DOE found that the environmental effects associated with the standards for refrigeration products were not significant. Therefore, DOE is issuing a Finding of No Significant Impact (FONSI), pursuant to NEPA, the regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), and DOE's regulations for compliance with NEPA (10 CFR part 1021). The FONSI is available in the docket for this rulemaking.

In the EA, DOE estimated the reduction in power sector emissions of CO_2, NO_X, and Hg using the NEMS–BT computer model. In the EA, NEMS–BT is run similarly to the AEO NEMS, except that refrigeration product energy use is reduced by the amount of energy saved (by fuel type) due to each TSL. The inputs of national energy savings come from the NIA spreadsheet model, while the output is the forecasted physical emissions. The net benefit of each TSL in today's final rule is the difference between the forecasted emissions estimated by NEMS–BT at each TSL and the AEO 2010 Reference Case. NEMS–BT tracks CO_2 emissions using a detailed module that provides results with broad coverage of all sectors and inclusion of interactive effects.

DOE has determined that SO_2 emissions from affected fossil fuel fired combustion devices (also known as Electric Generating Units (EGUs)) are subject to nationwide and regional emissions cap and trading programs that create uncertainty about the standards' impact on SO_2 emissions. Title IV of the Clean Air Act, 42 U.S.C. 7401–7671q, sets an annual emissions cap on SO_2 for affected EGUs in the 48 contiguous states and the District of Columbia (D.C.). SO_2 emissions from 28 eastern states and DC are also limited under the Clean Air Interstate Rule (CAIR, 70 FR 25162 (May 12, 2005)), which created an allowance-based trading program. Although CAIR has been remanded to EPA by the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit), see *North Carolina* v. *EPA,* 550 F.3d 1176 (D.C. Cir. 2008), it remains in effect temporarily, consistent with the D.C. Circuit's earlier opinion in *North Carolina* v. *EPA,* 531 F.3d 896 (D.C. Cir. 2008). On August 2, 2010, EPA issued the Transport Rule proposal, a replacement for CAIR, which would limit emissions from EGUs in 32 states, and may allow some amount of interstate trading. 75 FR 45210. EPA issued the final transport rule, entitled the Cross-State Air Pollution Rule, on July 6, 2011.[38] See *http://www.epa.gov/crossstaterule/.*

The attainment of emissions caps is typically flexible among EGUs and is enforced through the use of emissions allowances and tradable permits. Under existing EPA regulations, any excess SO_2 emissions allowances resulting from the lower electricity demand caused by the imposition of an efficiency standard could be used to permit offsetting increases in SO_2 emissions by any regulated EGU. However, if the standard resulted in a permanent increase in the quantity of unused emissions allowances, there would be an overall reduction in SO_2 emissions from the standards. While there remains some uncertainty about the ultimate effects of efficiency standards on SO_2 emissions covered by the existing cap and trade system, the NEMS–BT modeling system that DOE uses to forecast emissions reductions currently indicates that no physical reductions in power sector emissions would occur for SO_2. Because the Transport Rule has not been finalized, there is no way to predict the effect of this rulemaking on SO_2 emissions after the Transport Rule goes into effect.

A cap on NO_X emissions, affecting electric generating units in the CAIR region, means that standards on refrigeration products may have little or no physical effect on NO_X emissions in the 28 eastern States and the District of Columbia covered by CAIR. Again, as noted above, because the Transport Rule has not been finalized, there is no way to predict the effect of this rulemaking

[37] J. M. Roop, M. J. Scott, and R. W. Schultz, *ImSET 3.1: Impact of Sector Energy Technologies,* PNNL–18412, Pacific Northwest National Laboratory, 2009. Available at: *http://www.pnl.gov/main/publications/external/technical_reports/PNNL-18412.pdf.*

[38] DOE notes that future iterations of the NEMS–BT model will incorporate any changes necessitated by issuance of the Cross-State Air Pollution Rule.

on NOx emissions after the Transport Rule goes into effect.

Today's standards would, however, reduce NO_X emissions in those 22 States not affected by the CAIR. As a result, DOE used NEMS–BT to forecast emission reductions from the standards that are considered in today's final rule.

Similar to emissions of SO_2 and NO_X, future emissions of Hg would have been subject to emissions caps. In May 2005, EPA issued the Clean Air Mercury Rule (CAMR). 70 FR 28606 (May 18, 2005). CAMR would have permanently capped emissions of mercury for new and existing coal-fired power plants in all States by 2010. However, on February 8, 2008, the DC Circuit issued a decision in *New Jersey* v. *Environmental Protection Agency,* in which it vacated CAMR. 517 F.3d 574 (D.C. Cir. 2008). EPA has decided to develop emissions standards for power plants under the Clean Air Act (Section 112), consistent with the DC Circuit's opinion on CAMR. See *http://www.epa.gov/air/mercuryrule/pdfs/certpetition_withdrawal.pdf.* Pending EPA's forthcoming revisions to the rule, DOE is excluding CAMR from its Environmental Analysis. In the absence of CAMR, a DOE standard would likely reduce Hg emissions and DOE plans to use NEMS–BT to estimate these emission reductions. However, DOE continues to review the impact of rules that reduce energy consumption on Hg emissions, and may revise its assessment of Hg emission reductions in future rulemakings.

M. Monetizing Carbon Dioxide and Other Emissions Impacts

As part of the development of this final rule, DOE considered the estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that are expected to result from each of the TSLs considered. In order to make this calculation similar to the calculation of the NPV of consumer benefit, DOE considered the reduced emissions expected to result over the lifetime of products shipped in the forecast period for each TSL. This section summarizes the basis for the monetary values used for each of these emissions and presents the benefits estimates considered.

For today's final rule, DOE is relying on a set of values for the social cost of carbon (SCC) that were developed by an interagency process. A summary of the basis for these new values is provided below, and a more detailed description of the methodologies used is provided in appendix 16–A of the final rule TSD.

1. Social Cost of Carbon

Under Executive Order 12866, agencies must, to the extent permitted by law, ''assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.'' The purpose of the SCC estimates presented here is to allow agencies to incorporate the monetized social benefits of reducing CO_2 emissions into cost-benefit analyses of regulatory actions that have small, or ''marginal,'' impacts on cumulative global emissions. The estimates are presented with an acknowledgement of the many uncertainties involved and with a clear understanding that they should be updated over time to reflect increasing knowledge of the science and economics of climate impacts.

As part of the interagency process that developed these SCC estimates, technical experts from numerous agencies met on a regular basis to consider public comments, explore the technical literature in relevant fields, and discuss key model inputs and assumptions. The main objective of this process was to develop a range of SCC values using a defensible set of input assumptions grounded in the existing scientific and economic literatures. In this way, key uncertainties and model differences transparently and consistently inform the range of SCC estimates used in the rulemaking process.

a. Monetizing Carbon Dioxide Emissions

The SCC is an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services. Estimates of the social cost of carbon are provided in dollars per metric ton of carbon dioxide.

When attempting to assess the incremental economic impacts of carbon dioxide emissions, the analyst faces a number of serious challenges. A recent report from the National Research Council [39] points out that any assessment will suffer from uncertainty, speculation, and lack of information about (1) Future emissions of greenhouse gases, (2) the effects of past and future emissions on the climate system, (3) the impact of changes in climate on the physical and biological environment, and (4) the translation of these environmental impacts into economic damages. As a result, any effort to quantify and monetize the harms associated with climate change will raise serious questions of science, economics, and ethics and should be viewed as provisional.

Despite the serious limits of both quantification and monetization, SCC estimates can be useful in estimating the social benefits of reducing carbon dioxide emissions. Consistent with the directive quoted above, the purpose of the SCC estimates presented here is to make it possible for agencies to incorporate the social benefits from reducing carbon dioxide emissions into cost-benefit analyses of regulatory actions that have small, or ''marginal,'' impacts on cumulative global emissions. Most Federal regulatory actions can be expected to have marginal impacts on global emissions.

For such policies, the agency can estimate the benefits from reduced (or costs from increased) emissions in any future year by multiplying the change in emissions in that year by the SCC value appropriate for that year. The net present value of the benefits can then be calculated by multiplying each of these future benefits by an appropriate discount factor and summing across all affected years. This approach assumes that the marginal damages from increased emissions are constant for small departures from the baseline emissions path, an approximation that is reasonable for policies that have effects on emissions that are small relative to cumulative global carbon dioxide emissions. For policies that have a large (non-marginal) impact on global cumulative emissions, there is a separate question of whether the SCC is an appropriate tool for calculating the benefits of reduced emissions. DOE does not attempt to answer that question here.

At the time of the preparation of the notice, the most recent interagency estimates of the potential global benefits resulting from reduced CO_2 emissions in 2010, expressed in 2009$, were $4.9, $22.1, $36.3, and $67.1 per metric ton avoided. For emission reductions that occur in later years, these values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic

[39] National Research Council. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use.* National Academies Press: Washington, DC. 2009.

effects,[40] although preference is given to consideration of the global benefits of reducing CO_2 emissions.

It is important to emphasize that the interagency process is committed to updating these estimates as the science and economic understanding of climate change and its impacts on society improves over time. Specifically, the interagency group has set a preliminary goal of revisiting the SCC values within two years or at such time as substantially updated models become available, and to continue to support research in this area. In the meantime, the interagency group will continue to explore the issues raised by this analysis and consider public comments as part of the ongoing interagency process.

b. Social Cost of Carbon Values Used in Past Regulatory Analyses

To date, economic analyses for Federal regulations have used a wide range of values to estimate the benefits associated with reducing carbon dioxide emissions. In the final model year 2011 CAFE rule, the Department of Transportation (DOT) used both a ''domestic'' SCC value of $2 per ton of CO_2 and a ''global'' SCC value of $33 per ton of CO_2 for 2007 emission reductions (in 2007 dollars), increasing both values at 2.4 percent per year.[41] See *Average Fuel Economy Standards Passenger Cars and Light Trucks Model Year 2011,* 74 FR 14196 (March 30, 2009); Final Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015 at 3–90 (Oct. 2008) (Available at: *http://www.nhtsa.gov/fuel-economy*). It also included a sensitivity analysis at $80 per ton of CO_2. A domestic SCC value is meant to reflect the value of damages in the United States resulting from a unit change in carbon dioxide emissions, while a global SCC value is meant to reflect the value of damages worldwide.

A 2008 regulation proposed by DOT assumed a domestic SCC value of $7 per ton of CO_2 (in 2006 dollars) for 2011 emission reductions (with a range of $0–$14 for sensitivity analysis), also increasing at 2.4 percent per year. See *Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015,* 73 FR 24352 (May 2, 2008); Draft Environmental Impact Statement Corporate Average Fuel Economy Standards, Passenger Cars and Light Trucks, Model Years 2011–2015 at 3–58 (June 2008) (Available at: *http://www.nhtsa.gov/fuel-economy*). A regulation for packaged terminal air conditioners and packaged terminal heat pumps finalized by DOE in October of 2008 used a domestic SCC range of $0 to $20 per ton CO_2 for 2007 emission reductions (in 2007 dollars). 73 FR 58772, 58814 (Oct. 7, 2008) In addition, EPA's 2008 Advance Notice of Proposed Rulemaking for Greenhouse Gases identified what it described as ''very preliminary'' SCC estimates subject to revision. See *Regulating Greenhouse Gas Emissions Under the Clean Air Ac*t, 73 FR 44354 (July 30, 2008). EPA's global mean values were $68 and $40 per ton CO_2 for discount rates of approximately 2 percent and 3 percent, respectively (in 2006 dollars for 2007 emissions).

In 2009, an interagency process was initiated to offer a preliminary assessment of how best to quantify the benefits from reducing carbon dioxide emissions. To ensure consistency in how benefits are evaluated across agencies, the Administration sought to develop a transparent and defensible method, specifically designed for the rulemaking process, to quantify avoided climate change damages from reduced CO_2 emissions. The interagency group did not undertake any original analysis. Instead, it combined SCC estimates from the existing literature to use as interim values until a more comprehensive analysis could be conducted. The outcome of the preliminary assessment by the interagency group was a set of five interim values: Global SCC estimates for 2007 (in 2006 dollars) of $55, $33, $19, $10, and $5 per ton of CO_2.

These interim values represent the first sustained interagency effort within the U.S. government to develop an SCC for use in regulatory analysis. The results of this preliminary effort were presented in several proposed and final rules and were offered for public comment in connection with proposed rules, including the joint EPA–DOT fuel economy and CO_2 tailpipe emission proposed rules. See CAFE Rule for Passenger Cars and Light Trucks Draft EIS and Final EIS, cited above.

c. Current Approach and Key Assumptions

Since the release of the interim values, the interagency group reconvened on a regular basis to generate improved SCC estimates considered for this amended rule. Specifically, the group considered public comments and further explored the technical literature in relevant fields.

The interagency group relied on three integrated assessment models (IAMs) commonly used to estimate the SCC: The FUND, DICE, and PAGE models.[42] These models are frequently cited in the peer-reviewed literature and were used in the last assessment of the Intergovernmental Panel on Climate Change. Each model was given equal weight in the SCC values that were developed.

Each model takes a slightly different approach to model how changes in emissions result in changes in economic damages. A key objective of the interagency process was to enable a consistent exploration of the three models while respecting the different approaches to quantifying damages taken by the key modelers in the field. An extensive review of the literature was conducted to select three sets of input parameters for these models: Climate sensitivity, socio-economic and emissions trajectories, and discount rates. A probability distribution for climate sensitivity was specified as an input into all three models. In addition, the interagency group used a range of scenarios for the socio-economic parameters and a range of values for the discount rate. All other model features were left unchanged, relying on the model developers' best estimates and judgments.

The interagency group selected four SCC values for use in regulatory analyses. Three values are based on the average SCC from the three IAMs, at discount rates of 2.5, 3, and 5 percent. The fourth value, which represents the 95th percentile SCC estimate across all three models at a 3 percent discount rate, is included to represent higher-than-expected impacts from temperature change further out in the tails of the SCC distribution. For emissions (or emission reductions) that occur in later years, the SCC values grow in real terms over time, as depicted in Table IV.7.

[40] It is recognized that this calculation for domestic values is approximate, provisional, and highly speculative. There is no a priori reason why domestic benefits should be a constant fraction of net global damages over time.

[41] Values per ton of CO_2 given in this section refer to metric tons.

[42] The models are described in appendix 16–A of the final rule TSD.

TABLE IV.7—SCC VALUES FROM INTERAGENCY PROCESS, 2010–2050
[2007 Dollars per metric ton]

	Discount rate			
	5% Avg	3% Avg	2.5% Avg	3% 95th
2010	4.7	21.4	35.1	64.9
2015	5.7	23.8	38.4	72.8
2020	6.8	26.3	41.7	80.7
2025	8.2	29.6	45.9	90.4
2030	9.7	32.8	50.0	100.0
2035	11.2	36.0	54.2	109.7
2040	12.7	39.2	58.4	119.3
2045	14.2	42.1	61.7	127.8
2050	15.7	44.9	65.0	136.2

It is important to recognize that a number of key uncertainties remain, and that current SCC estimates should be treated as provisional and revisable since they will evolve with improved scientific and economic understanding. The interagency group also recognizes that the existing models are imperfect and incomplete. The National Research Council report mentioned above points out that there is tension between the goal of producing quantified estimates of the economic damages from an incremental ton of carbon and the limits of existing efforts to model these effects. There are a number of concerns and problems that should be addressed by the research community, including research programs housed in many of the agencies participating in the interagency process to estimate the SCC.

The U.S. Government intends to periodically review and reconsider estimates of the SCC used for cost-benefit analyses to reflect increasing knowledge of the science and economics of climate impacts, as well as improvements in modeling. In this context, statements recognizing the limitations of the analysis and calling for further research take on exceptional significance. The interagency group offers the new SCC values with all due humility about the uncertainties embedded in them and with a sincere promise to continue work to improve them.

In summary, in considering the potential global benefits resulting from reduced CO_2 emissions, DOE used the most recent values identified by the interagency process, adjusted to 2009$ using the GDP price deflator values for 2008 and 2009. For each of the four cases specified, the values used for emissions in 2010 were $4.9, $22.1, $36.3, and $67.1 per metric ton avoided (values expressed in 2009$). To monetize the CO_2 emissions reductions expected to result from amended standards for refrigeration products in 2014–2043, DOE used the values identified in Table A1 of the ''Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,'' which is reprinted in appendix 15–A of the final rule TSD, appropriately escalated to 2009$.[43] To calculate a present value of the stream of monetary values, DOE discounted the values in each of the four cases using the specific discount rate that had been used to obtain the SCC values in each case.

2. Valuation of Other Emissions Reductions

DOE investigated the potential monetary benefit of reduced NO_X emissions from the TSLs it considered. As noted above, new or amended energy conservation standards would reduce NO_X emissions in those 22 States that are not affected by the CAIR. DOE estimated the monetized value of NO_X emissions reductions resulting from each of the TSLs considered for today's NOPR based on environmental damage estimates from the literature. Available estimates suggest a very wide range of monetary values, ranging from $370 per ton to $3,800 per ton of NO_X from stationary sources, measured in 2001$ (equivalent to a range of $447 to $4,591 per ton in 2009$).[44] In accordance with OMB guidance, DOE conducted two calculations of the monetary benefits derived using each of the economic values used for NO_X, one using a real discount rate of 3 percent and another using a real discount rate of 7 percent.[45]

[43] Table A1 presents SCC values through 2050. For DOE's calculation, it derived values after 2050 using the 3-percent per year escalation rate used by the interagency group.

[44] For additional information, refer to U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, ''2006 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities,'' Washington, DC.

[45] OMB, Circular A–4: Regulatory Analysis (Sept. 17, 2003).

DOE is aware of multiple agency efforts to determine the appropriate range of values used in evaluating the potential economic benefits of reduced Hg emissions. DOE has decided to await further guidance regarding consistent valuation and reporting of Hg emissions before it once again monetizes Hg in its rulemakings.

V. Discussion of Other Comments

The following section discusses comments received by DOE related to other issues. In general, these issues involved subjects that generally fell outside of the framework described in detail above.

A. Demand Response

This section discusses comments received regarding demand response or smart grid controls. These are controls that can react to signals from utilities or other external organizations and alter the product's operation. This capability might be used to allow utilities to reduce energy use during peak demand hours by reducing the power input of many connected appliances.

DOE received comments on this topic during the preliminary analysis phase from LG, the U.S. Navy, and the IOUs. (LG, No. 44 at p. 5; USN, No. 35 at p. 2; IOUs, No. 39 at p. 13). DOE explained in the NOPR that it did not consider a demand response feature, in part because of the uncertainty of overall benefits and the limitations of the legal framework under which DOE would be able to pursue such a design requirement approach. 75 FR at 59530 (September 27, 2010).

AHAM disagreed with DOE's conclusion that demand response would not contribute significantly to energy use. (AHAM, No. 73 at p. 9) However, AHAM's comments did not provide any information quantifying the potential energy savings associated with implementation of demand response in refrigeration products. The highlighted conclusions of the Electric Power

Research Institute study cited by AHAM do not even explicitly indicate that refrigeration product demand response contributed to energy savings. (Id.) AHAM further indicates that demand response applied to appliances including refrigeration products would help to enable use of renewable energy sources. (AHAM, No. 73 at pp. 9–10)

DOE notes that this rulemaking involves the amending of an energy conservation standard for refrigeration products. The term ''energy conservation standard'' is defined as either a performance standard that prescribes a minimum level of energy efficiency or maximum amount of energy use or a design standard for certain specified products. As DOE stated previously, creating a design standard as an energy conservation standard is limited to specific enumerated consumer products under 42 U.S.C. 6291(6). See 75 FR at 59530 (September 27, 2010). Since setting a demand response feature requirement would be the same as setting a design standard, DOE must look to those products for which it has the authority to set design standards. As DOE also pointed out, refrigeration products are not within this list. Commenters made no effort to challenge the validity of this view, citing instead to policy-related initiatives that highlighted the potential benefits associated with smart grid approaches. While the issues cited by commenters are clearly important issues, they do not obviate the requirement that DOE act within the boundaries of its authority within the context of this rulemaking. Accordingly, DOE did not incorporate a demand response feature requirement as part of today's final rule.[46]

B. Energy Standard Round-Off

The NOPR discussed the adoption of a round-off when reporting energy test results. This approach, explained in greater detail in the test procedure NOPR, would require manufacturers to report the measured energy consumption to the nearest kWh/year based on consideration of achievable measurement accuracy. 75 FR at 29849 (May 27, 2010). The energy standard NOPR explained that similar round-off was necessary to avoid meaningless indications of non-compliance. DOE also requested comment on the implementation of energy standard round-off. 75 FR at 59570 (September 27, 2010).

AHAM supported using a round-off when calculating the energy standard using the energy standard equations for refrigeration products. (AHAM, Public Meeting Transcript, No. 67 at p. 94; AHAM, No. 73 at p. 10) Whirlpool concurred with this approach. (Whirlpool, No. 74 at p. 6) No commenter objected to the round-off approach.

DOE has implemented the energy use round-off approach as part of the test procedure final rule. As a result, manufacturers must follow this approach when reporting the energy consumption of its refrigeration products. The test procedure rule includes a round-off for the calculation of the energy standard when using the appropriate energy standard equations. See 75 FR at 78831–78832 (December 16, 2010).

C. Trial Standard Levels and Proposed Standards

1. Efficiency Levels

Many stakeholders supported DOE's selection of efficiency levels that mirrored the levels of the negotiated agreement. (AHAM, No. 73 at p. 1; IOUs, No. 77 at p. 1; PGEC, No. 68 at p. 1; JAC, No. 75 at p. 1) Sub Zero supported the selection of efficiency levels for built-ins that mirrored the negotiated agreement while indicating that the analyses suggest that less stringent levels would also have been appropriate. (Sub Zero, No. 69 at p. 5) Whirlpool supported the selection of efficiency levels for built-in products, subject to DOE's adoption of the built-in product definition developed for the consensus agreement. (Whirlpool, No. 74 at p. 6)

However, concerns about the negotiated levels for numerous products were expressed by other stakeholders, primarily utilities and organizations representing utilities. EEI and APPA expressed concern about the standard levels chosen for bottom-mount refrigerator-freezers, built-in bottom-mount refrigerator-freezers, and compact refrigerators and did not endorse the standard levels chosen for top-mount refrigerator-freezers, side-by-side refrigerator-freezers, built-in all-refrigerators, built-in side-by-side refrigerators, and built-in upright freezers. (EEI, No. 71 at pp. 3–4; APPA, No. 72 at pp. 2–3) SC expressed concern about selection of any standard levels above the levels of reasonable life cycle costs . (SC, No. 70 at p. 2) These concerns are based on (1) the percentage of consumers determined to experience life cycle cost benefits being uncertain or too high, and (2) the implication that DOE used the social cost of carbon dioxide emissions combined with consumer economics to justify the chosen standard levels. (EEI, No. 71 at p. 2; APPA, No. 72 at pp. 1–2; SC, No. 70 at p. 2) Moreover, SC argued that replacement of an older refrigerator with one meeting the current 2001 standard would save 23 times more energy. (SC, No. 70 at p. 2)

Responding to the concern about the percentage of consumers determined to experience a net life cycle cost, DOE must consider a range of factors in setting efficiency levels (see section II.A), and for almost all product classes, the net savings per consumer is positive.

Regarding the implication that DOE used the societal cost of carbon dioxide emissions to help justify the chosen standard levels, DOE did not, in fact, combine the societal cost of carbon with consumer economics in any of its calculations, but rather considered the positive benefit of reducing the societal cost of carbon, as part of a general assessment of environmental benefits, in making its final determination. Environmental benefits are an important rationale for national energy conservation, especially because the energy prices paid by consumers do not include some of the environmental costs associated with their use of energy. Energy savings from energy conservation standards often result in environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with energy production. DOE analyzed the environmental effects from the amended standards for refrigeration products, and from each TSL it considered, in the environmental assessment, which is described in section IV.L of this notice and in chapter 15 of the TSD. As a companion to the quantitative analysis in the environmental assessment, DOE also estimated a range of the economic value of emissions reductions resulting from the considered TSLs, as described in section IV.M of this notice.

With respect to the replacement of old refrigerators in lieu of a more stringent standard, this case was considered as an alternative regulatory policy in chapter 16 of the TSD. DOE found that the impact of such a policy would be, in all cases, much less effective than a new standard.

The PRC commented that the maximum energy use of the proposed standards was lower than the current ENERGY STAR levels for product classes 8, 9, 10, 10A, and 13A, suggested that the current ENERGY STAR levels reflect current advanced technologies and achieve the purpose of ''protection of the environment and consumers'',

[46] The inclusion of a demand response feature within these products would also require considerable analysis for which DOE has no data.

and recommended that the maximum allowable energy use be no lower than the current ENERGY STAR levels. (PRC, No. 87 at p. 3) In response, DOE first notes that ENERGY STAR is a voluntary program. As such, manufacturers do not need to meet these levels unless they wish to produce ENERGY STAR-qualified products. Second, DOE is required by EPCA to consider all feasible technology levels, regardless of whether they represent less energy use than current ENERGY STAR levels, and to set a standard at the most efficient and feasible level that is economically justified. (42 U.S.C. 6295(o)(2)(A)) Accordingly, the non-mandatory nature of ENERGY STAR, coupled with the mandatory nature of EPCA's statutory requirement to promulgate new standards cut in favor of today's action.

The PRC also commented that the standard levels proposed for product classes 5A, 6, 7, and 7–BI were not very stringent, being very close to their current standard levels expressed in kWh/year, even though the ENERGY STAR efficiency level has been set at a level representing 20 percent less energy consumption. The PRC provided an example of a product class 7 product with 500 liter adjusted volume, for which the proposed energy standard is 581.1 kWh/year, while the current standard is only slightly higher at 283.7 kWh/year. (PRC, No. 87 at p. 4) DOE believes that the PRC's 283.7 kWh/year value is in error and should have been 583.7 kWh/year. DOE notes that these values cannot be directly compared, because the new energy standard is based on the new test procedure, for which both measured energy use and the calculated adjusted volume are altered.

SMUD made two comments regarding the selection of standard levels. First, SMUD noted that DOE indicated that it was considering either increasing or decreasing the stringency of the proposed levels based on stakeholder comments. It recommended that DOE not consider any decreased stringency. (SMUD, No. 88 at pp. 1, 2) DOE has not altered the standards from those proposed in the NOPR. Second, SMUD noted that the NOPR stated that products of the efficiency levels of the proposed standards are already commercially available for some, if not most, of the product classes. (See 75 FR at 59474 (September 27, 2010)) SMUD recommended moving the standards to efficiency levels more stringent than those of commercially available products, since these higher levels should be viable. (Id. at p. 2) As described above, DOE is required by EPCA to consider all feasible technology levels and that it must set the standard at the most efficient of these feasible levels that is economically justified. (42 U.S.C. 6295(o)(2)(A)) The commercial availability of products at a specific efficiency level, alone, is not sufficient justification for setting the standard at a more stringent efficiency level, since the more stringent level may not be economically justified.

2. Maximum Energy Use Equations

Several stakeholders indicated that they could not comment on the specific values represented by the maximum energy use equations because they did not have sufficient time after the issuance of the test procedure final/interim final rule to conduct tests to evaluate the equation levels. (AHAM, No. 73 at pp. 1–2 ; Whirlpool, No. 74 at p. ; GE, No. 76 at pp. 1–2) This is discussed in greater detail in section 0.

VI. Analytical Results

The following section addresses the results from DOE's analyses with respect to potential energy efficiency standards for the various product classes examined as part of this rulemaking. Issues discussed include the trial standard levels examined by DOE, the projected impacts of each of these levels if adopted as energy efficiency standards for refrigeration products, and the standards levels that DOE is adopting in today's final rule. Additional details regarding the analyses conducted by the agency are contained in the publicly available TSD supporting this rulemaking.

A. Trial Standard Levels

DOE analyzed the benefits and burdens of a number of TSLs for the refrigeration products that are the subject of today's final rule. A description of each TSL DOE analyzed is provided below. DOE attempted to limit the number of TSLs considered for today's final rule by excluding efficiency levels that do not exhibit significantly different economic and/or engineering characteristics from the efficiency levels already selected as a TSL. While DOE only presents the results for those efficiency levels in TSL combinations in today's final rule, DOE presents the results for all efficiency levels that it analyzed in the final rule TSD.

Table VI.1 presents the TSLs and the corresponding product class efficiencies for standard-size refrigerator-freezers. TSL 1 consists of those efficiency levels that meet current ENERGY STAR criteria. TSL 2 consists of incrementally higher efficiency levels than the preceding TSL. TSL 3 consists of the highest efficiency levels for which the consumer NPV is positive, using a 7-percent discount rate, as well as the levels recommended in the Joint Comments. TSL 4 consists of those efficiency levels that yield energy use 30 percent below the baseline products, as well as the highest efficiency levels for which the consumer NPV is positive, using a 3-percent discount rate. TSL 5 consists of the max-tech efficiency levels.

TABLE VI.1—TRIAL STANDARD LEVELS FOR STANDARD-SIZE REFRIGERATOR-FREEZERS

Trial standard level	Efficiency level (% less than baseline energy use)		
	Top-mount refrigerator-freezers and all-refrigerators	Bottom-mount refrigerator-freezers	Side-by-side refrigerator-freezers
	Product classes 1, 1A, 2, 3, 3A, 3I and 6	Product classes 5, 5A, and 5I	Product classes 4, 4I, and 7
1	3 (20)	3 (20)	3 (20)
2	3(20)	3 (20)	4 (25)
3	*4 (25)	3 (20)	4 (25)
4	5 (30)	5 (30)	5 (30)
5	6 (36)	6 (36)	6 (33)

*Level for product classes 1, 1A, and 2 is 20%.

Table VI.2 presents the TSLs and the corresponding product class efficiencies for standard-size freezers. TSL 1 consists of those efficiency levels that yield energy use 20 percent below the baseline products. TSL 2 consists of the levels recommended in the Joint Comments. TSL 3 consists of incrementally higher efficiency levels than the preceding TSL. TSL 4 consists of incrementally higher efficiency levels than the preceding TSL. TSL 5 consists of the max-tech efficiency levels, which are also the highest efficiency levels for which the consumer NPV is positive, using both a 3-percent and a 7-percent discount rate.

TABLE VI.2—TRIAL STANDARD LEVELS FOR STANDARD-SIZE FREEZERS

Trial standard level	Efficiency level (% less than baseline energy use)		
	Upright freezers		Chest freezers
	Product classes 9 and 9I	Product class 8	Product classes 10 and 10A
1	3 (20)	3 (20)	3 (20)
2	5 (30)	4 (25)	*4 (25)
3	6 (35)	5 (30)	5 (30)
4	7 (40)	6 (35)	6 (35)
5	8 (44)	7 (41)	7 (41)

*Level for product class 10A is 30%.

Table VI.3 presents the TSLs and the corresponding product class efficiencies for compact refrigeration products. TSL 1 consists of efficiency levels that meet current ENERGY STAR criteria for some compact refrigerators (product classes 11, 11A, and 12), and efficiency levels that are 10 percent below the baseline energy use for other compact refrigerators (product classes 13, 13I, 13A, 14, 14I, 15 and 15I) and compact freezers (product classes 16, 17, and 18). TSL 2 consists of the levels recommended in the Joint Comments. TSL 3 consists of incrementally higher efficiency levels than the previous TSL. TSL 4 consists of the highest efficiency levels for which the consumer NPV is positive, using both a 3-percent and a 7-percent discount rate. TSL 5 consists of the max-tech efficiency levels.

TABLE VI.3—TRIAL STANDARD LEVELS FOR COMPACT REFRIGERATION PRODUCTS

Trial standard level	Efficiency level (% less than baseline energy use)		
	Compact refrigerators and refrigerator-freezers		Compact freezers
	Product classes 11, 11A, 12	Product classes 13, 13I, 13A, 14, 14I, 15, 15I	Product classes 16, 17, 18
1	3 (20)	1 (10)	1 (10)
2	4 (25)	*2 (15)	1 (10)
3	5 (30)	2 (15)	2 (15)
4	7 (40)	4 (25)	4 (25)
5	10 (59)	7 (42)	7 (42)

*Level for product class 13A is 25 percent, and for product classes 14 and 14I is 20 percent.

Table VI.4 presents the TSLs and the corresponding product class efficiencies for built-in refrigeration products. TSL 1 consists of the efficiency levels that are 10 percent better than the current standard. TSL 2 consists of the highest efficiency levels for which the consumer NPV is positive, using both a 3-percent and a 7-percent discount rate. TSL 3 consists of the levels recommended in the Joint Comments. TSL 4 consists of incrementally higher efficiency levels than TSL 3. TSL 5 consists of the max-tech efficiency levels.

TABLE VI.4—TRIAL STANDARD LEVELS FOR BUILT-IN REFRIGERATION PRODUCTS

Trial standard level	Efficiency level (% less than baseline energy use)			
	Built-in top-mount refrigerator-freezers and all-refrigerators	Built-in bottom-mount refrigerator-freezers	Built-in side-by-side refrigerator-freezers	Built-in upright freezers
	Product classes 3–BI, 3I–BI, and 3A–BI	Product classes 5–BI, 5I–BI, and 5A–BI	Product classes 4–BI, 4I–BI and 7–BI	Product classes 9–BI and 9I–BI
1	1 (10)	1 (10)	1 (10)	1 (10)
2	2 (15)	2 (15)	1 (10)	3 (20)
3	3 (20)	2 (15)	3 (20)	4 (25)
4	4 (25)	4 (25)	3 (20)	4 (25)

TABLE VI.4—TRIAL STANDARD LEVELS FOR BUILT-IN REFRIGERATION PRODUCTS—Continued

Trial standard level	Efficiency level (% less than baseline energy use)			
	Built-in top-mount refrigerator-freezers and all-refrigerators	Built-in bottom-mount refrigerator-freezers	Built-in side-by-side refrigerator-freezers	Built-in upright freezers
	Product classes 3–BI, 3I–BI, and 3A–BI	Product classes 5–BI, 5I–BI, and 5A–BI	Product classes 4–BI, 4I–BI and 7–BI	Product classes 9–BI and 9I–BI
5	5 (29)	5 (27)	4 (22)	5 (27)

B. Economic Justification and Energy Savings

1. Economic Impacts on Individual Consumers

a. Life-Cycle Cost and Payback Period

Consumers affected by new or amended standards usually experience higher purchase prices and lower operating costs. DOE evaluates these impacts on individual consumers by calculating changes in LCC and the PBP associated with potential standard levels. Using the approach described in section IV.F, DOE calculated the LCC impacts and PBPs for the efficiency levels considered in this rulemaking. For each representative product class, DOE's analysis provided several outputs for each TSL, which are reported in Table VI.5 through Table VI.15. Each table includes the average total LCC and the average LCC savings, as well as the fraction of product consumers for which the LCC will either decrease (net benefit), increase (net cost), or exhibit no change (no impact) relative to the product purchased in the base case. The last output in the tables is the median PBP for the consumer purchasing a design that complies with a given TSL. The results for each TSL are relative to the energy efficiency distribution in the base case (no amended standards). DOE based the LCC and PBP analyses on energy consumption under conditions of actual product use, whereas it based the rebuttable presumption PBPs on energy consumption under conditions prescribed by the DOE test procedure, as required by EPCA. (42 U.S.C. 6295(o)(2)(B)(iii))

TABLE VI.5—PRODUCT CLASS 3, TOP-MOUNT REFRIGERATOR-FREEZERS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			
						Net cost	No impact	Net benefit	Median
	Baseline	$491	$787	$1,278					
	1 (10)	501	730	1,231	46	0.28	21.9	77.8	2.3
	2 (15)	508	701	1,209	69	0.60	17.6	81.8	2.6
1, 2	3 (20)	564	671	1,235	44	34.0	8.31	57.7	8.0
3	4 (25)	602	634	1,236	42	45.7	0.0	54.3	9.5
4	5 (30)	686	598	1,284	−6	65.1	0.0	34.9	13.3
5	6 (36)	806	560	1,365	−87	79.7	0.0	20.3	17.8

TABLE VI.6—PRODUCT CLASS 5, BOTTOM-MOUNT REFRIGERATOR-FREEZERS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			
						Net cost	No impact	Net benefit	Median
	Baseline	$858	$970	$1,828					
	1 (10)	860	961	1,820	9	0.02	86.9	13.1	2.1
	2 (15)	861	956	1,817	14	0.05	86.9	13.1	2.3
1, 2, 3	3 (20)	867	943	1,809	22	2.53	67.8	29.7	4.2
	4 (25)	926	901	1,827	5	67.9	0.03	32.0	14.9
4	5 (30)	1,023	862	1,885	−53	82.8	0.03	17.2	21.0
5	6 (36)	1,157	810	1,968	−136	89.0	0.00	11.1	24.7

TABLE VI.7—PRODUCT CLASS 7, SIDE-BY-SIDE REFRIGERATOR-FREEZERS WITH THROUGH-THE-DOOR ICE SERVICE: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			
						Net cost	No impact	Net benefit	Median
	Baseline	$1,040	$1,252	$2,292					

TABLE VI.7—PRODUCT CLASS 7, SIDE-BY-SIDE REFRIGERATOR-FREEZERS WITH THROUGH-THE-DOOR ICE SERVICE: LCC AND PBP RESULTS—Continued

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			Median
						Net cost	No impact	Net benefit	
	1 (10)	1,043	1,228	2,271	22	0.00	78.1	21.9	1.3
	2 (15)	1,048	1,202	2,249	44	0.06	51.7	48.3	2.1
1	3 (20)	1,064	1,167	2,232	62	4.27	36.9	58.8	4.0
2, 3	4 (25)	1,123	1,114	2,237	57	41.5	0.00	58.6	9.2
4	5 (30)	1,251	1,061	2,312	−18	69.7	0.00	30.3	15.6
5	6 (33)	1,351	1,026	2,377	−83	79.5	0.00	20.5	19.1

TABLE VI.8—PRODUCT CLASS 9, UPRIGHT FREEZERS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback Period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			Median
						Net cost	No impact	Net benefit	
	Baseline	$505	$1,098	$1,603					
	1 (10)	516	1,015	1,530	73	0.25	19.9	79.9	1.9
	2 (15)	535	964	1,499	105	5.02	1.67	93.3	3.6
1	3 (20)	552	912	1,464	140	6.03	0.59	93.4	4.0
	4 (25)	578	859	1,437	166	9.58	0.41	90.0	4.9
2	5 (30)	602	806	1,408	195	11.5	0.22	88.2	5.3
3	6 (35)	656	758	1,414	189	21.9	0.00	78.1	7.1
4	7 (40)	731	711	1,442	161	34.6	0.00	65.4	9.3
5	8 (44)	898	673	1,570	33	59.7	0.00	40.3	14.7

TABLE VI.9—PRODUCT CLASS 10, CHEST FREEZER: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			Median
						Net cost	No impact	Net benefit	
	Baseline	$367	$623	$990					
	1 (10)	373	573	947	43	0.20	16.2	83.6	2.0
	2 (15)	383	544	927	63	3.01	1.18	95.8	3.2
1	3 (20)	393	515	908	82	5.14	0.22	94.6	3.9
2	4 (25)	436	485	921	69	27.3	0.22	72.5	8.1
3	5 (30)	456	455	911	79	29.1	0.22	70.6	8.5
4	6 (35)	510	433	943	47	48.7	0.00	51.4	12.1
5	7 (41)	620	395	1,015	−25	69.1	0.00	31.0	17.8

TABLE VI.10—PRODUCT CLASS 11, COMPACT REFRIGERATORS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			Median
						Net cost	No impact	Net benefit	
	Baseline	$131	$167	$298					
	1 (10)	137	151	287	11	9.01	1.60	89.4	1.8
	2 (15)	141	143	284	14	13.6	1.39	85.0	2.1
1	3 (20)	146	135	281	17	19.7	1.39	79.0	2.5
2	4 (25)	157	127	284	14	36.8	1.00	62.3	3.5
3	5 (30)	166	119	285	13	43.4	0.92	55.6	3.9
	6 (35)	192	112	304	−6	71.3	0.00	28.7	6.0
4	7 (40)	199	104	303	−5	69.8	0.00	30.2	5.8
	8 (45)	230	97	327	−29	83.5	0.00	16.5	7.7
	9 (50)	247	89	336	−38	85.4	0.00	14.6	8.0
5	10 (59)	308	75	383	−85	92.2	0.00	7.85	10.4

TABLE VI.11—PRODUCT CLASS 18, COMPACT FREEZERS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience: Net cost	No impact	Net benefit	Median
	Baseline	$182	$200	$382					
1, 2	1 (10)	189	182	370	12	7.98	4.66	87.4	2.2
3	2 (15)	201	172	373	9	33.9	0.00	66.1	4.2
	3 (20)	242	163	404	−22	87.4	0.00	12.6	9.8
4	4 (25)	252	153	405	−23	84.5	0.00	15.5	9.1
	5 (30)	282	146	428	−46	92.4	0.00	7.6	11.4
	6 (35)	289	137	426	−44	89.6	0.00	10.4	10.4
5	7 (42)	360	124	484	−102	96.7	0.00	3.3	14.4

TABLE VI.12—PRODUCT CLASS 3A–BI, BUILT-IN ALL-REFRIGERATORS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience: Net cost	No impact	Net benefit	Median
	Baseline	$4,316	$828	$5,144					
1	1 (10)	4,323	769	5,091	52	0.02	22.6	77.4	1.4
2	2 (15)	4,334	739	5,073	71	0.94	18.4	80.7	2.6
3	3 (20)	4,452	703	5,155	−11	61.5	9.10	29.4	13.7
4	4 (25)	4,625	670	5,295	−151	91.0	0.00	9.02	25.5
5	5 (29)	4,756	646	5,402	−258	95.0	0.00	5.01	31.4

TABLE VI.13—PRODUCT CLASS 5–BI, BUILT-IN BOTTOM-MOUNT REFRIGERATOR-FREEZERS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience: Net cost	No impact	Net benefit	Median
	Baseline	$4,968	$960	$5,928					
1	1 (10)	4,972	951	5,923	$8	0.60	87.1	12.3	3.8
2, 3	2 (15)	4,982	957	5,939	2	7.03	87.0	5.94	11.1
	3 (20)	5,013	943	5,955	−14	27.4	67.5	5.09	22.3
4	4 (25)	5,168	911	6,079	−138	98.0	0.00	2.03	52.8
5	5 (27)	5,257	891	6,148	−207	98.5	0.00	1.50	52.2

TABLE VI.14—PRODUCT CLASS 7–BI, BUILT-IN SIDE-BY-SIDE REFRIGERATOR-FREEZERS WITH THROUGH-THE-DOOR ICE SERVICE: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience: Net cost	No impact	Net benefit	Median
	Baseline	$7,134	$1,494	$8,628					
1, 2	1 (10)	7,147	1,476	8,623	$10	5.77	78.5	15.7	7.5
	2 (15)	7,188	1,459	8,647	−9	36.4	52.4	11.2	17.6
3, 4	3 (20)	7,307	1,423	8,729	−91	58.5	37.2	4.28	31.0
5	4 (22)	7,414	1,405	8,820	−182	97.6	0.00	2.40	50.4

TABLE VI.15—PRODUCT CLASS 9–BI, BUILT-IN UPRIGHT FREEZERS: LCC AND PBP RESULTS

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience: Net cost	No impact	Net benefit	Median
	Baseline	$3,928	$1,071	$4,999					
1	1 (10)	3,943	990	4,933	$66	1.53	19.9	78.6	2.9
	2 (15)	3,956	942	4,898	101	3.99	1.70	94.3	3.6
2	3 (20)	4,042	898	4,940	59	42.9	0.57	56.5	10.7

TABLE VI.15—PRODUCT CLASS 9–BI, BUILT-IN UPRIGHT FREEZERS: LCC AND PBP RESULTS—Continued

Trial standard level	Efficiency level (% less than baseline energy use)	Life-cycle cost 2009$			Life-cycle cost savings				Payback period (years)
		Installed cost	Discounted operating cost	LCC	Average savings 2009$	% of households that experience			
						Net cost	No impact	Net benefit	Median
3, 4	4 (25)	4,176	847	5,023	−23	68.8	0.49	30.7	17.8
5	5 (27)	4,278	822	5,100	−101	79.8	0.27	20.0	22.6

b. Consumer Subgroup Analysis

As described in section IV.H, DOE determined the impact of the considered TSLs on low-income households and senior-only households. DOE did not estimate impacts for compact refrigeration products because the household sample sizes were not large enough to yield meaningful results.

Table VI.16 through Table VI.18 compare the average LCC savings at each efficiency level for the two consumer subgroups with the average LCC savings for the entire sample for each representative product class. In general, the average LCC savings for low-income households and senior-only households at the considered efficiency levels are not substantially different from the average for all households. Chapter 11 of the final rule TSD presents the complete LCC and PBP results for the two subgroups.

TABLE VI.16—STANDARD-SIZE REFRIGERATOR-FREEZERS: COMPARISON OF AVERAGE LCC SAVINGS FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS

Efficiency level (% less than baseline energy use)	Top-mount refrigerator-freezers			Bottom-mount refrigerator-freezers			Side-by-side refrigerator-freezers		
	Product class 3			Product class 5			Product class 7		
	Senior	Low-income	All	Senior	Low-income	All	Senior	Low-income	All
1 (10)	$43	$49	$46	$9	$10	$9	$22	$23	$22
2 (15)	64	73	69	13	15	14	42	46	44
3 (20)	36	48	43	21	24	22	59	64	62
4 (25)	31	47	41	−1	6	5	48	56	57
5 (30)	−20	0	−7	−63	−52	−54	−31	−23	−18
6 (36/36/33)	−105	−81	−89	−151	−136	−137	−100	−91	−85

TABLE VI.17—STANDARD-SIZE FREEZERS: COMPARISON OF AVERAGE LCC SAVINGS FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS

Efficiency level (% less than baseline energy use)	Upright freezers			Chest freezers		
	Product class 9			Product class 10		
	Senior	Low-income	All	Senior	Low-income	All
1 (10)	$69	$69	$73	$45	$42	$43
2 (15)	98	98	105	66	61	63
3 (20)	130	129	139	86	79	82
4 (25)	153	153	166	74	65	68
5 (30)	179	179	195	$85	$75	79
6 (35)	170	170	189	54	42	47
7 (40/41)	139	139	160	−18	−32	−26
8 (44)	8	8	32			

TABLE VI.18—BUILT-IN REFRIGERATION PRODUCTS: COMPARISON OF AVERAGE LCC SAVINGS FOR CONSUMER SUBGROUPS AND ALL HOUSEHOLDS

Efficiency level (% less than baseline energy use)	Built-in all refrigerators			Built-in bottom-mount refrigerator-freezers			Built-in side-by-side refrigerator-freezers			Built-in upright freezers		
	Product class 3A–BI			Product class 5–BI			Product class 7–BI			Product class 9–BI		
	Senior	Low-income	All	Senior	Low-income	All	Senior	Low-income	All	Senior	Low-income	All
1 (10)	$48	$54	$52	$7	$8	$8	$8	$9	$10	$61	$61	$66
2 (15)	65	74	71	0	2	2	−15	−14	−9	93	92	101
3 (20)	−25	−14	−12	−19	−17	−15	−107	−109	−92	47	46	58
4 (25/25/22/25)	−170	−155	−152	−148	−141	−139	−199	−201	−183	−39	−41	−24
5 (29/27/-/27)	−280	−263	−260	−219	−210	−208				−119	−121	−102

c. Rebuttable Presumption Payback

As discussed in section III.D.2, EPCA provides a rebuttable presumption that an energy conservation standard is economically justified if the increased purchase cost for a product that meets the standard is less than three times the value of the first-year energy savings resulting from the standard. In calculating a rebuttable presumption payback period for the considered standard levels, DOE used discrete values rather than distributions for input values, and, as required by EPCA, based the energy use calculation on the DOE test procedures for refrigeration products. As a result, DOE calculated a single rebuttable presumption payback value, and not a distribution of payback periods, for each efficiency level. Table VI.19 through Table VI.22 present the average rebuttable presumption payback periods for those efficiency levels where the increased purchase cost for a product that meets a standard at that level is less than three times the value of the first-year energy savings resulting from the standard.

TABLE VI.19—STANDARD-SIZE REFRIGERATOR-FREEZERS: EFFICIENCY LEVELS WITH REBUTTABLE PAYBACK PERIOD LESS THAN THREE YEARS

Product class 3: Top-mount refrigerator-freezer		Product class 5: Bottom-mount refrigerator-freezer		Product class 7: Side-by-side refrigerator-freezer with TTD *	
Efficiency level (% less than baseline energy use)	PBP Years	Efficiency level (% less than baseline energy use)	PBP Years	Efficiency level (% less than baseline energy use)	PBP Years
1 (10)	2.4	1 (10)	2.1	1 (10)	1.4
2 (15)	2.6	2 (15)	2.4	2 (15)	1.7
	....	....	....	3 (20)	2.9

* Through-the-door ice service.

TABLE VI.20—STANDARD-SIZE FREEZERS: EFFICIENCY LEVELS WITH REBUTTABLE PAYBACK PERIOD LESS THAN THREE YEARS

Product class 9: Upright freezer		Product class 10: Chest freezer	
Efficiency level (% less than baseline energy use)	PBP Years	Efficiency level (% less than baseline energy use)	PBP Years
1 (10)	1.9	1 (10)	1.8
	....	2 (15)	2.7

TABLE VI.21—COMPACT REFRIGERATION PRODUCTS: EFFICIENCY LEVELS WITH REBUTTABLE PAYBACK PERIOD LESS THAN THREE YEARS

Product class 11: Compact refrigerator		Product class 18: Compact freezer	
Efficiency level (% less than baseline energy use)	PBP Years	Efficiency level (% less than baseline energy use)	PBP Years
1 (10)	1.8	1 (10)	2.0
2 (15)	2.1	....	....
3 (20)	2.7	....	....

TABLE VI.22—BUILT-IN REFRIGERATION PRODUCTS: EFFICIENCY LEVELS WITH REBUTTABLE PAYBACK PERIOD LESS THAN THREE YEARS

Product class 3A–BI: Built-in all-refrigerator		Product class 5–BI: Built-in bottom-mount refrigerator-freezer		Product class 7–BI: Built-in side-by-side refrigerator-freezer with TTD *		Product class 9–BI: Built-in upright freezer	
Efficiency level (% less than baseline energy use)	PBP Years	Efficiency level (% less than baseline energy use)	PBP Years	Efficiency level (% less than baseline energy use)	PBP Years	Efficiency level (% less than baseline energy use)	PBP Years
1 (10)	1.5	1 (10)	....	1 (10)	....	1 (10)	2.7
2 (15)	2.6	....	....	....	....	....	....

* Through-the-door ice service.

While DOE examined the rebuttable-presumption criterion, it considered whether the standard levels considered for today's rule are economically justified through a more detailed analysis of the economic impacts of these levels pursuant to 42 U.S.C. 6295(o)(2)(B)(i). The results of this analysis serve as the basis for DOE to definitively evaluate the economic justification for a potential standard level (thereby supporting or rebutting the results of any preliminary determination of economic justification).

2. Economic Impacts on Manufacturers

The NOPR MIA used changes in INPV to compare the financial impacts of different TSLs on manufacturers. 75 FR at 59537–59546 (September 27, 2010) (describing the MIA used by DOE in its analysis). DOE presented the industry impacts by the major product types (*i.e.,* standard size refrigerator-freezers, standard size freezers, compact refrigerators and freezers, and built-in refrigeration products). DOE used the GRIM to compare the INPV of the base case (no new energy conservation standards) to that of each TSL for each product grouping. The INPV is the sum of all net cash flows discounted by the industry's cost of capital (discount rate). The difference in INPV between the base case and the standards case is an estimate of the economic impacts that implementing that standard level would have on the entire industry. For today's final rule, DOE continues to use the methodology presented in the NOPR (75 FR at 59519–59526 (September 27, 2010)) and in section 0. The major methodology change DOE made for the final rule was incorporating long term product price trends into the analysis. Since the price trend for residential refrigeration products declines over the analysis period, the base case industry value is lower for all product groupings. Thus, incorporating price trends in the MIA increases the impacts on INPV due to standards.

a. Cash-Flow Analysis Results

The tables below depict the financial impacts on manufacturers (represented by changes in INPV) and the conversion costs DOE estimates manufacturers would incur at each TSL. DOE shows four sets of results, corresponding to the four sets of TSLs considered in this rulemaking. Each set of TSLs reflects the impacts on manufacturers of a certain group of product classes.

Each set of results below shows two tables of INPV impacts: the first table reflects the lower (less severe) bound of impacts and the second represents the upper bound. To evaluate this range of cash-flow impacts on the residential refrigeration products industry, DOE modeled two different scenarios using different markup assumptions. These assumptions correspond to the bounds of a range of market responses that DOE anticipates could occur in the standards case (*i.e.* where amended energy conservation standards apply). Each scenario results in a unique set of cash flows and corresponding industry value at each TSL.

To assess the lower (less severe) end of the range of potential impacts, DOE modeled the flat markup scenario. The flat markup scenario assumes that in the standards case manufacturers would be able to pass the higher production costs required for more efficient products on to their customers. Specifically, the industry would be able to maintain its average base-case gross margin, as a percentage of revenue, despite higher product costs. In general, the larger the product price increases, the less likely manufacturers are able to achieve the cash flow from operations calculated in this scenario because manufacturers would be less likely to be able to fully recoup these costs through larger price increases.

Through its discussions with manufacturers, DOE found that overall profit is driven more by the bundling of product features, such as stainless steel exteriors, ice dispensers, and digital displays, than by energy efficiency characteristics. In other words, more efficient products command higher prices, but these prices are driven by the many other features that are also bundled with increased efficiency. However, the overall profit margin percentage does not vary widely even if the dollar profit per unit increases for products with these additional features. Manufacturers are skeptical that customers would accept higher prices for increased energy efficiency because it does not command higher margins in the current market. Under such a scenario, it follows that the large retailers that compose the relatively concentrated customer base of the industry would not accept manufacturers fully passing through the additional cost of improved efficiency because consumers would be wary of higher prices without additional features. Therefore, to assess the higher (more severe) end of the range of potential impacts, DOE modeled the preservation of operating profit markup scenario in which higher energy conservation standards result in lower manufacturer markups. This scenario models manufacturers' concerns that the higher costs of more efficient technology would harm profitability if the full cost increases cannot be passed on. The scenario represents the upper end of the range of potential impacts on manufacturers because higher production costs erode profit margins and result in lower cash flows from operations.

DOE used the main NIA shipment scenario for both the lower- and higher-bound MIA scenarios that were used to characterize the potential INPV impacts. The shipment forecast is an important driver of the INPV results below. The main NIA shipment scenario includes a price elasticity effect, meaning higher prices in the standards case result in lower shipments. Lower shipments also reduce industry revenue, and, in turn, INPV.

i. Cash-Flow Analysis Results for Standard-Size Refrigerator-Freezers

As part of its cash-flow analysis for standard-size refrigerator-freezers, DOE applied two different scenarios to project the impacts on manufacturers from standards at the various TSLs that DOE considered. The following tables provide those projected impacts under the flat-markup and preservation of operating profit markup scenarios.

TABLE VI.23—MANUFACTURER IMPACT ANALYSIS FOR STANDARD-SIZE REFRIGERATOR-FREEZERS—FLAT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	2,670.1	2,552.2	2,450.9	2,325.1	1,885.1	1,627.9
Change in INPV	(2009$ millions)		(117.8)	(219.2)	(345.0)	(784.9)	(1,042.2)
	(%)		−4.4%	−8.2%	−12.9%	−29.4%	−39.0%
Product Conversion Costs	(2009$ millions)		153	197	229	348	406
Capital Conversion Costs	(2009$ millions)		229	393	620	1,405	2,013
Total Conversion Costs.	(2009$ millions)		382	590	848	1,753	2,419

TABLE VI.24—MANUFACTURER IMPACT ANALYSIS FOR STANDARD-SIZE REFRIGERATOR-FREEZERS—PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	2,670.1	2,417.5	2,274.2	2,089.4	1,360.8	828.6
Change in INPV	(2009$ millions)		(252.6)	(395.9)	(580.7)	(1,309.3)	(1,841.5)
	(%)		−9.5%	−14.8%	−21.7%	−49.0%	−69.0%
Product Conversion Costs	(2009$ millions)		153	197	229	348	406
Capital Conversion Costs	(2009$ millions)		229	393	620	1,405	2,013
Total Conversion Costs.	(2009$ millions)		382	590	848	1,753	2,419

TSL 1 represents the current ENERGY STAR level for standard-size refrigerator-freezers or a 20-percent reduction in measured energy consumption over the current energy conservation standards for the analyzed standard-size top-mount product class 3, a 20-perecent reduction for the analyzed standard-size bottom-mount product class 5, and a 20-percent reduction for the analyzed standard-size side-by-side product class 7. At TSL 1, DOE estimates impacts on INPV to range from −$117.8 million to −$252.6 million, or a change in INPV of −4.4 percent to −9.5 percent. At this TSL, industry free cash flow is estimated to decrease by approximately 71.8 percent to $51.5 million, compared to the base-case value of $182.8 million in the year leading up to the amended energy conservation standards.

The INPV impacts at TSL 1 are relatively minor, in part because the vast majority of manufacturers produce ENERGY STAR units in significant volumes, particularly for product classes 5 and 7. Approximately 42 percent of product class 7 shipments and 47 percent of product class 5 shipments currently meet this TSL. By contrast, the vast majority of product class 3 shipments are baseline units. Additionally, most of the design options DOE analyzed at this TSL are one-for-one component swaps, including more efficient compressors and brushless DC condenser and evaporator fan motors, which require only modest changes to the manufacturing process at TSL 1. As such, DOE estimated total product conversion costs of $153 million and capital conversion costs of $229 million.

While substantial on a nominal basis, the total conversion costs are relatively low compared to the industry value of $2.7 billion. The total conversion costs at TSL 1 are mostly driven by the design options that manufacturers could use to improve the efficiency of the smaller-sized units of the product classes analyzed. For example, the analyzed design options for the 22-cubic foot product class 7 unit included a VIP in the freezer door, while the 26-cubic foot product class 7 unit only analyzed less costly component swaps. VIP implementation would require significant capital and product conversion costs because additional production steps are required to hold and bind each panel in its location before the product is foamed. Each additional step requires more equipment to lengthen production lines and, because of lower throughput, more production lines for each manufacturer to maintain similar shipment volumes. Some manufacturers have experience with VIPs, but DOE expects substantial engineering and testing resources would be required for their use in new platforms and/or at higher production volumes.

Similarly, the 16-cubic foot product class 3 unit uses a variable speed compressor as a design option. While not a capital intensive solution, variable speed compressors would require substantial engineering time to integrate the complex component, especially if electronic control systems would also be required. Because these changes are more complex than the other analyzed design options, more than three-quarters of the conversion costs for TSL 1 are attributable to the use of the VIPs and variable speed compressors in the smaller-volume product class 7 and product class 3 units, respectively.

The flat markup scenario shows slightly negative impacts at TSL 1, indicating that the outlays for conversion costs marginally outweigh any additional profit earned on incrementally higher variable costs. On a shipment-weighted basis, the average MPC for standard-size refrigerator-freezers increases by 10 percent at TSL 1 after standards. These small component cost changes are not significant enough to fully recoup these investments even if manufacturers earn additional profit on these costs, as the flat markup scenario assumes. Hence, there is a slight negative impact, even in the upper-bound scenario, at TSL 1.

The efficiency requirements for product class 3 and product class 5 refrigerator-freezers are the same at TSL 2 as TSL 1. However, the efficiency requirements for product class 7 increase to a 25-percent reduction in measured energy consumption from current energy conservation standards. DOE estimates the INPV impacts at TSL 2 range from −$219.2 million to −$395.9 million, or a change in INPV of −8.2 percent to −14.8 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 113.9 percent to −$25.4 million, compared to the base-case value of $182.8 million in the year leading up to the amended energy conservation standard.

The additional impacts at TSL 2 relative to TSL 1 result from the further improvements manufacturers must make to product class 7 refrigerator-freezers to achieve a 25-percent energy reduction, as very few shipments of product class 7 currently exceed the ENERGY STAR level. Specifically, for the 22-cubic foot products, the design options DOE analyzed include a variable speed compressor and a VIP in the freezer cabinet, instead of the door as in TSL 1. For the 26-cubic foot product class 7 unit, the design options analyzed include a VIP in the freezer door in addition to additional component swaps and the component swaps needed to meet TSL 1. Total conversion costs increase by $208 million compared to TSL 1, which is largely driven by the initial use of VIPs in the 26-cubic foot product class 7 unit. Besides these specific changes to side-by-side units, at TSL 2 most production lines of standard-size refrigerator-freezers do not use VIPs or other very costly components, which mitigates some of the disruption to current facilities. Consequently, the INPV impacts, while greater than at TSL 1, are still relatively moderate compared to the value of the industry as a whole.

At TSL 2, the INPV in the flat markup is lower than at TSL 1, which means the additional conversion costs to add more VIPs leaves manufacturers worse off even if they can earn additional profit on these costly components. In the preservation of operating profit markup scenario, the industry earns no additional profit on this greater investment, lowering cash flow from operations in the standards case and resulting in greater INPV impacts.

The efficiency requirements for product class 5 and product class 7 refrigerator-freezers are the same at TSL 3 as TSL 2. However, the efficiency requirements for product class 3 increase to a 25-percent reduction in measured energy consumption from current energy conservation standards. TSL 3 represents a 25-percent reduction in measured energy consumption over the current energy conservation standards for both product class 3 and product class 7. In addition, TSL 3 represents a 20-percent reduction in measured energy consumption for product classes 1, 1A, and 2. DOE estimates the INPV impacts at TSL 3 to range from −$345.0 million to −$580.7 million, or a change in INPV of −12.9 percent to −21.7 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 168.0 percent to −$124.3 million, compared to the base-case value of $182.8 million in the year leading up to the standards.

The additional negative impacts on industry cash flow result from the changes to product class 3 refrigerator-freezers to reach a 25-percent reduction in energy use (side-by-side products met this efficiency level at TSL 2). Specifically, the design options DOE analyzed at TSL 3 for 16-cubic foot top-mount refrigerator-freezers included the use of VIPs for the first time (in the freezer cabinet), in addition to the component swaps discussed above. In total, DOE estimates product conversion costs of $229 million and capital conversion costs of $620 million at TSL 3. The high cost to purchase new production equipment and the large engineering effort to manufacture new platforms for these smaller-sized product class 3 units drive the vast majority of this additional $258 million in conversion costs that DOE estimates manufacturers would incur at TSL 3. Because the smaller size top-mounted units account for a large percentage of total shipments, the production equipment necessary to implement new platforms for these products is costly.

While production of units meeting TSL 3 is fairly limited, several manufacturers have introduced products that meet these efficiency levels in response to Federal production tax credits. This experience mitigates some of the product conversion costs by giving manufacturers some experience with the newer technologies. However, the more severe impacts at TSL 3, relative to TSL 2, are due to the incremental outlays for conversion costs to make the changes described above. In particular, any experience with VIPs on some products does not lower the substantial capital conversion necessary to purchase production equipment necessary to manufacture products that are substantially different from existing products.

As mentioned above, the preservation of operating profit markup scenario assumes no additional profit is earned on the higher production costs. This assumption lowers profit margins as a percentage of revenue and leads to worse impacts on INPV. In the flat markup scenario, the impact of the investments is mitigated by the assumption that manufacturers can earn a similar profit margin as a percentage of revenues on their higher variable costs. At TSL 3, MPCs increase by an average of 16 percent after standards, leading to additional per-unit profit in this scenario. However, the magnitude of the conversion investments still leads to negative INPV impacts even if additional profit is earned on the incremental manufacturing costs. The lower industry shipments driven by the relative price elasticity assumption account for approximately $45 million of the impact in the flat markup scenario.

TSL 4 represents a 30-percent reduction in measured energy consumption over the current energy conservation standards for product class 3, product class 5, and product class 7. DOE estimates the INPV impacts at TSL 4 to range from −$784.9 million to −$1,309.3 million, or a change in INPV of −29.4 percent to −49.0 percent. At this TSL, the industry cash flow is estimated to decrease by approximately a factor of 3.6 to −$469.3 million, compared to the base-case value of $182.8 million in the year leading up to the amended energy conservation standards.

At TSL 4, significant changes to the manufacturing process are necessary for all refrigerator-freezers. A 30-percent reduction in energy consumption is the maximum-efficiency top-mounted products available on the market;[47] the maximum available side-by-side and bottom-mount only slightly exceed a 30-percent reduction. The design options DOE analyzed for all standard-size products—with the exception of the 25-cubic foot product class 5 unit—use multiple VIPs in the fresh food compartment, freezer doors, and cabinets to reach the 30-percent efficiency level. The design options also include the use of variable speed compressors for all units analyzed except the 21-cubic foot product class 3 unit. These product changes substantially increase the variable costs across nearly all platforms at this TSL.

While products that meet the efficiency requirements of TSL 4 are not in widespread production, several manufacturers produce units at these efficiencies due to tax credit incentives. However, at TSL 4, most manufacturers expect to completely redesign existing production lines if the amended energy conservation standards were set at levels that necessitated these changes across most or all of their products. Manufacturers would need to purchase injection molding equipment, cabinet bending equipment, and other equipment for interior tooling as they would need to create new molds for these production lines. These changes drive DOE's estimate of the large product and capital conversion costs at TSL 4 ($348 million and $1,405 million, respectively). The significant incremental investment relative to TSL 3 results, in large part, from the design option of adding VIPs to the 21-cubic foot analyzed product class 3 unit. This top-mounted refrigerator-freezer represents a substantial portion of the market and manufacturers would have to completely redesign these platforms.

As a result of the large investment necessary to meet this TSL, some manufacturers could move production to lower-labor-costs countries to achieve cost savings for labor expenditures. (More information on employment impacts is provided in section 0.) In addition to the large capital conversion costs, the shipment-weighted average MPC increases by approximately 36 percent at TSL 4 after standards compared to the base case. However, the magnitude of the conversion costs at TSL 4 are so large that even if manufacturers can reap additional profit from these higher product costs (as in the flat markup scenario), they would still be substantially impacted, as shown by the negative INPV results in the flat markup scenario. Additionally, the 36-percent increase in MPC drives

[47] Throughout the document, the terms ''max available'' or ''max-tech available'' are intended to mean the maximum efficiency level of available products.

shipments lower due to the price elasticity. Lower industry volume from the decline in shipments accounts for a change in industry value of approximately 16 percent in the flat markup scenario. The large, negative impact on INPV is even greater under the preservation of operating profit markup scenario due to the inability to pass on the higher costs of expensive design options such as variable speed compressors and VIPs.

TSL 5 represents max tech for all standard-size refrigerator-freezers. The max-tech level corresponds to reductions in measured energy consumption compared to the current energy conservation standards for product class 3 (36 percent), product class 5 (36 percent), and product class 7 (33 percent), respectively. DOE estimates the INPV impacts at TSL 5 to range from −$1,042.2 million to −$1,841.5 million, or a change in INPV of −39.0 percent to −69.0 percent. At this TSL, the industry cash flow is estimated to decrease by a factor of approximately 5.0 to −$727.5 million, compared to the base-case value of $182.8 million in the year leading up to the amended energy conservation standards.

No products that meet TSL 5 are currently offered on the U.S. market. At TSL 5, the changes required to meet this TSL are similar to those at TSL 4, as complete redesigns of all platforms would be required. TSL 5 requires much more extensive use of VIPs, however. The higher conversion costs at TSL 5 are primarily due to the use of VIPs in additional locations in the door, cabinet and freezer, whereas at TSL 4 some of the analyzed design options of the larger-sized units included limited or no VIP use. This level would require manufacturers to further lengthen assembly lines and even modify or move their facilities outside of the United States. These factors drive the projected $2,419 million conversion cost estimate at this TSL. As with TSL 4, at TSL 5 some manufacturers could elect to move production out of the U.S. to offset some of the additional product costs. At TSL 5, DOE estimates MPCs increase by approximately 58 percent after standards compared to the base case. Similar to TSL 4, this substantially reduces shipments due to the price elasticity effect and exacerbates the industry impacts in both markup scenarios.

As with other TSLs, the impact on INPV is mitigated under the flat markup scenario because manufacturers are able to fully pass on the large increase in MPC to consumers, thereby increasing manufacturers' gross profit in absolute terms. However, even assuming manufacturers could earn the same gross margin percentage per unit on those higher costs, the capital and product conversion costs cause negative INPV impacts, as shown by the 39 percent decline in INPV in the flat markup scenario. This large impact even in the lower bound scenario demonstrates that the large conversion costs to redesign all existing platforms results in substantial harm. The result is predicted even if manufacturers earn a historical margin on these additional costs. Due to the extremely large cost increases at the max-tech level, it is less likely at TSL 5 than at other examined levels that manufacturers could fully pass through the increase in production costs. If margins are impacted, TSL 5 would result in a substantial INPV loss under this scenario.

ii. Cash-Flow Analysis Results for Standard-Size Freezers

As part of its cash-flow analysis for standard-size freezers, DOE applied two different scenarios to project the impacts on manufacturers from standards at the various TSLs that DOE considered. The following tables provide those projected impacts under the flat-markup and preservation of operating profit markup scenarios.

TABLE VI.25—MANUFACTURER IMPACT ANALYSIS FOR STANDARD-SIZE FREEZERS—FLAT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	337.8	308.0	214.1	225.3	252.4	192.7
Change in INPV	(2009$ millions)		(29.8)	(123.7)	(112.5)	(85.4)	(145.0)
	(%)		−8.8%	−36.6%	−33.3%	−25.3%	−42.9%
Product Conversion Costs	(2009$ millions)		22	51	55	63	70
Capital Conversion Costs	(2009$ millions)		50	175	182	183	320
Total Conversion Costs.	(2009$ millions)		72	226	237	247	390

TABLE VI.26—MANUFACTURER IMPACT ANALYSIS FOR STANDARD-SIZE FREEZERS—PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	337.8	287.7	167.3	159.6	155.3	39.0
Change in INPV	(2009$ millions)		(50.0)	(170.5)	(178.1)	(182.4)	(298.8)
	(%)		−14.8%	−50.5%	−52.7%	−54.0%	−88.5%
Product Conversion Costs	(2009$ millions)		22	51	55	63	70
Capital Conversion Costs	(2009$ millions)		50	175	182	183	320
Total Conversion Costs.	(2009$ millions)		72	226	237	247	390

TSL 1 represents a 20-percent reduction in measured energy use over the current energy conservation standards for the analyzed standard-size upright freezer product class 9 and a 20-percent reduction for the analyzed standard-size chest freezer product class 10. DOE estimates the INPV impacts at TSL 1 to range from −$29.8 million to −$50.0 million, or a change in INPV of −8.8 percent to −14.8 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 111.2 percent to −$2.6 million, compared to the base-case value of $23.2 million in the year leading up to the amended energy conservation standards.

While products meeting TSL 1 are currently produced only in limited volumes, the changes in the manufacturing process would not require completely new platforms to meet the energy requirements at this TSL. For most standard-size freezer platforms, the design options DOE analyzed include the use of brushless direct current (DC) evaporator fan motors and compressors with higher EERs. However, the design options to meet this efficiency level also include increasing door insulation thickness for all analyzed products except the 20-cubic foot product class 10 unit. Increasing door insulation thickness drives the majority of the conversion cost outlay DOE estimates manufacturers would incur at TSL 1. To increase door insulation thickness, manufacturers would need to purchase new tooling for their door assemblies. DOE estimates that these changes would result in product conversion costs of $22 million and capital conversion costs of $50 million at TSL 1. However, the conversion costs are somewhat mitigated at TSL 1 because the design options analyzed would not change the production equipment for the cabinet.

At TSL 1, variable costs increase by approximately 10 percent after standards relative to base case MPCs. The flat markup scenario shows less severe impacts because it assumes manufacturers can pass on these substantially higher product costs and maintain gross margin percentages. Additionally, the reduction in shipments due to the price elasticity has only a marginally negative effect at this TSL. The relatively large conversion costs decrease industry value under both markup scenarios and account for a substantial portion of the INPV impacts. This is especially the case if manufacturers are unable to earn any additional profit on the higher production costs (the preservation of operating profit scenario).

TSL 2 represents a reduction in measured energy consumption over the current standards of 30 percent for product class 9 and 25 percent for product class 10. TSL 2 also represents reductions for the other product classes as well—product class 8 (upright freezers with manual defrost, 25 percent) and product class 10A (chest freezers with automatic defrost, 30 percent). DOE estimates the INPV impacts at TSL 2 to range from −$123.7 million to −$170.5 million, or a change in INPV of −36.6 percent to −50.5 percent. At this TSL, the industry cash flow is estimated to decrease by approximately a factor of 3.6 to −$60.0 million, compared to the base-case value of $23.2 million in the year leading up to the amended energy conservation standards.

The vast majority of the standard-size freezer market does not currently meet the efficiency requirements at TSL 2. DOE's design options assume that, in addition to the component swaps noted above, manufacturers would increase the insulation thickness of both the door and cabinet. As a result, product redesigns are expected across most platforms, which could substantially disrupt current manufacturing processes. These changes account for the majority of DOE's estimates for total product conversion costs of $51 million and capital conversion costs of $175 million, an increase over TSL 1 of $29 million and $125 million, respectively. The magnitude of the investments, relative to the industry value, results in severe INPV impacts. Even if manufacturers are able to pass on the estimated 24-percent increase in product costs onto their customers after standards, the large product and capital conversion costs resulting from increased insulation thickness decrease INPV. If manufacturers are not able to pass on these costs, as shown by the preservation of operating profit scenario, INPV impacts are projected to be severe.

TSL 3 represents a 35-percent reduction in measured energy use over the current energy conservation standards for product class 9 and a 30-percent reduction for product class 10. DOE estimates the INPV impacts at TSL 3 to range from −$112.5 million to −$178.1 million, or a change in INPV of −33.3 percent to −52.7 percent. At this TSL, the industry cash flow is estimated to decrease by a factor of approximately 3.7 to −$63.8 million, compared to the base-case value of $23.2 million in the year leading up to the amended energy conservation standards.

The efficiency requirements at TSL 3 are more stringent than the max available products in the market for product class 9 and product class 10. The impacts at TSL 3 are similar to those at TSL 2 because the design options analyzed by DOE already required platform redesigns at TSL 2. However, the additional design options analyzed at TSL 3 also include a variable speed compressor in the 14-cubic foot product class 9 unit and VIPs in the bottom wall of the 20-cubic foot product class 10 unit. These design options substantially increase the variable costs associated with these products but do not greatly change the product and capital conversion costs. DOE estimates that under TSL 3, the average MPC of a standard-size freezer is roughly 34 percent higher after standards than in the base case, leading to a 9-percent drop in shipments from the price elasticity assumption for 2014 alone.

The impacts at TSL 3 under the flat markup scenario become less severe than at TSL 2 because the scenario assumes manufacturers can fully pass on the added cost to consumers, while investments do not significantly increase from TSL 2 to TSL 3. However, under the preservation of operating profit markup scenario, manufacturers do not receive any extra profit on units of higher cost, resulting in worse INPV impacts at TSL 3 than at TSL 2.

TSL 4 represents a 40-percent reduction in measured energy use over the current energy conservation standards for product class 9 and a 35-percent reduction for product class 10. DOE estimates the INPV impacts at TSL 4 to range from −$85.4 million to −$182.4 million, or a change in INPV of −25.3 percent to −54.0 percent. At this TSL, the industry cash flow is estimated to decrease by a factor of approximately 3.9 to −$66.5 million, compared to the base-case value of $23.2 million in the year leading up to the amended energy conservation standards.

At TSL 4, the design options DOE analyzed include the addition of a variable speed compressor for the 20-cubic foot product class 9 unit, the 15-cubic foot product class 10 unit, and the 20-cubic foot product class 10 unit. For the 14-cubic foot product class 9 unit, the design options analyzed were even thicker wall cabinet insulation and the implementation of VIPs.

The relative impacts at TSL 4 are also caused by the incremental MPCs compared to the conversion costs to implement these design options. Outlays for conversion costs increase only slightly at TSL 4 (by 4 percent, compared to TSL 3) while variable costs increase substantially (by approximately 52 percent after standards compared to the baseline) due to the addition of variable speed compressors and VIPs. Because manufacturers earn incrementally more profit on each unit at TSL 4 compared to TSL 3 in the flat markup scenario—without substantial changes to conversion costs—further declines in industry value, though still substantial, are mitigated in this scenario. However, manufacturers expressed skepticism that such large cost increases could be passed on. This view is reflected by the severely negative results in the preservation of operating profit scenario.

TSL 5 represents max tech for the standard-size freezer product classes. This TSL reflects a 44-percent reduction in measured energy use for product class 9 and a 41-percent reduction for product class 10. DOE estimates the INPV impacts at TSL 5 to range from −$145.0 million to −$298.8 million, or a change in INPV of −42.9 percent to −88.5 percent. At this TSL, the industry cash flow is estimated to decrease by a factor of approximately 6.3 to −$122.8 million, compared to the base-case value of $23.2 million in the year leading up to the amended energy conservation standards.

To achieve the max-tech level at TSL 5, DOE analyzed design options that include the widespread implementation of multiple VIPs on all standard-size freezers, in addition to the use of more efficient components and thicker insulation already necessary to achieve the efficiency requirements at TSL 4. DOE estimated that TSL 5 would require product and capital conversion costs of $70 million and $320 million, respectively. These large conversion costs result from the changes associated with multiple VIP implementation and wall thickness increases. In addition, DOE estimates that product costs would almost double base-case MPCs after standards, driven by the use of variable speed compressors and VIPs in the doors and cabinet of all product lines. As a result, INPV decreases substantially from TSL 4 to TSL 5.

iii. Cash-Flow Analysis Results for Compact Refrigeration Products

As part of its cash-flow analysis for compact refrigeration products, DOE applied two different scenarios to project the impacts on manufacturers from standards at the various TSLs that DOE considered. The following tables provide those projected impacts under the flat-markup and preservation of operating profit markup scenarios.

TABLE VI.27—MANUFACTURER IMPACT ANALYSIS FOR COMPACT REFRIGERATION PRODUCTS—FLAT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	169.4	152.8	133.3	106.5	127.9	14.5
Change in INPV	(2009$ millions)		(16.6)	(36.2)	(62.9)	(41.5)	(154.9)
	(%)		−9.8%	−21.4%	−37.1%	−24.5%	−91.4%
Product Conversion Costs	(2009$ millions)		15	35	41	48	67
Capital Conversion Costs	(2009$ millions)		24	46	76	71	220
Total Conversion Costs.	(2009$ millions)		39	80	118	119	287

TABLE VI.28—MANUFACTURER IMPACT ANALYSIS FOR COMPACT REFRIGERATION PRODUCTS—PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	169.4	141.6	110.8	80.1	76.6	(73.2)
Change in INPV	(2009$ millions)		(27.8)	(58.7)	(89.3)	(92.8)	(242.6)
	(%)		−16.4%	−34.6%	−52.7%	−54.8%	−143.2%
Product Conversion Costs	(2009$ millions)		15	35	41	48	67
Capital Conversion Costs	(2009$ millions)		24	46	76	71	220
Total Conversion Costs.	(2009$ millions)		39	80	118	119	287

TSL 1 represents a 20-percent reduction in measured energy use over the current energy conservation standards for compact refrigerators and refrigerator-freezers (product class 11) and a 10-percent reduction for compact freezers (product class 18) analyzed by DOE. DOE estimates the INPV impacts at TSL 1 to range from −$16.6 million to −$27.8 million, or a change in INPV of −9.8 percent to −16.4 percent. At this TSL, industry cash flow is estimated to decrease by approximately 125.1 percent to −$2.7 million, compared to the base-case value of $10.7 million in the year leading up to the amended energy conservation standards. A small percentage of product class 18 shipments currently meet this TSL, but most product class 11 shipments are baseline units.

The design options analyzed by DOE at TSL 1 assumed that more significant changes in the manufacturing process would be required for product class 11, while product class 18 would only require increased compressor efficiency. For product class 11, DOE analyzed several design options that represent component changes, such as a more efficient compressor and increased heat exchanger area, which do not have a significant impact on consumer prices or conversion costs. However, DOE also analyzed increasing door insulation thickness for product class 11, which drives the bulk of the estimated $15 million and $24 million outlays for product conversion and capital conversion costs, respectively. As described for standard-size refrigerator-freezers and standard-size freezers, increasing insulation thickness requires manufacturers to invest in injection molding equipment and other equipment for interior tooling to manufacture products with different door dimensions. The overall impacts at TSL 1 are relatively moderate because the conversion costs are still small compared to the industry value of $169.4 million.

The higher production costs at TSL 1 do not have a substantial impact on INPV at TSL 1. The MPC of compact refrigeration products on a shipment-weighted basis increases 11 percent over the base case at TSL 1 after standards. The combined INPV impacts are greater under the preservation of operating profit scenario since manufacturers cannot pass on any of the added cost to consumers under that scenario, resulting in lower cash flows from operations. However, because production costs do not greatly increase at TSL 1, the impacts on INPV are relatively low under this scenario as well.

TSL 2 represents a 25-percent reduction in measured energy use over the current energy conservation standards for product class 11 and a 10-percent reduction for product class 18. TSL 2 also represents a 15-percent reduction in measured energy consumption for the analyzed product classes 13, 13I, 15, and 15I, and a 20-percent reduction for the unanalyzed product classes 14 and 14I. DOE estimates the INPV impacts at TSL 2 to range from −$36.2 million to −$58.7 million, or a change in INPV of −21.4 percent to −34.6 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 254.9 percent to −$16.6 million, compared to the base-case value of $10.7 million in the year leading up to the amended energy conservation standards.

At TSL 2, further changes are required for product class 11. In addition to component swaps, the design options analyzed by DOE include thicker cabinet insulation. As discussed for TSL 1, increasing insulation thickness significantly impacts product and capital conversion costs, but much more so when adding insulation to the cabinet (as opposed to the door). To increase the insulation thickness of the cabinet, manufacturers must replace virtually all stamping equipment, which greatly increases the capital conversion costs. Additionally, DOE analyzed the use of isobutane refrigerant as a design option for the 4-cubic foot product class 11 unit. At TSL 2, a substantial portion of the investment to reach TSL 2 would likely be for training service technicians to handle this volatile refrigerant. As a result of thicker cabinet insulation and conversion to isobutane, product conversion and capital conversion costs roughly double at TSL 2 (to $35 million for product conversion costs and $46 million for capital conversion costs). The shipment-weighted MPC increased 22 percent at TSL 2 after standards compared to baseline costs, which also contributed to the more severe impacts projected under the preservation of operation profit scenario if manufacturers do not earn additional profit on these higher costs.

TSL 3 represents a 30-percent reduction in measured energy consumption over the current energy conservation standards for product class 11 and a 15-percent reduction for product class 18. DOE estimates the INPV impacts at TSL 3 to range from −$62.9 million to −$89.3 million, or a change in INPV of −37.1 percent to −52.7 percent. At this TSL, the industry cash flow is estimated to decrease by a factor of approximately 3.9 to −$30.6 million, compared to the base-case value of $10.7 million in the year leading up to the amended energy conservation standards.

At TSL 3, the design options analyzed for both product class 18 units include thicker door insulation, which further increases the capital conversion costs over TSL 1 and TSL 2, where this was not analyzed as a design option. The additional impacts at TSL 3 are also due to more stringent requirements for product class 11. A 30-percent reduction for product class 11 is greater than the most efficient units on the market today. For both analyzed sizes of product class 11, DOE analyzed the design option of thicker insulation in the cabinet for both units analyzed. The net effect is a large increase in conversion costs due to the much higher cost of the equipment necessary to manufacture the cabinet. At TSL 3, DOE estimated total product conversion costs of $41 million and capital conversion costs of $76 million, a 46 percent total increase in conversion costs over TSL 2. The effect of the design changes at TSL 3 on shipment-weighted unit cost is a 27-percent increase over the average baseline MPC after standards. The magnitude of the investments relative to the industry value leads to significant impacts, although they are moderated somewhat in the flat markup because manufacturers earn additional profit on the investments.

TSL 4 represents a 40-percent reduction in measured energy use over the current energy conservation standards for product class 11 and a 25-percent reduction for product class 18. DOE estimates the INPV impacts at TSL 4 to range from −$41.5 million to −$92.8 million, or a change in INPV of −24.5 percent to −54.8 percent. At this TSL, the industry cash flow is estimated to decrease by a factor of approximately 3.9 to −$30.5 million, compared to the base-case value of $10.7 million in the year leading up to the amended energy conservation standards.

The design options analyzed at TSL 4 would also severely disrupt current manufacturing processes. For the 1.7-cubic foot product class 11 unit, DOE analyzed a variable speed compressor and isobutane refrigerant as design options. For the 4-cubic foot product class 11 unit and the 7-cubic foot product class 18 unit, DOE analyzed thicker insulation in the cabinets. For 3.4-cubic foot product class 18 unit, DOE analyzed both an increase to cabinet insulation thickness and VIPs in the bottom wall as design options. Although increasing insulation thickness, converting to isobutane, and implementing VIPs all would necessitate large conversion costs, capital conversion costs decrease slightly from TSL 3 to TSL 4 because of the removal of all previous design options in the 1.7-cubic foot unit. In other words, the design options analyzed for this unit cause less substantial changes to existing production equipment, but would also require a large investment by manufacturers to train service technicians to deal with the refrigerant. Because this task would require a large outlay for product conversion costs, total conversion costs are roughly the same at TSL 3 and TSL 4. Adding a variable speed compressor in the smaller product class 11 unit analyzed also has a substantial impact on unit price because of its high component cost. At TSL 4, the shipment-weighted MPC is 60-percent higher than the baseline MPC after standards. These cost increases are projected to cause a 16-percent decrease in shipments at TSL 4 in 2014 alone. Over time, this decline significantly contributes to the negative impacts on INPV in both markup scenarios.

The large conversion costs and higher prices leading to lower shipments cause a decrease in INPV from TSL 3 to TSL 4 under the preservation of operating profit markup scenario (since this scenario assumes higher production costs are not passed on to consumers). However, under the flat markup scenario, manufacturers are able to earn additional profit on the new high-cost components such as variable speed compressors, resulting in an increase in INPV from TSL 3 to TSL 4.

TSL 5 represents max tech for both product classes 11 and 18. The max-tech level corresponds to a 59-percent and 42-percent reduction in measured energy use for product class 11 and product class 18, respectively. DOE estimates the INPV impacts at TSL 5 to range from −$154.9 million to −$242.6 million, or a change in INPV of −91.4 percent to −143.2 percent. At this TSL, the industry cash flow is estimated to decrease approximately ten-fold to −$97.6 million, compared to the base-case value of $10.7 million in the year leading up to the amended energy conservation standards.

The design options DOE analyzed include the use of VIPs for all analyzed product class 11 and 18 units to reach max-tech efficiency levels. Additionally, the design options analyzed for some products also included other costly changes. For the 1.7-cubic foot product class 11 unit, the design options analyzed included multiple VIPs, a larger heat exchanger, and thicker insulation. The design options analyzed for the 4-cubic foot product class 11 unit also included a variable speed compressor and thicker insulation. For product class 18, DOE assumed that manufacturers would remove the design options necessary to meet TSLs 1 through 4 and add a variable speed compressor and thicker insulation for both analyzed products. These significant changes greatly increase the investment required to manufacture standards-compliant products. DOE estimated that product conversion costs would be $67 million at TSL 5, an increase of almost 40 percent over TSL 4. DOE also estimated that capital conversion costs would be $220 million, a more than three-fold increase over TSL 4. This drastic increase in conversion costs demonstrates the significant investments required by implementing widespread use of VIPs and increasing wall thickness.

At TSL 5, the shipment-weighted MPC increases by over 150 percent over the baseline after standards due to the high material costs of VIPs and variable speed compressors. These large jumps cause shipments to decrease by 42 percent due to the price elasticity in 2014 alone. As a result of lower industry shipments and extremely high conversion costs, INPV decreases substantially from TSL 4 to TSL 5 and becomes negative under the preservation of operating profit scenario, which indicates the industry loses more than its base-case value in the standards case under this scenario.

iv. Cash-Flow Analysis Results for Built-In Refrigeration Products

As part of its cash-flow analysis for built-in refrigeration products, DOE applied two different scenarios to project the impacts on manufacturers from standards at the various TSLs that DOE considered. The following tables provide those projected impacts under the flat-markup and preservation of operating profit markup scenarios.

TABLE VI.29—MANUFACTURER IMPACT ANALYSIS FOR BUILT-IN REFRIGERATION PRODUCTS—FLAT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	554.1	502.2	499.0	486.1	471.2	464.2
Change in INPV	(2009$ millions)		(51.9)	(55.1)	(68.0)	(82.9)	(89.9)
	(%)		−9.4%	−9.9%	−12.3%	−15.0%	−16.2%
Product Conversion Costs	(2009$ millions)		41	51	65	75	87
Capital Conversion Costs	(2009$ millions)		40	38	55	74	84
Total Conversion Costs.	(2009$ millions)		81	89	119	149	171

TABLE VI.30—MANUFACTURER IMPACT ANALYSIS FOR BUILT-IN REFRIGERATION PRODUCTS—PRESERVATION OF OPERATING PROFIT MARKUP SCENARIO

	Units	Base case	Trial standard level				
			1	2	3	4	5
INPV	(2009$ millions)	554.1	501.5	497.6	477.0	456.5	442.0
Change in INPV	(2009$ millions)		(52.6)	(56.5)	(77.2)	(97.6)	(112.1)
	(%)		−9.5%	−10.2%	−13.9%	−17.6%	−20.2%
Product Conversion Costs	(2009$ millions)		41	51	65	75	87
Capital Conversion Costs	(2009$ millions)		40	38	55	74	84
Total Conversion Costs.	(2009$ millions)		81	89	119	149	171

TSL 1 represents a 10-percent reduction in measured energy use over the current energy conservation standards for the analyzed built-in all-refrigerator product class 3A–BI, the analyzed built-in bottom-mount product class 5–BI, the analyzed built-in side-by-side product class 7–BI, and for the analyzed built-in freezer product class 9–BI. DOE estimates the INPV impacts at TSL 1 to range from −$51.9 million to −$52.6 million, or a change in INPV of −9.4 percent to −9.5 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 70.7 percent to $11.0 million, compared to the base-case value of $37.5 million in the year leading up to the amended energy conservation standards.

At TSL 1, the design options that DOE analyzed result in moderate changes in the manufacturing process for built-in refrigeration products. For product classes 3A–BI and 9–BI, the design options that DOE analyzed to reach TSL 1 included the use of more efficient components that do not require significant changes to the manufacturing process. However, for product class 5–BI and product class 7–BI, the design options DOE analyzed also include the use of VIPs in the freezer door. While these components add to the overall costs of production, the added costs represent a small percentage of the total cost of a built-in refrigeration product. These cost deltas are low compared to the overall cost of the products and result in small impacts even if no additional profit is earned on the incremental MPCs. The estimated product conversion costs for all built-in refrigeration products at TSL 1 are $41 million and the estimated capital conversion costs are $40 million. The implementation of VIPs represents a substantial part of the conversion costs, but several built-in refrigeration manufacturers have products that use similar technology, which helps to mitigate some of the product conversion costs that would be required to design products from the ground up.

TSL 2 represents a 15-percent reduction in measured energy use for product class 3A–BI and product class 5–BI. For product classes 7–BI and 9–BI, TSL 2 represents a reduction of 10 percent and 20 percent, respectively. DOE estimates the INPV impacts at TSL 2 to range from −$55.1 million to −$56.5 million, or a change in INPV of −9.9 percent to −10.2 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 75.2 percent to $9.3 million, compared to the base-case value of $37.5 million in the year leading up to the amended energy conservation standards.

The efficiency requirements for product class 7–BI refrigerator-freezers do not change from TSL 1 to TSL 2, but the efficiency requirements for all other analyzed built-in product classes increase. The design options that DOE analyzes at TSL 2 for product classes 3A–BI and 7–BI still only include component swaps to reach a 15-percent efficiency improvement. Product class 5–BI uses a variable speed compressor in the freezer with a brushless DC condenser fan motor, but no longer use the VIPs used to reach TSL 1. The design options analyzed for product class 9–BI include a brushless DC evaporator and condenser fan motor, a larger condenser, a variable speed compressor, and a VIP in the upper door. Because product class 5–BI no longer uses VIPs and fewer changes to existing products are necessary, the overall impact is a slight decrease in capital conversion costs from $40 million at TSL 1 to $38 million at TSL 2. Product conversion costs increase to $51 million at TSL 2 because additional engineering time would be required to implement the additional component changes. However, because the complexity of the changes to the products and production facilities are similar at TSL 1 and TSL 2, there is only a small decrease in INPV from TSL 1 to TSL 2.

TSL 3 represents a 20-percent reduction in measured energy use for product class 3A–BI and product class 7–BI. For product classes 5–BI and 9–BI, TSL 3 represents a reduction of 15 percent and 25 percent, respectively. DOE estimates the INPV impacts at TSL 3 to range from −$68.0 million to −$77.2 million, or a change in INPV of −12.3 percent to −13.9 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 102.9 percent to −$1.1 million, compared to the base-case value of $37.5 million in the year leading up to the amended energy conservation standards.

The efficiency requirements for product class 5–BI do not change from TSL 2 to TSL 3. However, the design options for all other built-in refrigeration products at TSL 3 include the implementation of VIPs. The widespread implementation of VIPs increases product and capital conversion costs, which are estimated to be $65 million and $55 million at TSL 3, respectively. Substantial changes to existing production facilities would be required to manufacture products that meet the required efficiencies at TSL 3. Most of the capital conversion costs involve purchasing new production equipment and would result in high stranded assets. The extensive changes that manufacturers would be required to make to existing facilities and the projected erosion of profitability if the additional production cost of implementing VIPs does not yield additional profit result in a projected decrease in INPV from TSL 3 to TSL 4. However, the industry value is high relative to the required capital conversion costs and the cost of the additional VIP panels is relatively small compared to the overall cost of the products, which helps to mitigate some of the negative impacts caused by these changes.

TSL 4 represents a 25-percent reduction in measured energy use over the current energy conservation standards for the following product classes: 3A–BI, 5–BI, and 9–BI. For product class 7–BI, TSL 4 represents a 20-percent reduction in measured energy use from current energy conservation standards. DOE estimates the INPV impacts at TSL 4 to range from −$82.9 million to −$97.6 million, or a change in INPV of −15.0 percent to −17.6 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 130.3 percent to −$11.4 million, compared to the base-case value of $37.5 million in the year leading up to the amended energy conservation standards.

The efficiency requirements for product class 7–BI do not change from TSL 3 to TSL 4. The design options for the other built-in refrigeration products all include the addition of more VIPs to reach TSL 4. The design options analyzed for product classes 3A–BI and 5–BI also include using a variable speed compressor. The complexity of implementing multiple component swaps and the additional production equipment necessary to use additional VIPs increases both the product and capital conversion costs. These costs are estimated to be $75 million and $74 million at TSL 4, respectively, and result in a decrease in INPV from TSL 3 to TSL 4.

TSL 5 represents max tech for the four built-in product classes. This TSL represents a reduction in measured energy use of 29 percent, 27 percent, 22 percent, and 27 percent, respectively, for product classes 3A–BI, 5–BI, 7–BI, and 9–BI. DOE estimates the INPV impacts at TSL 5 to range from −$89.9 million to −$112.1 million, or a change in INPV of −16.2 percent to −20.2 percent. At this TSL, the industry cash flow is estimated to decrease by approximately 149.5 percent to −$18.6 million, compared to the base-case value of $37.5 million in the year leading up to the amended energy conservation standards.

The design options analyzed by DOE include the widespread use of VIPs to achieve the max-tech efficiency levels at TSL 5. Additionally, product class 3A–BI uses multiple variable speed compressors. Since the implementation of VIPs is both research and capital intensive, product and capital conversion costs increase to $87 million and $84 million, respectively. The complexity of implementing multiple component swaps and the additional production equipment necessary to use additional VIPs increases both the product and capital costs.

b. Impacts on Employment

DOE quantitatively assessed the impacts of potential amended energy conservation standards on employment. DOE used the GRIM to estimate the domestic labor expenditures and number of domestic production workers in the base case and at each TSL from 2010 to 2043. DOE used statistical data from the most recent U.S. Census

Bureau's 2007 Economic Census, the results of the engineering analysis, and interviews with manufacturers to determine the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels. Labor expenditures involved with the manufacture of the product are a function of the labor intensity of the product, the sales volume, and an assumption that wages remain fixed in real terms over time.

In each GRIM, DOE used the labor content of each product and the manufacturing production costs from the engineering analysis to estimate the annual labor expenditures in the residential refrigeration product industry. DOE used Census data and interviews with manufacturers to estimate the portion of the total labor expenditures that is attributable to U.S. (*i.e.,* domestic) labor.

The production worker estimates in this section only cover workers up to the line-supervisor level who are directly involved in fabricating and assembling a product within an Original Equipment Manufacturer (OEM) facility. Workers performing services that are closely associated with production operations, such as material handing with a forklift, are also included as production labor. DOE's estimates only account for production workers who manufacture the specific products covered by this rulemaking. For example, a worker on a wine cooler line would not be included with the estimate of the number of residential refrigeration workers.

The employment impacts shown in Table VI.31 through Table VI.33 represent the potential production employment that could result following amended energy conservation standards. The upper end of the results in these tables estimates the maximum change in the number of production workers after amended energy conservation standards must be met. The upper end of the results assumes manufacturers would continue to produce the same scope of covered products in the same production facilities. The upper end of the range also assumes that domestic production does not shift to lower-labor-cost countries. Because there is a real risk of manufacturers evaluating sourcing decisions in response to amended energy conservation standards, the lower end of the range of employment results in Table VI.31 through Table VI.33 includes the estimated total number of U.S. production workers in the industry who could lose their jobs if all existing production were moved outside of the U.S. While the results present a range of employment impacts following the compliance date of amended energy conservation standards, the discussion below also includes a qualitative discussion of the likelihood of negative employment impacts at the various TSLs. Finally, the employment impacts shown are independent of the employment impacts from the broader U.S. economy, which are documented in chapter 13, Employment Impact Analysis, of the final rule TSD.

i. Standard-Size Refrigerator-Freezer Employment Impacts

Using the GRIM, DOE estimates that, in the absence of amended energy conservation standards, there would be 7,351 domestic production workers involved in manufacturing standard-size refrigerator-freezers in 2014. Using 2007 Census Bureau data and interviews with manufacturers, DOE estimates that approximately 42 percent of standard-size refrigerator-freezers sold in the United States are manufactured domestically. Table VI.31 shows the range of the impacts of potential amended energy conservation standards on U.S. production workers in the standard-size refrigerator-freezer market.

TABLE VI.31—POTENTIAL CHANGES IN THE TOTAL NUMBER OF DOMESTIC STANDARD-SIZE REFRIGERATOR-FREEZER PRODUCTION WORKERS IN 2014

	Trial standard level					
	Base case	1	2	3	4	5
Total Number of Domestic Production Workers in 2014 (without changes in production locations)	7,351	7,164	7,127	7,172	7,109	6,981
Potential Changes in Domestic Production Workers in 2014 *		(187)–(7,351)	(224)–(7,351)	(179)–(7,351)	(242)–(7,351)	(307)–(7,351)

* DOE presents a range of potential employment impacts. Numbers in parentheses indicate negative numbers.

All examined TSLs show relatively minor impacts on domestic employment levels at the lower end of the range. Most of the design options used in the engineering analysis involve the swapping of components in baseline units with more efficient parts for top-mounted, side-by-side, and bottom-mounted refrigerator-freezers. These component swaps for these design options add primarily material costs and do not greatly impact the labor content of the baseline products. The relatively small decreases in domestic production employment for the lower end of the range of the employment impacts arise from higher product prices lowering shipments the year the standard becomes effective. At these higher TSLs, the effects of lower shipments more than offset the additional product labor that is required to manufacture products that use VIP panels.

During interviews, manufacturers indicated that their domestic employment levels could be impacted under two scenarios: (1) The widespread adoption of VIPs or (2) significant capital conversion costs that would force them to consider non-domestic manufacturing locations once the compliance date for the amended energy conservation standards arrive. The widespread adoption of VIPs would increase the labor content of today's products. The labor content of products with VIPs increases because of the extra handling steps that would be required to ensure that VIPs are not damaged during production. Because of the competitive nature of the industry, manufacturers believed the extra labor costs could force them to move their remaining domestic production to lower labor cost countries to take advantage of the cheaper labor they offer.

Manufacturers also indicated that large conversion costs would likely force them to consider investing in lower-labor-cost countries. For most product categories, there is a range of efficiency levels that can be met with relatively low-cost components (as analyzed in the engineering analysis).

Beyond these levels, manufacturers would need to decide to follow the MPC design options analyzed in the engineering analysis for each product category. Manufacturers indicated the analyzed design options that use multiple VIPs would involve significant capital conversion costs and add very large material costs to their products that would likely result in the relocation of their production facilities abroad. However, manufacturers indicated they would face even larger capital conversion costs at lower efficiencies if they redesigned their products with thicker walls. While not analyzed as a design option for standard-size refrigerator-freezers, increasing wall thickness would likely result in moving domestic production outside of the U.S. at lower efficiency levels.

ii. Standard-Size Freezer Employment Impacts

Using the GRIM, DOE estimates that, in the absence of amended energy conservation standards, there would be 1,643 standard-size freezer production workers in the U.S. in 2014. Using the 2007 Census data and interviews with manufacturers, DOE estimates that approximately 80 percent of standard-size freezers sold in the United States are manufactured domestically. Table VI.32 shows the impacts of amended energy conservation standards on U.S. production workers in the standard-size freezer market.

TABLE VI.32—POTENTIAL CHANGES IN THE TOTAL NUMBER OF DOMESTIC STANDARD-SIZE FREEZER PRODUCTION WORKERS IN 2014

	Trial standard level					
	Base case	1	2	3	4	5
Total Number of Domestic Production Workers in 2014 (without changes in production locations)	1,643	1,597	1,537	1,497	1,410	1,303
Potential Changes in Domestic Production Workers in 2014*	....	(46)–(1,643)	(106)–(1,643)	(146)–(1,643)	(233)–(1,643)	(340)–(1,643)

* DOE presents a range of potential employment impacts. Numbers in parentheses indicate negative numbers.

Similar to standard-size refrigerator-freezers, there are relatively small decreases in employment at the lower end of the range of employment impacts. These slight declines are caused by higher prices that drive lower shipments once manufacturers must meet the amended energy conservation standard. Standard-size freezer manufacturers also indicated that domestic production could be shifted abroad with any efficiency level that required large capital conversion costs. At TSL 1, DOE does not expect substantial changes to domestic employment in the standard-size freezer market if manufacturers use the design options listed in the engineering analysis to reach the efficiency requirements at this TSL.

However, at TSL 2 through TSL 5, manufacturers indicated that there could be domestic employment impacts depending on the design pathway used to reach the required efficiencies. At TSL 2 and above, the engineering analysis assumes that manufacturers would have to change wall thicknesses to reach the required efficiencies. Manufacturers indicated that because these products are typically low-end, they would likely follow the design pathways in the engineering analysis and increase the wall insulation thickness to reach higher efficiencies in order to avoid having to pass large price increases on to consumers. While this approach would result in extremely large conversion costs and would be more likely lead to manufacturers moving production abroad, manufacturers believed this strategy would help to maintain sales volumes.

iii. Compact Refrigeration Product Employment Impacts

DOE's research suggests that a limited percentage of compact refrigerators and refrigerator-freezers are made domestically (see Table VI.33). The overwhelming majority of products are imported. Manufacturers with domestic manufacturing facilities tend to source or import their compact products. The small employment numbers are mostly from remaining domestic production of compact chest freezers. As a result, amended energy conservation standards for compact refrigerators or refrigerator-freezers are unlikely to noticeably alter domestic employment levels.

TABLE VI.33—POTENTIAL CHANGES IN THE TOTAL NUMBER OF DOMESTIC COMPACT REFRIGERATION PRODUCT PRODUCTION WORKERS IN 2014

	Trial standard level					
	Base case	1	2	3	4	5
Total Number of Domestic Production Workers in 2014 (without changes in production locations)	27	26	26	25	24	40
Potential Changes in Domestic Production Workers in 2014*	....	(1)–(27)	(1)–(27)	(2)–(27)	(3)–(27)	13–(27)

* DOE presents a range of potential employment impacts. Numbers in parentheses indicate negative numbers.

iv. Built-In Refrigeration Product Employment Impacts

Using the GRIM, DOE estimates that, in the absence of amended energy conservation standards, there would be 1,139 U.S. works manufacturing built-in refrigeration products in 2014. Using the 2007 Census data and interviews with manufacturers, DOE estimates that approximately 94 percent of the built-in refrigeration products sold in the United States are manufactured domestically. Table VI.34 shows the impacts of amended energy conservation standards on U.S. production workers in the built-in refrigeration market.

TABLE VI.34—POTENTIAL CHANGES IN THE TOTAL NUMBER OF BUILT-IN REFRIGERATION PRODUCT PRODUCTION WORKERS IN 2014

	Trial standard level					
	Base case	1	2	3	4	5
Total Number of Domestic Production Workers in 2014 (without changes in production locations)	1,139	1,139	1,138	1,145	1,148	1,171
Potential Changes in Domestic Production Workers in 2014*		0–(1,139)	(1)–(1,139)	6–(1,139)	9–(1,139)	32–(1,139)

* DOE presents a range of potential employment impacts. Numbers in parentheses indicate negative numbers.

Employment in the built-in refrigeration market follows a pattern similar to that seen in the market for standard-size refrigerator-freezers and standard-size freezers at lower TSLs. At TSL 1 and TSL 2, higher prices result in fewer shipments, and a consequent reduction in labor expenditures that more than offsets the additional labor required to manufacture products with VIPs. However, at TSL 3 and above, the use of additional VIPs in built-in refrigeration products requires enough additional labor to cause a slight increase in the number of domestic production workers. Because built-in products are high-end products with far fewer shipments, it is less likely that manufacturers would choose to move all production facilities in response to amended energy conservation standards. The higher margins and profit earned in this market also make it more likely that manufacturers could earn a return on the investments required to reach the amended energy conservation standards and invest in existing facilities rather than move production abroad.

c. Impacts on Manufacturing Capacity

Manufacturers indicated that design changes involving thicker walls or multiple VIP panels would require substantial changes to their current manufacturing process. While these technologies would require the purchase of millions of dollars of production equipment, most manufacturers indicated they would likely be able to make even these substantial changes in between the announcement of the final rule and compliance date of an amended energy conservation standard. Manufacturers have had experience with the design options involving VIPs (even if not at the scale that would be required if the higher efficiency levels were adopted) and thickening walls. In addition, the design changes and investments analyzed at the levels required by the amended energy conservation standards for most product classes are more similar in magnitude to the introduction of a new product line—rather than complete redesigning of all products. Therefore, a larger capacity concern of manufacturers is the ability of their suppliers, particularly manufacturers of VIPs and more efficient compressors, to ramp up production in time to meet the amended energy conservation standard.

d. Impacts on Sub-Group(s) of Manufacturers

For this rulemaking, DOE used the results of the industry characterization to identify any subgroups of refrigerator manufacturers that exhibit similar characteristics different from the industry as a whole. The only such subgroup DOE identified was built-in manufacturers. DOE is establishing separate product classes for built-in products and is presenting separate analytical results for those products classes. Therefore, the MIA results DOE presents for those product classes already allow DOE to examine the MIA impacts on these manufacturers. Section 0 presents a more detailed discussion of the results for built-in product classes.

e. Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of several impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. In addition to energy conservation standards, other regulations can significantly affect manufacturers' financial health. Multiple regulations affecting the same manufacturer can strain profits and can lead companies to abandon product lines or markets with lower expected future returns than competing products. For these reasons, DOE conducts an analysis of cumulative regulatory burden as part of its rulemakings pertaining to appliance efficiency.

During previous stages of this rulemaking DOE identified a number of requirements with which manufacturers of these refrigeration products must comply and which take effect within three years of the anticipated effective date of the amended standards. DOE discusses these and other requirements, and includes the full details of the cumulative regulatory burden, in chapter 12 of the final rule's TSD. In chapter 12, DOE shows that many of the same products produced by residential refrigeration product manufacturers are also regulated by DOE and have a compliance date within 3 years of the compliance date of this rulemaking.

3. National Impact Analysis

a. Significance of Energy Savings

To estimate the national energy savings attributable to potential standards for refrigeration products, DOE compared the energy consumption of these products under the base case to their anticipated energy consumption under each TSL. Table VI–35 through Table VI–38 present DOE's forecasts of the national energy savings for each TSL, which were calculated using the approach described in section IV.G. Chapter 10 of the final rule TSD presents tables that also show the magnitude of the energy savings if the savings are discounted at rates of seven and three percent. Discounted energy savings represent a policy perspective in which energy savings realized farther in the future are less significant than energy savings realized in the nearer term.

TABLE VI.35—STANDARD-SIZE REFRIGERATOR-FREEZERS: CUMULATIVE NATIONAL ENERGY SAVINGS IN QUADS

Trial standard level	Top-mount refrigerator-freezers and all-refrigerators	Bottom-mount refrigerator-freezers	Side-by-side refrigerator-freezers
	Product classes 1, 1A, 2, 3, 3A, 3I and 6	Product classes 5, 5A, and 5I	Product classes 4, 4I, and 7
1	1.73	0.10	0.58
2	1.73	0.10	0.95
3	2.22	0.10	0.95
4	2.67	0.48	1.30
5	3.11	0.70	1.50

TABLE VI.36—STANDARD-SIZE FREEZERS: CUMULATIVE NATIONAL ENERGY SAVINGS IN QUADS

Trial standard level	Upright freezers	Chest freezers
	Product classes 8, 9 and 9I	Product classes 10 and 10A
1	0.49	0.31
2	0.75	0.38
3	0.87	0.46
4	0.98	0.53
5	1.01	0.60

TABLE VI.37—COMPACT REFRIGERATION PRODUCTS: CUMULATIVE NATIONAL ENERGY SAVINGS IN QUADS

Trial standard level	Compact refrigerators	Compact freezers
	Product classes 11, 11A, 12, 13, 13I, 13A, 14, 14I, 15 and 15I	Product classes 16, 17, 18
1	0.28	0.03
2	0.35	0.03
3	0.39	0.04
4	0.48	0.07
5	0.51	0.09

TABLE VI.38—BUILT-IN REFRIGERATION PRODUCTS: CUMULATIVE NATIONAL ENERGY SAVINGS IN QUADS

Trial standard level	Built-in all refrigerators	Built-in bottom-mount refrigerator-freezers	Built-in side-by-side refrigerator-freezers	Built-in upright freezers
	Product class 3A–BI	Product classes 5–BI and 5I–BI	Product classes 4–BI, 4I–BI and 7–BI	Product classes 9–BI and 9I–BI
1	0.00	0.00	0.01	0.00
2	0.01	0.00	0.01	0.01
3	0.01	0.00	0.03	0.01
4	0.01	0.02	0.03	0.01
5	0.01	0.02	0.04	0.02

b. Net Present Value of Consumer Costs and Benefits

DOE estimated the cumulative NPV to the Nation of the total costs and savings for consumers that would result from particular standard levels for refrigeration products. In accordance with the OMB's guidelines on regulatory analysis (OMB Circular A–4, section E, September 17, 2003), DOE calculated NPV using both a 7-percent and a 3-percent real discount rate. The 7-percent rate is an estimate of the average before-tax rate of return on private capital in the U.S. economy and reflects the returns on real estate and small business capital as well as corporate capital. DOE used this discount rate to approximate the opportunity cost of capital in the private sector, since a recent OMB analysis has found the average rate of return on capital to be near this rate. See *http://www.whitehouse.gov/omb/circulars_a004_a-4/.* In addition, DOE used the 3-percent rate to capture the potential effects of standards on private consumption (*e.g.,* through higher prices for products and the purchase of reduced amounts of energy). This rate represents the rate at which society discounts future consumption flows to their present value. It can be approximated by the real rate of return on long-term government debt (*i.e.* yield on Treasury notes minus annual rate of change in the Consumer Price Index), which has averaged about 3 percent on a pre-tax basis for the last 30 years.

Table VI–39 through Table VI–46 show the default consumer NPV results for each TSL DOE considered for refrigeration products, using both a 7-percent and a 3-percent discount rate. In each case, the impacts cover the lifetime of products purchased in 2014–2043. See chapter 10 of the final rule TSD for more detailed NPV results.

TABLE VI.39—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR STANDARD-SIZE REFRIGERATOR-FREEZERS, 3-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars		
	Top-mount refrigerator-freezers and all-refrigerators	Bottom-mount refrigerator-freezers	Side-by-side refrigerator-freezers
	Product classes 1, 1A, 2, 3, 3A, 3I and 6	Product classes 5, 5A, and 5I	Product classes 4, 4I, and 7
1	11.45	0.94	5.43
2	11.45	0.94	6.34
3	12.91	0.94	6.34
4	9.11	(0.47)	3.52
5	1.87	(2.52)	0.83

TABLE VI.40—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR STANDARD-SIZE REFRIGERATOR-FREEZERS, 7-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars		
	Top-mount refrigerator-freezers and all-refrigerators	Bottom-mount refrigerator-freezers	Side-by-side refrigerator-freezers
	Product classes 1, 1A, 2, 3, 3A, 3I and 6	Product classes 5, 5A, and 5I	Product classes 4, 4I, and 7
1	2.99	0.34	1.88
2	2.99	0.34	1.67
3	2.81	0.34	1.67
4	(0.31)	(1.17)	(0.60)
5	(5.28)	(2.74)	(2.53)

TABLE VI.41—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR STANDARD-SIZE FREEZERS, 3-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars	
	Upright freezers	Chest freezers
	Product classes 8, 9 and 9I	Product classes 10 and 10A
1	5.03	3.25
2	7.37	3.33
3	7.69	3.94
4	7.51	3.52
5	5.17	2.42

TABLE VI.42—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR STANDARD-SIZE FREEZERS, 7-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars	
	Upright freezers	Chest freezers
	Product classes 8, 9 and 9I	Product classes 10 and 10A
1	1.70	1.11
2	2.38	0.96

TABLE VI.42—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR STANDARD-SIZE FREEZERS, 7-PERCENT DISCOUNT RATE—Continued

Trial standard level	Billion 2009 dollars	
	Upright freezers	Chest freezers
	Product classes 8, 9 and 9I	Product classes 10 and 10A
3	2.30	1.12
4	1.96	0.75
5	0.56	(0.04)

TABLE VI.43—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR COMPACT REFRIGERATION PRODUCTS, 3-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars	
	Compact refrigerators	Compact freezers
	Product classes 11, 11A, 12, 13, 13I, 13A, 14, 14I, 15 and 15I	Product classes 16, 17, 18
1	1.61	0.20
2	1.42	0.20
3	1.62	0.21
4	0.81	(0.01)
5	(1.86)	(0.48)

TABLE VI.44—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR COMPACT REFRIGERATION PRODUCTS, 7-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars	
	Compact refrigerators	Compact freezers
	Product classes 11, 11A, 12, 13, 13I, 13A, 14, 14I, 15 and 15I	Product classes 16, 17, 18
1	0.67	0.09
2	0.51	0.09
3	0.59	0.08
4	0.08	(0.07)
5	(1.44)	(0.36)

TABLE VI.45—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR BUILT-IN REFRIGERATION PRODUCTS, 3-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars			
	Built-in all refrigerators	Built-in bottom-mount refrigerator-freezers	Built-in side-by-side refrigerator-freezers	Built-in upright freezers
	Product class 3A–BI	Product classes 5–BI and 5I–BI	Product classes 4–BI, 4I–BI and 7–BI	Product classes 9–BI and 9I–BI
1	0.04	0.02	0.06	0.05
2	0.05	0.01	0.06	0.07
3	0.02	0.01	(0.17)	0.05
4	(0.04)	(0.20)	(0.17)	0.05
5	(0.08)	(0.31)	(0.43)	0.02

TABLE VI.46—CUMULATIVE NET PRESENT VALUE OF CONSUMER BENEFITS FOR BUILT-IN REFRIGERATION PRODUCTS, 7-PERCENT DISCOUNT RATE

Trial standard level	Billion 2009 dollars			
	Built-in all refrigerators	Built-in bottom-mount refrigerator-freezers	Built-in side-by-side refrigerator-freezers	Built-in upright freezers
	Product class 3A–BI	Product classes 5–BI and 5I–BI	Product classes 4–BI, 4I–BI and 7–BI	Product classes 9–BI and 9I–BI
1	0.01	0.01	0.02	0.02
2	0.02	0.00	0.02	0.02
3	0.00	0.00	(0.16)	0.00
4	(0.04)	(0.14)	(0.16)	0.00
5	(0.07)	(0.21)	(0.32)	(0.02)

The NPV results presented above are based on a product price trend that reflects the default price trend. As discussed in section IV.G.3, DOE investigated the impact of different price trends on the NPV for the considered TSLs. DOE selected a high price decline case and a low price decline case from among a number of price trends that it analyzed. Table VI.47 through Table VI.54 provide the annualized NPV of consumer benefits at 7-percent and 3-percent discount rates, combined with the annualized present value of monetized benefits from CO_2 and NO_X emissions reductions, for each of the considered TSLs for the default price trend and the two sensitivity cases. (DOE's method for annualization is described in section VI.C.5 of this notice. Section VI.B.6 provides a complete description and summary of the monetized benefits from CO_2 and NO_X emissions reductions.) For details on the combined NPV results, see appendix 10–C of the final rule TSD.

TABLE VI.47—STANDARD-SIZE REFRIGERATOR-FREEZERS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (7-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	0.825	0.902	0.726
2	0.845	0.948	0.715
3	0.881	1.017	0.708
4	0.288	0.593	(0.100)
5	(0.507)	(0.029)	(1.114)

Parentheses indicate negative (−) values.

* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 7-percent discount rate.

TABLE VI.48—STANDARD-SIZE REFRIGERATOR-FREEZERS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (3-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	1.302	1.389	1.195
2	1.397	1.513	1.255
3	1.537	1.691	1.349
4	1.213	1.560	0.791
5	0.626	1.171	(0.036)

Parentheses indicate negative (−) values.

* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 3-percent discount rate.

TABLE VI.49—STANDARD-SIZE FREEZERS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (7-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	0.387	0.398	0.372
2	0.482	0.508	0.448
3	0.513	0.550	0.465
4	0.459	0.516	0.387
5	0.239	0.333	0.118

* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 7-percent discount rate.

TABLE VI.50—STANDARD-SIZE FREEZERS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (3-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	0.566	0.579	0.551
2	0.745	0.775	0.708
3	0.822	0.865	0.770
4	0.808	0.873	0.729
5	0.623	0.730	0.492

* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 3-percent discount rate.

TABLE VI.51—COMPACT REFRIGERATION PRODUCTS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (7-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	0.105	0.112	0.096
2	0.094	0.107	0.077
3	0.106	0.122	0.086
4	0.045	0.077	0.006
5	(0.142)	(0.083)	(0.216)

Parentheses indicate negative (−) values.
* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 7-percent discount rate.

TABLE VI.52—COMPACT REFRIGERATION PRODUCTS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (3-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	0.129	0.137	0.119
2	0.124	0.139	0.105
3	0.141	0.159	0.119
4	0.091	0.127	0.047
5	(0.085)	(0.018)	(0.166)

Parentheses indicate negative (−) values.
* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 3-percent discount rate.

TABLE VI.53—BUILT-IN REFRIGERATION PRODUCTS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (7-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	0.008	0.009	0.008
2	0.009	0.010	0.008
3	(0.011)	(0.005)	(0.018)
4	(0.028)	(0.019)	(0.040)
5	(0.056)	(0.043)	(0.074)

Parentheses indicate negative (−) values.

* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 7-percent discount rate.

TABLE VI.54—BUILT-IN REFRIGERATION PRODUCTS: ANNUALIZED NET PRESENT VALUE OF CONSUMER BENEFITS (3-PERCENT DISCOUNT RATE) AND ANNUALIZED PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS * FOR PRODUCTS SHIPPED IN 2014–2043

Trial standard level	Billion 2009$		
	Medium price decline (default)	High price decline	Low price decline
1	0.012	0.013	0.012
2	0.015	0.016	0.014
3	0.002	0.008	(0.006)
4	(0.013)	(0.002)	(0.025)
5	(0.036)	(0.021)	(0.056)

Parentheses indicate negative (−) values.

* The economic benefits from reduced CO_2 emissions were calculated using a SCC value of $22.1/metric ton in 2010 (in 2009$) for CO_2, increasing at 3% per year, and a discount rate of 3%. The economic benefits from reduced NO_X emissions were calculated using a value of $2,519/ton (in 2009$), which is the average of the low and high values used in DOE's analysis, and a 3-percent discount rate.

c. Indirect Impacts on Employment

DOE develops estimates of the indirect employment impacts of potential standards on the economy in general. As discussed above, DOE expects amended energy conservation standards for refrigeration products to reduce energy bills for consumers and the resulting net savings to be redirected to other forms of economic activity. These expected shifts in spending and economic activity could affect the demand for labor. As described in section IV.J, above, to estimate these effects, DOE used an input/output model of the U.S. economy. Table VI.55 presents the estimated net indirect employment impacts in 2020 and 2043 for the TSLs that DOE considered in this rulemaking. Chapter 13 of the final rule TSD presents more detailed results.

TABLE VI.55—NET INCREASE IN JOBS FROM INDIRECT EMPLOYMENT EFFECTS UNDER REFRIGERATION PRODUCT TSLS

	Thousands				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Standard-Size Refrigerator-Freezers:					
2020	2.35	2.34	2.33	−0.06	−3.18
2043	16.24	18.45	21.33	26.31	28.85
Standard-Size Freezers:					
2020	0.93	1.06	1.06	0.82	−0.05
2043	5.18	7.24	8.38	9.19	9.12
Compact Refrigeration Products:					
2020	0.51	0.52	0.60	0.50	−0.04
2043	1.44	1.64	1.88	2.02	1.53
Built-In Refrigeration Products:					
2020	0.02	0.02	−0.05	−0.11	−0.21
2043	0.14	0.19	0.29	0.31	−0.30

The input/output model suggests that today's amended standards are likely to increase the net demand for labor in the economy. However, the model suggests that the projected gains are very small relative to total national employment (currently approximately 120 million). Moreover, neither the BLS data nor the input/output model DOE uses includes the quality or wage level of the jobs. Therefore, because the analysis indicates an increased demand for labor would likely result from the amended energy conservation standards in this rulemaking, DOE has concluded that the amended standards are likely to produce employment benefits sufficient to offset fully any adverse impacts on employment in the manufacturing industry for the refrigeration products that are the subject of this rulemaking.

4. Impact on Utility or Performance of Products

As presented in section III.D.1.d of this notice, DOE concluded that none of the TSLs considered in this notice would substantially reduce the utility or performance of the products under consideration in this rulemaking. However, the availability of features that increase energy use, such as multiple drawers, might shift to higher-price products because the cost premium for implementing such features will likely increase. Manufacturers currently offer refrigeration products that meet or exceed the amended standards for most of the product classes. (42 U.S.C. 6295(o)(2)(B)(i)(IV))

5. Impact of Any Lessening of Competition

DOE has also considered any lessening of competition that is likely to result from amended standards. The Attorney General determines the impact, if any, of any lessening of competition likely to result from an amended standard, and transmits such determination to the Secretary, together with an analysis of the nature and extent of such impact. (42 U.S.C. 6295(o)(2)(B)(i)(V) and (B)(ii))

To assist the Attorney General in making such determination, DOE has provided DOJ with copies of this final rule and the TSD for review. As indicated earlier, DOE did not receive comments from DOJ. Accordingly, DOE does not believe that there is likely to be any lessening of competition as a result of today's final rule.

6. Need of the Nation To Conserve Energy

An improvement in the energy efficiency of the products subject to today's rule is likely to improve the security of the Nation's energy system by reducing overall demand for energy. Reduced electricity demand may also improve the reliability of the electricity system. As a measure of this reduced demand, Table VI–56 presents the estimated reduction in generating capacity in 2043 for the TSLs that DOE considered in this rulemaking.

TABLE VI.56—REDUCTION IN ELECTRIC GENERATING CAPACITY IN 2043 UNDER REFRIGERATION PRODUCT TSLS

	Gigawatts				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Standard-Size Refrigerator-Freezers	2.62	3.03	3.56	4.86	5.82
Standard-Size Freezers	0.83	0.83	1.40	1.59	1.71
Compact Refrigeration Products	0.273	0.335	0.386	0.480	0.511
Built-In Refrigeration Products	0.021	0.031	0.062	0.077	0.092

DOE used NEMS–BT to assess the impacts on electricity prices of the reduced need for new electric power plants and infrastructure projected to result from standards. The projected impacts on prices, and their value to electricity consumers, are presented in chapter 14 and chapter 10, respectively, of the final rule TSD. Although the aggregate benefits for all electricity users are potentially large, there may be negative effects on the actors involved in electricity supply. Because there is uncertainty about the extent to which the calculated impacts from reduced electricity prices would be a transfer from the actors involved in electricity supply to electricity consumers, DOE has concluded that, at present, it should not assign a heavy weight to this factor in considering the economic justification of standards on refrigeration products.

Energy savings from amended standards for refrigeration products could also produce environmental benefits in the form of reduced emissions of air pollutants and greenhouse gases associated with electricity production. Table VI.57 provides DOE's estimate of cumulative CO_2, NO_X, and Hg emissions reductions projected to result from the TSLs considered in this rulemaking. DOE reports annual CO_2, NO_X, and Hg emissions reductions for each TSL in chapter 15 of the final rule TSD.

As discussed in section V.M, DOE did not report SO_2 emissions reductions from power plants because there is uncertainty about the effect of energy conservation standards on the overall level of SO_2 emissions in the United States due to SO_2 emissions caps. DOE also did not include NO_X emissions reduction from power plants in States subject to CAIR because an energy conservation standard would not affect the overall level of NO_X emissions in those States due to the emissions caps mandated by CAIR.

TABLE VI.57—SUMMARY OF EMISSIONS REDUCTION ESTIMATED FOR REFRIGERATION PRODUCT TSLS

[Cumulative for 2014 through 2043]

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Standard-Size Refrigerator-Freezers:					
CO_2 (Mt)	175	202	238	323	386
NO_X (1000 tons)	141	162	191	260	310
Hg (tons)	0.79	0.91	1.07	1.45	1.73
Standard-Size Freezers:					
CO_2 (Mt)	54	77	91	103	110
NO_X (1000 tons)	43	62	73	83	89
Hg (tons)	0.24	0.34	0.41	0.47	0.50
Compact Refrigeration Products:					
CO_2 (Mt)	20	24	28	35	39
NO_X (1000 tons)	16	20	23	29	32
Hg (tons)	0.10	0.12	0.15	0.19	0.21
Built-In Refrigeration Products:					
CO_2 (Mt)	1.41	2.05	4.10	5.09	6.09

TABLE VI.57—SUMMARY OF EMISSIONS REDUCTION ESTIMATED FOR REFRIGERATION PRODUCT TSLS—Continued

[Cumulative for 2014 through 2043]

	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
NO_X (1000 tons)	1.14	1.65	3.30	4.09	4.90
Hg (tons)	0.01	0.01	0.02	0.02	0.03

As part the analysis for this final rule, DOE estimated monetary benefits likely to result from the reduced emissions of CO_2 and NO_X that DOE estimated for each of the TSLs considered. As discussed in section IV.M, DOE used values for the SCC developed by an interagency process. The four values for CO_2 emissions reductions resulting from that process (expressed in 2009$) are $4.9/ton (the average value from a distribution that uses a 5-percent discount rate), $22.1/ton (the average value from a distribution that uses a 3-percent discount rate), $36.3/ton (the average value from a distribution that uses a 2.5-percent discount rate), and $67.1/ton (the 95th-percentile value from a distribution that uses a 3-percent discount rate). These values correspond to the value of emission reductions in 2010; the values for later years are higher due to increasing damages as the magnitude of climate change increases.

Table VI–58 through Table VI–61 present the global values of CO_2 emissions reductions at each TSL. For each of the four cases, DOE calculated a present value of the stream of annual values using the same discount rate as was used in the studies upon which the dollar-per-ton values are based. DOE calculated domestic values as a range from 7 percent to 23 percent of the global values, and these results are presented in Table VI–62 through Table VI–65.

TABLE VI.58—STANDARD-SIZE REFRIGERATOR-FREEZERS: ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$			
	5% discount rate, average *	3% discount rate, average *	2.5% discount rate, average *	3% discount rate, 95th percentile *
1	1.45	4.60	6.90	14.0
2	1.67	5.31	7.96	16.16
3	1.96	6.24	9.36	19.00
4	2.68	8.51	12.76	25.90
5	3.20	10.18	15.26	30.98

* Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

TABLE VI.59—STANDARD-SIZE FREEZERS: ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$			
	5% discount rate, average *	3% discount rate, average *	2.5% discount rate, average *	3% discount rate, 95th percentile *
1	0.48	1.51	2.25	4.58
2	0.69	2.16	3.24	6.59
3	0.81	2.55	3.81	7.76
4	0.92	2.89	4.32	8.80
5	0.98	3.09	4.62	9.41

* Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

TABLE VI.60—COMPACT REFRIGERATION PRODUCTS: ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$			
	5% discount rate, average *	3% discount rate, average *	2.5% discount rate, average *	3% discount rate, 95th percentile *
1	0.12	0.41	0.63	1.26
2	0.15	0.51	0.77	1.54
3	0.18	0.59	0.89	1.79
4	0.22	0.74	1.12	2.25
5	0.24	0.81	1.23	2.47

* Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

TABLE VI.61—BUILT-IN REFRIGERATION PRODUCTS: ESTIMATES OF GLOBAL PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$			
	5% discount rate, average *	3% discount rate, average *	2.5% discount rate, average *	3% discount rate, 95th percentile *
1	0.012	0.038	0.057	0.12
2	0.017	0.055	0.083	0.17
3	0.035	0.11	0.17	0.34
4	0.043	0.014	0.20	0.41
5	0.051	0.16	0.24	0.50

* Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

TABLE VI.62—STANDARD-SIZE REFRIGERATOR-FREEZERS: ESTIMATES OF DOMESTIC PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$ *			
	5% discount rate, average **	3% discount rate, average **	2.5% discount rate, average **	3% discount rate, 95th percentile **
1	0.10 to 0.33	0.32 to 1.06	0.48 to 1.59	0.98 to 3.22.
2	0.12 to 0.38	0.37 to 1.22	0.56 to 1.83	1.13 to 3.72.
3	0.14 to 0.45	0.44 to 1.44	0.66 to 2.15	1.33 to 4.37.
4	0.19 to 0.62	0.60 to 1.96	0.89 to 2.93	1.81 to 5.96.
5	0.22 to 0.74	0.71 to 2.34	1.07 to 3.51	2.17 to 7.13.

* Domestic values are presented as a range between 7% and 23% of the global values.
** Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

TABLE VI.63—STANDARD-SIZE FREEZERS: ESTIMATES OF DOMESTIC PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$ *			
	5% discount rate, average **	3% discount rate, average **	2.5% discount rate, average **	3% discount rate, 95th percentile **
1	0.033 to 0.11	0.11 to 0.35	0.16 to 0.52	0.32 to 1.05.
2	0.048 to 0.16	0.15 to 0.50	0.23 to 0.74	0.46 to 1.51.
3	0.057 to 0.19	0.057 to 0.19	0.057 to 0.19	0.057 to 0.19.
4	0.064 to 0.21	0.20 to 0.67	0.30 to 0.99	0.62 to 2.02.
5	0.069 to 0.23	0.22 to 0.71	0.32 to 1.06	0.069 to 0.23.

* Domestic values are presented as a range between 7% and 23% of the global values.
** Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

TABLE VI.64—COMPACT REFRIGERATION PRODUCTS: ESTIMATES OF DOMESTIC PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$ *			
	5% discount rate, average **	3% discount rate, average **	2.5% discount rate, average **	3% discount rate, 95th percentile **
1	0.0087 to 0.029	0.029 to 0.095	0.044 to 0.14	0.09 to 0.29.
2	0.011 to 0.035	0.035 to 0.12	0.054 to 0.18	0.11 to 0.36.
3	0.012 to 0.041	0.041 to 0.14	0.062 to 0.21	0.13 to 0.41.
4	0.016 to 0.051	0.052 to 0.17	0.078 to 0.26	0.16 to 0.52.
5	0.017 to 0.056	0.057 to 0.19	0.086 to 0.28	0.17 to 0.57.

* Domestic values are presented as a range between 7% and 23% of the global values.
** Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

TABLE VI.65—BUILT-IN REFRIGERATION PRODUCTS: ESTIMATES OF DOMESTIC PRESENT VALUE OF CO_2 EMISSIONS REDUCTION UNDER TRIAL STANDARD LEVELS

TSL	Billion 2009$ *			
	5% discount rate, average **	3% discount rate, average **	2.5% discount rate, average **	3% discount rate, 95th percentile **
1	0.00083 to 0.0027	0.0026 to 0.0087	0.0040 to 0.013	0.0081 to 0.026.
2	0.0012 to 0.0040	0.0039 to 0.013	0.0058 to 0.019	0.012 to 0.039.
3	0.0024 to 0.0080	0.0077 to 0.025	0.012 to 0.038	0.023 to 0.077.
4	0.0030 to 0.010	0.010 to 0.031	0.014 to 0.047	0.029 to 0.10.
5	0.0036 to 0.012	0.011 to 0.037	0.017 to 0.056	0.035 to 0.11.

* Domestic values are presented as a range between 7% and 23% of the global values.
** Columns are labeled by the discount rate used to calculate the SCC and whether it is an average value or drawn from a different part of the distribution. Values presented in the table incorporate the escalation of the SCC over time.

DOE is well aware that scientific and economic knowledge about the contribution of CO_2 and other GHG emissions to changes in the future global climate and the potential resulting damages to the world economy continues to evolve rapidly. Thus, any value placed in this rulemaking on reducing CO_2 emissions is subject to change. DOE, together with other Federal agencies, will continue to review various methodologies for estimating the monetary value of reductions in CO_2 and other GHG emissions. This ongoing review will consider the comments on this subject that are part of the public record for this and other rulemakings, as well as other methodological assumptions and issues. However, consistent with DOE's legal obligations, and taking into account the uncertainty involved with this particular issue, DOE has included in this final rule the most recent values and analyses resulting from the ongoing interagency review process.

DOE also estimated a range for the cumulative monetary value of the economic benefits associated with NO_X emissions reductions anticipated to result from amended standards for refrigeration products. The dollar-per-ton values that DOE used are discussed in section IV.M. Table VI.66 presents the cumulative present values for each TSL calculated using seven-percent and three-percent discount rates.

TABLE VI.66—ESTIMATES OF PRESENT VALUE OF NO_X EMISSIONS REDUCTION UNDER REFRIGERATION PRODUCT TRIAL STANDARD LEVELS

	Billion 2009$				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Standard-Size Refrigerator-Freezers:					
7% discount rate	0.018 to 0.18	0.020 to 0.21	0.024 to 0.25	0.033 to 0.34	0.039 to 0.40.
3% discount rate	0.044 to 0.45	0.051 to 0.52	0.060 to 0.62	0.082 to 0.84	0.097 to 1.00.
Standard-Size Freezers:					
7% discount rate	0.0055 to 0.056	0.008 to 0.081	0.009 to 0.095	0.011 to 0.107	0.011 to 0.12.
3% discount rate	0.014 to 0.15	0.020 to 0.21	0.024 to 0.25	0.027 to 0.28	0.029 to 0.30.
Compact Refrigeration Products:					
7% discount rate	0.002 to 0.021	0.003 to 0.026	0.003 to 0.030	0.004 to 0.038	0.004 to 0.042.
3% discount rate	0.004 to 0.044	0.005 to 0.054	0.006 to 0.063	0.008 to 0.079	0.009 to 0.088.
Built-In Refrigeration Products:					
7% discount rate	0.000 to 0.002	0.001 to 0.002	0.000 to 0.004	0.001 to 0.005	0.001 to 0.006.
3% discount rate	0.000 to 0.004	0.001 to 0.005	0.001 to 0.018	0.001 to 0.013	0.002 to 0.016.

The NPV of the monetized benefits associated with emissions reductions can be viewed as a complement to the NPV of the consumer savings calculated for each TSL considered in this rulemaking. Table VI.67 shows an example of the calculation of the combined NPV including benefits from emissions reductions for the case of TSL 3 for standard-size refrigerator-freezers. Table VI.68 and Table VI.69 present the NPV values that would result if DOE were to add the estimates of the potential economic benefits resulting from reduced CO_2 and NO_X emissions in each of four valuation scenarios to the NPV of consumer savings calculated for each TSL considered in this rulemaking, at both a seven-percent and three-percent discount rate. The CO_2 values used in the columns of each table correspond to the four scenarios for the valuation of CO_2 emission reductions presented in section IV.M.

TABLE VI.67—ADDING NET PRESENT VALUE OF CONSUMER SAVINGS TO PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS AT TSL 3 FOR STANDARD-SIZE REFRIGERATOR-FREEZERS

Category	Present value billion 2009$	Discount rate (percent)
Benefits:		
Operating Cost Savings	14.65	7
	37.41	3

TABLE VI.67—ADDING NET PRESENT VALUE OF CONSUMER SAVINGS TO PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS AT TSL 3 FOR STANDARD-SIZE REFRIGERATOR-FREEZERS—Continued

Category	Present value billion 2009$	Discount rate (percent)
CO_2 Reduction Monetized Value (at $4.9/t) *	1.96	5
CO_2 Reduction Monetized Value (at $22.1/t) *	6.24	3
CO_2 Reduction Monetized Value (at $36.3/t) *	9.36	2.5
CO_2 Reduction Monetized Value (at $67.1/t) *	19.0	3
NO_X Reduction Monetized Value (at $2,519/ton) *	0.136	7
	0.338	3
Total Monetary Benefits **	21.02	7
	43.99	3
Costs:		
Total Incremental Installed Costs	9.83	7
	17.22	3
Net Benefits:		
Including CO_2 and NO_X**	11.19	7
	26.77	3

* These values represent global values (in 2009$) of the social cost of CO_2 emissions in 2010 under several scenarios. The values of $4.9, $22.1, and $36.3 per metric ton (t) are the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The value of $67.1/t represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. See section IV.M for details. The value for NO_X (in 2009$) is the average of the low and high values used in DOE's analysis.
** Total Monetary Benefits for both the 3% and 7% cases utilize the central estimate of social cost of CO_2 emissions calculated at a 3% discount rate, which is equal to $22.1/t in 2010 (in 2009$).

TABLE VI.68—ADDING NET PRESENT VALUE OF CONSUMER SAVINGS (AT 7% DISCOUNT RATE) TO PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS AT TRIAL STANDARD LEVELS FOR REFRIGERATION PRODUCTS

TSL	Consumer NPV at 7% discount rate added with			
	SCC Value of $4.9/metric ton CO_2* and low value for NO_X** billion 2009$	SCC Value of $22.1/metric ton CO_2* and medium value for NO_X** billion 2009$	SCC Value of $36.3/metric ton CO_2* and medium value for NO_X** billion 2009$	SCC Value of $67.1/metric ton CO_2* and high value for NO_X** billion 2009$
1	10.92	15.53	18.81	29.06
2	11.55	17.20	21.22	33.77
3	11.75	18.42	23.17	37.99
4	4.20	12.83	18.97	38.14
5	(7.93)	2.08	9.20	31.45

* These label values represent the global SCC of CO_2 in 2010, in 2009$. Their present values have been calculated with scenario-consistent discount rates. See section IV.M for a discussion of the derivation of these values.
** Low Value corresponds to $447 per ton of NO_X emissions. Medium Value corresponds to $2,519 per ton of NO_X emissions. High Value corresponds to $4,591 per ton of NO_X emissions.

TABLE VI.69—ADDING NET PRESENT VALUE OF CONSUMER SAVINGS (AT 3% DISCOUNT RATE) TO PRESENT VALUE OF MONETIZED BENEFITS FROM CO_2 AND NO_X EMISSIONS REDUCTIONS AT TRIAL STANDARD LEVELS FOR REFRIGERATION PRODUCTS

TSL	Consumer NPV at 3% discount rate added with			
	SCC Value of $4.9/metric ton CO_2* and low value for NO_X** billion 2009$	SCC Value of $22.1/metric ton CO_2* and medium value for NO_X** billion 2009$	SCC Value of $36.31/metric ton CO_2* and medium value for NO_X** billion 2009$	SCC Value of $67.1/metric ton CO_2* and high value for NO_X** billion 2009$
1	30.20	34.99	38.27	48.69
2	33.85	39.71	43.73	56.50
3	36.64	43.57	48.31	63.39
4	27.59	36.56	42.69	62.19
5	9.25	19.65	26.76	49.39

* These label values represent the global SCC of CO_2 in 2010, in 2009$. Their present values have been calculated with scenario-consistent discount rates. See section IV.M for a discussion of the derivation of these values.
** Low Value corresponds to $447 per ton of NO_X emissions. Medium Value corresponds to $2,519 per ton of NO_X emissions. High Value corresponds to $4,591 per ton of NO_X emissions.

Although adding the value of consumer savings to the values of emission reductions provides a valuable perspective, two issues should be considered. First, the national operating savings are domestic U.S. consumer monetary savings that occur as a result of market transactions while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and CO_2 savings are performed with different methods that use quite different time frames for analysis. The national operating cost savings is measured for the lifetime of refrigeration products shipped in 2014–2043. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

7. Other Factors

The Secretary, in determining whether a standard is economically justified, may consider any other factors that he deems to be relevant. (42 U.S.C. 6295(o)(2)(B)(i)(VI))) DOE is aware of pending legislation that proposes to phase out substances with significant GWP and that HFCs are included in the list of substances to be phased out. DOE recognizes the significance that such legislation would have to the refrigeration products industry and the impact it would have on the ability of manufacturers to meet energy conservation standards. Given the uncertainty regarding such legislation, however, DOE did not factor the impact of potential HFC limitations in developing the standard levels presented in today's final rule.

DOE has also considered the Joint Comments submitted to DOE containing the various recommended standard levels for refrigeration products. DOE recognizes the value of consensus agreements submitted by parties in accordance with 42 U.S.C. 6295(p)(4) and has weighed the value of such consensus in establishing the standards set forth in today's final rule.

C. Conclusion

When prescribing new or amended standards, the standard that DOE adopts for any type (or class) of covered product shall be designed to achieve the maximum improvement in energy efficiency that the Secretary determines is technologically feasible and economically justified. (42 U.S.C. 6295(o)(2)(A)) In determining whether a standard is economically justified, the Secretary must determine whether the benefits of the standard exceed its burdens to the greatest extent practicable, in light of the seven statutory factors discussed previously. (42 U.S.C. 6295(o)(2)(B)(i)) The new or amended standard must also ''result in significant conservation of energy.'' (42 U.S.C. 6295(o)(3)(B))

For today's final rule, DOE considered the impacts of standards at each trial standard level, beginning with the maximum technologically feasible level, to determine whether that level was economically justified. Where the max-tech level was not justified, DOE then considered the next most efficient level and undertook the same evaluation until it reached the most efficient level that is both technologically feasible and economically justified and saves a significant amount of energy.

For ease of presentation, DOE separately discusses the benefits and/or burdens of each trial standard level for standard-size refrigerator-freezers, standard-size freezers, compact refrigeration products, and built-in refrigeration products. Tables that present a summary of the results of DOE's quantitative analysis for each TSL have been provided to aid the reader as DOE discusses the benefits and/or burdens of each trial standard level.

In addition to the quantitative results presented in the tables, DOE also considers other burdens and benefits that affect economic justification. These include the impacts on identifiable subgroups of consumers, such as low-income households and seniors, who may be disproportionately affected by a national standard. Section VI.B.1.b presents the estimated impacts of each TSL for these subgroups.

DOE notes that the proposed standards set forth in the Joint Comments were also carefully considered by the agency. These suggested standards, along with the comments from all interested parties and the agency's analytical work developed in preparation of today's final rule, were considered during the development of the standards being adopted today.

DOE also notes that the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. This undervaluation suggests that regulation that promotes energy efficiency can produce significant net private gains (as well as producing social gains by, for example, reducing pollution). There is evidence that consumers undervalue future energy savings as a result of (1) A lack of information, (2) a lack of sufficient salience of the long-term or aggregate benefits, (3) a lack of sufficient savings to warrant delaying or altering purchases (*e.g.* an inefficient ventilation fan in a new building or the delayed replacement of a water pump), (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments, (5) computational or other difficulties associated with the evaluation of relevant tradeoffs, and (6) a divergence in incentives (*e.g.,* renter versus building owner; builder vs. home buyer). Other literature indicates that with less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off these types of investments at a higher than expected rate between current consumption and uncertain future energy cost savings.

In DOE's current regulatory analysis, potential changes in the benefits and costs of a regulation due to changes in consumer purchase decisions are included in two ways. First, if consumers forego a purchase of a product in the standards case, this decreases sales for product manufacturers, and the cost to manufacturers is included in the MIA. Second, DOE accounts for energy savings attributable only to products actually used by consumers in the standards case; if a regulatory option decreases the number of products used by consumers, this decreases the potential energy savings from an energy conservation standard. DOE provides detailed estimates of shipments and changes in the volume of product purchases in chapter 9 of the final rule TSD. However, DOE's current analysis does not explicitly control for heterogeneity in consumer preferences, preferences across subcategories of products or specific features, or consumer price sensitivity variation according to household income.

While DOE is not prepared at present to provide a fuller quantifiable framework for estimating the benefits and costs of changes in consumer purchase decisions due to an energy conservation standard, DOE has posted a paper that discusses the issue of consumer welfare impacts of appliance energy efficiency standards, and potential enhancements to the methodology by which these impacts are defined and estimated in the regulatory process.[48] DOE is committed to developing a framework that can support empirical quantitative tools for improved assessment of the consumer welfare impacts of appliance standards. DOE welcomes comments on how to more fully assess the potential impact of energy conservation standards on consumer choice and how to quantify this impact in its regulatory analysis in future rulemakings.

1. Standard-Size Refrigerator-Freezers

Table VI–70 presents a summary of the quantitative impacts estimated for each TSL for standard-size refrigerator-freezers. The efficiency levels contained in each TSL are described in section VI.A. The range of results for NPV of consumer benefits reflects the range of product price forecasts discussed in section IV.G.3.

TABLE VI.70—SUMMARY OF RESULTS FOR STANDARD-SIZE REFRIGERATOR-FREEZERS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
National Energy Savings (quads)	2.41	2.78	3.27	4.45	5.30.
NPV of Consumer Benefits (2009$ billion)					
3% discount rate	15.96 to 19.35	16.26 to 20.76	16.92 to 22.88	4.800 to 18.20	(11.4) to 9.67.
7% discount rate	4.272 to 5.940	3.764 to 5.973	3.173 to 6.104	(5.756) to 0.804	(16.30) to (6.03).
Industry Impacts					
Industry NPV (2009$ million)	(117.8) to (252.6)	(219.2) to (395.9)	(345.0) to (580.7)	(784.9) to (1,309.3).	(1,042.2) to (1,841.5).
Industry NPV (% change)	(4.4) to (9.5)	(8.2) to (14.8)	(12.9) to (21.7)	(29.4) to (49.0)	(39.0) to (69.0).
Cumulative Emissions Reduction					
CO_2 (Mt)	175	202	238	323	386.
NO_X (1000 tons)	141	162	191	260	310.
Hg (tons)	0.79	0.91	1.07	1.45	1.73.
Value of Cumulative Emissions Reduction					
CO_2 (2009$ billion) *	1.45 to 14.0	1.67 to 16.2	1.96 to 19.0	2.68 to 25.9	3.20 to 31.0.
NO_X—3% discount rate (2009$ billion)	0.044 to 0.45	0.051 to 0.52	0.060 to 0.62	0.082 to 0.84	0.097 to 1.00.
NO_X—7% discount rate (2009$ billion)	0.018 to 0.18	0.020 to 0.21	0.024 to 0.25	0.033 to 0.34	0.039 to 0.40.
Mean LCC Savings ** (2009$)					
Top-Mount Refrigerator-Freezers	44	44	42	(6)	(87).
Bottom-Mount Refrigerator-Freezers	22	22	22	(53)	(136).
Side-by-Side Refrigerator-Freezers	62	57	57	(18)	(83).
Median PBP (years)					
Top-Mount Refrigerator-Freezers	8.0	8.0	9.5	13.3	17.8.
Bottom-Mount Refrigerator-Freezers	4.2	4.2	4.2	21.0	24.7.
Side-by-Side Refrigerator-Freezers	4.0	9.2	9.2	15.6	19.1.
Distribution of Consumer LCC Impacts					
Top-Mount Refrigerator-Freezers:					
Net Cost (%)	34	34	46	65	80.
No Impact (%)	8.3	8.3	0.0	0.0	0.0.
Net Benefit (%)	58	58	54	35	20.
Bottom-Mount Refrigerator-Freezers:					
Net Cost (%)	2.5	2.5	2.5	83	89.
No Impact (%)	68	68	68	0.0	0.0.
Net Benefit (%)	30	30	30	17	11.
Side-by-Side Refrigerator-Freezers:					
Net Cost (%)	4.3	42	42	70	80.
No Impact (%)	37	0.0	0.0	0.0	0.0.
Net Benefit (%)	59	59	59	30	21.
Generation Capacity Reduction (GW) †	2.62	3.03	3.56	4.86	5.82.
Employment Impacts					
Total Potential Changes in Domestic Production Workers in 2014 (thousands).	(0.19) to (7.35)	(0.22) to (7.35)	(0.18) to (7.35)	(0.24) to (7.35)	(0.37) to (7.35).

[48] Alan Sanstad, Notes on the Economics of Household Energy Consumption and Technology Choice. Lawrence Berkeley National Laboratory. 2010. *http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/consumer_ee_theory.pdf.*

TABLE VI.70—SUMMARY OF RESULTS FOR STANDARD-SIZE REFRIGERATOR-FREEZERS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Indirect Domestic Jobs (thousands) †	16.24	18.45	21.33	26.31	28.85.

Parentheses indicate negative (−) values.
* Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** For LCCs, a negative value means an increase in LCC by the amount indicated.
† Changes in 2043.

DOE first considered TSL 5, which represents the max-tech efficiency levels. TSL 5 would save 5.30 quads of energy, an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be −$6.03 billion to −$16.3 billion, using a discount rate of 7 percent, and −$11.4 to $9.67 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 386 Mt of CO_2, 310,000 tons of NO_X, and 1.73 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 5 ranges from $3.20 billion to $30.98 billion. Total generating capacity in 2043 is estimated to decrease by 5.82 GW under TSL 5.

At TSL 5, the average LCC impact is a cost (LCC increase) of $87 for top-mount refrigerator-freezers, a cost of $136 for bottom-mount refrigerator-freezers, and a cost of $83 for side-by-side refrigerator-freezers. The median payback period is 17.8 years for top-mount refrigerator-freezers, 24.7 years for bottom-mount refrigerator-freezers, and 19.1 years for side-by-side refrigerator-freezers. The fraction of consumers experiencing an LCC benefit is 20 percent for top-mount refrigerator-freezers, 11 percent for bottom-mount refrigerator-freezers, and 21 percent for side-by-side refrigerator-freezers. The fraction of consumers experiencing an LCC cost is 80 percent for top-mount refrigerator-freezers, 89 percent for bottom-mount refrigerator-freezers, and 80 percent for side-by-side refrigerator-freezers.

At TSL 5, the projected change in INPV ranges from a decrease of $1,042.2 million to a decrease of $1,841.5 million. At TSL 5, DOE recognizes the risk of very large negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the high end of the range of impacts is reached as DOE expects, TSL 5 could result in a net loss of 69.0 percent in INPV to standard-size refrigerator-freezer manufacturers.

The Secretary has concluded that at TSL 5 for standard-size refrigerator-freezers, the benefits of energy savings, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV of consumer benefits, the economic burden on a significant fraction of consumers due to the large increases in product cost, and the capital conversion costs and profit margin impacts that could result in a very large reduction in INPV for manufacturers. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

DOE then considered TSL 4. TSL 4 would save 4.45 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be −$5.76 billion to $0.80 billion, using a discount rate of 7 percent, and $4.80 billion to $18.2 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 323 Mt of CO_2, 260,000 tons of NO_X, and 1.45 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 4 ranges from $2.68 billion to $25.9 billion. Total generating capacity in 2043 is estimated to decrease by 4.86 GW under TSL 4.

At TSL 4, DOE projects that the average LCC impact is a cost (LCC increase) of $6 for top-mount refrigerator-freezers, a cost of $53 for bottom-mount refrigerator-freezers, and a cost of $18 for side-by-side refrigerator-freezers. The median payback period is 13.3 years for top-mount refrigerator-freezers, 21.0 years for bottom-mount refrigerator-freezers, and 15.6 years for side-by-side refrigerator-freezers. The fraction of consumers experiencing an LCC benefit is 35 percent for top-mount refrigerator-freezers, 17 percent for bottom-mount refrigerator-freezers, and 30 percent for side-by-side refrigerator-freezers. The fraction of consumers experiencing an LCC cost is 65 percent for top-mount refrigerator-freezers, 83 percent for bottom-mount refrigerator-freezers, and 70 percent for side-by-side refrigerator-freezers.

At TSL 4, the projected change in INPV ranges from a decrease of $784.9 million to a decrease of $1,309.3 million. DOE recognizes the risk of large negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the high end of the range of impacts is reached as DOE expects, TSL 4 could result in a net loss of 49.0 percent in INPV to standard-size refrigerator-freezer manufacturers.

The Secretary has concluded that at TSL 4 for standard-size refrigerator-freezers, the benefits of energy savings, positive NPV of consumer benefits at 3-percent discount rate, generating capacity reductions, and emission reductions and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV of consumer benefits at 7-percent discount rate, the economic burden on a significant fraction of consumers due to the large increases in product cost, and the capital conversion costs and profit margin impacts that could result in a substantial reduction in INPV for the manufacturers. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3. TSL 3 would save 3.27 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $3.17 billion to $6.10 billion, using a discount rate of 7 percent, and $16.9 billion to $22.9 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 238 Mt of CO_2, 191,000 tons of NO_X, and 1.07 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 3 ranges from $1.96 billion to $19.0 billion. Total generating capacity in 2043 is estimated to decrease by 3.56 GW under TSL 3.

At TSL 3, the average LCC impact is a gain (consumer savings) of $42 for top-mount refrigerator-freezers, a gain of $22 for bottom-mount refrigerator-freezers, and a gain of $57 for side-by-side refrigerator-freezers. The median payback period is 9.5 years for top-mount refrigerator-freezers, 4.2 years for bottom-mount refrigerator-freezers, and 9.2 years for side-by-side refrigerator-freezers. The fraction of consumers experiencing an LCC benefit is 54 percent for top-mount refrigerator-freezers, 30 percent for bottom-mount refrigerator-freezers, and 59 percent for side-by-side refrigerator-freezers. The fraction of consumers experiencing an LCC cost is 46 percent for top-mount refrigerator-freezers, 2.5 percent for bottom-mount refrigerator-freezers, and 42 percent for side-by-side refrigerator-freezers.

At TSL 3, the projected change in INPV ranges from a decrease of $345.0 million to a decrease of $580.7 million. DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. If the high end of the range of impacts is reached as DOE expects, TSL 3 could result in a net loss of 21.7 percent in INPV to standard-size refrigerator-freezer manufacturers.

The Secretary has concluded that at TSL 3 for standard-size refrigerator-freezers, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions outweigh the economic burden on a significant fraction of consumers due to the increases in product cost, and the capital conversion costs and profit margin impacts that could result in a reduction in INPV for the manufacturers. In addition to the aforementioned benefits of the amended standards, DOE notes that the efficiency levels in TSL 3 correspond to the recommended levels presented in the Joint Comments and, as stated previously, DOE recognizes the value of consensus agreements submitted in accordance with 42 U.S.C. 6295(p)(4).

After considering the analysis, comments responding to the September 2010 NOPR, and the benefits and burdens of TSL 3, the Secretary has concluded that this trial standard level will offer the maximum improvement in efficiency that is technologically feasible and economically justified, and will result in the significant conservation of energy. Therefore, DOE is adopting TSL 3 for standard-size refrigerator-freezers. The amended energy conservation standards for standard-size refrigerator-freezers, expressed as equations for maximum energy use, are shown in Table VI.71.

TABLE VI.71—AMENDED STANDARDS FOR STANDARD-SIZE REFRIGERATORS AND REFRIGERATOR-FREEZERS

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft³)	Based on av (L)
1. Refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost	7.99AV + 225.0	0.282av + 225.0
1A. All-refrigerators—manual defrost	6.79AV + 193.6	0.240av + 193.6
2. Refrigerator-freezers—partial automatic defrost	7.99AV + 225.0	0.282av + 225.0
3. Refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker	8.07AV + 233.7	0.285av + 233.7
3I. Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.	8.07AV + 317.7	0.285av + 317.7
3A. All-refrigerators—automatic defrost	7.07AV + 201.6	0.250av + 201.6
4. Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker	8.51AV + 297.8	0.301av + 297.8
4I. Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.	8.51AV + 381.8	0.301av + 381.8
5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic ice-maker.	8.85AV + 317.0	0.312av + 317.0
5I. Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.	8.85AV + 401.0	0.312av + 401.0
5A. Refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service.	9.25AV + 475.4	0.327av + 475.4
6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service.	8.40AV + 385.4	0.297av + 385.4
7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	8.54AV + 432.8	0.302av + 432.8

AV = adjusted volume in cubic feet; av = adjusted volume in liters.

2. Standard-Size Freezers

Table VI.72 presents a summary of the quantitative impacts estimated for each TSL for standard-size freezers. The efficiency levels contained in each TSL are described in section VI.A. The range of results for NPV of consumer benefits reflects the range of product price forecasts discussed in section IV.G.3.

TABLE VI.72—SUMMARY OF RESULTS FOR STANDARD-SIZE FREEZERS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
National Energy Savings (quads)	0.79	1.14	1.34	1.52	1.62.
NPV of Consumer Benefits (2009$ billion)					
3% discount rate	8.00 to 8.50	10.1 to 11.2	10.7 to 12.4	9.66 to 12.2	5.32 to 9.46.
7% discount rate	2.67 to 2.92	3.02 to 3.59	2.96 to 3.77	2.03 to 3.25	(0.63) to 1.41.
Industry Impacts					
Industry NPV (2009$ million)	(29.8) to (50.0)	(123.7) to (170.5)	(112.5) to (178.1)	(85.4) to (182.4)	(145.0) to (298.8).
Industry NPV (% change)	(8.8) to (14.8)	(36.6) to (50.5)	(33.3) to (52.7)	(25.3) to (54.0)	(42.9) to (88.5).

TABLE VI.72—SUMMARY OF RESULTS FOR STANDARD-SIZE FREEZERS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Cumulative Emissions Reduction					
CO_2 (Mt)	54	77	91	103	110.
NO_X (1000 tons)	43	62	73	83	89.
Hg (tons)	0.24	0.34	0.41	0.47	0.50.
Value of Cumulative Emissions Reduction					
CO_2 (2009$ billion) *	0.48 to 4.58	0.69 to 6.59	0.81 to 7.76	0.92 to 8.80	0.98 to 9.41.
NO_X—3% discount rate (2009$ billion)	0.014 to 0.15	0.020 to 0.21	0.024 to 0.25	0.027 to 0.28	0.029 to 0.30.
NO_X—7% discount rate (2009$ billion)	0.006 to 0.056	0.008 to 0.081	0.009 to 0.095	0.011 to 0.107	0.011 to 0.115.
Mean LCC Savings (2009$)**					
Upright Freezers	140	195	189	161	33.
Chest Freezers	82	69	79	47	(25).
Median PBP (years)					
Upright Freezers	4.0	5.3	7.1	9.3	14.7.
Chest Freezers	3.9	8.1	8.5	12.1	17.8.
Distribution of Consumer LCC Impacts					
Upright Freezers:					
Net Cost (%)	6.0	12	22	35	60.
No Impact (%)	0.6	0.2	0.0	0.0	0.0.
Net Benefit (%)	93	88	78	65	40.
Chest Freezers:					
Net Cost (%)	5	27	29	49	69.
No Impact (%)	0.2	0.2	0.2	0.0	0.0.
Net Benefit (%)	95	73	71	51	31.
Generation Capacity Reduction (GW) †	0.83	0.83	1.40	1.59	1.71.
Employment Impacts					
Total Potential Changes in Domestic Production Workers in 2014 (thousands).	(0.05) to (1.64)	(0.11) to (1.64)	(0.15) to (1.64)	(0.23) to (1.64)	(0.34) to (1.64).
Indirect Domestic Jobs (thousands) †	5.18	7.24	8.38	9.19	9.12.

Parentheses indicate negative (−) values.
Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** For LCCs, a negative value means an increase in LCC by the amount indicated.
† Changes in 2043.

DOE first considered TSL 5, which represents the max-tech efficiency levels. TSL 5 would save 1.62 quads of energy, an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be −$0.63 billion to $1.41 billion, using a discount rate of 7 percent, and $5.32 billion to $9.46 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 110 Mt of CO_2, 89,000 tons of NO_X, and 0.50 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 5 ranges from $0.98 billion to $9.41 billion. Total generating capacity in 2043 is estimated to decrease by 1.71 GW under TSL 5.

At TSL 5, the average LCC impact is a gain (LCC decrease) of $33 for upright freezers, and a cost of $25 for chest freezers. The median payback period is 14.7 years for upright freezers and 17.8 years for chest freezers. The fraction of consumers experiencing an LCC benefit is 40 percent for upright freezers and 31 percent for chest freezers. The fraction of consumers experiencing an LCC cost is 60 percent for upright freezers and 69 percent for chest freezers.

At TSL 5, the projected change in INPV ranges from a decrease of $145.0 million to a decrease of $298.8 million. DOE recognizes the risk of very large negative impacts if manufacturers' expectations concerning reduced profit margins are realized. Standards at TSL 5 would require efficiency levels that are far higher than the most efficient products currently available on the market. Manufacturing products to meet standards at TSL 5 would require large investments in product redesign and conversion of facilities. Because standard-size freezers are currently low-cost, low-margin products, there is a limited ability to pass on to consumers the required conversion costs and added product costs associated with efficiency-improving technologies for freezers. If the high end of the range of impacts is reached as DOE expects, TSL 5 could result in a net loss of 88.5 percent in INPV to standard-size freezer manufacturers.

The Secretary has concluded that at TSL 5 for standard-size freezers, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the economic burden on a significant fraction of consumers due to the large increases in product cost, and the capital conversion costs and profit margin impacts that could result in a very large reduction in

INPV for manufacturers. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

DOE then considered TSL 4. TSL 4 would save 1.52 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be $2.03 billion to $3.25 billion, using a discount rate of 7 percent, and $9.66 billion to $12.2 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 103 Mt of CO_2, 83,000 tons of NO_X, and 0.47 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 4 ranges from $0.92 billion to $8.80 billion. Total generating capacity in 2043 is estimated to decrease by 1.59 GW under TSL 4.

At TSL 4, the average LCC impact is a gain (consumer savings) of $161 for upright freezers and a gain of $47 for chest freezers. The median payback period is 9.3 years for upright freezers and 12.1 years for chest freezers. The fraction of consumers experiencing an LCC benefit is 65 percent for upright freezers and 51 percent for chest freezers. The fraction of consumers experiencing an LCC cost is 35 percent for upright freezers and 49 percent for chest freezers.

At TSL 4, the projected change in INPV ranges from a decrease of $85.4 million to a decrease of $182.4 million. DOE recognizes the risk of very large negative impacts if manufacturers' expectations concerning reduced profit margins are realized. Standards at TSL 4 would require efficiency levels that are substantially higher than the most efficient products currently available on the market. Manufacturing products to meet standards at TSL 4 would require large investments in product redesign and conversion of facilities. Because standard-size freezers are currently low-cost, low-margin products, there is a limited ability to pass on to consumers the required conversion costs and added product costs associated with efficiency-improving technologies for freezers. If the high end of the range of impacts is reached as DOE expects, TSL 4 could result in a net loss of 54.0 percent in INPV to standard-size freezer manufacturers.

The Secretary has concluded that at TSL 4 for standard-size freezers, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, the estimated monetary value of the cumulative CO_2 emissions reductions, and the economic benefit on a significant fraction of upright freezer consumers would be outweighed by the economic burden on a significant fraction of chest freezer consumers due to the increase in product cost, and the large capital conversion costs and margin impacts that could result in a large reduction in INPV for manufacturers.

DOE then considered TSL 3. TSL 3 would save 1.34 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $2.96 billion to $3.77 billion, using a discount rate of 7 percent, and $10.7 billion to $12.4 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 91 Mt of CO_2, 73,000 tons of NO_X, and 0.41 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 3 ranges from $0.81 billion to $7.76 billion. Total generating capacity in 2043 is estimated to decrease by 1.40 GW under TSL 3.

At TSL 3, the average LCC impact is a gain (consumer savings) of $189 for upright freezers and a gain of $79 for chest freezers. The median payback period is 7.1 years for upright freezers and 8.5 years for chest freezers. The fraction of consumers experiencing an LCC benefit is 78 percent for upright freezers and 71 percent for chest freezers. The fraction of consumers experiencing an LCC cost is 22 percent for upright freezers and 29 percent for chest freezers.

At TSL 3, the projected change in INPV ranges from a decrease of $112.5 million to a decrease of $178.1 million. DOE recognizes the risk of very large negative impacts if manufacturers' expectations concerning reduced profit margins are realized. Standards at TSL 3 would require efficiency levels that are substantially higher than the most efficient products currently available on the market. Similar to the case of TSL 4, manufacturing products to meet standards at TSL 3 would require large investments in product redesign and conversion of facilities. Because standard-size freezers are currently low-cost, low-margin products, there is a limited ability to pass on to consumers the required conversion costs and added product costs associated with more energy efficient technologies for freezers. If the high end of the range of impacts is reached, as DOE expects, TSL 3 could result in a net loss of 52.7 percent in INPV to standard-size freezer manufacturers.

DOE notes that TSL 3 is not at the level recommended in the consensus agreement. DOE also notes that the TSL 3 efficiency levels are significantly higher than the maximum-efficiency products on the market: From 8% higher for product class 9 (upright freezers with automatic defrost) to 15% higher for product class 10 (chest freezers). Hence, DOE believes that there may be other factors, including additional burdens, that the parties to that agreement may have considered that are not reflected in DOE's analysis. Given this possibility, the strong support expressed by commenters in favor of the consensus agreement levels, and the lack of product on the market that is close to meeting the requirements of this level, DOE is declining to adopt TSL 3 as part of today's final rule. It may, however, reconsider this level as part of a future review of the standards set by today's rulemaking as part of the agency's required review under 42 U.S.C. 6295(m).

Accordingly, the Secretary has concluded that at TSL 3 for standard-size freezers, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, the estimated monetary value of the cumulative CO_2 emissions reductions, and the economic benefit for a significant fraction of freezer consumers would be outweighed by the large capital conversion costs and profit margin impacts and other burdens that manufacturers would bear in order to produce freezers that meet efficiency requirements substantially more stringent than what products on the market presently can satisfy.

DOE then considered TSL 2. TSL 2 would save 1.14 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $3.02 billion to $3.59 billion, using a discount rate of 7 percent, and $10.1 billion to $11.2 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 77 Mt of CO_2, 62,000 tons of NO_X, and 0.34 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 2 ranges from $0.69 billion to $6.59 billion. Total generating capacity in 2043 is estimated to decrease by 0.83 GW under TSL 2.

At TSL 2, the average LCC impact is a gain (consumer savings) of $195 for upright freezers and a gain of $69 for chest freezers. The median payback period is 5.3 years for upright freezers and 8.1 years for chest freezers. The fraction of consumers experiencing an LCC benefit is 88 percent for upright freezers and 73 percent for chest freezers. The fraction of consumers experiencing an LCC cost is 12 percent for upright freezers and 27 percent for chest freezers.

DOE estimated the projected change in INPV ranges from a decrease of $123.7 million to a decrease of $170.5 million. At TSL 2, DOE recognizes the risk of negative impacts if manufacturers' expectations concerning reduced profit margins are realized. Standards at TSL 2 would pose many of the same issues as discussed above for TSL3, but the projected negative impacts are somewhat less. If the high end of the range of impacts is reached as DOE expects, TSL 2 could result in a net loss of 50.5 percent in INPV to standard-size freezer manufacturers.

The Secretary has concluded that at TSL 2 for standard-size freezers, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, the estimated monetary value of the cumulative CO_2 emissions reductions, and the economic benefit for a significant fraction of freezer consumers would outweigh the capital conversion costs and profit margin impacts that could result in a reduction in INPV for the manufacturers. In addition to the aforementioned benefits, DOE notes that the efficiency levels in TSL 2 correspond to the recommended levels in the Joint Comments and, as stated previously, DOE recognizes the value of consensus agreements submitted in accordance with 42 U.S.C. 6295(p)(4).

After considering the analysis, comments responding to the September 2010 NOPR, and the benefits and burdens of TSL 2, the Secretary has concluded that this trial standard level will offer the maximum improvement in efficiency that is technologically feasible and economically justified, and will result in the significant conservation of energy. Therefore, DOE today is adopting TSL 2 for standard-size freezers. The amended energy conservation standards for standard-size freezers, expressed as equations for maximum energy use, are shown in Table VI.73.

TABLE VI.73—AMENDED STANDARDS FOR STANDARD-SIZE FREEZERS

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft^3)	Based on av (L)
8. Upright freezers with manual defrost	5.57AV + 193.7	0.197av + 193.7
9. Upright freezers with automatic defrost without an automatic icemaker	8.62AV + 228.3	0.305av + 228.3
9I. Upright freezers with automatic defrost with an automatic icemaker	8.62AV + 312.3	0.305av + 312.3
10. Chest freezers and all other freezers except compact freezers	7.29AV + 107.8	0.257av + 107.8
10A. Chest freezers with automatic defrost	10.24AV + 148.1	0.362av + 148.1

AV = adjusted volume in cubic feet; av = adjusted volume in liters.

3. Compact Refrigeration Products

Table VI.74 presents a summary of the quantitative impacts estimated for each TSL for compact refrigeration products. The efficiency levels contained in each TSL are described in section VI.A. The range of results for NPV of consumer benefits reflects the range of product price forecasts discussed in section IV.G.3.

TABLE VI.74—SUMMARY OF RESULTS FOR COMPACT REFRIGERATION PRODUCTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
National Energy Savings (quads)	0.30	0.37	0.43	0.54	0.59.
NPV of Consumer Benefits (2009$ billion)					
3% discount rate	1.64 to 1.95	1.29 to 1.89	1.45 to 2.15	0.046 to 1.43	(3.75) to (1.17).
7% discount rate	0.675 to 0.821	0.439 to 0.724	0.482 to 0.819	(0.363) to 0.304	(2.51) to (1.25).
Industry Impacts					
Compact Refrigeration Products:					
Industry NPV (2009$ million)	(16.6) to (27.8)	(36.2) to (58.7)	(62.9) to (89.3)	(41.5) to (92.8)	(154.9) to (242.6).
Industry NPV (% change)	(9.8) to (16.4)	(21.4) to (34.6)	(37.1) to (52.7)	(24.5) to (54.8)	(91.4) to (143.2).
Cumulative Emissions Reduction					
CO_2 (Mt)	20	24	28	35	39.
NO_X (1000 tons)	16	20	23	29	31.
Hg (tons)	0.10	0.12	0.15	0.19	0.21.
Value of Cumulative Emissions Reduction					
CO_2 (2009$ billion)*	0.12 to 1.26	0.15 to 1.54	0.18 to 1.79	0.22 to 2.25	0.24 to 2.47.
NO_X—3% discount rate (2009$ billion)	0.004 to 0.044	0.005 to 0.054	0.006 to 0.063	0.008 to 0.079	0.009 to 0.088.
NO_X—7% discount rate (2009$ billion)	0.002 to 0.021	0.003 to 0.026	0.003 to 0.030	0.004 to 0.038	0.004 to 0.042.
Mean LCC Savings ** (2009$)					
Compact Refrigerators	17	14	13	(5)	(85).
Compact Freezers	12	12	9	(23)	(102).

TABLE VI.74—SUMMARY OF RESULTS FOR COMPACT REFRIGERATION PRODUCTS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Median PBP (years)					
Compact Refrigerators	2.5	3.5	3.9	5.8	10.4.
Compact Freezers	2.2	2.2	4.2	9.1	14.4.
Distribution of Consumer LCC Impacts					
Compact Refrigerators:					
Net Cost (%)	20	37	44	70	92.
No Impact (%)	1.4	1.0	0.9	0.0	0.0.
Net Benefit (%)	79	62	56	30	7.9.
Compact Freezers:					
Net Cost (%)	8	8	34	85	97.
No Impact (%)	5	5	0.0	0.0	0.0.
Net Benefit (%)	87	87	66	16	3.3.
Generation Capacity Reduction (GW) †	0.27	0.34	0.39	0.48	0.51.
Employment Impacts					
Total Potential Changes in Domestic Production Workers in 2014 (thousands).	(0.00) to (0.03)	(0.00) to (0.03)	(0.00) to (0.03)	(0.00) to (0.03)	(0.01) to (0.03).
Indirect Domestic Jobs (thousands) †	1.44	1.64	1.88	2.02	1.53.

Parentheses indicate negative (−) values.
* Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** For LCCs, a negative value means an increase in LCC by the amount indicated.
† Changes in 2043.

DOE first considered TSL 5, which represents the max-tech efficiency levels. TSL 5 would save 0.59 quads of energy, an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be −$2.51 billion to −$1.25 billion, using a discount rate of 7 percent, and −$3.75 billion to −$1.17 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 39 Mt of CO_2, 31,000 tons of NO_X, and 0.21 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 5 ranges from $0.24 billion to $2.47 billion. Total generating capacity in 2043 is estimated to decrease by 0.51 GW under TSL 5.

At TSL 5, the average LCC impact is a cost (LCC increase) of $85 for compact refrigerators and a cost of $102 for compact freezers. The median payback period is 10.4 years for compact refrigerators and 14.4 years for compact freezers. The fraction of consumers experiencing an LCC benefit is 7.9 percent for compact refrigerators and 3.3 percent for compact freezers. The fraction of consumers experiencing an LCC cost is 92 percent for compact refrigerators and 97 percent for compact freezers.

At TSL 5, the projected change in INPV ranges from a decrease of $154.9 million to a decrease of $242.6 million. DOE recognizes the risk of very large negative impacts if manufacturers' expectations concerning reduced profit margins are realized. Manufacturing products to meet standards at TSL 5 would require large investments in product redesign and conversion of facilities. Because compact refrigeration products are currently low-cost, low-margin products, there is a limited ability to pass on to consumers the required conversion costs and added product costs associated with efficiency-improving technologies. If the high end of the range of impacts is reached as DOE expects, TSL 5 could result in a net loss of 143.2 percent in INPV to compact refrigeration product manufacturers.

The Secretary has concluded that at TSL 5 for compact refrigeration products, the benefits of energy savings, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV of consumer benefits, the economic burden on a significant fraction of consumers due to the increases in product cost, the capital conversion costs and profit margin impacts that could result in a large reduction in INPV for manufacturers. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

DOE then considered TSL 4. TSL 4 would save 0.54 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be −$0.363 billion to $0.304 billion, using a discount rate of 7 percent, and $0.46 billion to $1.43 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 35 Mt of CO_2, 29,000 tons of NO_X, and 0.19 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 4 ranges from $0.22 billion to $2.25 billion. Total generating capacity in 2043 is estimated to decrease by 0.48 GW under TSL 4.

At TSL 4, the average LCC impact is a cost (LCC increase) of $5 for compact refrigerators and a cost of $23 for compact freezers. The median payback period is 5.8 years for compact refrigerators and 9.1 years for compact freezers. The fraction of consumers experiencing an LCC benefit is 30 percent for compact refrigerators and 16 percent for compact freezers. The fraction of consumers experiencing an LCC cost is 70 percent for compact refrigerators and 85 percent for compact freezers.

At TSL 4, the projected change in INPV ranges from a decrease of $41.5 million to a decrease of $92.8 million. DOE recognizes the risk of very large negative impacts if manufacturers' expectations about reduced profit margins are realized. Manufacturing products to meet standards at TSL 4 would require large investments in product redesign and conversion of facilities. Because compact refrigeration products are currently low-cost, low-margin products, there is a limited ability to pass on to consumers the required conversion costs and added product costs associated with efficiency-improving technologies. If the high end of the range of impacts is reached as DOE expects, TSL 4 could result in a net loss of 54.8 percent in INPV to compact refrigeration product manufacturers.

The Secretary has concluded that at TSL 4 for compact refrigeration products, the benefits of energy savings, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV of consumer benefits, the economic burden on a significant fraction of consumers due to the increases in product costs, and the capital conversion costs and profit margin impacts that could result in a large reduction in INPV for manufacturers. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3. TSL 3 would save 0.43 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be $0.482 billion to $0.819 billion, using a discount rate of 7 percent, and $1.45 to $2.15 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 28 Mt of CO_2, 23,000 tons of NO_X, and 0.15 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 3 ranges from $0.18 billion to $1.79 billion. Total generating capacity in 2043 is estimated to decrease by 0.39 GW under TSL 3.

At TSL 3, the average LCC impact is a gain (consumer savings) of $13 for compact refrigerators and a gain of $9 for compact freezers. The median payback period is 3.9 years for compact refrigerators and 4.2 years for compact freezers. The fraction of consumers experiencing an LCC benefit is 56 percent for compact refrigerators and 66 percent for compact freezers. The fraction of consumers experiencing an LCC cost is 44 percent for compact refrigerators and 34 percent for compact freezers.

At TSL 3, the projected change in INPV ranges from a decrease of $62.9 million to a decrease of $89.3 million. DOE recognizes the risk of large negative impacts if manufacturers' expectations about reduced profit margins are realized. Manufacturing products to meet standards at TSL 3 would require large investments in product redesign and conversion of facilities. Because compact refrigeration products are currently low-cost, low-margin products, there is a limited ability to pass on to consumers the required conversion costs and added product costs associated with efficiency-improving technologies. If the high end of the range of impacts is reached as DOE expects, TSL 3 could result in a net loss of 52.7 percent in INPV to compact refrigeration product manufacturers.

The Secretary has concluded that at TSL 3 for compact refrigeration products, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, and the estimated monetary value of the cumulative CO_2 emissions reductions would be outweighed by the economic burden on a significant fraction of consumers due to the increases in product costs, and by the capital conversion costs and profit margin impacts that could result in a large reduction in INPV for manufacturers. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered TSL 2. TSL 2 would save 0.37 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $0.439 billion to $0.724 billion, using a discount rate of 7 percent, and $1.29 billion to $1.89 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 24 Mt of CO_2, 20,000 tons of NO_X, and 0.12 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 2 ranges from $0.15 billion to $1.54 billion. Total generating capacity in 2043 is estimated to decrease by 0.34 GW under TSL 2.

At TSL 2, the average LCC impact is a gain (consumer savings) of $14 for compact refrigerators and a gain of $12 for compact freezers. The median payback period is 3.5 years for compact refrigerators and 2.2 years for compact freezers. The fraction of consumers experiencing an LCC benefit is 62 percent for compact refrigerators and 87 percent for compact freezers. The fraction of consumers experiencing an LCC cost is 37 percent for compact refrigerators and 8 percent for compact freezers.

At TSL 2, the projected change in INPV ranges from a decrease of $36.2 million to a decrease of $58.7 million. DOE recognizes the risk of negative impacts if manufacturers' expectations about reduced profit margins are realized. Manufacturing products to meet standards at TSL 2 would require investments in product redesign and conversion of facilities. Because compact refrigeration products are currently low-cost, low-margin products, there is a limited ability to pass on to consumers the required conversion costs and added product costs associated with efficiency-improving technologies. If the high end of the range of impacts is reached as DOE expects, TSL 2 could result in a net loss of 34.6 percent in INPV to compact refrigeration product manufacturers.

The Secretary has concluded that at TSL 2 for compact refrigeration products, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, the estimated monetary value of the cumulative CO_2 emissions reductions, and the economic benefit to a significant fraction of consumers would outweigh the capital conversion costs that could result in a reduction in INPV for manufacturers. In addition to the aforementioned benefits of the amended standards, DOE notes that the efficiency levels in TSL 2 correspond to the recommended levels in the Joint Comments

AHAM and ASAP both commented that the proposed standard energy efficiency equation for product class 15 (compact refrigerator-freezers—automatic defrost with bottom-mounted freezer) was inconsistent with the consensus agreement, which had recommended that both product class 15 and product class 13 (compact refrigerator-freezers—automatic defrost with top-mounted freezer) should have identical standards. (ASAP, Public Meeting Transcript, No. 67 at p. 91; AHAM, Public Meeting Transcript, No. 67 at p. 92) DOE agrees that the standards of these two product classes should be the same, based on the similarities between these classes. Commenters favored this approach and none offered any information suggesting an alternative approach. As stated previously, DOE recognizes the value of consensus agreements submitted in accordance with 42 U.S.C. 6295(p)(4).

After considering the analysis, comments responding to the September 2010 NOPR, and the benefits and burdens of TSL 2, the Secretary has concluded that this trial standard level will offer the maximum improvement in efficiency that is technologically feasible and economically justified, and will result in the significant conservation of energy. Therefore, DOE today is adopting TSL 2 for compact refrigeration products. The amended energy conservation standards for compact refrigeration products, expressed as equations for maximum energy use, are shown in Table VI–75.

TABLE VI.75—AMENDED STANDARDS FOR COMPACT REFRIGERATION PRODUCTS

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft^3)	Based on av (L)
11. Compact refrigerators and refrigerator-freezers with manual defrost	9.03AV + 252.3	0.319av + 252.3
11A. Compact all-refrigerators—manual defrost	7.84AV + 219.1	0.277av + 219.1
12. Compact refrigerator-freezers—partial automatic defrost	5.91AV + 335.8	0.209av + 335.8
13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer	11.80AV + 339.2	0.417av + 339.2
13I. Compact refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker.	11.80AV + 423.2	0.417av + 423.2
13A. Compact all-refrigerators—automatic defrost	9.17AV + 259.3	0.324av + 259.3
14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer	6.82AV + 456.9	0.241av + 456.9
14I. Compact refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker.	6.82AV + 540.9	0.241av + 540.9
15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer	11.80AV + 339.2	0.417av + 339.2
15I. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker.	11.80AV + 423.2	0.417av + 423.2
16. Compact upright freezers with manual defrost	8.65AV + 225.7	0.306av + 225.7
17. Compact upright freezers with automatic defrost	10.17AV + 351.9	0.359av + 351.9
18. Compact chest freezers.	9.25AV + 136.8	0.327av + 136.8

AV = adjusted volume in cubic feet; av = adjusted volume in liters.

4. Built-In Refrigeration Products

Table V–76 presents a summary of the quantitative impacts estimated for each TSL for built-in refrigeration products. The efficiency levels contained in each TSL are described in section VI.A. The range of results for NPV of consumer benefits reflects the range of product price forecasts discussed in section IV.G.3.

TABLE VI.76—SUMMARY OF RESULTS FOR BUILT-IN REFRIGERATION PRODUCTS

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
National Energy Savings (quads)	0.02	0.03	0.058	0.071	0.085.
NPV of Consumer Benefits (2009$ billion)					
3% discount rate	0.166 to 0.184	0.183 to 0.226	(0.228) to 0.029	(0.580) to (0.185)	(1.14) to (0.531).
7% discount rate	0.053 to 0.062	0.045 to 0.066	(0.237) to (0.111)	(0.455) to (0.261)	(0.791) to (0.495).
Industry Impacts					
Industry NPV (2009$ million)	(51.9) to (52.6)	(55.1) to (56.5)	(68.0) to (77.2)	(82.9) to (97.6)	(89.9) to (112.1).
Industry NPV (% change)	(9.4) to (9.5)	(9.9) to (10.2)	(12.3) to (13.9)	(15.0) to (17.6)	(16.2) to (20.2).
Cumulative Emissions Reduction					
CO_2 (Mt)	1.41	2.05	4.1	5.09	6.09.
NO_X (1000 tons)	1.14	1.65	3.3	4.09	4.9.
Hg (tons)	0.01	0.01	0.02	0.02	0.03.
Value of Cumulative Emissions Reduction					
CO_2 (2009$ billion) *	0.012 to 0.12	0.017 to 0.17	0.035 to 0.34	0.043 to 0.41	0.051 to 0.50.
NO_X—3% discount rate (2009$ billion)	0.000 to 0.004	0.001 to 0.005	0.001 to 0.011	0.001 to 0.013	0.002 to 0.016.
NO_X—7% discount rate (2009$ billion)	0.000 to 0.002	0.000 to 0.002	0.000 to 0.004	0.001 to 0.005	0.001 to 0.006.
Mean LCC Savings ** (2009$)					
Built-in All-Refrigerators	52	71	(11)	(151)	(258).
Built-in Bottom-Mount Refrigerator-Freezers	8	2	2	(138)	(207).
Built-in Side-by-Side Refrigerator-Freezers	10	10	(91)	(91)	(182).
Built-in Upright Freezers	66	59	(23)	(23)	(101).
Median PBP (years)					
Built-in All-Refrigerators	1.4	2.6	13.7	25.5	31.4.
Built-in Bottom-Mount Refrigerator-Freezers	3.8	11.1	11.1	52.8	52.2.
Built-in Side-by-Side Refrigerator-Freezers	7.5	7.5	31.0	31.0	50.4.
Built-in Upright Freezers	2.9	10.7	17.8	17.8	22.6.

TABLE VI.76—SUMMARY OF RESULTS FOR BUILT-IN REFRIGERATION PRODUCTS—Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Distribution of Consumer LCC Impacts					
Built-in All-Refrigerators:					
Net Cost (%)	0.0	0.9	62	91	95.
No Impact (%)	23	18.	9.1	0.0	0.0.
Net Benefit (%)	77.	81	29	9.0	5.0.
Built-in Bottom-Mount Refrigerator-Freezers:					
Net Cost (%)	0.6	7.0	7.0	98	99.
No Impact (%)	87	87	87	0.0	0.0.
Net Benefit (%)	12	5.9	5.9	2.0	1.5.
Built-in Side-by-Side Refrigerator-Freezers:					
Net Cost (%)	5.8	5.8	59	59	98.
No Impact (%)	79	79	37	37	0.0.
Net Benefit (%)	16	16	4.3	4.3	2.4.
Built-in Upright Freezers:					
Net Cost (%)	1.5	43	69	69	80.
No Impact (%)	20	0.6	0.5	0.5	0.3.
Net Benefit (%)	79	57	31	31	20.
Generation Capacity Reduction (GW) †	0.02	0.03	0.06	0.08	0.09.
Employment Impacts					
Total Potential Changes in Domestic Production Workers in 2014 (thousands).	0.00 to (1.14)	(0.00) to (1.14)	0.01 to (1.14)	0.01 to (1.14)	0.03 to (1.14).
Indirect Domestic Jobs (thousands) †	0.14	0.19	0.29	0.31	0.30.

Parentheses indicate negative (−) values.
Range of the economic value of CO_2 reductions is based on estimates of the global benefit of reduced CO_2 emissions.
** For LCCs, a negative value means an increase in LCC by the amount indicated.
† Changes in 2043.

DOE first considered TSL 5, which represents the max-tech efficiency levels. TSL 5 would save 0.085 quads of energy, an amount DOE considers significant. Under TSL 5, the NPV of consumer benefit would be −$0.791 billion to −$0.495 billion, using a discount rate of 7 percent, and −$1.14 billion to −$0.531 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 5 are 6.09 Mt of CO_2, 4,900 tons of NO_X, and 0.03 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 5 ranges from $0.051 billion to $0.50 billion. Total generating capacity in 2043 is estimated to decrease by 0.09 GW under TSL 5.

At TSL 5, the average LCC impact is a cost (LCC increase) of $258 for built-in all-refrigerators, a cost of $207 for built-in bottom-mount refrigerator-freezers, a cost of $182 for built-in side-by-side refrigerator-freezers, and a cost of $101 for built-in upright freezers. The median payback period is 31.4 years for built-in all-refrigerators, 52.2 years for built-in bottom-mount refrigerator-freezers, 50.4 years for built-in side-by-side refrigerator-freezers, and 22.6 years for built-in upright freezers. The fraction of consumers experiencing an LCC benefit is 5 percent for built-in all-refrigerators, 1.5 percent for built-in bottom-mount refrigerator-freezers, 2.4 percent for built-in side-by-side refrigerator-freezers, and 20 percent for built-in upright freezers. The fraction of consumers experiencing an LCC cost is 95 percent for built-in all-refrigerators, 99 percent for built-in bottom-mount refrigerator-freezers, 98 percent for built-in side-by-side refrigerator-freezers, and 80 percent for built-in upright freezers.

At TSL 5, the projected change in INPV ranges from a decrease of $89.9 million to a decrease of $112.1 million. If the high end of the range of impacts is reached as DOE expects, TSL 5 could result in a net loss of 20.2 percent in INPV to built-in refrigeration product manufacturers.

The Secretary has concluded that at TSL 5 for built-in refrigeration products, the benefits of energy savings, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV of consumer benefits, the economic burden on a significant fraction of consumers due to the large increases in product cost, and the capital conversion costs and profit margin impacts that could result in a reduction in INPV for the manufacturers. Consequently, the Secretary has concluded that TSL 5 is not economically justified.

DOE then considered TSL 4. TSL 4 would save 0.071 quads of energy, an amount DOE considers significant. Under TSL 4, the NPV of consumer benefit would be −$0.455 billion to −$0.261 billion, using a discount rate of 7 percent, and −$0.580 billion to −$0.185 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 4 are 5.09 Mt of CO_2, 4,090 tons of NO_X, and 0.02 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reductions at TSL 4 ranges from $0.043 billion to $0.41 billion. Total generating capacity in 2043 is estimated to decrease by 0.08 GW under TSL 4.

At TSL 4, DOE projects that the average LCC impact is a cost (LCC increase) of $151 for built-in all-refrigerators, a cost of $138 for built-in bottom-mount refrigerator-freezers, a cost of $91 for built-in side-by-side refrigerator-freezers, and a cost of $23 for built-in upright freezers. The median payback period is 25.5 years for built-in all-refrigerators, 52.8 years for built-in bottom-mount refrigerator-freezers, 31.0 years for built-in side-by-side refrigerator-freezers, and 17.8 years for built-in upright freezers. The fraction of consumers experiencing an LCC benefit is 9 percent for built-in all-refrigerators, 2 percent for built-in bottom-mount refrigerator-freezers, 4.3 percent for built-in side-by-side refrigerator-freezers, and 31 percent for built-in upright freezers. The fraction of consumers experiencing an LCC cost is 91 percent for built-in all-refrigerators, 98 percent for built-in bottom-mount refrigerator-freezers, 59 percent for built-in side-by-side refrigerator-freezers, and 69 percent for built-in upright freezers.

At TSL 4, the projected change in INPV ranges from a decrease of $82.9 million to a decrease of $97.6 million. If the high end of the range of impacts is reached as DOE expects, TSL 4 could result in a net loss of 17.6 percent in INPV to built-in refrigeration product manufacturers.

The Secretary has concluded that at TSL 4 for built-in refrigeration products, the benefits of energy savings, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV of consumer benefits, the economic burden on a significant fraction of consumers due to the increases in product cost, and the capital conversion costs and profit margin impacts that could result in a reduction in INPV for the manufacturers. Consequently, the Secretary has concluded that TSL 4 is not economically justified.

DOE then considered TSL 3. TSL 3 would save 0.058 quads of energy, an amount DOE considers significant. Under TSL 3, the NPV of consumer benefit would be −0.237 billion to −$0.111 billion, using a discount rate of 7 percent, and −$0.228 billion to $0.029 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 3 are 4.1 Mt of CO_2, 3,300 tons of NO_X, and 0.02 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reduction at TSL 3 ranges from $0.035 billion to $0.34 billion. Total generating capacity in 2043 is estimated to decrease by 0.06 GW under TSL 3.

At TSL 3, the average LCC impact is a cost (LCC increase) of $11 for built-in all-refrigerators, a gain of $2 for built-in bottom-mount refrigerator-freezers, a cost of $91 for built-in side-by-side refrigerator-freezers, and a cost of $23 for built-in upright freezers. The median payback period is 13.7 years for built-in all-refrigerators, 11.1 years for built-in bottom-mount refrigerator-freezers, 31.0 years for built-in side-by-side refrigerator-freezers, and 17.8 years for built-in upright freezers. The fraction of consumers experiencing an LCC benefit is 29 percent for built-in all-refrigerators, 5.9 percent for built-in bottom-mount refrigerator-freezers, 4.3 percent for built-in side-by-side refrigerator-freezers, and 31 percent for built-in upright freezers. The fraction of consumers experiencing an LCC cost is 62 percent for built-in all-refrigerators, 7 percent for built-in bottom-mount refrigerator-freezers, 59 percent for built-in side-by-side refrigerator-freezers, and 69 percent for built-in upright freezers.

At TSL 3, the projected change in INPV ranges from a decrease of $68.0 million to a decrease of $77.2 million. If the high end of the range of impacts is reached as DOE expects, TSL 3 could result in a net loss of 13.9 percent in INPV to built-in refrigeration product manufacturers.

The Secretary has concluded that at TSL 3 for built-in refrigeration products, the benefits of energy savings, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would be outweighed by the negative NPV of of consumer benefits, the slight economic burden on a significant fraction of consumers due to the increases in product cost, and the capital conversion costs and profit margin impacts that could result in a reduction in INPV for the manufacturers. Consequently, the Secretary has concluded that TSL 3 is not economically justified.

DOE then considered TSL 2. TSL 2 would save 0.03 quads of energy, an amount DOE considers significant. Under TSL 2, the NPV of consumer benefit would be $0.045 billion to $0.066 billion, using a discount rate of 7 percent, and $0.183 billion to $0.226 billion, using a discount rate of 3 percent.

The cumulative emissions reductions at TSL 2 are 2.05 Mt of CO_2, 1,650 tons of NO_X, and 0.01 tons of Hg. The estimated monetary value of the cumulative CO_2 emissions reduction at TSL 2 ranges from $0.017 billion to $0.17 billion. Total generating capacity in 2043 is estimated to decrease by 0.03 GW under TSL 2.

At TSL 2, the average LCC impact is a gain (LCC decrease) of $71 for built-in all-refrigerators, a gain of $2 for built-in bottom-mount refrigerator-freezers, a gain of $10 for built-in side-by-side refrigerator-freezers, and a gain of $59 for built-in upright freezers. The median payback period is 2.6 years for built-in all-refrigerators, 11.1 years for built-in bottom-mount refrigerator-freezers, 7.5 years for built-in side-by-side refrigerator-freezers, and 10.7 years for built-in upright freezers. The fraction of consumers experiencing an LCC benefit is 81 percent for built-in all-refrigerators, 5.9 percent for built-in bottom-mount refrigerator-freezers, 16 percent for built-in side-by-side refrigerator-freezers, and 57 percent for built-in upright freezers. The fraction of consumers experiencing an LCC cost is 0.9 percent for built-in all-refrigerators, 7 percent for built-in bottom-mount refrigerator-freezers, 5.8 percent for built-in side-by-side refrigerator-freezers, and 43 percent for built-in upright freezers.

At TSL 2, the projected change in INPV ranges from a decrease of $55.1 million to a decrease of $56.5 million. If the high end of the range of impacts is reached as DOE expects, TSL 2 could result in a net loss of 10.2 percent in INPV to built-in refrigeration product manufacturers.

The Secretary has concluded that at TSL 2 for built-in refrigeration products, the benefits of energy savings, positive NPV of consumer benefits, generating capacity reductions, emission reductions, and the estimated monetary value of the CO_2 emissions reductions would outweigh the slight economic burden on a small fraction of consumers due to the increases in product cost, and the capital conversion costs and profit margin impacts that could result in a reduction in INPV for the manufacturers.

After considering the analysis, comments responding to the September 2010 NOPR, and the benefits and burdens of TSL 2, the Secretary has concluded that this trial standard level will offer the maximum improvement in efficiency that is technologically feasible and economically justified, and will result in significant conservation of energy. Therefore, DOE today is adopting TSL 2 for built-in refrigeration products. The amended energy conservation standards for built-in refrigeration products, expressed as equations for maximum energy use, are shown in Table VI.77.

TABLE VI.77—AMENDED STANDARDS FOR BUILT-IN REFRIGERATION PRODUCTS

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft³)	Based on av (L)
3–BI. Built-in Refrigerator-freezer—automatic defrost with top-mounted freezer without an automatic icemaker.	9.15AV + 264.9	0.323av + 264.9
3I–BI. Built-in Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.	9.15AV + 348.9	0.323av + 348.9
3A–BI. Built-in All-refrigerators—automatic defrost	8.02AV + 228.5	0.283av + 228.5
4–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker.	10.22AV + 357.4	0.361av + 357.4
4I–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.	10.22AV + 441.4	0.361av + 441.4
5–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker.	9.40AV + 336.9	0.332av + 336.9
5I–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.	9.40AV + 420.9	0.332av + 420.9
5A–BI. Built-in Refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service.	9.83AV + 499.9	0.347av + 499.9
7–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	10.25AV + 502.6	0.362av + 502.6
9–BI. Built-In Upright freezers with automatic defrost without an automatic icemaker	9.86AV + 260.9	0.348av + 260.9
9I–BI. Built-in Upright freezers with automatic defrost with an automatic icemaker	9.86AV + 344.9	0.348av + 344.9

AV= adjusted volume in cubic feet; av = adjusted volume in liters.

5. Summary of Benefits and Costs (Annualized) of Amended Standards

The benefits and costs of today's amended standards can also be expressed in terms of annualized values. The annualized monetary values are the sum of (1) the annualized national economic value, expressed in 2009$, of the benefits from operating products that meet the amended standards (consisting primarily of operating cost savings from using less energy, minus increases in equipment purchase costs, which is another way of representing consumer NPV), and (2) the monetary value of the benefits of emission reductions, including CO_2 emission reductions.[49] The value of the CO_2 reductions (*i.e.* SCC) is calculated using a range of values per metric ton of CO_2 developed by a recent interagency process. The monetary costs and benefits of cumulative emissions reductions are reported in 2009$ to permit comparisons with the other costs and benefits in the same dollar units.

Although combining the values of operating savings and CO_2 reductions provides a useful perspective, two issues should be considered. First, the national operating savings are domestic U.S. consumer monetary savings that occur as a result of market transactions while the value of CO_2 reductions is based on a global value. Second, the assessments of operating cost savings and SCC are performed with different methods that use quite different time frames for analysis. The national operating cost savings is measured for the lifetime of refrigeration products shipped in 2014–2043. The SCC values, on the other hand, reflect the present value of future climate-related impacts resulting from the emission of one ton of carbon dioxide in each year. These impacts continue well beyond 2100.

Estimates of annualized values are shown in Table VI.78. The results under the primary estimate are as follows. Using a 7-percent discount rate and the SCC series having a value of $22.1/ton in 2010 (in 2009$), the cost of the standards in today's rule is $1,167 to $1,569 million per year in increased equipment costs, while the annualized benefits are $2,275 million per year in reduced equipment operating costs, $515 million in CO_2 reductions, and $21 million in reduced NO_X emissions. In this case, the net benefit amounts to $1,241 to $1,643 million per year. Using a 3-percent discount rate and the SCC series having a value of $22.1/ton in 2010, the cost of the standards in today's rule is $1,081 to $1,526 million per year in increased equipment costs, while the benefits are $3,160 million per year in reduced operating costs, $515 million in CO_2 reductions, and $28 million in reduced NO_X emissions. In this case, the net benefit amounts to $2,176 to $2,622 million per year.

TABLE VI–78—ANNUALIZED BENEFITS AND COSTS OF AMENDED STANDARDS FOR REFRIGERATION PRODUCTS SOLD IN 2014–2043

	Discount rate	Monetized (million 2009$/year)		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
Benefits:				
Operating Cost Savings	7%	2275	1996	2560.
	3%	3160	2720	3596.

[49] DOE used a two-step calculation process to convert the time-series of costs and benefits into annualized values. First, DOE calculated a present value in 2010, the year used for discounting the NPV of total consumer costs and savings, for the time-series of costs and benefits using discount rates of three and seven percent for all costs and benefits except for the value of CO_2 reductions. For the latter, DOE used a range of discount rates, as shown in Table I.2. From the present value, DOE then calculated the fixed annual payment over a 30-year period (2014 through 2043) that yields the same present value. The fixed annual payment is the annualized value. Although DOE calculated annualized values, this does not imply that the time-series of cost and benefits from which the annualized values were determined is a steady stream of payments.

TABLE VI–78—ANNUALIZED BENEFITS AND COSTS OF AMENDED STANDARDS FOR REFRIGERATION PRODUCTS SOLD IN 2014–2043—Continued

	Discount rate	Monetized (million 2009$/year)		
		Primary estimate *	Low net benefits estimate *	High net benefits estimate *
CO_2 Reduction at $4.9/t **	5%	162	162	162.
CO_2 Reduction at $22.1/t **	3%	515	515	515.
CO_2 Reduction at $36.3/t **	2.5%	772	772	772.
CO_2 Reduction at $67.1/t **	3%	1567	1567	1567.
NO_X Reduction at $2,519/ton **	7%	21	21	21.
	3%	28	28	28.
Total †	7% plus CO_2 range	2457 to 3863	2178 to 3584	2742 to 4148.
	7%	2810	2531	3095.
	3%	3703	3263	4139.
	3% plus CO_2 range	3350 to 4755	2910 to 4315	3786 to 5192.
Costs:				
Incremental Product Costs	7%	1167 to 1569	1480	1232.
	3%	1081 to 1526	1430	1147.
Net Benefits/Costs:				
Total †	7% plus CO_2 range	888 to 2696	698 to 2103	1511 to 2916.
	7%	1241 to 1643	1051	1863.
	3%	2176 to 2622	1832	2993.
	3% plus CO_2 range	1823 to 3674	1479 to 2885	2640 to 4045.

* The Primary, Low Benefits, and High Benefits Estimates utilize forecasts of energy prices and housing starts from the AEO2010 Reference case, Low Economic Growth case, and High Economic Growth case, respectively. In addition, incremental product costs reflect a medium decline rate for product prices in the Primary Estimate, a low decline rate for product prices in the Low Benefits Estimate, and a high decline rate for product prices in the High Benefits Estimate. In the Primary estimate, the range of results for incremental product costs reflects the range of product price forecasts.

** The CO_2 values represent global values (in 2009$) of the social cost of CO_2 emissions in 2010 under several scenarios. The values of $4.9, $22.1, and $36.3 per metric ton (t) are the averages of SCC distributions calculated using 5%, 3%, and 2.5% discount rates, respectively. The value of $67.1/t represents the 95th percentile of the SCC distribution calculated using a 3% discount rate. The value for NO_X (in 2009$) is the average of the low and high values used in DOE's analysis.

† Total Benefits for both the 3% and 7% cases are derived using the SCC value calculated at a 3% discount rate, which is $22.1/t in 2010 (in 2009$). In the rows labeled as "7% plus CO_2 range" and "3% plus CO_2 range," the operating cost and NO_X benefits are calculated using the labeled discount rate, and those values are added to the full range of CO_2 values.

VII. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866 and 13563

Section 1(b)(1) of Executive Order 12866, ''Regulatory Planning and Review,'' 58 FR 51735 (Oct. 4, 1993), requires each agency to identify the problem that it intends to address, including, where applicable, the failures of private markets or public institutions that warrant new agency action, as well as to assess the significance of that problem. The problems that today's standards address are as follows:

(1) There is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the home appliance market.

(2) There is asymmetric information (one party to a transaction has more and better information than the other) and/or high transactions costs (costs of gathering information and effecting exchanges of goods and services).

(3) There are external benefits resulting from improved energy efficiency of refrigeration products that are not captured by the users of such products. These benefits include externalities related to environmental protection and energy security that are not reflected in energy prices, such as reduced emissions of greenhouse gases.

In addition, DOE has determined that today's regulatory action is an ''economically significant regulatory action'' under section 3(f)(1) of Executive Order 12866. Accordingly, section 6(a)(3) of the Executive Order requires that DOE prepare a regulatory impact analysis (RIA) on today's rule and that the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB) review this rule. DOE presented to OIRA for review the draft rule and other documents prepared for this rulemaking, including the RIA, and has included these documents in the rulemaking record. The assessments prepared pursuant to Executive Order 12866 can be found in the technical support document for this rulemaking. They are available for public review in the Resource Room of DOE's Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC 20024, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays.

DOE has also reviewed this regulation pursuant to Executive Order 13563, issued on January 18, 2011 (76 FR 3281, Jan. 21, 2011). EO 13563 is supplemental to, and explicitly reaffirms the principles, structures, and definitions governing regulatory review established in, Executive Order 12866. To the extent permitted by law, agencies are required by Executive Order 13563 to: (1) Propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

We emphasize as well that Executive Order 13563 requires agencies ''to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible.'' In its guidance, the Office of Information and Regulatory Affairs has emphasized that such techniques may include ''identifying changing future compliance costs that might result from technological innovation or anticipated behavioral changes.''

DOE emphasizes that Executive Order 13563 calls for ''periodic review of existing significant regulations,'' with close reference to empirical evidence. Moreover, with respect to energy conservation standards, EPCA mandates that DOE review its regulations, ''not later than 6 years after issuance of any final rule establishing or amending an energy efficiency standard. As part of the retrospective review, DOE will review its data on refrigerator prices and costs and, as part of that review, will consider tracking additional data on retail refrigerator prices and costs for the product classes identified in the rule as a means of comparing actual refrigerator prices and costs to prices and costs forecasted as a result of the standards imposed by today's and any future rule. Such a review will likely be a part of the periodic review of energy efficiency standards for refrigerators called for under Executive Order 13563. DOE's plan for conducting periodic review, which will be updated regularly, should be consulted for further information. See: *http://energy.gov/gc/report-appliance-regulation-violation/ex-parte-communications/restrospective-regulatory-review*.

For the reasons stated in the preamble, DOE believes that today's final rule is consistent with these principles, including that, to the extent permitted by law, agencies adopt a regulation only upon a reasoned determination that its benefits justify its costs and select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, and a final regulatory flexibility analysis (FRFA) for any such rule that an agency adopts as a final rule, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site (*http://www.gc.doe.gov*).

For manufacturers of residential refrigerators, refrigerator-freezers, and freezers, the Small Business Administration (SBA) has set a size threshold, which defines those entities classified as ''small businesses'' for the purposes of the statute. DOE used the SBA's small business size standards to determine whether any small entities would be subject to the requirements of the rule. 65 FR 30836, 30850 (May 15, 2000), as amended at 65 FR 53533, 53545 (September 5, 2000) and codified at 13 CFR part 121.The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf* . Residential refrigeration product manufacturing is classified under NAICS 335222, ''Household Refrigerator and Home Freezer Manufacturing.'' The SBA sets a threshold of 1,000 employees or less for an entity to be considered as a small business for this category.

DOE reviewed its September 2010 NOPR under the provisions of the Regulatory Flexibility Act and the procedure and policies published on February 19, 2003. In the NOPR, DOE certified that the standards for residential refrigeration products set forth in the proposed rule, if promulgated, would not have a significant economic impact on a substantial number of small entities. DOE made this determination because only one small business manufacturer would potentially be impacted by the proposed energy conservation standards, and that manufacturer represents a small percentage of covered products and is a leader in a niche market. 75 FR at 59571–59572 (September 27, 2010).

DOE also sought comment on the impacts of the proposed amended energy conservation standards on small business manufacturers of residential refrigeration products. DOE received no comments on the certification or its additional requests for comment on small business impacts in response to the NOPR. Thus, DOE reaffirms the certification and has not prepared a FRFA for this final rule.

C. Review Under the Paperwork Reduction Act

Manufacturers of refrigeration products must certify to DOE that those products comply with any applicable energy conservation standard. In certifying compliance, manufacturers must test their refrigeration products according to the DOE test procedure for refrigeration products, including any amendments adopted for that test procedure. DOE has proposed regulations for the certification and recordkeeping requirements for all covered consumer products and commercial equipment, including refrigeration products (*i.e.* refrigerators, refrigerator-freezers, and freezers). 75 FR 56796 (Sept. 16, 2010). The information collection requirement for the certification and recordkeeping is subject to review and approval by OMB under the Paperwork Reduction Act (PRA). DOE received OMB approval for collecting certification, compliance, and enforcement information for all covered products and covered equipment on February 3, 2011 under OMB control number 1910–1400.

Public reporting burden for the certification is estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Office of the Chief Information Officer, Records Management Division, IM–23, Paperwork Reduction Project (1910–1400), U.S. Department of Energy, 1000 Independence Ave., SW., Washington, DC 20585–1290; and to the Office of Management and Budget (OMB), OIRA, Paperwork Reduction Project (1910–1400), Washington, DC 20503.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

DOE has prepared an environmental assessment (EA) of the impacts of the amended rule pursuant to the National

Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*), the regulations of the Council on Environmental Quality (40 CFR parts 1500–1508), and DOE's regulations for compliance with the National Environmental Policy Act of 1969 (10 CFR part 1021). This assessment includes an examination of the potential effects of emission reductions likely to result from the rule in the context of global climate change, as well as other types of environmental impacts. The final EA has been included as chapter 15 of the final rule TSD. Before issuing this final rule for refrigeration products, DOE considered public comments. A finding of no significant impact (FONSI) accompanies the final EA.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 10, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's final rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

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

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, section 201 (codified at 2 U.S.C. 1531). For an amended regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *http://www.gc.doe.gov.*

Although today's final rule does not contain a Federal intergovernmental mandate, it may impose expenditures of $100 million or more on the private sector. Specifically, the final rule will likely result in a final rule that could impose expenditures of $100 million or more. Such expenditures may include (1) investment in research and development and in capital expenditures by refrigeration product manufacturers in the years between the final rule and the compliance date for the new standard, and (2) incremental additional expenditures by consumers to purchase higher-efficiency refrigeration products, starting in 2014.

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

Under section 205 of UMRA, the Department is obligated to identify and consider a reasonable number of regulatory alternatives before promulgating a rule for which a written statement under section 202 is required. 2 U.S.C. 1535(a). DOE is required to select from those alternatives the most cost-effective and least burdensome alternative that achieves the objectives of the rule unless DOE publishes an explanation for doing otherwise or the selection of such an alternative is inconsistent with law. As required by 42 U.S.C. 6295(h) and (o), 6313(e), and 6316(a), today's final rule would establish energy conservation standards for residential refrigeration products that are designed to achieve the maximum improvement in energy efficiency that DOE has determined to be both technologically feasible and economically justified. A full discussion of the alternatives considered by DOE is presented in the ''Regulatory Impact Analysis'' section of the TSD for today's final rule.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

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

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516, note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (February 22, 2002), and DOE's guidelines were published at 67 FR 62446 (October 7, 2002). DOE has reviewed today's final rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OIRA at OMB, a Statement of Energy Effects for any significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgates or is expected to lead to promulgation of a final rule, and that (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy, or (3) is designated by the Administrator of OIRA as a significant energy action. For any significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

DOE has concluded that today's regulatory action, which sets forth energy conservation standards for refrigeration products, is not a significant energy action because the amended standards are not likely to have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as such by the Administrator at OIRA. Accordingly, DOE has not prepared a Statement of Energy Effects on the final rule.

L. Review Under the Information Quality Bulletin for Peer Review

On December 16, 2004, OMB, in consultation with the Office of Science and Technology (OSTP), issued its Final Information Quality Bulletin for Peer Review (the Bulletin). 70 FR 2664 (January 14, 2005). The Bulletin establishes that certain scientific information shall be peer reviewed by qualified specialists before it is disseminated by the Federal Government, including influential scientific information related to agency regulatory actions. The purpose of the bulletin is to enhance the quality and credibility of the Government's scientific information. Under the Bulletin, the energy conservation standards rulemaking analyses are ''influential scientific information,'' which the Bulletin defines as ''scientific information the agency reasonably can determine will have or does have a clear and substantial impact on important public policies or private sector decisions.'' 70 FR 2667.

In response to OMB's Bulletin, DOE conducted formal in-progress peer reviews of the energy conservation standards development process and analyses and has prepared a Peer Review Report pertaining to the energy conservation standards rulemaking analyses. Generation of this report involved a rigorous, formal, and documented evaluation using objective criteria and qualified and independent reviewers to make a judgment as to the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects. The ''Energy Conservation Standards Rulemaking Peer Review Report'' dated February 2007 has been disseminated and is available at the following Web site: *http://www1.eere.energy.gov/buildings/appliance_standards/peer_review.html.*

M. Congressional Notification

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

VIII. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of today's amended rule.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Reporting and recordkeeping requirements, and Small businesses.

Issued in Washington, DC, on August 25, 2011.

Henry Kelly,

Acting Assistant Secretary, Energy Efficiency and Renewable Energy.

For the reasons set forth in the preamble, DOE amends chapter II, subchapter D, of title 10 of the Code of Federal Regulations, as set forth below:

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

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

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

■ 2. In § 430.2, add the definition for ''Built-in refrigerator/refrigerator-freezer/freezer,'' in alphabetical order, and revise the definition for ''Compact refrigerator/refrigerator-freezer/freezer'' to read as follows:

§ 430.2 Definitions.

* * * * *

Built-in refrigerator/refrigerator-freezer/freezer means any refrigerator, refrigerator-freezer or freezer with 7.75 cubic feet or greater total volume and 24 inches or less depth not including doors, handles, and custom front panels; with sides which are not finished and not designed to be visible after installation; and that is designed, intended, and marketed exclusively (1) To be installed totally encased by cabinetry or panels that are attached during installation, (2) to be securely fastened to adjacent cabinetry, walls or floor, and (3) to either be equipped with an integral factory-finished face or accept a custom front panel.

* * * * *

Compact refrigerator/refrigerator-freezer/freezer means any refrigerator, refrigerator-freezer or freezer with total volume less than 7.75 cubic foot (220 liters) (rated volume as determined in appendices A1 and B1 of subpart B of this part before appendices A and B become mandatory and as determined in appendices A and B of this subpart once appendices A and B become mandatory (see the notes at the beginning of appendices A and B)).

* * * * *

■ 3. In § 430.32 revise paragraph (a) to read as follows:

§ 430.32 Energy and water conservation standards and their effective dates.

* * * * *

(a) *Refrigerators/refrigerator-freezers/freezers.* These standards do not apply to refrigerators and refrigerator-freezers with total refrigerated volume exceeding 39 cubic feet (1104 liters) or freezers with total refrigerated volume exceeding 30 cubic feet (850 liters). The energy standards as determined by the equations of the following table(s) shall be rounded off to the nearest kWh per year. If the equation calculation is halfway between the nearest two kWh per year values, the standard shall be rounded up to the higher of these values.

The following standards remain in effect from July 1, 2001 until September 15, 2014:

Product class	Energy standard equations for maximum energy use (kWh/yr)
1. Refrigerators and refrigerator-freezers with manual defrost	8.82AV + 248.4 0.31av + 248.4
2. Refrigerator-freezers—partial automatic defrost	8.82AV + 248.4 0.31av + 248.4
3. Refrigerator-freezers—automatic defrost with top-mounted freezer without through-the-door ice service and all-refrigerator—automatic defrost.	9.80AV + 276.0 0.35av + 276.0
4. Refrigerator-freezers—automatic defrost with side-mounted freezer without through-the-door ice service	4.91AV + 507.5 0.17av + 507.5
5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without through-the-door ice service	4.60AV + 459.0 0.16av + 459.0
6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service	10.20AV + 356.0 0.36av + 356.0
7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service	10.10AV + 406.0 0.36av + 406.0
8. Upright freezers with manual defrost	7.55AV + 258.3 0.27av + 258.3
9. Upright freezers with automatic defrost	12.43AV + 326.1 0.44av + 326.1
10. Chest freezers and all other freezers except compact freezers	9.88AV + 143.7 0.35av + 143.7
11. Compact refrigerators and refrigerator-freezers with manual defrost	10.70AV + 299.0 0.38av + 299.0
12. Compact refrigerator-freezer—partial automatic defrost	7.00AV + 398.0 0.25av + 398.0
13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer and compact all-refrigerator—automatic defrost.	12.70AV + 355.0 0.45av + 355.0
14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer	7.60AV + 501.0 0.27av + 501.0
15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer	13.10AV + 367.0 0.46av + 367.0
16. Compact upright freezers with manual defrost	9.78AV + 250.8 0.35av + 250.8
17. Compact upright freezers with automatic defrost	11.40AV + 391.0 0.40av + 391.0
18. Compact chest freezers	10.45AV + 152.0 0.37av + 152.0

AV: Adjusted Volume in ft^3; av: Adjusted Volume in liters (L).

The following standards apply to products manufactured starting on September 14, 2014:

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft^3)	Based on av (L)
1. Refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost	7.99AV + 225.0	0.282av + 225.0
1A. All-refrigerators—manual defrost	6.79AV + 193.6	0.240av + 193.6
2. Refrigerator-freezers—partial automatic defrost	7.99AV + 225.0	0.282av + 225.0
3. Refrigerator-freezers—automatic defrost with top-mounted freezer without an automatic icemaker	8.07AV + 233.7	0.285av + 233.7
3–BI. Built-in refrigerator-freezer—automatic defrost with top-mounted freezer without an automatic icemaker.	9.15AV + 264.9	0.323av + 264.9
3I. Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.	8.07AV + 317.7	0.285av + 317.7

Product class	Equations for maximum energy use (kWh/yr)	
	Based on AV (ft^3)	Based on av (L)
3I–BI. Built-in refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service.	9.15AV + 348.9	0.323av + 348.9
3A. All-refrigerators—automatic defrost	7.07AV + 201.6	0.250av + 201.6
3A–BI. Built-in All-refrigerators—automatic defrost	8.02AV + 228.5	0.283av + 228.5
4. Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker	8.51AV + 297.8	0.301av + 297.8
4–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer without an automatic icemaker.	10.22AV + 357.4	0.361av + 357.4
4I. Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.	8.51AV + 381.8	0.301av + 381.8
4I–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker without through-the-door ice service.	10.22AV + 441.4	0.361av + 441.4
5. Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker.	8.85AV + 317.0	0.312av + 317.0
5–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer without an automatic icemaker.	9.40AV + 336.9	0.332av + 336.9
5I. Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.	8.85AV + 401.0	0.312av + 401.0
5I–BI. Built-In Refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker without through-the-door ice service.	9.40AV + 420.9	0.332av + 420.9
5A. Refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service.	9.25AV + 475.4	0.327av + 475.4
5A–BI. Built-in refrigerator-freezer—automatic defrost with bottom-mounted freezer with through-the-door ice service.	9.83AV + 499.9	0.347av + 499.9
6. Refrigerator-freezers—automatic defrost with top-mounted freezer with through-the-door ice service.	8.40AV + 385.4	0.297av + 385.4
7. Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	8.54AV + 432.8	0.302av + 432.8
7–BI. Built-In Refrigerator-freezers—automatic defrost with side-mounted freezer with through-the-door ice service.	10.25AV + 502.6	0.362av + 502.6
8. Upright freezers with manual defrost	5.57AV + 193.7	0.197av + 193.7
9. Upright freezers with automatic defrost without an automatic icemaker	8.62AV + 228.3	0.305av + 228.3
9I. Upright freezers with automatic defrost with an automatic icemaker	8.62AV + 312.3	0.305av + 312.3
9–BI. Built-In Upright freezers with automatic defrost without an automatic icemaker	9.86AV + 260.9	0.348av + 260.9
9I–BI. Built-in upright freezers with automatic defrost with an automatic icemaker	9.86AV + 344.9	0.348av + 344.9
10. Chest freezers and all other freezers except compact freezers	7.29AV + 107.8	0.257av + 107.8
10A. Chest freezers with automatic defrost	10.24AV + 148.1	0.362av + 148.1
11. Compact refrigerator-freezers and refrigerators other than all-refrigerators with manual defrost	9.03AV + 252.3	0.319av + 252.3
11A.Compact all-refrigerators—manual defrost	7.84AV + 219.1	0.277av + 219.1
12. Compact refrigerator-freezers—partial automatic defrost	5.91AV + 335.8	0.209av + 335.8
13. Compact refrigerator-freezers—automatic defrost with top-mounted freezer	11.80AV + 339.2	0.417av + 339.2
13I. Compact refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker.	11.80AV + 423.2	0.417av + 423.2
13A. Compact all-refrigerators—automatic defrost	9.17AV + 259.3	0.324av + 259.3
14. Compact refrigerator-freezers—automatic defrost with side-mounted freezer	6.82AV + 456.9	0.241av + 456.9
14I. Compact refrigerator-freezers—automatic defrost with side-mounted freezer with an automatic icemaker.	6.82AV + 540.9	0.241av + 540.9
15. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer	11.80AV + 339.2	0.417av + 339.2
15I. Compact refrigerator-freezers—automatic defrost with bottom-mounted freezer with an automatic icemaker.	11.80AV + 423.2	0.417av + 423.2
16. Compact upright freezers with manual defrost	8.65AV + 225.7	0.306av + 225.7
17. Compact upright freezers with automatic defrost	10.17AV + 351.9	0.359av + 351.9
18. Compact chest freezers	9.25AV + 136.8	0.327av + 136.8

AV = Total adjusted volume, expressed in ft^3, as determined in appendices A and B of subpart B of this part.
av = Total adjusted volume, expressed in Liters.

* * * * *

[FR Doc. 2011–22329 Filed 9–14–11; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket No. EERE–2009–BT–TP–0003]

RIN 1904–AB92

Energy Efficiency Program for Consumer Products: Test Procedures for Residential Refrigerators, Refrigerator-Freezers, and Freezers

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

ACTION: Interim final rule; reopening of comment period.

SUMMARY: This document announces a limited reopening of the comment period for interested parties seeking to submit comments on the December 16, 2011 interim final rule to amend the test procedures for residential refrigerators, refrigerator-freezers, and freezers that will apply to products that are manufactured starting in 2014. The comment period is extended until October 17, 2011.

DATES: Comments must be submitted no later than October 17, 2011.

ADDRESSES: Any comments submitted must identify the ''Interim Final Rule on Test Procedures for Residential Refrigerators, Refrigerator-Freezers, and Freezers'' and provide the appropriate docket number EERE–2009–BT–TP–0003 and/or RIN number 1904–AB92. Comments may be submitted using any of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.
- *E-mail: Refrig-2009-TP-0003@ee.doe.gov.* Include docket number EERE–BT–TP–0003 and/or RIN number 1904–AB92 in the subject line of the message.
- *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mail-stop EE–2J, Interim Final Rule for Test Procedures for Refrigerators and Refrigerator-Freezers, docket number EERE–2009–BT–TP–0003 and/or RIN number 1904–AB92, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Please submit one signed paper original.
- *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC 20024. Telephone: (202) 586–2945. Please submit one signed paper original.

The public may review copies of all materials related to this rulemaking at the U.S. Department of Energy, Resource Room of the Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC, (202) 586–2945, between 9 a.m. and 4 p.m., Monday through Friday, except Federal holidays. Please call Ms. Brenda Edwards at the above telephone number for additional information regarding visiting the Resource Room.

FOR FURTHER INFORMATION CONTACT: Mr. Lucas Adin, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 287–1317. E-mail: *Lucas.Adin@ee.doe.gov.*

Mr. Michael Kido, U.S. Department of Energy, Office of the General Counsel, GC–71, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–8145. E-mail: *Michael.Kido@hq.doe.gov.*

For information on how to submit or review public comments, contact Ms. Brenda Edwards, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue, SW., Washington, DC 20585–0121. Telephone: (202) 586–2945. E-mail: *Brenda.Edwards@ee.doe.gov.*

SUPPLEMENTARY INFORMATION: On December 16, 2010, the U.S. Department of Energy (DOE) published in the **Federal Register** a Final Rule that amended the test procedures for residential refrigerators, refrigerator-freezers, and freezers (collectively, ''refrigeration products''). 75 FR 78810. The amended test procedures for residential refrigerators and refrigerator-freezers are found in 10 CFR part 430, subpart B, appendix A1 and the test procedures for residential freezers are found in 10 CFR part 430, subpart B, appendix B1. These revised test procedures, which do not affect measured energy use, became effective on January 18, 2011. Consistent with 42 U.S.C. 6293(c)(2), however, manufacturers do not need to use these procedures for making representations regarding energy usage until June 14, 2011.

Concurrently with this Final Rule, DOE published an Interim Final Rule establishing new amended test procedures for these products, Appendix A and Appendix B, that incorporate the same revisions made to Appendix A1 and Appendix B1. 75 FR 78810. The Interim Final Rule also included amendments to these procedures that will, once finalized, apply to refrigeration products starting in 2014. It also provided interested parties with an opportunity to submit comments on the Interim Final Rule by February 14, 2011—i.e., an extra 60 days within which to provide comment.

On February 7, 2011, prior to the closing of that comment period, DOE received an emailed request from the Association of Home Appliance Manufacturers (AHAM) requesting that DOE extend the comment period deadline to ''30 days after the [refrigeration products] standards final rule is made available to the public.'' That email noted that AHAM had also consulted with the American Council for an Energy Efficient Economy regarding this request.

The AHAM request explained that the group required additional time to provide comment to the agency. AHAM asserted that:

> The Department released the test procedure for refrigerator/freezers as a final rule and interim final rule in order to allow stakeholders to comment on the necessary revisions to the energy conservation standards. DOE's strategy, as discussed with AHAM, assumed that the standards final rule would be released no later than the statutorily mandated deadline of December 31, 2010. But that final rule has not been released. *Thus, stakeholders cannot provide substantive comments and data on whether the equations are accurate or require some revision.* (Emphasis in original.)

DOE notes that once it issues a final rule promulgating the energy conservation standards for a particular product type, the agency is prohibited by statute from altering those standards in any way that would permit either an increase in the maximum energy consumption of that product or a decrease in that product's minimum energy efficiency. See 42 U.S.C. 6295(o)(1). As a result, to the extent that interested parties seek a wholesale revision of the standards that DOE has set, barring the presence of calculation or typographical error, those standards cannot be altered in a manner that would result in refrigeration products that consume more energy—or that are less efficient.

However, to ensure that the test procedure accurately captures as reasonably as possible the energy consumption of those products that are addressed in the Interim Final Rule, DOE is re-opening the comment period for that test procedure proceeding to enable interested parties to comment given that the energy conservation standards rule has been issued. The purpose of this limited re-opening is to